Consultative Document

on the

Framework for Fifth Generation (5G) Public Mobile Telecommunications Networks

(Second of Two Rounds)

January 2023

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Abbreviations

4IR	fourth industrial revolution
5G	fifth generation
AGCOM	Autorità per le Garanzie nelle Comunicazioni
AWS	Advanced Wireless Services
BWA	broadband wireless access
CISA	US Cybersecurity and Infrastructure Security Agency
CCA	combinatorial clock auction
CDF	cumulative distribution function
DSS	dynamic spectrum sharing
eMBB	enhanced mobile broadband
ESF	Enduring Security Framework
FDD	frequency division duplex
GORTT	Government of the Republic of Trinidad and Tobago
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICT	Information and Communications Technology
IMT	International Mobile Telecommunications
ITU	International Telecommunication Union
M&A	mergers and acquisitions
MIMO	multiple-input, multiple-output
mMTC	massive machine-type communications
NSA	National Security Agency
NPRM	notice of proposed rulemaking
PAL	priority access licence
QoS	quality of service
RF	radio frequency
RFR	radio frequency radiation
SMRA	Simultaneous Multiple Round Auction
TDD	time division duplex
URLLC	ultra-reliable and low latency communications

1 Introduction

1.1 Background

In 2015, the International Telecommunication Union (ITU), which designated fifth generation (5G) as International Mobile Telecommunication 2020 (IMT-2020), laid out a vision for IMT-2020 and has since been refining its requirements. IMT-2020, or 5G, is the new generation of mobile communications that will improve current systems and services by offering, among other things, increased data rates, lower latency and better mobility.

ITU has outlined specific criteria for 5G, which will support the following use cases (ITU 2015):

1. Enhanced mobile broadband (eMBB), with speeds of 100 Mbit/s, making it possible to offer ultra high-definition content and virtual reality experiences

2. Ultra-reliable and low latency communications (URLLC) such as autonomous driving and industrial automation

3. Massive machine-type communications (mMTC), for example, traffic management

4. Fixed wireless access, i.e., the ability to offer fibre-type speeds to homes and businesses in both developed and developing markets, using new wider frequency bands, massive multiple-input, multiple-output (MIMO) and 3D beamforming technologies

5G not only meets the evolving requirements of consumers but can also have a transformative impact on businesses, to the extent that it is being hailed as vital to the fourth industrial revolution (4IR) which calls for greater use of mobile technology and yields increased mobile data benefits.

The rollout of 5G has been progressing in many jurisdictions. The UK rollout has been valued at an estimated US$25 billion of the country's economy. Italy was the first European country to award three 5G bands simultaneously through auction, extracting spectrum value from fragmented bands of spectrum. The reserve price of US$2.86 billion was eventually surpassed more than twice, with the auction totalling US$7.4 billion. In Latin America, spectrum allocation for 5G has been planned and, to a lesser degree, deployed in numerous territories. Chile was the first country in the region to grant 5G spectrum, using an auction. In 2021, three mobile operators acquired 50 MHz of 3.5 GHz spectrum each, paying approximately US$163 million, US$139 million and US44 million, respectively (rcrwireless 2021). These developments demonstrate the need to facilitate and encourage the deployment of 5G networks to meet national economic objectives.

1.2 Purpose

The *Framework for Fifth Generation (5G) Public Mobile Telecommunications Networks* (the Framework) was developed to create the regulatory environment to support the introduction and development of 5G networks in Trinidad and Tobago. Facilitating the adoption of these networks nationally directly promotes the aim of the "Improving Connectivity" thematic area of the *National Information and Communications Technology Plan (2018 to 2022)* to facilitate and incentivise private sector investment and market actors to advance the national ICT infrastructure, as 5G offers the potential for significant benefits to both consumers and the private sector.

1.3 Objectives

This Framework:

1. highlights the benefits of 5G, to encourage the industry to take advantage of this technology, whilst also reassuring the public that the deployment of 5G is safe, planned and regulated.

2. discusses viewpoints from relevant international bodies to assist in educating the public on 5G.

3. assesses the accommodation of 5G within the current regulatory framework.

4. discusses trends and amendments observed in the valuation of spectrum with respect to 5G.

5. informs revisions to other regulatory instruments, such as existing spectrum plans, authorisation frameworks and standards.

6. addresses radio frequency radiation (RFR) limits for 5G.

7. specifies policy statements which support sustainable 5G development.

1.4 Scope

This Framework outlines the regulatory framework to facilitate the introduction and development of 5G networks in Trinidad and Tobago and:

1. identifies the appropriate policies, rules and regulations for the planning, authorisation and deployment of 5G networks in Trinidad and Tobago.

2. identifies the key requirements relating to the minimum technical performance of IMT-2020 as defined by ITU.

3. does not focus on the 5G network design and architecture, related technologies, or on the actual pricing for 5G spectrum.

1.5 Relevant Legislation

The Telecommunications Authority of Trinidad and Tobago (the Authority) is guided by the Telecommunications Act, Chap. 47:31 (the Act). The sections of the Act that inform this Framework are as follows:

Section 18:

Subject to the provisions of this Act, the Authority may exercise such functions and powers as are imposed on it by this Act and in particular –
plan, supervise, regulate and manage the use of the radio frequency spectrum, including –

(i) the licensing and registration of radio frequencies and call signs to be used by all stations operating in Trinidad and Tobago or on any ship, aircraft, or other vessel or satellite registered in Trinidad and Tobago;
(ii) the allocation, assignment and reallocation or reassignment of frequency bands where necessary

18. (1) Subject to the provisions of this Act, the Authority may exercise such functions and powers as are imposed on it by this Act and in particular—
(o) test and certify telecommunications equipment, subject to section 48(3), to ensure compliance with— (i) international standards; and (ii) environmental health and safety standards, including electro-magnetic radiation and emissions;

Section 41:

(1) The Authority shall regulate the use of the spectrum in order to promote the economic and orderly utilisation of frequencies for the operation of all means of telecommunications and to recover the cost incurred in the management of the spectrum.
(2) The Authority shall develop a spectrum plan in order to regulate the use of the spectrum.
(3) The National Spectrum Plan shall be made available to the public in the manner prescribed by the Authority.
(4) The National Spectrum Plan shall state how the spectrum shall be used and the procedures for licensing frequency bands.
(5) The procedures referred to in subsection (4) may include, but are not limited to -
    (a) procedures for licensing frequency bands by auction;
    (b) procedures for licensing frequency bands by tender;
    (c) procedures for licensing frequency bands at a fixed price; or
    (d) procedures for licensing frequency bands on stated criteria.

Section 42:

(1) Subject to subsection (2), the Authority may, in accordance with the spectrum plan allocate and re-allocate frequency bands.
(2) In the allocation or assignment and re-allocation or reassignment of frequency bands by the Authority priority shall be given to the needs of the State in respect of matters of national security.

