CRAN

Communications Regulatory Authority of Namibia

# STRATEGY IN RESPECT OF IMPLEMENTATION OF IMT-2020 (5G) IN THE REPUBLIC OF NAMIBIA 2022-2027

## PURSUANT TO CABINET RESOLUTION NO. 10TH/21.07.20/006 1 JULY 2022

## Issued for public consultation

# Contents

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 3GPP | Third Generation Partnership Project |
| 4IR | 4th Industrial Revolution |
| AI | Artificial intelligence |
| AKA | Authentication and Key Agreement |
| ARIB | Association of Radio Industries and Businesses |
| ATIS | Alliance for Telecommunications Industry Solutions |
| ATU | Africa Telecommunications Union |
| Authority | Communications Regulatory Authority of Namibia |
| CAPEX | Capital expenses |
| CCSA | China Communications Standards Association |
| CI | Critical infrastructure |
| CII | Critical information infrastructure |
| COMMS | Communications |
| eMBB | Enhanced Mobile Broadband |
| ENUM | E.164 NUmber Mapping |
| DL | Down link |
| DTT | Digital terrestrial television |
| EMF | Electric and magnetic field strength |
| ETSI | European Telecommunications Standards Institute |
| FWA | Fixed wireless access |
| GE06 | Geneva 2006 |
| GHz | Gigahertz |
| HAPS | High Altitude Platform Systems |
| HTS | High throughput satellite |
| ICNIRP | International Commission on Non-Ionizing Radiation Protection |
| ICT | Information Communications Technology |
| IMT | International Mobile Telecommunications |
| IP | Internet protocol |
| IoT | Internet-of-Things |
| ITU | International Telecommunications Union |
| kHz | Kilohertz |
| LTE | Long term evolution |
| MHz | Megahertz |
| mMTC | Massive machine type communications |
| NG | Next generation |
| NG-RAN | Next generation radio access network |
| NR | New Radio |
| NSA | Non-standalone |
| NSCIRT | National security and cyber incidence response team |
| RAN | Radio access network |
| RF | Radio frequency |
| Rurtel | Rural telecommunications |

| | |
|---|---|
| SA | Standalone |
| SDG | Sustainable Development Goal |
| SEAF | Security anchor function |
| SEPP | Security edge protection proxy |
| SIM | Subscriber Identity Module |
| SUPI | Subscriber permanent identifier |
| TSDSI | Telecommunications Standards Development Society India |
| TTA | Telecommunications Technology Association |
| TTC | Telecommunications Technology Committee |
| UE | User equipment |
| uRLLC | Ultra-reliable low latency communications |
| VoLTE | Voice-over-LTE |
| VoNR | Voice-over-NR |
| WiMax | Worldwide Interoperability for Microwave Access |
| WiGig | When it’s Gone it’s Gone |
| WRC | World Radio Conference |

## 1. INTRODUCTION

IMT-2020 (commonly referred to as "5G") is the fifth generation of wireless communication technologies, which follows 2G, 3G and 4G (IMT-2000) mobile technologies. Future networks will require an increasing number of innovative solutions to provide for higher traffic volumes, connection of more devices with diverse service requirements, provision of person-to-person, person-to-machine and machine-to-machine communication, reduction of costs, affordability and improved quality of user experience.

Looking forward, broadband connectivity will have the same level of importance as access to electricity and water. Electronic communications networks provide people with communications tool and facilitate the development of other industry sectors such as education, health, agriculture, manufacturing and transport. Deployment of IMT-2020 networks and services will-

(i) Continue to serve as a key enabler of mobile service delivery *via* a variety of applications, services and wireless connectivity;
(ii) Promote establishment of an integrated ICT industry through the convergence of telecommunications and information technology (IT);
(iii) Provide for enhanced mobile broadband, improving user experience and supporting ultra-reliable and low latency communications;
(iv) Provide for massive machine type communications as envisaged by the Internet-of-Things (IoT) concept by connecting a range of smart appliances, machines and objects with no human intervention;
(v) Provide flexibility and diversity in networks to serve many different use cases and scenarios; and
(vi) Provide for energy efficiency for networks and devices.

It is necessary to adopt a holistic approach considering mobile broadband network rollout, as well as requirements for platforms and applications to be delivered to the benefit of the end user. These platforms and applications referred to as "use cases" imposes different requirements on future networks in respect of quality of services, spectrum utilisations, coverage, varying levels of energy consumption, latency requirements for stable connects amongst other factors.

The Authority was subsequently directed by Cabinet (Decision 10th/27.02.20/006) to develop a 5G (IMT-2020) strategy for consideration prior to implementation of the technology in the Republic of Namibia

## 2. POTENTIAL SOCIO-ECONOMIC IMPACT

Not only Information Communication Technologies (ICTs) plays an essential role in achieving the Sustainable Development Goal (SDG) 9 for industry innovation and

infrastructure as set out by the United Nations, but is also an essential enabler for achieving all other SDGs as shown hereunder:


ICTs are a key enabler to achieve SDG 1 by providing timely and accurate Information services which will help ensure equal rights to economic resources


ICTs give farmers new ways of accessing information and services for increased productivity and effectiveness of agriculture


ICTs have the potential to deliver incredible benefits across the whole of the healthcare ecosystem


There is tremendous potential to improve education globally, and especially in the developing world, with the power of ICTs through on-line platforms


ICTs allow women and girls to access information of importance to their productive, reproductive and community roles and to obtain additional resources


ICTs will play a crucial role in ensuring the availability and sustainable management of water and sanitation for all


ICTs will play a vital role in improving energy efficiency, and in particular in reducing emissions in many sectors of the economy


ICT capacity building must be prioritised in national youth employment and entrepreneurship strategies in all countries


ICTs play and will continue to play an essential role in building resilient infrastructure, in promoting inclusive and sustainable industrialization, and in fostering innovation


ICTs clearly have the potential to help reduce inequality, both within and between countries, ensuring that all people have equal opportunity to manage their own development


ICTs will be essential in offering innovative approaches to managing cities more effectively and holistically through applications for smart cities and efficient way of resource management

| | |
|---|---|
| 12 RESPONSIBLE CONSUMPTION AND PRODUCTION | ICTs have the potential to foster sustainable consumption and production through product-specific improvements, increased dematerialization and virtualization, and smart technologies |
| 13 CLIMATE ACTION | Smart ICT applications have the potential to improve the environment and tackle climate change. ICTs also help to foster sustainable consumption and greener lifestyles |
| 14 LIFE BELOW WATER | ICTs can play a significant role in the conservation and sustainable use of the oceans – notably through improved monitoring and reporting which leads to increased accountability |
| 15 LIFE ON LAND | ICTs can play a significant role in the conservation and sustainable use of terrestrial ecosystems and the prevention of the loss of biodiversity |
| 16 PEACE, JUSTICE AND STRONG INSTITUTIONS | ICTs play an important role in crisis management, humanitarian aid and peace building. It has proved to be a powerful aid in many areas. |
| 17 PARTNERSHIPS FOR THE GOALS | The spread of ICTs and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies |

Source: itu.int/ICT4SDG

Although goal No. 9 above specifically addresses infrastructure, ICT plays a fundamental role in attaining all sustainable development goals. Similarly, IMT-2020 will support Namibia's ability to benefit from the 4th Industrial Revolution (4IR). The rollout of these technologies will contribute to industrial development through improving operational effectiveness, improving workplace and worker safety and enabling faster and effective inspections through predictive intelligence. The aforementioned factors will potentially have a positive impact on the manufacturing, transportation, public services, education, health, agriculture, energy, logistics and mining industry sectors. Social value can be added through contributing to good health and well-being, enhancing infrastructure, fostering innovation and enabling sustainable cities and communities thereby promoting economic growth.

IMT-2020 is supported by five (5) key functional drivers[1] namely-

[1] GSM Association: 2019: The 5G Guide: A reference for Operators, London, United Kingdom
World Economic Forum: 2020: The Impact of 5G: Creating New Value across Industries and Society, Geneva, Switzerland
International Telecommunications Union: 2015: ITU-R M.2083-0, IMT-Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond, Geneva, Switzerland

(i) **Enhanced Mobile Broadband (eMBB)** for faster data connections, higher throughput, greater capacity (up to 10 Gbps) and extended mobile coverage with the ability to support a higher number of devices using high amounts of data. This driver addresses the requirements for human-centric use cases requiring access to multimedia content, services and data.

(ii) **Ultra-reliable low latency communication (uRLLC)** for time-sensitive connections providing for reduced latency for data, uploaded from a devices to reach its target (1ms on 5G compared to 50ms on 4G). This driver requires stringent requirements in respect of latency, throughput and availability to enable wireless control of manufacturing processes, remote medical surgery, and automation of electricity distribution amongst other uses.

(iii) **Massive machine type communications (mMTC)** characterised by a very large number of devices being connected to the network providing for data-intensive applications transmitting low-volume data. This driver relies on small cell deployment and spectral efficiency within networks.

(iv) **Energy efficiency** leading to lower costs are realised on the network via the quantity of information transmitted to or received from users per unit of energy consumption of the radio access network. Similarly, energy efficiency on communications devices are measured based on the quantity of information per unit of power consumption. These drivers supports smart electricity grids and metering, industrial automation, smart consumer wearables to name but a few use cases.

(v) **Security** within networks, platforms and applications lead to high reliability and availability and is central driver to the adoption of 5G by end users and private and public institutions.

Implementation of use cases utilising IMT-2020 95G) technologies are dependent on attaining one or more of these functional drivers as set out in Table 1 on the next page.