The Authority executes this mandate through the development of authorisation frameworks and spectrum plans that prescribe rules and terms and conditions for the orderly utilisation of the radio frequency (RF) spectrum. Through this Framework, the Authority outlines the regulatory rules and guidelines for the deployment of 5G in Trinidad and Tobago.

1.6 Other Relevant Documentation

Other relevant policies, plans and regulations, currently in effect, to be read along with this Framework, include:

1. *Spectrum Plan for the Accommodation of Public Mobile Telecommunications Services, November 2017*

2. The *Trinidad and Tobago Frequency Allocation Table (8.3 kHz–3000 GHz), November 2019*

3. *Spectrum Management Framework (Version 2.0), October 2022*

4. *Spectrum Plan for the Accommodation of Broadband Wireless Access Services, September 2008*

5. *Maximum Permissible Exposure Limits for Radio frequency Radiation in Trinidad and Tobago, August 2007*

6. *Telecommunications (Access to Facilities) Regulations, September 2014*

7. *Standards and Guidelines for the Development of Reference Access Offer (RAO), September 2014*

8. *Position and Procedures in Respect of Non-Objections for Applications to Town and Country Planning Division for Site Approval of Telecommunications Structures, July 2007*

9. *Schedule of Devices Eligible for Use Under a Class Licence, June 2022*

These documents can be found on the Authority's website, www.tatt.org.tt

1.7 Review Cycle

This Framework will be reviewed every four years, or otherwise, as deemed necessary by the Authority, to reflect the evolving needs of the telecommunications industry and meet changing circumstances. When the need for modification is identified, the Authority will announce its intention to review the Framework, and any entity in the telecommunications sector or any appropriate industry forum or interested party may suggest changes. Questions or concerns regarding the maintenance of this Framework may be directed to the Authority via e-mail consultation@tatt.org.tt.

1.8 The Consultation Process

In accordance with its *Procedures for Consultation in the Telecommunications and Broadcasting Sectors of Trinidad and Tobago* (TATT 2021) (Consultation Procedures), the Authority sought the views of the general public and stakeholders on the rules put forward in this Framework.

In July 2022, version 0.1 of the Framework was released for the first round of two rounds of public consultation for a period of six weeks. The decisions on recommendations (DORs) matrix for the first round of public consultation is attached as Appendix I.

The following modifications were made to the Framework based on the comments received from the first round of public consultation:

1. Section 1.1, Background was updated to align with the topic.

2. The scope, section 1.4, was added for clarity.

3. Section 3.5.2.2 was updated to include information on the 3.7–3.98 GHz band.

4. Sections 3.5.5; 3.5.7; 3.5.8; and 3.5.8.1 were added to provide information based on recent developments relating to 5G in some countries like Canada and Chile.

5. With the publication of the *Spectrum Management Framework (Ver. 2.0)*, section 6.1 was updated to reflect the status of the document and relevant policies.

6. Section 6.2 was updated to include the 3.3–3.4 GHz band and to provide clarity on the Authority's positions as it relates to the 3.7–4.2 GHz band and the 6 GHz band.

2 Key Characteristics of 5G Mobile Technologies

ITU outlines the key requirements relating to the minimum technical performance of International Mobile Telecommunications 2020 (IMT-2020) candidate radio interface technologies (ITU 2017). The following are the characteristics for which requirements are specified:

1. Peak data rate (downlink and uplink)
2. User experienced data rate (downlink and uplink)
3. Spectral efficiency
4. Latency
5. Connection density
6. Area traffic capacity
7. Bandwidth

2.1 Peak Data Rate

The peak data rate is the maximum achievable transmission speed under ideal conditions and is defined for a single mobile station. The minimum requirements for the peak data rate are as follows:

1. Downlink peak data rate is 20 Gbit/s.

2. Uplink peak data rate is 10 Gbit/s.

2.2 User Experienced Data Rate

The user experienced data rate is the 5% point of the cumulative distribution function (CDF) of the user throughput. The target values for the user experienced data rate in the dense urban test environment are as follows:

1. Downlink user experienced data rate is 100 Mbit/s.

2. Uplink user experienced data rate is 50 Mbit/s.

2.3 Spectral Efficiency

The peak spectral efficiency is the maximum data rate under ideal conditions normalised by channel bandwidth. The minimum requirements for peak spectral efficiencies are as follows:

1. Downlink peak spectral efficiency is 30 bit/s/Hz.

2. Uplink peak spectral efficiency is 15 bit/s/Hz.

2.4 Latency

User plane latency is the contribution of the radio network from the time when the source sends a packet to when the destination receives it. The maximum tolerable user plane latency values are:

1. 4 ms for eMBB

2. 1 ms for URLLC

Control plane latency refers to the transition time from a most "battery efficient" state (e.g., idle state) to the start of continuous data transfer (e.g., active state). The minimum requirement for control plane latency is 20 ms.

2.5 Connection Density

Connection density is the total number of devices which achieve a specific quality of service (QoS) per unit area (per km^2). The target QoS is to support the delivery of a message of a certain size within a certain time and with a certain success probability. The minimum requirement for connection density is 1,000,000 devices per km^2.

2.6 Area Traffic Capacity

This parameter is the total traffic throughput served per geographic area. Throughput refers to how much data can be transferred from one location to another in a given amount of time (Techterms 2006). Area traffic capacity is summed over all applicable bands. This requirement is defined in the related eMBB test environment in an indoor picocell. The target value for area traffic capacity in the downlink is 10 $Mbit/s/m^2$.

2.7 Bandwidth

Bandwidth refers to the maximum aggregated spectrum allocation which may be facilitated through single or multiple RF carriers. The requirement for bandwidth is at least 100 MHz, with the radio interface technology supporting bandwidths of up to 1 GHz for operation in higher frequency bands (e.g., above 6 GHz), with support for scalable bandwidth. Scalable bandwidth is the ability of the candidate radio interface technology to operate with different bandwidths.

3 Policy and Regulatory Considerations

A diverse set of policy measures and spectrum is required for 5G. The Global System for Mobile Communications Association (GSMA), a global organisation which looks at unifying the mobile ecosystem (GSMA 2020), recognises that 5G network deployments will require significant investment, and recommends that regulators adopt policy measures to encourage long-term heavy investment in 5G networks, by:

1. producing a national broadband plan including 5G rollout, which details activities and timeframes.

2. publishing a 5G spectrum roadmap.

3. supporting exclusive, long-term 5G mobile licences with a predictable renewal process.

Several regulators have published action plans or roadmaps for 5G. Ofcom, the UK's telecommunications regulator, published a 2018 report outlining the action plan to facilitate 5G rollout in the UK (Ofcom 2018). The Federal Communications Commission (FCC), the telecommunications regulator for the USA, drafted the 5G FAST Plan ("Facilitate America's Superiority in 5G Technology") (FCC 2018). Several European countries including France, Germany and Spain have laid plans for 5G. Germany also set out national policies to promote the country's development towards becoming a lead market for 5G networks and applications through its "5G Strategy for Germany" which is part of a larger framework, the "5G Initiative for Germany", launched in 2016.

In South America, regulators in almost all countries have conducted public consultations on the use of spectrum for 5G, and have announced plans for spectrum auctions or awards, with 5G already available commercially in Brazil, Chile and Uruguay.

3.1 Coverage Obligations

Coverage of rural areas is of special concern for 5G deployment, not only due to the limited access to fibre broadband, but also because many 5G services, like connected and autonomous vehicles, require ubiquitous coverage (Forbes 2020).

Ofcom's intention was to ensure that low frequency spectrum such as 700 MHz would be used to extend the reach of their operators' 5G offering and provide a potential uplift in service quality. By rolling out 5G at 700 MHz on their sites that currently use low-frequency spectrum, operators would achieve similar coverage to 4G for 5G devices, as well as potentially improve consumer

experience at the cell edge in rural areas. Furthermore, 700 MHz, as all other sub-1 GHz bands, is well suited for narrowband Internet of Things (IoT) services that require wide coverage area or high penetration into buildings and basements.

To ensure widespread improvement in mobile coverage across the UK, Ofcom proposed to attach coverage obligations to some of the licences to be awarded for the 700 MHz band. In the case of Ofcom, these obligations will be shaped based on consultation and will require winning bidders to roll out improved mobile coverage in rural areas.

Italy attached conditions for operators, of 80% population reached with 5G services, and collective obligation to reach 99.4% within 4.5 years (ITU 2019). Operators in Italy further agreed to lease unused spectrum in the bands up to 3.6–3.8 GHz in any "free list" communities, meaning communities with less than 5,000 inhabitants are not included in the coverage obligations of all licensees (ITU 2019).

3.2 Siting Reforms

The deployment of 5G will rely heavily on smaller cells, in addition to macro cells for which the existing regulatory regimes were designed. The expectation is that, particularly in urban areas, mobile operators will build out smaller cells with outdoor antennas and wireless infrastructure, to supplement existing cell towers. The required infrastructure upgrade may include the introduction of small cells on utility poles and streetlights. This is known as network densification.

Increased path loss in the higher spectrum ranges severely limits the coverage radius from base stations. Because of their limited propagation, these high bands will mainly be used to build out dense networks, outdoors or indoors (5G Americas and Small Cell Forum 2018).

The Information Technology Industry Council (ITI 2020) recommends that governments at all levels consider local siting reforms to speed up the deployment of 5G infrastructure. This will require revising legacy permit and siting regulations for wireless infrastructure, as these would have been designed with previous generations of technology in mind.

3.3 Technology Neutrality in Licences

By making spectrum available in a way that is technology neutral, 5G can also be rolled out in bands with existing authorisations, such as bands currently used for 2G, 3G and 4G, within the confines of the technical parameters specified for use. The GSMA recommends that existing mobile licences also be technology neutral, to allow their evolution to 5G services. It should be

noted that technology neutrality does not imply zero restrictions on the use of an assigned frequency band. There are still regulations that can govern the deployment of radio communications networks including those designed, for example, to protect other spectrum users and to ensure that radiation limits are not breached. The GSMA defines technology neutral spectrum licences as “licences which allow the deployment of any standards-based technology which complies with regulations in the licensed frequency band” (GSMA 2019).

Technological neutrality is different from service neutrality. While technology neutrality refers to applying no constraints or prescriptions on choices of technology or equipment, within the bounds of compatibility and interference avoidance, service neutrality means the spectrum holder can choose what service to offer using its spectrum rights (Law Insider 2022).

Ofcom has already authorised and made it possible for 5G deployment in some bands, due to their policy of offering technology neutral licences. This enables licensees to innovate by allowing them to change the technology or service they wish to deploy without needing to approach Ofcom, provided the technology falls within existing licensed technical parameters.

To facilitate innovation and advance the development of 5G technologies, Ofcom has also made spectrum available in the form of innovation and trial licences for testing and development.

Technology neutrality in licences could be implemented by operators through dynamic spectrum sharing (DSS), which would allow for smooth and efficient migration from 4G/LTE to 5G New Radio (5G NR) by giving both technologies instant access to the same spectrum.

3.4 Network Security

The US Cybersecurity and Infrastructure Security Agency (CISA), in coordination with the National Security Agency (NSA), and the Office of the Director of National Intelligence, as part of the Enduring Security Framework (ESF), a cross-sector, public-private working group, released a paper detailing potential threat vectors to 5G (CISA 2021). The paper identifies and assesses the risks and vulnerabilities introduced by 5G. Three primary threat vectors (i.e., the path or means by which a threat may exploit a vulnerability) were considered: policies and standards, supply chain, and 5G systems architecture.

For network security, infrastructure components, such as cellular towers, beamforming transmission, small cells and mobile devices, are particularly vulnerable. If network devices are compromised through a network layer exploit, malicious actors could gain unauthorised access to the 5G network, potentially disrupting operations and enabling the interception, manipulation and destruction of critical data.

The GSMA further details security issues surrounding 5G (GSMA 2019), indicating that hacking 5G could become similar to hacking the web, given the IP-based, end-to-end architecture and a network core which makes heavy use of protocols that are well known and widely used on the Internet. This makes it easy to exploit vulnerabilities.

A number of new security features have been incorporated into 5G deployment, as follows:

1. Inter-operator security will be provided by security proxy servers, which are essentially an evolution of 2G, 3G, and 4G signalling firewalls.

2. 5G networks will use the home network public key for asymmetric encryption to prevent disclosure of subscriber identifiers.

3. Networks and devices in 5G are mutually authenticated.

4. Data transmission networks outside the mobile operator domain, such as Wi-Fi calling, will require secondary authentication.

5. 5G utilises key separation. This limits the damage if a part of the infrastructure is compromised, and protects the integrity of data transmitted by the user.

6. In the base station, the data-processing module and the radio module are separated at the architecture level and interact via a secure interface. Such separation prevents the attacker from breaching the operator's network, even if successful in gaining access to the radio module.

3.5 Spectrum Requirements

The demand for 5G spectrum is driven not only by the speed it offers but by its "ability to accommodate tens of billions of connected devices, smart objects and embedded sensors online, facilitating the Internet of Things" (Carpenter 2020).

5G requires a significant amount of mobile spectrum across low, mid and high ranges, in order to deliver widespread coverage and support all use cases. The GSMA recommends that regulators aim to make available 80–100 MHz of contiguous spectrum per operator in prime 5G mid bands, e.g., 3.5 GHz, and around 1 GHz per operator in higher bands (GSMA 2020).