**Table 1: Functional drivers for successful implementation of IMT-2020(5G)**

| Functional Drivers | Use Cases (applications) |
|---|---|
| Enhanced Mobile Broadband (eMBB) | Fixed and mobile wireless access services, public protection and disaster response services, massive content streaming services, remote examinations, remote surgery, enhanced in-building broadband services, high-definition cloud gaming, real-time virtual and mixed reality services, etc. |
| Ultra-reliable Low Latency Communications (uRLLC) | Autonomous vehicles, drones and robotic applications, health monitoring systems /tele-health, smart electricity/water grid and metering, factory automation, mission-critical security and safety services, high-definition real-time gaming, etc. |
| Security | |
| Massive Machine-Type Communications (mMTC) | Asset tracking, smart cities and building, e-agriculture, energy/utility management, industrial automation, smart consume wearables, environmental managements, intelligent surveillance, smart retail services, smart electricity/water grid and metering, etc. |
| Power efficiency | |

***It is important to note, that although IMT-2020 technologies are the ideal technologies for some of these use cases, other use cases can be provided utilising Wi-Fi/WiGiG, and 4G and networks. Furthermore, it should be emphasized that the performance of legacy 2G and 3G networks falls short in meeting broadband service quality set out in the National Broadband Policy and will not be able to support digital transformation and industrialisation going forward***

## 3. PRE-REQUISITES FOR IMPLEMENTATION OF IMT-2020 (5G)

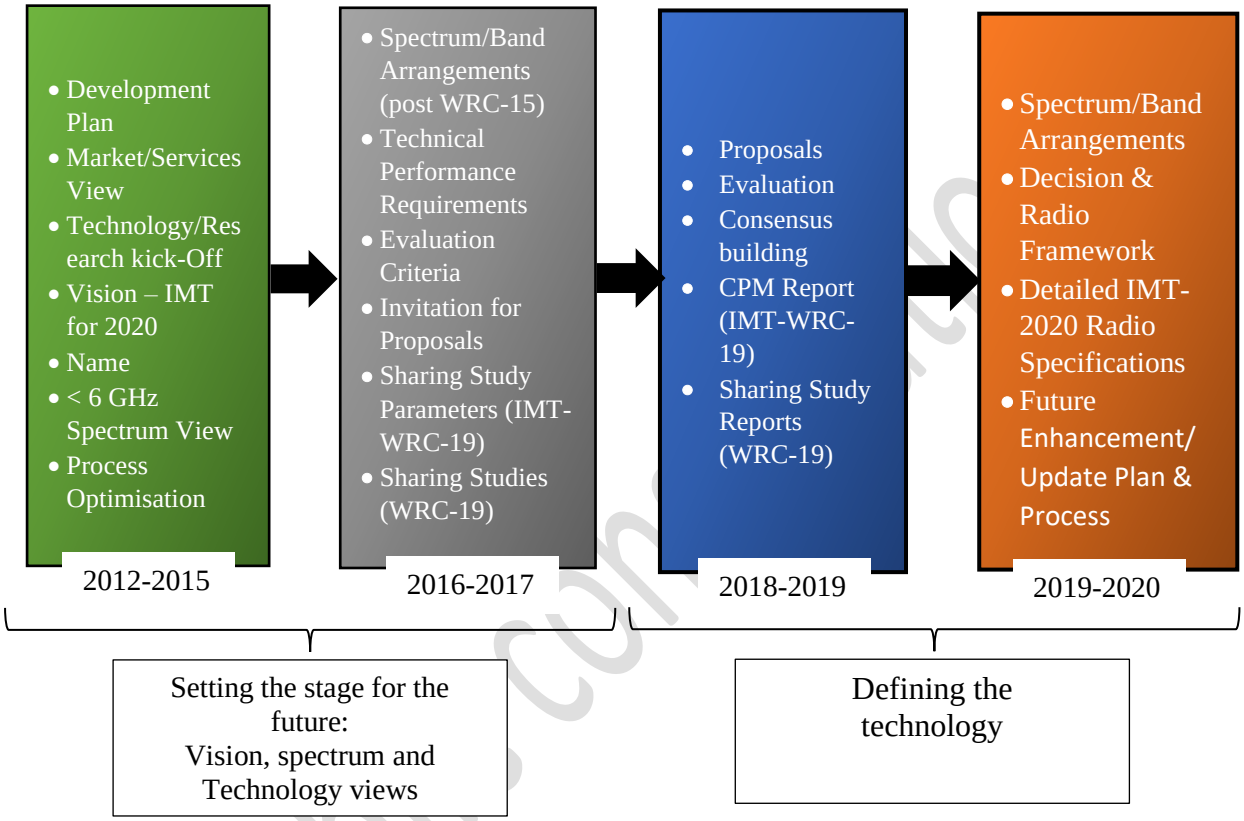
Implementation of IMT-2020(5G) is subject to Namibia meeting several pre-requisites. Meeting the pre-requisites discussed in this section will support successful implementation of the technology and rollout of ICT networks, whilst creating a safe and trusted environment for Namibians to make use of the various services and applications provided, thereby promoting digital transformation.

### 3.1 Technical standards for systems and end-user equipment

The International Telecommunications Union (ITU) published Guidelines for the Evaluation of Radio Interface Technologies for IMT-2020 (ITU-R M.2412-0) in October 2017 and set out the key performance requirements for IMT-2020 on 23 February 2020. These guidelines

set out the procedure, methodology and criteria to be used in evaluation of IMT-2020 technologies in respect of spectrum, technical and service requirements and constitutes the culmination of work carried out as part of the IMT-2020 Standardization Process as illustrated below.

**IMT-2020 Standardization Process**




Source: ITU, 2020

ITU finalised the standardization process and published final technical specifications for IMT-2020 in respect of both the core network and the radio access network on 3 February 2021 (ITU-R M.2150-0). All network equipment vendors will be required to adhere to these specifications and obtain type approval.

The aforementioned process was supported by studies and subsequent technical and health standards set by the 3rd Generation Partnership Project (3GPP) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) as highlighted hereunder.

## 3.2 International Commission on Non-Ionizing Radiation Protection (ICNIRP)

Non-ionizing radiation (NIR) refers to electromagnetic radiation, i.e. light, ultraviolet, infrared, mechanical wave and radio waves situated below the ionizing radiation band. These bands are grouped based on wavelength and frequency. Each group has different effects on the body and thus requires different protection measures.

ICNIRP provides recommendations on limiting exposure for frequencies in the different NIR subgroups. To this end, it published Guidelines for limiting exposure to Electromagnetic Fields (100 kHz to 300 GHz) on 31 March 2020. The publication provides guidelines to limit exposure to electromagnetic fields in order to provide a high level of protection for humans against adverse health effects due to long or short term exposure to radio frequency electromagnetic fields.

The limitations set out in these guidelines serves as input to the standardisation work conducted by 3GPP and is incorporated into the final technical specifications set by ITU for deployment of IMT-2020 in spectrum band allocated for this purpose.

Namibia has enacted the Non-Ionising Radiation Regulations under the Atomic Energy and Radiation Protection Act (Act No 5 of 2005). The ICNIRP Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz) was adopted as the relevant non-ionising radiation exposure limits for the purposes of protecting members of the public and workers from adverse health effects arising from exposure to non-ionising radiation in the living or working environment.

The following technical considerations were taken into account in respect of adoption of the ICNIRP Guidelines-

(i) The ICNIRP Guidelines for limiting exposure to EMFs is adequate to provide for protection of people against substantiated adverse health effects from exposures to radiofrequency EMFs. Therefore, compliance with the Regulations / Guidelines is intended to protect people from all substantiated harmful effects of radiofrequency EMF exposure.

(ii) The only substantiated adverse health effects caused by exposure to radiofrequency EMFs are nerve stimulation, changes in the permeability of cell membranes, and effects due to temperature elevation.

(iii) The Exposure Limits in the ICNIRP Guidelines were determined on the basis of published scientific literature, focusing on those that were reporting scientifically substantiated harmful effects to human health as a result of exposure to radiofrequency EMF.

(iv) The literature that are taken as evidence for setting ICNIRP exposure limits are those where the reported adverse effects of radiofrequency EMFs on health are -
   a. independently verified;
   b. are of sufficient scientific quality; and
   c. consistent with current scientific understanding. Therefore, the guidelines are based on the best science available at the time and it is recognized that there may be limitations to the knowledge that could have implications for the exposure limits.

### 3.3 3rd Generation Partnership Project (3GPP)

3GPP comprises of seven (7) telecommunications standard development organisations namely-

| | | |
|---|---|---|
| (i) | ARIB | Association of Radio Industries and Businesses |
| (ii) | ATIS | Alliance for Telecommunications Industry Solutions |
| (iii) | CCSA | China Communications Standards Association |
| (iv) | ETSI | European Telecommunications Standards Institute |
| (v) | TSDSI | Telecommunications Standards Development Society India |
| (vi) | TTA | Telecommunications Technology Association |
| (vii) | TTC | Telecommunications Technology Committee |

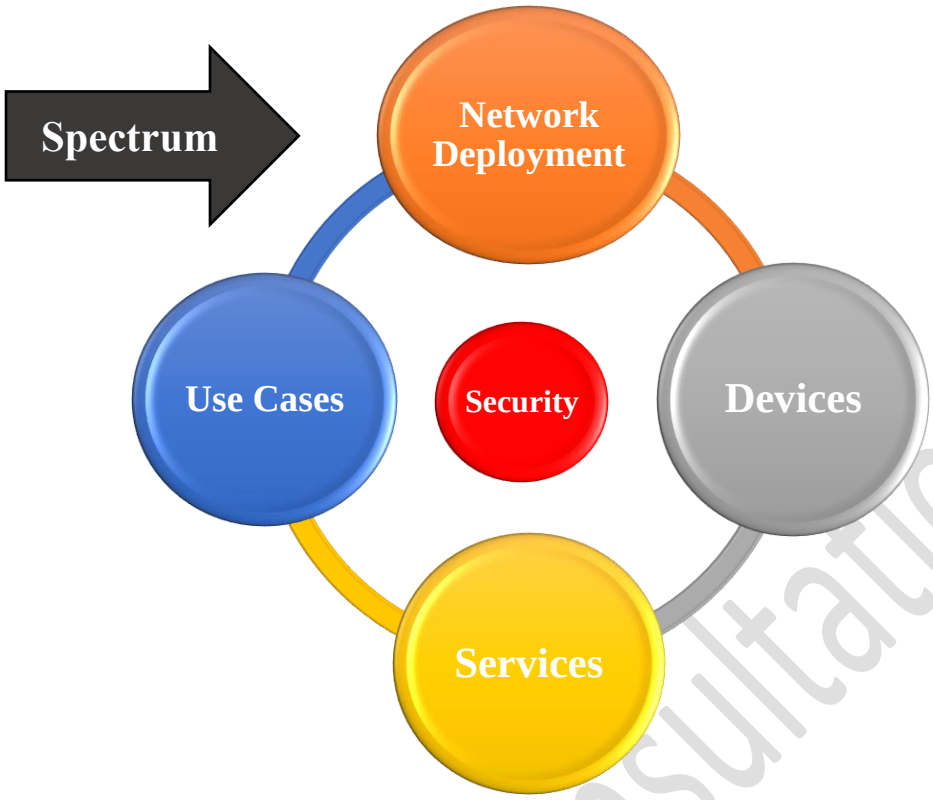
3GPP sets standards for mobile telecommunications technologies in respect of radio access and core networks as well as service capabilities thereby providing technical specifications end-to-end for mobile systems. The specifications developed by 3GPP are submitted to ITU for consideration and inclusion into ITU standards.

3GPP has produced several standard documents since 2014, each document improving on the technical requirements for IMT-2020 taking into account improvement in the technology as well as studies and tests conducted. In June 2019, 3GPP published Rel.15 of the technical specifications for 5G.

It should be noted that security is a critical enabler for IMT-2020 deployment. To this end, the standardisation bodies has incorporated industry defined and supported IP protocols and introduced controls aimed at the prevention of fraud and improvement of security features. These improvements are discussed in more detail under section 7 in this document.