Low-band spectrum is considered any spectrum lower than 1 GHz. The propagation characteristics of the spectrum in this band and the allowable power limits make it conducive to business models

that are built on serving consumers over a large area. This enables widespread coverage across more suburban and rural areas and supports IoT services.

Mid-band spectrum offers a balance of coverage and capacity benefits. The spectrum under consideration includes the 2.5 GHz, 3.5 GHz, and 3.7–4.2 GHz bands. The 3.3–3.8 GHz range is of particular interest, as it can provide the same coverage and use the same cell sites as the 2.6 GHz and 1800 MHz mobile bands. Notably, 10 South American countries, namely, Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Peru and Uruguay, have designated part of the 3.3–3.8 GHz (from 300 to 500 MHz) for mobile broadband deployment. Other bands which may be assigned to, or refarmed by, regulators for 5G include 1800 MHz, 2.3 GHz and 2.6 GHz.

High-band spectrum is critical because this is what is needed to meet the ultra-high broadband speeds envisioned for 5G. While this spectrum has previously not been used to deliver mobile services, it will now allow for high capacity and very low latency. To date, the 24 GHz, 26 GHz and 40 GHz bands have had the most international support and momentum.

3.5.1 Frequency Bands Identified for International Mobile Telecommunications (IMT) by ITU

The bands identified by ITU for IMT for Region 2 (ITU 2019) are listed below:

1. 450–470 MHz
2. 470–698 MHz
3. 698–960 MHz
4. 1427–1518 MHz
5. 1710–2025 MHz
6. 2110–2200 MHz
7. 2300–2400 MHz
8. 2500–2690 MHz
9. 3300–3400 MHz
10. 3400–3600 MHz
11. 3600–3700 MHz
12. 4800–4990 MHz
13. 24.25–27.5 GHz
14. 37–43.5 GHz
15. 45.5–47 GHz
16. 47.2–48.2 GHz
17. 66–71 GHz

3.5.2 The United States

The FCC has taken strategic steps to make additional spectrum available for 5G services.

3.5.2.1 Low-Band Spectrum

The FCC completed an auction in 2017 for new 600 MHz licences. They also adopted a comprehensive plan to reconfigure the 800 MHz band. Finally, in 2019, they proposed a plan to reconfigure the 900 MHz band (896–901/935–940 MHz), to facilitate broadband via a market-driven, voluntary exchange process, to allow existing licensees to agree to a plan for relocating incumbents and transitioning the band.

3.5.2.2 Mid-Band Spectrum

For the 2.5 GHz band, a notice of proposed rulemaking (NPRM) was adopted in 2018 to consider updating the framework for licensing educational broadband service (EBS) spectrum. The 2.5 GHz band (2496–2690 MHz) constitutes the single largest band of contiguous spectrum below 3 GHz and is a prime spectrum for 5G. The EBS spectrum in this band currently lies fallow across approximately half of the United States, primarily in rural areas. The NPRM will enable more flexible, efficient and effective use of this spectrum in the 2.5 GHz band (FCC 2018). The NPRM provides new opportunities for EBS eligible entities, rural tribal nations, and commercial entities to obtain unused 2.5 GHz spectrum to facilitate improved access to next generation wireless broadband, including 5G.

Some changes were made to the rules governing priority access licences (PALs) that will be issued in the 3.5 GHz band, including larger licence areas, longer licence terms, renewability, and performance requirements, as well as changes to the competitive bidding rules for the issuance of PALs, and to the ability to partition and disaggregate areas within PALs (FCC 2018). On 25th August 2020, bidding concluded for the auction of PALs in the 3550–3650 MHz portion of the 3.5 GHz band (FCC 2020).

On 17th February 2021, the auction of new flexible-use overlay licences[1] in the 3.7–3.98 GHz band concluded, following the close of bidding in the assignment phase. The auction offered 5,684 new flexible-use overlay licences for spectrum in the 3.7–3.98 GHz band throughout the contiguous United States, subject to clearing requirements.

[1] Overlay licences mean flexible-use licences to use a particular band occupied by another licensee. Overlay licences grant auction winners the right to use only unoccupied spectrum adjacent to an incumbent system in the band, and exclusive rights to bargain with those existing users (Brent Skorup, 2015).

A licensee in the 3.7–3.98 GHz band may provide any services permitted under terrestrial fixed or mobile allocations, as outlined in the non-federal government column of the *Table of Frequency Allocations* in section 2.106 of the Commission's rules. Initial authorisations will have a term not to exceed 15 years from the date of initial issuance or renewal.

3.5.2.3 High-Band Spectrum

The FCC held auctions for high-band spectrum and has concluded its first 5G spectrum auctions in the 28 GHz band, the 24 GHz band, and the upper 37 GHz, 39 GHz, and 47 GHz bands. With these auctions, the FCC is releasing almost 5 GHz of 5G spectrum into the market – more than all other flexible-use bands combined.

3.5.2.4 Unlicensed Spectrum

The FCC adopted rules that will make 1200 MHz of spectrum in the 6 GHz band (5.925–7.125 GHz) available for unlicensed use, as well as rules to encourage the development of new communications technologies. Low-power operations are authorised over the full 1200 MHz of spectrum; standard-power indoor and outdoor operations have use of 850 MHz of the band, with an automated frequency coordination system intended to help avoid interference with incumbent services. This will allow for the operation of Wi-Fi 6E devices under the 802.11ax standard.

3.5.3 The United Kingdom

Ofcom has identified spectrum bands at low, mid and high frequencies with different characteristics and intended to deliver different benefits.

3.5.3.1 Low-Band Spectrum

Ofcom decided to release 700 MHz spectrum for 4G initially, due to the wide availability of devices. They set out to make the 700 MHz band available for mobile services, publishing an update in October 2017 on this effort. Ofcom proceeded with the auction process in late November 2020, with the final auction results published in April 2021.

3.5.3.2 Mid-Band Spectrum

The 3.4–3.8 GHz band has been identified by Ofcom as a primary band for 5G. Ofcom began the process of auctioning the 2.3 GHz and 3.4 GHz bands and awarded spectrum in the 3.6–3.8 GHz bands via auction, with the final auction results published in April 2021. Ofcom is also considering the possibility of increased sharing in the 3.8–4.2 GHz spectrum, extending shared access to broadband wireless systems within the 3.8–4.2 GHz band. This will build on the coordination arrangements for shared use in the lower part of the band.

3.5.3.3 High-Band Spectrum

Ofcom initially stated in 2018 that it would collate evidence from stakeholders across different sectors to inform their understanding of the 26 GHz band, given the wide international interest in using high frequency spectrum for mobile. Since then, a decision was taken that the 24.25–26.5 GHz band, also known as the lower 26 GHz band, would be added to the spectrum-sharing framework for indoor-only deployment.