## 4. IMPLEMENTATION OF IMT-2020 TECHNOLOGY

Implementation of IMT-2020 provide for a perpetually increasing number of applications and services to add to the services and applications already provided by current telecommunications networks. Whilst services historically focussed on the mass market, the new capabilities inherent to IMT-2020 will going forward provide the capability to develop new applications and services for specific segments within and external to the ICT industry. It is therefore, necessary to assess the entire IMT-2020 ecosystem to ensure sustainable implementation by analysing the functional drivers to benefit from new technologies and to understand the interdependencies between key areas of this ecosystem such as spectrum, core and access network deployment, use cases and services, devices and security. These key elements and their inter-dependency are illustrated in the diagram on the next page.




Source: IMF, 2020

This section will discuss the elements within the ecosystem related to use cases, services, devices and network deployment, whilst further sections will discuss spectrum and security, which elements are central to implementation of IMT-2020.

## 4.1 5G Core Network deployment

Different telecommunications service licensees will have different approaches to the deployment of 5G depending on the existing capabilities of their networks. The 5G network equipment has been designed to interwork with existing 4G networks at core and radio access network levels. Two standardised approaches have been adopted by the industry namely-

(i) Non-standalone (NSA) 5G network deployment whereby the 5G radio access network connects to and is controlled by the existing 4G core network. Software and hardware within the legacy 4G radio network will need to be upgraded to support 5G spectrum frequency bands, to provide for aggregation of processing capacity as required by 5G and to support antenna systems for multiple-input and multiple-output (MIMO). This approach does not require the implementation of a 5G core network; and

(ii) Standalone (SA) 5G network deployment whereby the 5G radio access network connects to the 5G core network only. The 5G core network integrates with the legacy 4G core network at network level. The SA 5G network deployment will allow telecommunications service licensees to fully utilise 5G radio equipment as well as

new core network capabilities such as network slicing. This approach to network deployment will provide for optimal implementation of 5G technologies.

The aforementioned features supported by SA deployment of 5G networks will support new services in that-

(i) Network slicing allows for the creation of dedicated virtual networks over a common physical network infrastructure. This 5G feature allows telecommunications network operators to address specific quality of service requirements of customers depending on the use case, e.g. e-agriculture applications have different requirements from e-health and e-educations applications. This network feature will also provide for enhanced connectivity for mission critical services deployed in public safety networks; and

(ii) Virtualisation of the network will support faster service provisions and enhance network maintenance in that 5G networks will allow for the division of hardware resources into functions that can be controlled by software. Centralisation of control functions allows for routing decisions to be made globally to fit specific requirements and provided end-to-end visibility of the network for establishing and maintaining connectivity.

## 4.2 5G Access Network deployment

As listed in Government *Gazette* No. 4878, General Notice No. 29 published on 6 February 2012, the following activities may not be undertaken without an environmental clearance certificate-

(i) Communications networks including towers, telecommunications and marine telecommunications lines and cables; and

(ii) Masts of any material or type and of any height, including those used for telecommunication broadcasting and radio transmission, but excluding-
   a. Flag poles; and
   b. Lightning conductor poles.

Telecommunications service licensees are therefore required to obtain the necessary environmental clearance certificates from the Ministry of Environment, Forestry and Tourism prior to commencing with network deployment. Furthermore, the Authority will impose specific licence conditions, in respect of technical requirements for IMT network deployment, in accordance with ITU regulations, and in accordance with section 99 of the Communications Act (Act No. 8 of 2009).

### 4.2.1. Site deployment

Deployment of IMT-2020 (5G) networks may require denser network deployments, potentially increasing the number of base stations and towers. To avoid duplication of infrastructure and decrease environmental impact the Authority will enforce its infrastructure sharing regulatory framework.

To this end telecommunications service licences will be required to improve 5G site deployment efficiency through sharing of resources such as antennas, power and transmission and minimising site infrastructure reconstruction.

### 4.2.2. Backhaul transmission deployment

Telecommunications service licensees will face its biggest challenge in providing sufficient backhaul transmission from sites to the core network to support growing mobile data traffic. If backhaul capacity is not provided for during 5G rollout, it will result in a bottleneck that may lead to a market failure for 5G. The backhaul transmission network is therefore a key consideration in deciding on a 5G implementation model.

#### (i) Fibre backhaul deployment

Fibre backhaul provide for stable connections with very high interference immunity and is suitable for deployment to support outdoor sites, access network and core network implementation. Fibre is considered as the preferred backhaul technology for 5G networks. The cost of fibre deployment may decrease with increasing competition and economies of scale. The relatively high cost and time period for installation of fibre related to trenching, installing ducts and deployment of physical cables to date means that use will be limited

Incumbent telecommunications service licensees with existing fibre assets, such as Telecom Namibia Limited and Paratus Telecommunications (Pty) Ltd, have a backhaul cost advantage when considering the deployment of 5G.

#### (ii) Microwave backhaul deployment

Microwave can be used to support 5G cell sites at lower cost within the spectrum bands 7-40 GHz, 70/80 GHz, 75-110 GHz and 110-170 GHz. It is expected that microwave links will be implemented in *lieu* of fiber in regions with low fibre penetration due to cost of implementation.

Microwave (fixed wireless) backhaul networks can be deployed to support outdoor sites and the 5G access network in that depending on the spectrum band it provide for backhaul solutions ranging for less than one (1) km to more than 30 km. Fixed wireless backhaul provides a lower cost alternative to fibre backhaul networks which can be reduced further through point-to-multipoint deployment and daisy-chaining of multiple small cells to a fibre-connected cell. Such deployment will serve to shorten the time to market.

## 4.3 Use Cases

The implementation of 5G and associated technologies within the IMT-2020 family provides an opportunity to provide more services over the telecommunications network than just voice, SMS and broadband data to the mass market. The deployment of IMT-2020 networks provides for impactful industrial advances in a multitude of industries utilising ICT. These advances will be attained through enhancing operational effectiveness, improving safety of workers and the workplace, enabling faster and effective assembly of products, use of artificial intelligence

and robotics to name but a few. The ICT sector will provide the necessary support and underlying networks through-

(i) **Continuity of voice services**

Given the importance of voice services to date and the fact the licensees may re-farm spectrum previously used for 2G and 3G, will necessitate the deployment of voice services. To ensure continuity of voice services when customers move within areas with different access technologies it is foreseen that operators will deploy VoLTE and VoNR to continue providing voice services to their customers.

(ii) **eMBB products and services**

IMT-2020 networks will provide for bigger capacity, low latency and lower cost/bit that will be offered by telecommunications service licensees trending to provision of unlimited data bundles. Namibian telecommunications services licensees already offer unlimited data bundles and it is foreseen that this trend will continue in future.

Low latency of up to 1 millisecond support use cases in on-line gaming requiring real-time feedback, content streaming, critical communications e.g. remote visual monitoring of patients, remote control of devices and industrial automation.

(iii) **Enterprise products and services**

IMT-2020 networks will be a key enabler of the 4$^{th}$ Industrial Revolution in that it provides for network slicing and quality of service differentiation. These network features provide the capability and flexibility to serve the needs of different enterprise customers.

With the deployment of these network IoT applications will be able to make use of new IMT-2020 functionality such as ultra-reliable low latency communications and time sensitive networking required of time-critical manufacturing processes, interpretation of data from diverse assets, production lines and machine-to-machine interactions allowing for risk mitigation and infrastructure management e.g. smart grids, smart metering, factory automation, etc.

The deployment of these services opens the market for private 5G networks and small licensees creating an opportunity for smaller licensees to provide applications and services tailor-made to niche markets whilst leasing the network from 5G network owners on a wholesale basis. The aforementioned scenario not only fosters entrepreneurship but also creates new employment opportunities contributing to economic and social well-being.

Examples of various use cases identified as being of relevance to Africa are shown in Table 2 on the next page.

**Table 2: Selected 5G use cases relevant to Africa**

| Application | Use Cases | Examples |
|---|---|---|
| Communications | • High-speed broadband in the home<br>• High-speed broadband in the office | • Improved broadband connectivity due to higher-speed, lower-latency connections<br>• Expanded Internet access due to new or expanded network deployments |
| Agriculture | • Stationary/near-stationary monitoring networks<br>• Collaborative robots | • Connected sensors can be quickly deployed in agricultural settings, allowing for better monitoring of crops, animals, and equipment<br>• Monitoring could also benefit wildlife management and protection<br>• Integration into agricultural processes can increase efficiencies and lower costs for labour-intensive industries |
| Healthcare | • Virtual meeting<br>• High-speed broadband in the home<br>• High-speed broadband in the office<br>• Remote object manipulation<br>• Smart wearables | • Remote access to medical professionals and specialized care through enhanced videoconferencing, remote diagnosis, and remote surgery<br>• Collection and analysis of patient data from connected wearable sensors/monitors<br>• Personalized medicine leveraging data collected from wearables and improved access to providers |
| Education | • High-speed broadband in homes, schools and businesses<br>• Virtual meeting<br>• Virtual or augmented reality<br>• Remote object manipulation | • Improved and more immersive distance learning via videoconferencing and improved access to rich media resources<br>• Industrial/workplace education due to videoconferencing, augmented reality/ virtual reality, and haptic feedback |
| Manufacturing, Mining, and Construction | • Collaborative robots<br>• Remote object manipulation<br>• Virtual meeting<br>• Virtual or augmented reality | • Smart factories, including replacement of wired connections, cell automation, machine vision, improved efficiency<br>• Real-time assistance via video-conferencing and augmented reality<br>• Remote control of industrial equipment |

| | | |
|---|---|---|
| | • Ultra-low-cost networks | |
| Public Safety and Disaster Response | • Broadband to special events<br>• Remote object manipulation | • Enhanced, secure, mission-critical communications<br>• Coverage extension in out-of-network areas through new device-to-device connectivity models<br>• Unmanned vehicles for rescue and reconnaissance |

Source: ATU-R Recommendation 005-0

The implementation of the aforementioned use cases will necessitate the Authority, to not only provide for geographical spectrum licences, but to also consider licensed shared access to spectrum resources dependent on business cases presented to the Authority when considering applications for spectrum licences.

## 4.4 Devices

The Global Suppliers Association, in its monthly report on availability of 5G devices states that as of October 2021 suppliers have announced more the 1,060 devices representing an increase of 21% in the last three months. The aforementioned devices are not limited to mobile handsets only.

Of the 1,060+ devices mentioned above 66.4% (704) are already commercially available in the world, although not necessarily in Africa, in that early IMT-2020 deployment in Africa is limited. These devices include amongst others-

(i) 523 phones;
(ii) 188 Fixed-wireless access customer premises devices (CPEs) for indoor and outdoor use;
(iii) 70 industrial/enterprise routers, gateways and modems;
(iv) 46 battery operated hotspots;
(v) 19 laptops;
(vi) 11 in-vehicle routers/modems/hotspots;
(vii) 8 USB terminals/dongles; and
(viii) 34 other devices (including drones, head-mounted displays, robots, TVs, cameras, vending machines and repeaters

The cost of end-user equipment e.g. mobile handsets will be a critical element to the uptake of 5G services. This cost will be determined by availability and affordability of devices. Initially, with the rollout of IMT-2020 networks based on a Non-Standalone model there will not be much difference in user experience from 4G to 5G networks. 5G phones offered in the market to date are expensive, ranging from N$4,500 to N$36,000 per phone, as vendors need to recoup their research and development cost. However, it should be noted that prices are decreasing with introduction of new 5G capable phones in mid to lower market segments.

To entice the mass market to use 5G broadband services by driving the demand for these services, it will be necessary to introduce 5G capable models in the lower market segments as well as more expensive models in the mid to higher market segments.

## 5. ENVIRONMENTAL REQUIREMENTS

Operators intending to deploy an IMT-2020(5G) network are required to develop an Environmental Scoping and Environmental Management Plan (EMP) to identify the environmental impact that specific sites may have on the environment and develop the necessary measures to mitigate such impacts at that specific site. This plan forms the basis to submit an application for an environmental clearance certificate for each site to be deployed

A site specific environmental clearance certificate must be obtained from the Ministry of Environment, Forestry and Tourism, in accordance with the provisions of the Environmental Management Act (Act No.7 of 2007) as published in Government *Gazette* No. 3966, General Notice No. 232 on 27 December 2007 and the Environmental Impact Assessment Regulations as published in Government *Gazette* No. 4878, General Notice No. 30 on 6 February 2012, prior to deployment of telecommunications facilities.

## 6. SPECTRUM REQUIREMENTS

Section 99 of the Communications Act mandates the Authority with the planning, monitoring and licensing of spectrum in accordance with ITU regulations and international treaties. The spectrum bands **700 MHz and 3300-3600 MHz** has already been allocated for IMT-2000 and IMT-2020 at the ITU World Radio Conference 2015 (WRC-15) and the frequency channelling plans for these spectrum bands were approved by ITU.

The ITU World Radio Conference 2019 (WRC-19) held in Egypt concluded on the spectrum band to be allocated for the implementation of IMT-2020 (5G) and published the resolutions in the WRC-19 Final Acts on 31 March 2020. This document carries international treaty status and binds Namibia as an ITU member state to the provisions for spectrum allocation contained therein.

The following spectrum bands (referred to as millimetre wave bands) were allocated for IMT-2020 (5G) subject to the WRC-19 Resolutions and radio regulations-

| | |
|---|---|
| **24.25-27.5 GHz** | **37.0-43.5 GHz** |
| **47.2-48.2 GHz** | **66.0-71.0 GHz** |

### 6.1 Spectrum availability

The characteristics of different spectrum bands determine whether spectrum bands can be utilised for rural, urban or for both rural and urban network and service deployment. IMT-2020 applications and use cases also have different spectrum requirements. It is therefore necessary to provide for multiple spectrum bands to be allocated for IMT as set out below-

**(i) Low-band spectrum (below 1 GHz)**

Spectrum below 1 GHz is suitable for providing indoor and outdoor coverage over wide areas in urban and rural environments with 4G (LTE/IMT) and 5G (IMT-2020). In accordance with the ITU GE06 agreement, signed by Namibia, analogue television services were migrated to a new spectrum band to allow for the deployment of IMT services in the 700 MHz and 800 MHz spectrum bands.

The **700 MHz** spectrum band is earmarked for implementation of 5G services and applications as well as public protection and disaster relief services (when required) in rural areas. The **800 MHz** spectrum band is currently utilised for 4G services, but may be utilised for future 5G services based on dynamic spectrum sharing between 4G and 5G services.

**Mid-band spectrum (between 2 - 5 GHz)**

Mid-band spectrum refers to the 2300 MHz, 2600 MHz and 3300-3600 MHz spectrum bands and is suited for urban and rural IMT-2020 network rollout. The spectrum band 3400-3600 MHz has emerged as a primary band for IMT-2020 deployed in that it is near-globally harmonised and allows for assignment of large (80-100 MHz) contiguous blocks of spectrum as per the frequency channelling arrangements contained in ITU-R M.1036-6. The further harmonisation of this spectrum band for IMT-2020 will allow for economies of scale in respect of equipment availability.

The aforementioned spectrum bands, was not historically allocated to mobile services on a primary basis and thus the available spectrum is shared with fixed satellite services and fixed services (point-to-point links and WiMax).

It is therefore necessary that the Authority gives consideration to the following options going forward prior to consideration of the spectrum band 2300 MHz, 2600 MHz, and 3400-3600 MHz for IMT-2020-

(a) Propose a migration path to licensees to replace legacy Wimax and other fixed networks and services with IMT(4G) and IMT-2020(5G);
(b) Restrict spectrum utilisation for fixed satellite services to above 3600 MHz;
(c) Allow for amendment of existing spectrum licences to be utilised for IMT-2020 (5G) in lieu of fixed services; or
(d) Revoke spectrum licences in the event that spectrum licensees are in material breach of the said spectrum licence due to inefficient use of spectrum.

The aforementioned measures will need to be implemented to be able to ensure sufficient vacant spectrum to provide for assignment of contiguous spectrum blocks of 80-100 MHz for assignment to telecommunications licensees for implementation of IMT-2020.

**(ii) High-band spectrum (above 24 GHz)**

The spectrum bands above 24 GHz, as allocated at WRC-19, is suitable for transmission of high volumes of data in urban areas in that coverage areas are small.

Further thereto these spectrum bands are shared with fixed and satellite services. As such, deployment of IMT-2020 services in these bands will be subject to the applicable ITU WRC-19 resolutions, technical requirements set out in the ITU Radio Regulations and specific spectrum licence conditions.

### 6.2 Dynamic spectrum sharing

At present 4G (LTE) services are offered in the mid and lower spectrum bands, resulting in limited to no spectrum availability for rollout of 5G (IMT-2020) services. It is not feasible to re-farm the spectrum for deployment of 5G services given that 4G bands are extensively utilised and the availability of affordable 5G devices are still limited.

With dynamic spectrum sharing between 4G and 5G it is possible to implement 5G in the same band as the existing 4G network. Such deployment allows for the allocation of spectrum resources on demand in that the device will connect to the network on 4G spectrum in the lower band and 5G spectrum in the mid band. The network then has the capability to schedule uplink user data on the 4G network and the downlink user data on the 5G network thereby allowing the utilisation of the entire assignment improving spectral efficiency and transmission speed for 5G services.

## 7. SECURITY REQUIREMENTS

Both critical infrastructure (CI) and critical information infrastructure (CII) refers to infrastructure utilised in the provision of services that have a serious negative impact in case of failure on the socio-economic sectors of Namibia. Identification of infrastructure and services provided by such infrastructure is based on four (4) criteria namely-

(i) Could the failure of such infrastructure/services endanger "life and limb" of the population;
(ii) Could the failure of such infrastructure/services endanger "public order and safety";
(iii) Could the failure of such infrastructure/service seriously disrupt "social life" or "economic performance"; and
(iv) Is the infrastructure/service essential for the provision of other services whose failure would endanger life and limb and/or public order and safety or seriously disrupt social life or economic performance?

Telecommunications service licensees not only provide electronic communications networks but also vital ICT services, data storage and data bases with customer data and are thus deemed as critical infrastructure. The implementation of IMT-2020 that allows for the convergence of information technology and telecommunications sectors through horizontal and vertical integration will further entrench the critical nature of this infrastructure warranting strict security measures going forward.

To foster the confidence of the public to make full use of ICTs for socio-economic development it is necessary to build trust and improve security measures within the ICT sector.

At present Namibia encounters challenges in this regard which will increase further with the deployment of IMT-2020 if not timeously addressed.

## 7.1 Policy and Legislative Framework

Although technological advances and the industrialisation and digitalization of the economy presents many opportunities to uplift the livelihoods of Namibian citizens, it also presents opportunities for cybercrime, invasion of privacy, infringement on constitutional rights and attacks on critical sectors of the economy.

At present Namibia lacks a holistic policy and legislative framework to coordinate and protect against aforementioned transgressions due to the slow pace at which essential strategies and legislation is finalised e.g. the National Cyber Security Strategy, Cyber Crime Bill and the Data Protection Bill.

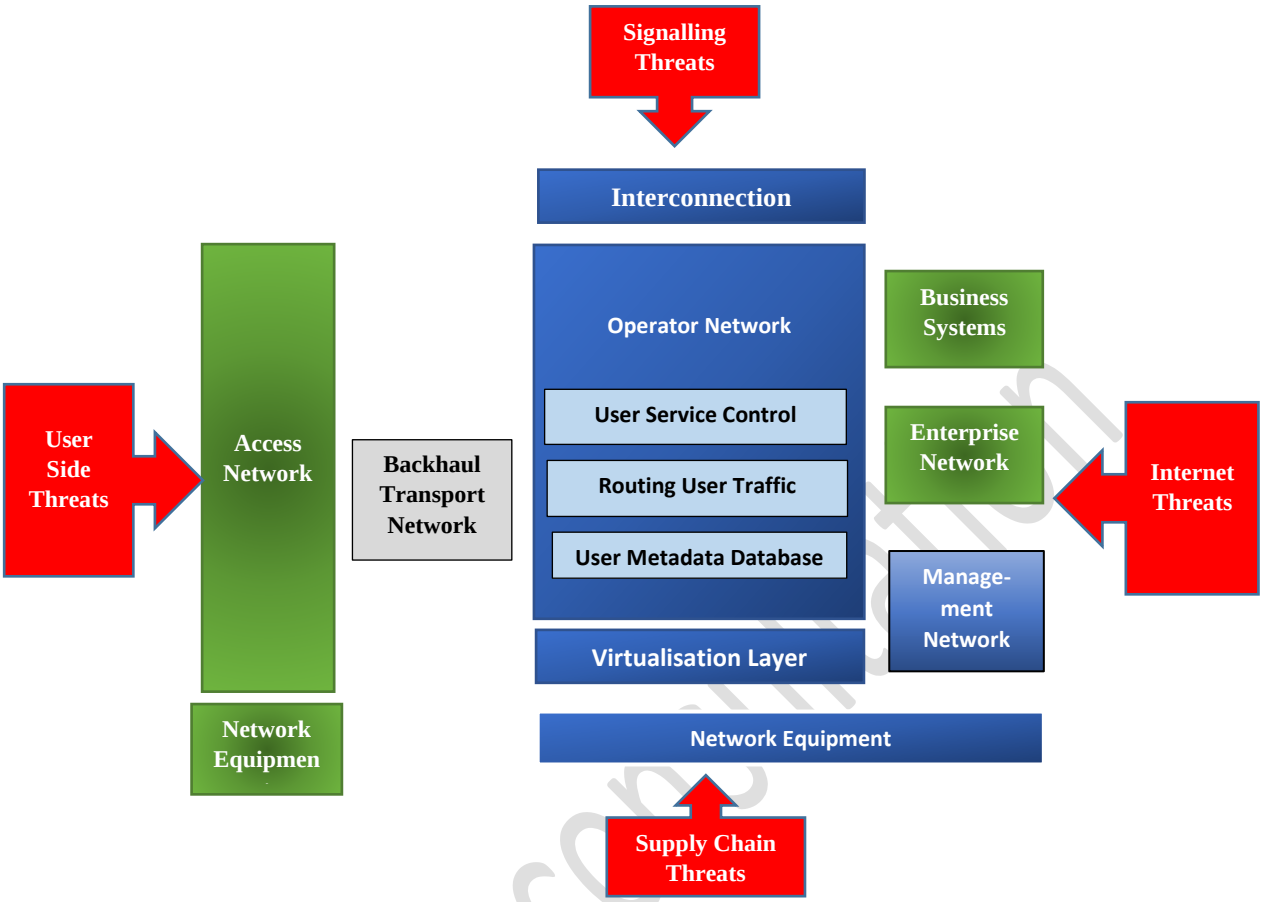
Security measures at a national level are to be strengthened further through the establishment of the National Security and Cyber Incidence Response Team (NSCIRT) to ensure that measures are put in place to protect critical infrastructure and critical information infrastructure deployed by the telecommunications sector.