The band 66–71 GHz was also identified as a possibility for 5G licence-exempt use.

3.5.3.4 Unlicensed Spectrum

Ofcom recognises that access to licence-exempt spectrum enables innovation, helping consumers to have reliable broadband wherever they live, work or travel and, as such, it made new spectrum available for technologies including Wi-Fi at 5.8 GHz.

To facilitate innovation and support the development of 5G technologies, Ofcom issues innovation and trial licences. These licences enable the time-limited use of spectrum for innovative purposes. It is intended to allow for quick, inexpensive access to radio spectrum for wireless tests, and trial scenarios involving consumers, to help build an understanding of how 5G services could be used. Recognising that unlicensed spectrum will be important for 5G, the agency is also creating new opportunities for the next generation of Wi-Fi in the 6 GHz (5925–6425 MHz) band and above the 95 GHz band.

3.5.4 Brazil

Brazil approved their 5G auction process in February 2020, with spectrum in the 700 MHz, 2.3 GHz and 3.5 GHz bands set for sale alongside 26 GHz spectrum. Brazil’s spectrum auction for the

award of 5G frequencies was set to take place in July 2021 (rcrwireless 2021), but was shifted to October 2021 (rcrwireless 2021). Three operators – Claro, Vivo, and Tim – won 3.5 GHz spectrum; Winity II Telecom won the 700 MHz frequency. Algar Telecom won regional lots in the 3.5GHz, 2.3GHz and 26GHz bands (AgenciaBrasil 2021).

3.5.4.1 Unlicensed Spectrum

In 2021, Brazil opened the complete 5925–7125 MHz band (6 GHz band) for unlicensed access. The allocation of the full 6 GHz band is critical so that technologies using unlicensed spectrum, such as Wi-Fi 6E, may launch, develop, and thrive in Brazil. ANATEL's decision paves the way for the future implementation of Wi-Fi 7 and NR-U technologies in Brazil, making the country a leader in cutting-edge connectivity solutions (DSA 2021).

3.5.5 Chile

In March 2021, Chile completed its first auction to assign 5G spectrum. The spectrum awarded per operator was as follows (European 5G Observatory 2021):

1. WOM: 2×10 MHz in the 700 MHz band, 2×15 MHz in the Advanced Wireless Services (AWS) band, 50 MHz in the 3500 MHz band and 400 MHz in the 26 GHz band
2. Entel: 50 MHz in the 3500 MHz band and 400 MHz in the 26 GHz band
3. Movistar: 50MHz in the 3500 MHz band
4. Claro: 400MHz in the 26GHz band

3.5.5.1 Unlicensed Spectrum

In 2022, Chile's Ministry of Transport and Telecommunications opened the door to using the 6 GHz for 5G, reversing an earlier decision to make the whole band (5925–7125 MHz) available for Wi-Fi. Instead of assigning the full 6 GHz band for licence-exempt use, only the lower part of the range (5925–6425 MHz) will now be set aside for RLAN technologies like Wi-Fi 6E.

The upper part of the 6 GHz (6425–7125 MHz) may be considered for 5G and, in the official documentation of the decision, the Chilean Ministry stated that the reasoning behind the reversal is the need to adapt to the reality of the market. It was further stated that Chile will now await a

potential decision on the band's future at ITU World Radiocommunication Conference 2023 (WRC-23) (GSMA 2022)

3.5.6 Canada

The auctions held in Canada in July 2021 assigned 200 MHz of spectrum between 3.45 and 3.65 GHz. Moreover, of this 200 MHz, only 111 MHz was actually up for auction, with the remaining 89 MHz retained by incumbents.

Innovation, Science and Economic Development (ISED) Canada views the licensing of the 3800 MHz band as an opportunity to support investment by telecommunications service providers and to improve the quality, affordability, and availability of wireless services for Canadians. The licensing of 3800 MHz spectrum (3650–3900 MHz) will allow wireless service providers to acquire additional mid-band spectrum to support the rollout of 5G networks. ISED published its policy and licensing framework for spectrum in the 3800 MHz band in June 2022.

3.5.6.1 Unlicensed Spectrum

In 2021, the Canadian government announced its decision to make available 1200 MHz of 6 GHz spectrum for unlicensed services, joining Brazil, Costa Rica, Peru, Saudi Arabia, South Korea, and the United States who have adopted the same policy.

4 Maximum Permissible Exposure Limits for Radio Frequency Radiation for 5G

The Authority is responsible for monitoring electromagnetic radiation emissions from radio-transmitting equipment in Trinidad and Tobago, ensuring compliance with health and safety standards (TATT 2007).

Radiation is the propagation of energy through space in the form of particles or waves. Waves of magnetic and electric energy propagating together through space constitute electromagnetic radiation. Radio frequency, or RF, energy refers to that portion of the electromagnetic spectrum specific to radio waves and microwave radiation.

Regarding 5G, the World Health Organization (WHO) concluded and maintains the following (WHO 2020):

> To date, and after much research performed, no adverse health effect has been causally linked with exposure to wireless technologies. Health-related conclusions are drawn from studies performed across the entire radio spectrum but, so far, only a few studies have been carried out at the frequencies to be used by 5G.
>
> Tissue heating is the main mechanism of interaction between radio frequency fields and the human body. Radio frequency exposure levels from current technologies result in negligible temperature rise in the human body.
>
> As the frequency increases, there is less penetration into the body tissues and absorption of the energy becomes more confined to the surface of the body (skin and eye). Provided that the overall exposure remains below international guidelines, no consequences for public health are anticipated.

The Committee on Man and Radiation (COMAR) is a technical committee of the Engineering in Medicine and Biology Society (EMBS) of the Institute of Electrical and Electronics Engineers (IEEE). It consists of a group of experts on health and safety issues related to electromagnetic fields, from powerline through microwave frequency ranges. COMAR has stated (IEEE 2020):

> [W]e [sic] anticipate in all cases, exposure levels will remain well below major international exposure limits and that network operators will be aware of their obligation to maintain their systems within compliant operating parameters. When exposure levels are maintained below current exposure limits, neither health agencies nor guideline/standards setting organizations have identified hazards from exposure to

> millimetre waves or RF signals in lower frequency bands used in previous generation technologies.

Julius Knapp, chief of the FCC's Office of Engineering and Technology, has said that (FCC 2019):

> The FCC sets radiofrequency limits in close consultation with the FDA and other health agencies. After a thorough review of the record and consultation with these agencies, we find it appropriate to maintain the existing radiofrequency limits, which are among the most stringent in the world for cell phones.