## 7.2 Protection of IMT-2020 networks as critical infrastructure

Threats to telecommunications networks, being mobile or fixed, can be grouped into four main areas impacting negatively on networks and/or services as indicated below-

(i) **Disruption of networks** thereby have a negative impact of services or equipment;
(ii) **Network espionage** through the malicious acquisition, modification or use of data, including customer information and/or customer business data stored by the telecommunications service licensee on behalf of the customer;
(iii) **National-scale supplier dependence** in that the telecommunications service licensees deploying and operating national telecommunications network are dependent on the same external supplier for effective operation of their networks; and
(iv) **Network pre-positioning attackers** gaining presence or administrative access within Namibia's network with the aim of future exploitation.

Network threats can be grouped further, based on the origin of the attack as shown in the high level diagram on the next page.




Source: National Cyber Security Centre: UK, 2019

The origin of threats towards an IMT-2020 network differs slightly compared to existing network topographies in that some additional protection are provided by splitting the signalling plane and the user plane. This approach ensure that network functions responsible for processing of user traffic cannot be addressed *via* the international signalling network.

However, IMT-2020 networks utilises a service-based architecture and commonly used web protocols. Thus the inherent design of IMT-2020 networks provides an increased attack surface over network APIs and signalling networks.

It is thus important to regularly assess high risk areas within critical network infrastructure itself, the supply chain to implement, maintain and support telecommunications networks, and national capability to operate and secure telecommunications networks. The associated external and internal risks are discussed below-

### (i) Management level

All administrative functions take place at the management level within network infrastructure whether changes are made to existing infrastructure and services, or with configuration and provisioning of new equipment. The management level is considered

as a primary target for malicious attacks with the aim to disrupt or compromise the operations of telecommunications networks.

These attacks may have a long term impact on the availability of telecommunications networks and confidentiality of operator's services and databases.

**(ii) Signalling level**

Traditionally public telecommunications networks connect to each other over signalling networks at national and international level. Malicious attacks via inbound signalling routes can have a negative impact on core network elements, re-route user calls and/or data and extract user metadata.

The situation is not different to IP data received from external sources e.g. the internet.

**(iii) Virtualisation level**

IMT-2020 networks allows for virtual and horizontal integration of networks. Virtualisation allows available network resources to be utilised in the most efficient manner. Should the virtualisation structure be compromised it may impact on network availability or in case of the core network being compromised, also affect all workloads running on it.

Although virtualisation presents a risk, it also allows for implementation of various protection measures that may be more secure and resilient than a traditional network built on dedicated hardware.

**(iv) Supply chain**

All telecommunications providers are reliant on a supply chain which can include the provision of hardware, software and managed services depending on the level of technical skills within the telecommunications service provider.

The supply chain can be assessed based on four (4) risk components –

**(a) National dependence, supply disruptions and sanctions**

At present three (3) of the four (4) telecommunications licensees providing mobile and fixed services are dependent on the same supplier, namely Huawei. National dependence arises from these operator's need to access support services and equipment from the said supplier to maintain their networks and implement new technologies such as IMT-2020.

Should such a supplier become unreliable due to insolvency or international sanctions or legislation in countries from which they source equipment components or pose a security risk due to legislation in their country of origin, it will have a disruptive impact on the provisioning of ICT services in Namibia.

The advent of cloud computing has further given rise to business decisions being made to increasingly design, operate, maintain and secure networks at international "hub" locations to provide services in Namibia. This approach has increased the risk of network availability, data protection and securing of the network in that Namibia has no

jurisdiction in these international locations and access to data and services are therefore subject to the legislation of that country.

With implementation of IMT-2020 technologies Namibia will progress to a digital economy with higher dependency on the ICT infrastructure and services. It is thus imperative to put measures in place to mitigate the aforementioned risk factors.

**(b) Equipment supply, both hardware and software**

Primary risks, namely security and equipment quality, associated with IMT-2020 equipment can be linked to systematic failures due to software faults, design faults and equipment vulnerabilities that may be exploited for malicious intent.

Quality issues as a result of poor software development, legacy network environments, poor processes or vulnerability management can result in widespread equipment failure or be exploited by an attacker to gain control of network equipment. It is thus important to improve security standards across the ICT sector inclusive of the end user of services.

**(c) Supplier network access and support**

Telecommunications network operators provide administrative access to suppliers for support (1st, 2nd or 3rd line) depending on the skill set of the local staff complement or as part of a managed services contract to an equipment vendor. Due to their model of operation equipment vendors have access to multiple networks increasing the risk on networks should access be gained for malicious intent.

A further risk is created by the telecommunications operator's dependence on the equipment vendor to ensure continued operation of its network.

It thus presents an even higher risk should multiple telecommunications operators and networks within the same country be dependent on the same equipment vendor.

**(d) Operator data including SIM card supply.**

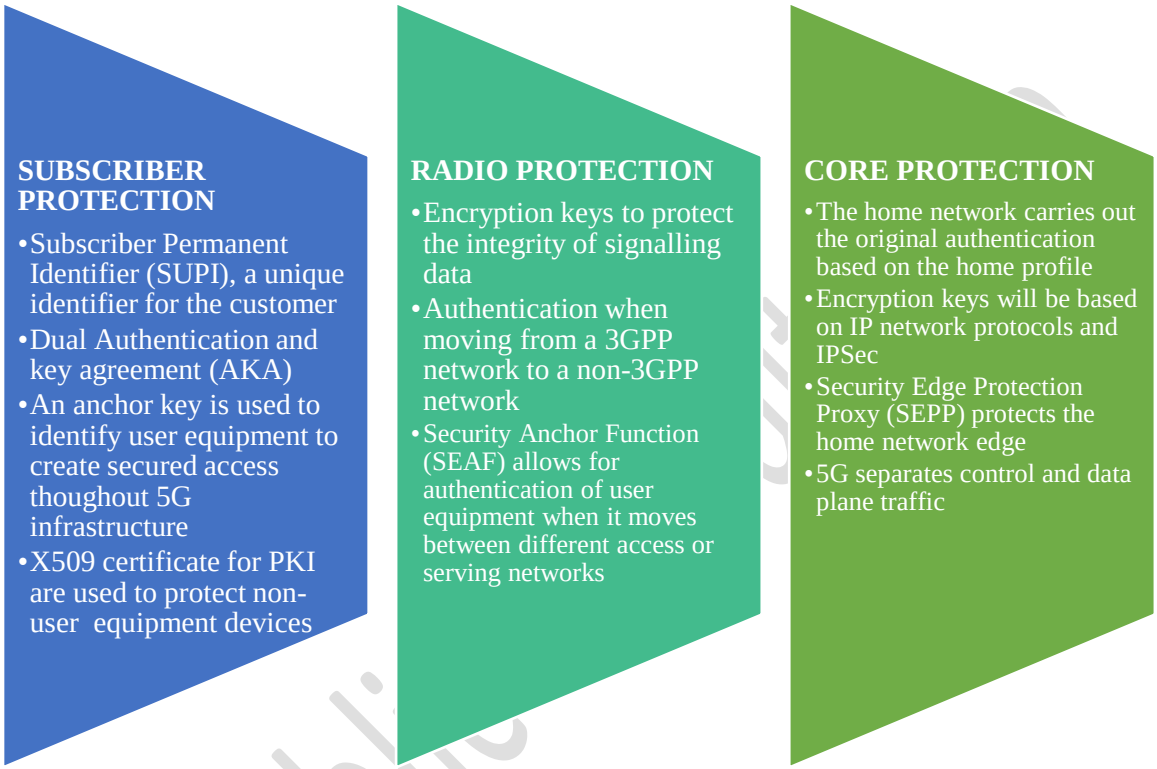
As part of support provided by equipment vendors, telecommunications operators may share network or user data. It is thus necessary to have strict controls in place to mitigate vulnerabilities either due to insider threats within the equipment supplier or due to a compromise of the supplier's networks.

At present mobile telecommunications operators uses SIM cards to allow access to the network. With the deployment of IMT-2020 networks for 5G and IoT services, eSIMs will gain traction in the ICT industry, which create an opportunity that the functionality may be misused to disrupt networks and services. Network operators will need to put the necessary mitigations in place to prevent corruption of credentials leading to unauthorised transfers of services or prohibiting access to networks.

Mitigating risk does not per se require that networks must be restricted to local operations and cannot be distributed globally with the necessary protective measures. However, it is advisable that sufficient technical knowledge, skills and data storage should reside locally to ensure resilience and security of networks in that these networks a critical infrastructure to support economic and social functions within the country.

These risk components, as discussed above are directly linked to each other, and thus affect each other in terms of increasing or decreasing risk.

To this end, and given the fact that security is a critical enabler for IMT-2020, several security controls have been incorporated into the 3GPP standards for IMT-2020 as shown in the diagram below-




Source: 3GPP, 2020

Lastly, a digital ID is becoming a critical requirement in today's digital society. As the Namibian economy progresses towards industrialization, it will become increasingly important for citizens to be able to provide their identity digitally to ensure inclusion and participation in the economy.

## 8. STRATEGIC CONTEXT

Introduction of new technologies requires the assessment of the business context in which this technology will be utilised and the readiness of different stakeholders to support introduction and sustainable operation of the new technology.

### 8.1 Operator readiness

Mobile telecommunications entered the Namibian ICT landscape with the launch of the first 2G network by Mobile Telecommunications Limited in 1995. At that time, mobile telecommunication technology was deployed in the rest of the world since 1980. To date Namibia has benefitted from further deployment of 3G and 4G mobile technologies leveraging

on the initial 2G network deployment. The table below depicts the current 2G, 3G and 4G geographical and population coverage as at September 2021:

| Region | Population Coverage | | | No. of people not covered | | |
|---|---|---|---|---|---|---|
| | 2G | 3G | 4G | 2G | 3G | 4G |
| **Erongo** | 98% | 96% | 92% | 4,461 | 9,671 | 17,616 |
| **Hardap** | 87% | 80% | 72% | 12,364 | 19,385 | 26,711 |
| **!Karas** | 89% | 83% | 73% | 9,912 | 15,252 | 24,113 |
| **Kavango East** | 97% | 90% | 69% | 4,622 | 15,526 | 50,734 |
| **Kavango West** | 94% | 74% | 40% | 5,818 | 23,724 | 55,271 |
| **Khomas** | 99% | 97% | 96% | 6,826 | 12,142 | 17,447 |
| **Kunene** | 66% | 50% | 33% | 36,817 | 54,792 | 73,110 |
| **Ohangwena** | 99% | 94% | 90% | 2,298 | 17,305 | 26,486 |
| **Omaheke** | 88% | 66% | 48% | 9,309 | 27,247 | 41,581 |
| **Omusati** | 99% | 97% | 82% | 1,865 | 9,069 | 48,504 |
| **Oshana** | 100% | 99% | 96% | 108 | 1,501 | 7,533 |
| **Oshikoto** | 99% | 86% | 73% | 2,887 | 30,195 | 57,636 |
| **Otjozondjupa** | 94% | 84% | 72% | 9,551 | 26,569 | 45,866 |
| **Zambezi** | 100% | 94% | 60% | 191 | 5,919 | 41,985 |

Source: CRAN Telecommunications Sector Market Report 2021

2G and 3G technologies are considered as legacy technologies in that, these technologies have been overtaken by technological advances with the introduction of IMT-2000 (4G) and IMT-2020 (5G). Subsequently, there are no backwards compatibility with 2G and 3G technologies, i.e. IMT technologies cannot be implemented re-using 2G or 3G equipment. Internationally, some countries have already commenced with de-commissioning of 2G networks and re-farming the spectrum to be utilised for IMT deployment.

In September 2018, the SADC ICT Ministers[2] approved the following broadband targets for 2025-

(i) 80% of the population of each SADC Member State should be covered by broadband services; in particular, at least 80% of rural areas should be within the reach of entry-level broadband services, be it fixed or mobile;
(ii) 50% of households in each SADC Member State should be connected to broadband;
(iii) Entry-level broadband services should be made affordable in SADC, at less than 2% of monthly Gross National Income (GNI) per capita;
(iv) Entry-level terminals and household installation for fixed or mobile broadband should be made affordable in SADC, at less than 50 USD or 2% of yearly GNI per capita, whichever is lower;
(v) All SADC Member States should have funded National Broadband Plans or Strategies, or include broadband in their Universal Access and Service definition;

[2] Records of the SADC ICT Ministers meeting held from 24 September 2018 to 27 September 2018 in Windhoek, Namibia

(vi) Broadband/Internet user penetration in each SADC Member State should reach 65%;
(vii) 60% of youth and adults in each SADC Member State should have achieved at least a minimum level of proficiency in sustainable digital skills
(viii) Un-connectedness of Micro-Small-Medium sized Enterprises (MSMEs) should be reduced by 50%, by sector;
(ix) 40% of the population in each SAC Member State should be using digital financial services;
(x) Gender equality should be achieved across all SADC broadband targets.

Further thereto, entry-level broadband for fixed and mobile services were defined by the SADC ICT Ministers as-

(i) Mobile broadband: at least 1 Mbps (downlink) and;
(ii) Fixed broadband: at least 4 Mbps (downlink)

In order to achieve the aforementioned targets, it is necessary to prepare for and implement the latest technologies in both urban and rural areas, whilst phasing out legacy fixed and mobile technologies. It is thus important to ensure that 5G, is not rolled out or does not receive priority, to the detriment of 3G and 4G, which are the technologies required to bridge the digital divide, especially in rural areas. At the same time, 5G has the capability to support implementation of e-health and e-agriculture applications contributing to socio-economic development. There is thus a need to strike a balance between technological innovation and universal access and services.

It is required that licensees holds spectrum licences for IMT and wireless backhaul transmission in that fibre networks have not been deployed to rural areas. Table 3 on the next page depicts the current spectrum holdings of telecommunications service licensees for IMT that facilitate the implementation of 2G, 3G, and 4G as well as fixed broadband and wireless backhaul transmission spectrum based on spectrum licences awarded by the Authority-

**Table 3: Spectrum assigned to Telecommunications Service Licensees**

| MOBILE SERVICES(2G/3G/4G) | | | | |
|---|---|---|---|---|
| **Spectrum Band** | **Mobile Telecommunications Limited** | **Telecom Namibia Limited** | **Paratus Telecommunications (Pty) Ltd** | **MTN Business Solutions (Namibia) (Pty) Ltd** |
| 800 MHz band | | | | 20 MHz (2x 10 MHz) (FDD) National |
| E-GSM | 20 MHz (2x 10 MHz) (FDD) National | | | |
| 900 MHz band | 26 MHz (2x 13 MHz)(FDD) National | 24 MHz (2x 12 MHz)(FDD) National | | |
| 1800 MHz band | 70 MHz (2x 35 MHz)(FDD) National | 40 MHz (2x 20 MHz)(FDD) National | 40 MHz (2x 20 MHz)(FDD) National | |
| 2100 MHz band | 40 MHz (2x 20 MHz)(FDD) National | 40 MHz (2x 20 MHz)(FDD) National | | 40 MHz (2x 20 MHz)(FDD) National |
| 2300 MHz band | | 40 MHz (TDD) National | | 10 MHz (TDD) National |
| 2600 MHz band | | 86 MHz (TDD) National | 40 MHz (TDD) National | |
| 3500 MHz band | | | | 20 MHz (TDD) National |
| **TOTAL SPECTRUM HOLDINGS FOR MOBILE SERVICES** | **146 MHz** | **230 MHz** | **80 MHz** | **90 MHz** |

| FIXED SERVICES(Point-to-Point/Point-to-Multipoint/WiMax) | | | | |
|---|---|---|---|---|
| **Spectrum Band** | **Mobile Telecommunications Limited** | **Telecom Namibia Limited** | **Paratus Telecommunications (Pty) Ltd** | **MTN Business Solutions (Namibia)(Pty) Ltd** |
| 2500-2690 MHz | | | | |
| 3400-3600 MHz | | 84 MHz National | | |
| 3600-4200 MHz | 80 MHz National | | | |
| 4400-8500 MHz | 280 MHz National | 280 MHz National | 112 MHz National | |
| 10-15.35 GHz | 56 MHz National | 224 MHz National | 28 MHz National | |
| 17.7-100 GHz | 448 MHz National | | 194.5 MHz National | 280 MHz National |
| **TOTAL SPECTRUM HOLDINGS FOR FIXED SERVICES** | **864 MHz** | **588 MHz** | **334.5 MHz** | **280 MHz** |

Operators each have their own objectives and rationale as to how and when IMT-2020 networks and services are to be offered and what spectrum is required to support the intended rollout. At present time, Namibia has four (4) existing operators, holding a telecommunications services licence, that are well placed to implement IMT-2020 in future namely, Telecom Namibia Limited, Mobile Telecommunications Limited, Paratus Telecommunications (Pty) Ltd and MTN Business Solutions (Namibia) (Pty) Ltd.

In the opinion of the Authority, the entities can be categorised based on the aforementioned operator archetypes as follows-

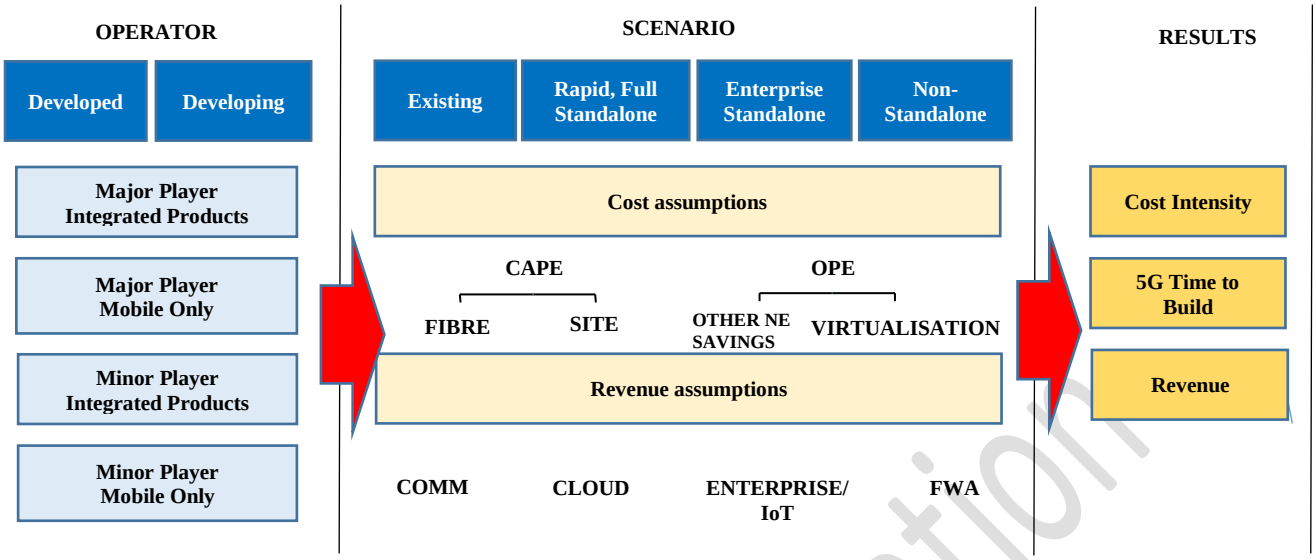
(i) **Telecom Namibia Limited** can be categorised as a **Major Player, Integrated Products** because it holds more than 25% market share in the fixed market, has its own extensive fibre infrastructure and offers an integrated product portfolio. However, it holds far less than 25% market share in the mobile market. With outdated legacy systems for both technologies it will require extensive investment to deploy an IMT-2020 network and services;

(ii) **Mobile Telecommunications Limited** can be categorised as a **Major Player, Integrated Products** because it holds more than 25% market share in the mobile market, and offers an integrated product portfolio. This licensee is considered a de facto monopoly in the mobile market. However, it does not own fibre backhaul infrastructure to support IMT-2020 rollout. Deployment of an IMT-2020 network with the focus on eMBB providing broadband services in the short term is possible by leveraging on its existing 4G network. To harness the full potential of IMT-2020 through introduction of new use cases other than broadband will require further investment and product development;

(iii) **Paratus Telecommunications (Pty) Ltd** can be categorised as a **Minor Player, Integrated Products** because it holds less than 25% market share in the fixed and mobile market, has its own fibre infrastructure and offers an integrated product portfolio. This licensee is not weighed down by legacy systems and can access the necessary funding to deploy an IMT-2020 network and services leveraging on the modern core network, existing 4G network and fibre network in the near future; and

(iv) **MTN Business Solutions (Namibia) (Pty) Ltd** can be categorised as a **Minor Player, Integrated Products** because it holds less than 25% market share in the fixed and mobile market and offers an integrated product portfolio. Although it does not own fibre backhaul infrastructure, it is not weighed down by legacy systems and can deploy an IMT-2020 network and services leveraging on the modern core network, existing 4G network in the near future.