It should be noted that a ruling of the US Court of Appeals has mandated that the FCC re-examine its health and safety guidelines for 5G and other wireless-based technologies (US Court of Appeals 2021).

The US Food and Drug Administration (FDA) issued the following statement (FDA 2020):

> [T]he scientific knowledge continues to demonstrate that:
>
> - The current limit on radio frequency (RF) energy set by the Federal Communications Commission remains acceptable for protecting public health. The FDA recently provided an updated assessment of the current limits based on the currently available scientific evidence
>
> - To date, there is no consistent or credible scientific evidence of health problems caused by exposure to radio frequency energy emitted by cell phones.

The FDA, as part of its ongoing monitoring activities, has reviewed epidemiological studies (studies relating to the causes of health outcomes and diseases in populations) and in vivo studies (referring to tests, experiments, and procedures that researchers perform in or on a whole living organism, such as a person, laboratory animal or plant) (FDA 2020). The outcomes of these studies were reviewed for any evidence of adverse events. The FDA believes that the weight of the scientific evidence does not suggest there is an increase in health risks from RF exposure from cell phone use at or below the exposure limits set by the FCC.

Specifically concerning 5G, the FDA stated:

> The FDA is responsible for, among other things, ensuring cell phones – and any radiation-emitting electronic product – are safe for the public to use. This includes, understanding the health risks (if any) of new electronic products that emit radiation as they become widely available to the U.S. public, such as 5G cell phones. While many of the specifics of 5G remain ill-defined, it is known that 5G cell phones will use

> frequencies covered by the current FCC exposure guidelines (300 kHz–100 GHz), and the conclusions reached based on the current body of scientific evidence covers these frequencies. The FDA will continue to monitor scientific information as it becomes available regarding the potential impacts of 5G.

A public advisory statement was also published by the Authority, clarifying there is no scientific evidence that 5G causes COVID-19 (TATT 2020).

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is the primary organisation which specifies RF exposure limits. The guidelines set out levels for limiting human exposure to time-varying electromagnetic fields (EMFs) and are intended to protect against adverse health effects due to EMF exposure in the 100 kHz to 300 GHz range, thus covering the radio frequency EMF spectrum.

The guidelines were first published in 1998 and updated in March 2020 (ICNIRP 2020). The recommended limits were determined through reviews of scientifically substantiated, published literature concerning the effects of radio frequency EMF exposure on biological systems. Adherence to the recommended levels is intended to protect people from all substantiated harmful effects of radio frequency EMF exposure. The guidelines differentiate between occupationally exposed individuals and members of the general public.

The RFR limits in the 2020 guidelines applicable to frequencies below 6 GHz used by 5G base stations are essentially unchanged from the 1998 guidelines. The main changes in the 2020 guidelines that are relevant to 5G are for frequencies above 6 GHz. An additional restriction for exposure to the whole body was included, with the addition of a restriction for brief exposures (less than six minutes) to small regions of the body, and the reduction of the maximum exposure permitted over a small region of the body.

It should be noted that there will be a negative impact if lower national RFR limits are adopted. Overly restrictive RFR limits make it impossible to optimise radio coverage and investment. Examples are the cases of Poland and Lithuania, where changes had to be made to national RFR limits (which were previously approximately 100 times lower), to enable 5G deployment (GSMA 2014).

5 Valuation Methods and Pricing Models

The valuation of 5G spectrum can be influenced by many variables, including assignment methodology, frequency bands assigned, how the spectrum is to be used, environmental and social characteristics of network locality as well as other local factors (Gary Kim 2018).

5.1 Valuation Methods

Spectrum value is the worth of a block of spectrum to organisations, operators or users. It involves the valuation of the goods and services that make use of the resource, or the savings generated from it.

Overpriced spectrum can pose a challenge to network investment and contributes to higher prices of dependent services. Conversely, underpriced spectrum can lead to inefficient use and allocation, for example, where operators purchase spectrum and it is held idle (Shaw 2017).

5G spectrum should be priced to recoup the fair market value while ensuring that targets for ubiquitous uptake of telecommunications services are achieved. Approaches generally used to price 5G spectrum have been categorised into direct assignment methods and market-based methods, as explained in the following subsections.

5.1.1 Direct Assignment Methods

Under direct assignment methods, the price of spectrum is determined largely by the administrators. With the incremental value method, the 5G network is owned by the state, with the value derived from accessing the network recovered on an operational or incremental basis. The access charge to the single centralised (state-owned) 5G network, or part thereof, forms part of the economic value of the spectrum over the operational life of the network instead of the upfront value. The economic value of spectrum is established by the ability and willingness of users of the end services to pay for these services.

Malaysia has adopted this approach, to reduce upfront capital investment critical to the rollout of network infrastructure. This centrally coordinated 5G network is expected to create a level playing field for smaller operators, by eliminating the hurdle of the capital required to deploy 5G networks individually (Asia News Network/ The Star 2021). Drawbacks include concerns over discrimination against private operators, long-term operating costs, and low productive efficiency (Asia News Network/ The Star 2021).

With this approach, the regulator assigns spectrum based on its criteria or conditions. Consequently, the value of the spectrum may be captured by a smaller upfront price. There may be greater downstream value, however, through quicker investment in network build out, with the possibility of more rural communities being served, and higher end-user returns. Direct assignments, including an award by comparative evaluation, have been employed in many countries including China, Japan and Singapore (Computer Weekly 2019).

Japan used the comparative evaluation method for the assignment of 5G spectrum (3.7 and 4.5 GHz bands). In 2019, Japan approved four operators' plans based on their ability to offer 5G services by 2020 rather than being the highest bidders.

In 2021, Chile used the beauty contest evaluation method to select participants in four different bands: 700 MHz, AWS, 3.5 GHz, and 26 GHz (Dynamic Markets 2021).

5.1.2 Market-Based Methods

Under market-based methods, the price of spectrum is determined by the forces of demand and supply.

Auctions are market-based methods used to derive spectrum value. Spectrum auctions have been used by Austria, Germany, the UK and the USA, amongst other countries, to assign spectrum and recover its economic value. Auctions attract high economic value and award spectrum to those who value the resource the most and are expected to use it most efficiently. They can, however, result in excessive spectrum aggregation by incumbents who have deep financial capacity.

They can also push prices beyond competitors' reach and they run the risk of a "winner's curse", whereby the winning bid exceeds the value of the auctioned spectrum. Conditions can be included to avoid spectrum resource consolidation, promote competition and service penetration, and ensure quality end service. Examples of these terms and conditions include fragmentation of spectrum blocks on offer, restrictions on bidder volumes, and performance obligations for the winning bidder. The types of auctions and conditions attached to the winners can impact the value of spectrum. Three types of auctions are discussed in further detail below: single round, combinatorial clock and simultaneous multiple rounds.