A high level structure to develop a business case for implementation of IMT-2020 based on the abovementioned archetypes, is shown in the diagram below and can be equally applied to developed and developing countries.




Source: GSMA, 2015

The business model shown above further provides possible rollout models taking into account the speed of rollout, envisaged target market and product portfolio, required and intensity of capital and operational investment and future revenue. It should be noted that a rapid full scale deployment will be the most cost intensive whilst deployment over a longer time period focussing on coverage enhancement through sharing of spectrum resources with existing 4G networks will be less cost intensive and allow for an evolutionary approach to infrastructure investment.

However, the approach to implementation of the latest technology and product portfolio of telecommunications service licensees does not form part of the mandate of the Authority and remains a business decision of the said licensee. This is due to the fact that rollout of these networks are financed by the licensees themselves and thus requires diligent planning by the respective operators to ensure sustainability and return of investment over time

The Authority will provide an enabling regulatory environment that will allow for deployment of telecommunications networks and services by existing and possible new entrants to the socio-economic benefit of Namibia as per the objects of the Communications Act to support operators in their future business endeavours.



## 8.2 Regulatory readiness

The future implementation of IMT-2020 networks and services are dependent on the regulatory framework as set out by the Authority. It is important to note that spectrum is not the only aspect to consider for implementation of the aforementioned networks. Regulatory frameworks and measures need to be in place to ensure equal opportunities for industry players and/or new entrants, fair competition, protection of the environment and consumers to ensure the realisation of the objects Communications Act, national policies and Vision 2030.

Various regulatory aspects, other than spectrum, that will also play a fundamental role to ensure rollout of IMT-2020 networks and services.

### 8.2.1 Service licensing

IMT-2020 allows for innovative new applications and services resulting in improvement and easy interoperability between networks, services and applications. This is evident in multiple instances where boundaries between different sectors become blurred between telecommunications and computing sectors has also decreased with the disappearance of the two distinct features that distinguished between telecommunications and computing namely-

(i) Telecommunications primarily focused on immediate user-to-user applications such as voice telephony; whilst
(ii) Computing primarily focussed on information storage and data retrieval for use at a later stage.

These features have been eliminated in that in the digital age applications will share common network infrastructure and seamlessly mix user-to-user with information-to-user management components as can been seen in the increasing availability of internet enabled devices and multimedia devices;

Governments and regulators need to develop new legislative and regulatory environments to allow the industry to benefit from the rapid pace of digital development. Flexibility and foresight are critical factors in creation of the aforementioned environment. Attention should be given to not only horizontal and vertical integration of networks and services, but also the positive or negative impact of market factors, as set out by Hwanho Choi (2018)-

(i) That excessive market concentration can foster monopolies causing market asymmetry between operators and customers thereby have a negative effect on diversity and services being offered by multiple players affecting competition in the market; or
(ii) Firms with larger bargaining power may also be able to provide service offerings increasing the benefits to consumers by offering multiple services over one platform. This has a positive effect if operators provide services with the customer's interest at heart while it has a negative effect on both the customer and the market if operators pursue their own benefits to maximise revenues.

It is important, that the Authority maintains a regulatory framework in line with the objects of the Communications Act, i.e. to promote technological innovation and the deployment of advanced facilities and services in order to respond to the diverse needs of commerce and industry and support the social and economic growth of Namibia, to encourage local participation and investment, and to ensure fair competition.

The definition of Electronic Communications contained in the Communications Act reads as follows-

*"electronic communications" means any emission, transmission or reception of sound, pictures, text or any other information by wire, radio waves, optical media, electromagnetic systems or any other means of a like nature"*

The above definition encompasses the market opportunities that IMT-2020 networks represent through Internet-of-Things, Artificial Intelligence (AI), big data and mobile broadband amongst others to provide services and applications for e-health, e-education, e-government, emergency and rescue communications will bring to Namibia.

As prescribed by the Communications Act, the Authority implemented a service technology neutral service licence regime for the telecommunications sector, providing for the provisioning of innovative new telecommunications services within the ambit of the definitions of electronic communications as stated above.

As such, the regulatory framework places no prohibition on telecommunications services licensees to adopt IMT-2020 technologies in constructing networks and providing services and applications.

Telecommunications services licensees are authorised to construct operate and maintain electronic communications networks and provide electronic communications services subject to the provisions of the Communications Act and the regulatory framework and licence conditions prescribed by the Authority.

Furthermore, the Authority implemented a regulatory levy that allows licensees to pay a levy based on a sliding scale in accordance with its annual turnover as the organization grows i.e. smaller licensees pays less than large licensees. This approach allows for new entrants and entities targeting niche markets to enter the market at a lower cost and to grow over time.

### 8.2.2 Numbering Management

In order to address convergence between telecommunications services and IP based services ITU-T developed the E.164 NUmber Mapping (ENUM) protocol. This protocol allows for the mapping of an E.164 number to an IP address, thus enabling the use of telephone numbers to resources or services on the internet.

The introduction of ENUM thus enabled the adoption of a service technology neutral approach to numbering allowing electronic communications users to be contacted via a single number utilising voice, email, messenger services, machine-to-person communications or similar services.

The national numbering plan as contained in the numbering regulations supports a technology service neutral licensing regime since its publication in the Government Gazette on 1 April 2016. In addition, provision was made for machine-to-machine services as well as implementation of ENUM in the numbering plan.

It thus places no prohibition on the implementation of IMT-2020 networks and services in those provisions for machine-to-machine communications and ENUM is already contained in the numbering regulations.

### 8.2.3 Infrastructure Sharing

The Authority, implemented an infrastructure regulatory framework in 2016 to-

(i) Extend geographical access beyond current urban, semi-urban and rural areas to underserved areas by lowering investment cost with shared infrastructure. This will result in lower entry barriers and thereby benefiting the consumer through a variety of affordable and quality communications services;

(ii) Decrease environmental impact as a result of implementation of infrastructure by reducing levels of duplication of infrastructure through infrastructure sharing agreements by licensees *inter se* as well as between licensees and utilities thereby promoting green ICT;

(iii) Stimulate innovation of new services in rural areas by allowing alternative technologies for last-mile access whilst transmission networks are provided on a shared basis;

(iv) Address abuse of dominance and anti-competitive behaviour of infrastructure owners by establishing a regulatory framework with clear rules for sharing to ensure quality of service at affordable prices provided to all licensees on a non-discriminatory basis

Infrastructure sharing will remain a key requirement for the sustainable implementation of IMT-2020 networks, not only to lower capital investment requirements, but also to protect the environment going forward.

The regulations as published by the Authority provides for both active and passive infrastructure sharing on a non-discriminatory basis and regulate the duties placed on dominant carriers and utilities as contained in section 48 and 50 of the Communications Act. Strict enforcement of these regulations will be a key component to implementation of IMT-2020 networks.

### 8.2.4 Type Approval

IMT-2020 will utilize frequencies that are already addressed by international radio protection standards. The International Commission on non-Ionizing Radiation Protection (ICNIRP) developed exposure guidelines and define exposure limited in terms of power density, electric and magnetic field strength (EMF) and specific absorption rate(SARS) for the IMTI-2020 bands. Restrictions are based directly on established health effects. To the end, IICNIRP has published Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz).

The Communications Act and Type Approval Regulations provides for the type approval of all telecommunications equipment including 5G equipment prior to importation to ensure adherence to international standards including protection of public health.

The Authority need to review the type approval regulatory framework going forward to include 5G network equipment prior to importation of such equipment into the Republic of Namibia.

Security readiness-add paragraph

### 8.3 Legislative readiness

Given that security is a key enabler for the deployment of IMT-2020 networks and uptake of services, it is important to finalize legislation in respect of Cyber Security and Data Protection to support a digital economy. The provisions of the aforementioned legislation will support the creation of a secure and enabling environment building trust in the use of ICT services, platforms and applications by all Namibians.

The Cyber Crime Bill sets out the funding mechanisms, reporting structure and functions of the National Cyber and Security Incidence Response Team (NSCIRT). Finalisation of the aforementioned legislation will allow The Authority to fully implement the NSCIRT and regulatory framework providing protection of critical infrastructure and consumers against cybercrime that has a negative impact on the economy of Namibia.

Although the Electronic Transactions Act (Act No. 6 of 2019) was promulgated on 16 March 2020 as published in Government Gazette No. 7142, Notice No. 75, chapters 4 and 5 as well as section 20 of the said Act did not come into force. The Authority is therefore unable to implement its mandate set out in the Electronic Transactions Act.

It should be noted that the Electronic Transactions Act encompasses critical legislative provisions to drive e-commerce and online services as envisaged by the 4$^{th}$ Industrial Revolution that can be provided by IMT-2020 networks going forward.

## 9. VISION

Creating an enabling ICT sector for digital transformation in Namibia

## 10. MISSION

Facilitate utilisation of advanced ICT technologies in fostering socio-economic development

## 11. STRATEGIC OBJECTIVES

It should be noted that the business decision to implement IMT-2020 (5G) technologies to expand network deployment and associated services offering rests solely with the telecommunications service licensees. This strategy is therefore not aimed at providing funding for deployment of IMT-2020 (5G) networks, as the responsibility to secure sufficient financial resources remains with the respective telecommunications service licensee.

This strategy focusses on creating a sustainable environment to support implementation of IMT-2020(5G) technology and encompasses four strategic objectives namely- an enabling legislative and regulatory framework, development and research, safeguarding the environment and health and establishing a secure digital ICT environment. These objectives are actualised through specific strategic initiatives aimed at-

(i) Setting out a legislative and regulatory framework to support introduction of IMT-2020 (5G) technologies in the Republic of Namibia;
(ii) Ensuring that the ICT sector supports digital transformation through innovation and expansion of services throughout Namibia
(iii) Promoting the establishment of a secure digital ICT environment to build confidence and trust in the use of ICTs being a fundamental requirement for a knowledge-based digital economy; and
(iv) Assess and monitor the environmental impact of ICT.

The strategic initiatives under each strategic objective is set out hereunder-

### 11.1 Strategic Objective 1: An enabling legislative and regulatory framework

This objective is aimed at creating a legislative framework that promotes the implementation of IMT technologies to support digital transformation within all economic sectors. That this framework is further amplified by a regulatory framework that provide investment certainty and supports innovation and expansion of service offerings by the ICT sector.

The aforementioned objective will be attained through implementations of three strategic initiatives-

(i) Commencement of Chapters 4 and 5 as well as section 20 of the Electronic Transactions Act to create an enabling environment for digital transactions and services to progress towards a digital economy;
(ii) Availing of spectrum resources as necessary for deployment of IMT-2020 (5G) networks and services as per the mandate of the Authority;
(iii) Review of the regulatory framework to support digital transformation of the ICT sector;

### 11.2 Strategic Objective 2: Development and research

This objective is aimed at building skills and fostering innovation to promote optimal utilisation of new technologies through provision of services and applications to address

consumer needs and foster economic development in the government, agriculture, education, health, trade and industry sectors.

The aforementioned objective will be attained through implementations of two strategic initiatives-

(i) Incorporation of coding into curricula for secondary schools to empower the youth to participate actively in a digital economy; and
(ii) Availing necessary financial resources to invest in research and development to harness IMT-2020 technologies to provide applications for commerce, mining, agriculture, health and education sectors.

### 11.3 Strategic Objective 3: Safeguarding the environment and public health

The objective is aimed the assessing environmental impact associated with deployment of ICT infrastructure and addressing public health concerns

The aforementioned objective will be attained through implementations of four strategic initiatives-

(i) Ensuring compliance to the provisions of the Environmental Management Act the Environmental Impact Assessment Regulations by all telecommunications service licensees;
(ii) Obtaining type approval from the Authority for all telecommunications equipment prior to importation;
(iii) Enforcement of infrastructure sharing to limit environmental impact; and
(iv) The National Radiation Protection Authority to invest in human resources, training, information technology devices and equipment relevant for measurement of radiofrequency EMF radiation if required.

### 11.4. Strategic Objective 4: Establishing a secure digital ICT environment

This objective is aimed at building trust and improving security measures within the ICT sector to foster confidence in utilisation of ICT services and digital applications in support of socio-economic development.

The aforementioned objective will be attained through implementations of three strategic initiatives-

(i) Finalisation of Cyber Crime and Data Protection legislation to promote a safe a secure environment to use the latest technologies, services and applications;
(ii) Establish the national Cyber and Security Incidence Response team; and
(iii) Ensure protection of critical infrastructure through restriction of utilisation of a single vendor by dominant telecommunications service licensees to address associated security risks.

The implementation plan setting out various actions for implementation under each strategic initiative is attached hereto as **Annexure A**.

## 12. MONITORING AND EVALUATION

The IMT-2020 (5G) strategy will be operationalised after consideration and approval by Cabinet as set out in Cabinet Decision No. 10TH 21.07.20/006.

Implementation of this strategy will be monitored on a bi-annual basis by the Authority, being the entity to avail telecommunications service and spectrum licences for implementation of IMT-2000 (4G) and IMT-2020(5G) technology as per its mandate contained in the Communications Act (Act No.8 of 2009). In turn the Authority will submit a report to the Ministry of Information and Communication Technology for consideration.

This report is to consist of-

(i) A progress report on implementation of activities identified under each strategic initiative in the Implementation Action Plan on a bi-annual basis;

(ii) An evaluation report based on the following criteria-
   i. Effectiveness of the strategic initiatives in attaining the strategic objective;
   ii. The impact of implementation of the strategic initiatives on socio-economic development and digital transformation

(iii) Identification of challenges encountered in implementation of the strategic initiatives; and

(iv) Identification of any strategic initiatives that is no longer relevant and propose changes or new initiatives as may be required.

## ANNEXURE A

## ANNUAL IMPLEMENTATION PLAN

| STRATEGIC OBJECTIVE 1: SO1: AN ENABLING LEGISLATIVE AND REGULATORY FRAMEWORK | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Strategic Initiative** | **Activities** | **Output** | **Key Indicators** | **Baseline** | **Timeline for completion** | | | | | **Budget (NAD)** | **Responsible Entity** |
| | | | | | **2022** | **2023** | **2024** | **2025** | **2026** | | |
| **SI1: Commencement of Chapters 4 and 5 as well as section 20 of the Electronic Transactions Act to create an enabling environment for digital transactions and services to progress towards a digital economy** | 1.Enable Chapter 4 and 5 and section 20 of the Electronic Transactions Act | Gazette notice | Publication of notice to enable Chapter 4 and 5 and section 20 in the Government Gazette | Electronic Transaction Act (Act No.4 of 2019) | | 30% | 70% | 100% | | 20,000,000 | Ministry of Information and Communications Technology |
| | 2.Develop regulations for electronic signatures as per section 20(3) of the Electronic Transactions Act | Finalised regulations for electronic signatures | Publication of regulations in the Government Gazette | Electronic Transaction Act (Act No.4 of 2019) | | | | | | | Ministry of Information and Communications Technology |
| | 3.Accreditation of security services and products | Finalised accreditation regulations | Publication of regulations in the Government Gazette Number of accreditation certificates issued | Electronic Transaction Act (Act No.4 of 2019) | | 50% | 100% | | | 1,000,000 | CRAN |
| **SI2:Availing spectrum resources as necessary for deployment of IMT-2020 (5G) networks** | 4.Formulate a 3 year spectrum assignment strategy 2022-2024 | Finalised spectrum assignment strategy | Roadmap for issuance of spectrum resources for IMT-2020 (5G) | National Frequency Band Plan (Government | 100% | | | | | 20,000 | CRAN |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **and services as per the mandate of the Authority** | | | | Gazette No. 7617 | | | | | | | |
| | 5.Avail spectrum resources for implementation of IMT-2020 (5G) | Issuance of spectrum licence to telecommunications service licensees | Number of spectrum licences awarded subject to spectrum licence conditions for network rollout and implementation of IMT-2020 (5G) use cases | Outcome of Cabinet Decision No. 10TH 21.07.20/006 granting approval for implementation of IMT-2020 (5G) | | 50% | 100% | | | 40,000 | CRAN |
| | 6. Implementation of spectrum licence conditions | Report on network deployment and implementation of IMT-2020 (5G) use cases | Written report submitted to MICT | Spectrum licence conditions | | | 30% | 60% | 100% | 40,000 | CRAN |
| **SI3: Review of the regulatory framework to support digital transformation of the ICT sector** | 7.Assessment of existing regulatory framework's fitness for digital transformation | Development of an appropriate regulatory framework to support digital transformation | New/Amended Regulations published in Government Gazette | Existing regulatory framework | | 50% | 70% | 100% | | 1,000,000 | CRAN |

| STRATEGIC OBJECTIVE 2: SO2: RESEARCH AND DEVELOPMENT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Strategic Initiative** | **Activities** | **Output** | **Key Indicators** | **Baseline** | **Timeline for completion** | | | | | **Budget (NAD)** | **Responsible Entity** |
| | | | | | **2022** | **2023** | **2024** | **2025** | **2026** | | |
| **SI4: Incorporation of coding into curricula for secondary schools to empower the youth to participate actively in a digital economy** | | | | | | | | | | | Ministry of Education |
| **SI5:Availing necessary financial resources to invest in research a development to harness IMT-2020 technologies to provide applications from commerce, mining, agriculture, health and education sectors** | | | | | | | | | | | |

| STRATEGIC OBJECTIVE 3: SO3: SAFEGUARDING THE ENVIRONMENT AND PUBLIC HEALTH | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Strategic Initiative** | **Activities** | **Output** | **Key Indicators** | **Baseline** | **Timeline for completion** | | | | | **Budget (NAD)** | **Responsible Entity** |
| | | | | | **2022** | **2023** | **2024** | **2025** | **2026** | | |
| **SI6: Ensuring compliance to the provisions of the Environmental Management Act and the Environmental Impact Assessment regulations** | 1.Licensees to obtain Environmental Impact Assessment (EIA)certification on a per site basis prior to network rollout | EIA certificates issued | Number of EIA certificates issued | EIA regulations | | | | | | | Ministry of Environment, Forestry and Tourism Telecommunications Service Licensees |
| **SI7:Review of type approval regulatory framework to provide for type approval of all IMT-2020 (5G) telecommunications equipment prior to importation.** | 2.Amend type approval regulatory framework to allow for importation of IMT-2020 (5G) telecommunications equipment | Final regulations | Final regulations published in Government Gazette | Existing type approval regulations, Outcome of Cabinet Decision No. 10TH 21.07.20/006 granting approval for implementation of IMT-2020 (5G) | 100% | | | | | 20,000 | CRAN |
| **SI8: Enforcement of infrastructure sharing to limit environmental impact** | 3.Enforce active and passive infrastructure sharing | Infrastructure sharing disputes mediated Infrastructure sharing agreements for IMT-2020 (5G) concluded | Report on number of disputes resolved Report on Number of infrastructure sharing agreements concluded | Infrastructure sharing Regulations Government Gazette No. 6141 | 20% | 40% | 60% | 80% | 100% | 500,000 | CRAN, telecommunications service licensees |
| **SI9:The National Radiation Protection** | 4.Building capacity within NRPA | | | | | | | | | | NPRA |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Authority to invest in human resources, training, information technology devices and equipment relevant for measurement of radiofrequency EMF radiation if required** | | | | | | | | | | | |

| STRATEGIC OBJECTIVE 4: SO4: ESTABLISHING A SECURE DIGITAL ICT ENVIRONMENT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Strategic Initiative** | **Activities** | **Output** | **Key Indicators** | **Baseline** | **Timeline for completion** | | | | | **Budget (NAD)** | **Responsible Entity** |
| | | | | | **2022** | **2023** | **2024** | **2025** | **2026** | | |
| **SI10: Finalisation of Cyber Crime and Data Protection legislation to promote a safe a secure environment to use the latest technologies, services and applications** | 1.Finalisation of the Cyber Crime Bill | Cyber Crime Act | Publication and Promulgation of the Cyber Crime Act in Government Gazette | Draft Cyber Crime Bill | | | | | | | MICT |
| | 2.Finalisation of the Data Protection Bill | Data Protection Act | Publication and Promulgation of the Data Protection Act in Government Gazette | Draft Data Protection Bill | | | | | | | MICT |
| **SI11: Establish the national Cyber and Security Incidence Response Team (NSCIRT)** | 3.Implement NSCIRT | Fully functional NSCIRT | Annual report on activities of NSCIRT to MICT | Draft Cyber Crime Bill | 10% | 50% | 100% | | | | MICT, CRAN |
| **Ensure protection of critical infrastructure through restriction of utilisation of a single vendor by dominant telecommunications service licensees to address associated security risks.** | Consult dominant telecommunications service licence on utilisation of multiple vendors for IMT-2020 (5G) networks | Multiple vendors contracted for network deployment to address security concerns around utilising a single vendor for critical infrastructure | | Outcome of Cabinet Decision No. 10TH 21.07.20/006 granting approval for implementation of IMT-2020 (5G) | 100% | | | | | | |