In single round auctions, the regulator offers each licence in one bidding round. Bidders submit, review, and potentially resubmit and confirm their bids. Bidders are unable to modify prices due to observations from multiple rounds. The single round format shortens the duration of an auction. In 2021, the FCC sought comments on bidding procedures for single round auctions for licences

of up to three blocks of spectrum (50.5 MHz, 49.5 MHz and 16.5 MHz) on a county basis (Hanbury 2021).

The combinatorial clock auction format allows bids on available frequency bands simultaneously. This was utilised by Switzerland's regulator, the Federal Communications Commission (ComCom), using established spectrum caps to ensure that all mobile operators could acquire a wide range of 5G frequencies at reasonable prices. Following the first stage, known as the clock phase, winning bidders of generic blocks are rewarded with the opportunity to bid during the assignment phase, for their preferred combination of frequency-specific licence assignments.

The simultaneous multiple-round auction (SMRA) facilitates bidding for spectrum by interested operators, round by round until demand is exhausted. In the format adopted by Ofcom, operators first bid for airwaves in separate lots, to determine how much spectrum each company wins. In the second phase, the operators participate in a round of bidding to determine the specific frequencies that winning bidders will be allocated (Telecoms.com 2021). Drawbacks include the possibility of exorbitant pricing, spectrum consolidation, spectrum hoarding and lengthy assignment processes, though these can be mitigated by measures such as spectrum caps, limits on the number of rounds, and minimum and maximum bid increments.

The Authority has employed the simultaneous multi-round combinatorial clocked auction method for three auctions: one mobile auction in 2005, and two broadband wireless access (BWA) auctions for spectrum blocks in the 2.3 GHz (2.3–2.36 GHz) and 2.5 GHz (2.5–2.69 GHz) bands, along with spectrum in the lower 700 MHz band (TATT 2009).

6 Policies, Regulations, Plans and Procedures Pertinent to 5G in Trinidad and Tobago

The following policies, regulations, plans and procedures are pertinent to the deployment of 5G in Trinidad and Tobago:

1. *Spectrum Management Framework* (TATT 2022)
2. *Spectrum Plan for the Accommodation of Public Mobile Telecommunications Services* (TATT 2017)
3. *Spectrum Plan for the Accommodation of Broadband Wireless Access Services* (TATT 2008)
4. *Schedule of Devices Eligible for Use Under a Class Licence* (TATT 2022)
5. *Maximum Permissible Exposure Limits for Radio Frequency Radiation in Trinidad and Tobago* (TATT 2007)
6. *Telecommunications (Access to Facilities) Regulations* (TATT 2014)
7. *The Telecommunications (Fees) Regulations, 2006* (TATT 2006)
8. *Position and Procedures in Respect of Non-Objections for Applications to Town and Country Planning Division for Site Approval of Telecommunications Structures* (TATT 2007)

6.1 Spectrum Management Framework

The *Spectrum Management Framework (ver. 2.0)* for the management of the radio frequency spectrum was revised and published in October 2022. It identifies the appropriate spectrum policies, rules and regulations for the management of national spectrum resources.

The framework guides the planning, authorisation and monitoring of the national spectrum resource, for equitable and timely access to spectrum while supporting national goals. The document identifies new and emerging technologies that promote the efficient and effective use of spectrum.

5G Framework Policy Statement

1. *The Spectrum Management Framework (Ver. 2.0) has been published to guide the planning, authorisation and monitoring of the national spectrum resource, for equitable and timely access to spectrum while supporting national goals.*

6.2 Spectrum Plan for the Accommodation of Public Mobile Telecommunications Services (PMTS)

The *Spectrum Plan for the Accommodation of Public Mobile Telecommunications Services* (Spectrum Plan for PMTS) identifies the frequency ranges that will be allocated for the provision of public mobile telecommunications services, in accordance with market and sector interests. It also sets out the licensing process for the assignment of frequency ranges, including any licensing conditions, and specifies the technical operating conditions and specifications to be imposed on the licensed radiocommunications systems in the allocated frequency ranges.

The last approved version of the document was published in November 2017, following consultation, and included the AWS band, as well as the change from the use of the US 700 MHz Band Plan to the APT 700 MHz Band Plan for the provision of PMTS.

Based on the frequency ranges identified for the accommodation of 5G services by the ITU (ITU 2019), the following bands will be reviewed for their suitability:

1. 3.3–3.4 GHz
2. 24.25–27.5 GHz
3. 37–43.5 GHz
4. 45.5–47 GHz
5. 47.2–48.2 GHz

The Spectrum Plan for PMTS shall be revised in 2023. Mid-band spectrum in the 2.5 GHz band and the 3.3–3.7 GHz range will be allocated to PMTS with defined spectrum caps.

The 3.7–4.2 GHz range will not be considered at this time, but shall be reviewed for the accommodation of 5G services in the future, taking into consideration the current state of licensees in the band in Trinidad and Tobago, and international references on 5G and radio altimeters coexistence. In the event that a portion of this spectrum is under consideration for inclusion, the Authority will consider limiting the location and output power of transmitters relative to the airports.

Spectrum usage techniques such as frequency division duplex (FDD) or time division duplex (TDD) and spectrum allocation methods will be specified in the Spectrum Plan for PMTS.

The Authority is closely monitoring developments on the accommodation of public mobile telecommunications services, which may use 5G technology, in the upper 6 GHz band. In deciding on the use of the upper 6 GHz band, the Authority will evaluate among other factors, whether:

1. ITU has identified this band for IMT for Region 2.

2. relevant studies have confirmed the coexistence of PMTS with existing 6 GHz class-licensed devices and existing licensed systems in the upper 6 GHz band.

3. a suitable ecosystem of public mobile telecommunications equipment exists.

4. there is a level of demand for mid-band spectrum for PMTS in Trinidad and Tobago.

5. there is a regional harmonisation effort for the 6 GHz band.

As it pertains to the PMTS spectrum plan, consideration will be given to:

1. re-farming the current 850 MHz band (B5), namely the 5 MHz allocated for future use, to afford more spectrum per operator, whilst maintaining spectrum for up to three operators.

2. expanding the AWS band (B4) to band (B66) to afford an additional 25 MHz for mobile services.

5G Framework Policy Statements

2. *The Spectrum Plan for PMTS will include the bands identified in this Framework that can be used for 5G cellular mobile services. The respective licensing approaches and frequency assignment plans for each band will be stated in the plan.*

3. *Additional mid-band spectrum in the 2.5 GHz band and the 3.3–3.7 GHz range will be allocated to PMTS, with spectrum caps to be determined.*

4. *The 3.7–4.2 GHz range is not under consideration for inclusion in the 5G Framework at this time, but shall be reviewed for the accommodation of 5G services in the future, taking into consideration the current state of licensees in the band in Trinidad and Tobago, and international references on 5G and radio altimeters coexistence.*

5. *An additional 5 MHz x 2 in the 850 MHz band, and 25 MHz x 2 in the AWS band will be allocated for IMT, to be used by PMTS operators.*

6.3 Spectrum Plan for the Accommodation of Broadband Wireless Access Services

This spectrum plan identifies the frequency ranges allocated for the provision of BWA services, in accordance with market and sector interests. The plan indicates the licensing process to be implemented for the allocated frequency ranges, including any licensing conditions, and specifies the maximum technical operating conditions and specifications to be imposed on the licensed radiocommunications systems in the allocated frequency ranges.

Following the conclusion of a competitive licensing process in October 2007, the spectrum plan for BWA was revised in September 2008 to include frequency assignment plans for the 2.3 GHz, 2.5 GHz and 3.5 GHz bands, based on the approved version of the refarming plan for BWA services in the 2.3 GHz, 2.5 GHz and 3.5 GHz bands. A second BWA auction was conducted in 2009 for spectrum blocks in the 2.3 GHz (2.3–2.36 GHz) and 2.5 GHz (2.5–2.69 GHz) bands, along with the spectrum remaining in the lower 700 MHz band from the first BWA auction.

The Spectrum Plan for PMTS will be revised first, to include the additional bands allocated for mobile radiocommunications service. Following this, the BWA spectrum plan will be revised to include the bands allocated to accommodate fixed radiocommunications services using 5G.

Consideration will be given to:

1. increasing the current spectrum cap for BWA services in the 2.5 GHz and 3.5 GHz bands, to allow more spectrum to existing operators, with consideration:

    a. to allow for a minimum of three licensees in the 2.5 GHz band.

    b. to allow for a minimum of three licensees in the 3.5 GHz band.

5G Framework Policy Statements

6. *Frequency allocations, licensing approaches and frequency assignment plans for any additional bands allocated to accommodate 5G fixed wireless access will be added to the spectrum plan for BWA.*

7. *The bands identified for mobile service in the Spectrum Plan for PMTS under policy statement 3 will be removed from the BWA spectrum plan.*

8. *The spectrum caps for the 2.5 GHz and 3.5 GHz bands will be increased by at least 25 MHz, to allow more spectrum to existing operators.*

6.4 Schedule of Devices Eligible for Use Under a Class Licence

The Schedule identifies those devices for which class licensing shall apply and contains the required technical operating parameters for all devices listed. This document is updated periodically as devices are added to the schedule or operating parameters are amended.

The Schedule of Devices Eligible for Use Under a Class Licence will be updated periodically to include class licence devices associated with 5G services.

5G Framework Policy Statement

9. *The Schedule of Devices Eligible for Use Under a Class Licence will be updated periodically as devices associated with 5G are added to the schedule or operating parameters are amended to accommodate 5G devices.*

6.5 Maximum Permissible Exposure Limits for Radio Frequency Radiation (RFR) in Trinidad and Tobago

This document establishes maximum permissible exposure limits for RFR for Trinidad and Tobago, in accordance with internationally accepted guidelines. It ensures that operators and/or owners of radio-transmitting equipment comply with the Authority's established standards regarding the exposure of their workers and members of the public to levels of RFR. The document also educates the public on the nature of RFR with respect to health and safety issues.

To accommodate 5G, the maximum permissible exposure limits for RFR adopted by the Authority, for both occupational and general population exposure, will be revised in 2023 to ensure it is in alignment with updated international standards.

5G Framework Policy Statement

10. *The maximum permissible exposure limits within the document,* Maximum Permissible Exposure Limits for Radio Frequency Radiation in Trinidad and Tobago, *shall be revised in 2023 to the 2020 ICNIRP guidelines to accommodate 5G.*

6.6 Position and Procedures in Respect of Non-Objections for Applications to Town and Country Planning Division for Site Approval of Telecommunications Structures

The Authority's *Position and Procedures in Respect of Non-Objections for Applications to Town and Country Planning Division for Site Approval of Telecommunications Structures* was published in 2006 and revised in 2007 (TATT 2007). It outlines the role of the Town and Country Planning Division (TCPD) and specifies procedures with respect to non-objection for applications to TCPD for their approval of telecommunications structures.

The Authority will adhere to the document, *Position and Procedures in Respect of Non-Objections for Applications to Town and Country Planning Division for Site Approval of Telecommunications Structures* for 5G services.

5G Framework Policy Statements

11. *The document,* Position and Procedures in Respect of Non-Objections for Applications to Town and Country Planning Division for Site Approval of Telecommunications Structures, *outlines the role of the Town and Country Planning Division (TCPD) and specifies procedures with respect to non-objection for applications to TCPD for their approval of telecommunications structures, which will be adhered to for 5G services.*

12. *The Authority will oversee the deployment of an appropriate instrument for the regulation and administration of telecommunications sites for operators and the general public. This paper will address issues such as utility colocations, picocells, lamp sites, rooftop sites, small cells and road reserve sites, and will be subject to consultation, in keeping with the* Procedures for Consultation in the Telecommunications and Broadcasting Sectors of Trinidad and Tobago.

6.7 Telecommunications (Access to Facilities) Regulations

The *Telecommunications (Access to Facilities) Regulations* (the Regulations) was intended to facilitate the provision of a wide range of telecommunications services for both public and private use through infrastructure sharing. This was revised in 2014 to ensure fair and non-discriminatory access among concessionaires, in order to foster the orderly development of the sector. The Regulations support GORTT's telecommunications policies and ensures the effective liberalisation of the telecommunications sector.

5G Framework Policy Statement

13. The Telecommunications (Access to Facilities) Regulations *allows for infrastructure sharing and will be maintained for 5G.*

6.8 The Telecommunications (Fees) Regulations, 2006

The *Telecommunications (Fees) Regulations, 2006* (Fees Regulations) outlines the pricing of spectrum in Trinidad and Tobago, which may be determined through auction or competitive processes, or through licensing fees (administrative plus operating plus spectrum usage). Specifically, administrative cellular mobile licence fees are outlined in the second schedule.

Considering the increasing value of 5G spectrum globally, it may be prudent for the Authority to update its application and licence fee values in accordance with the fair market value of the resource, for optimal allocation and sustainability of the services provided.

The Authority may also use auctions. For these competitive processes, reserve prices for auctions may be set based on the market value of the resource. The current Fees Regulations allows for the use of auctions in the establishment of licence fees for spectrum.

5G Framework Policy Statement

14. The Authority may use auctions, direct assignments and/or price methodologies for the pricing of spectrum for 5G, with the requisite consideration of the availability of information and data, economic value, efficient allocation of spectrum resources and other relevant and reasonable factors. The current Fees Regulations allows for the use of auctions to determine the licence fee for 5G.

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