UNIVERSITY OF NAIROBI

SCHOOL OF LAW

MASTERS OF LAW PROGRAMME 2019/2020

LLM THESIS

IS KENYA'S REGULATORY FRAMEWORK READY FOR DISRUPTIONS BROUGHT ABOUT BY 5G?

SUBMITTED BY: MAINA MARGARET GATHONI

G62/35039/2019

DECLARATION PAGE

I, Margaret Gathoni Maina, hereby declare that this is my original work and has not been presented for the award of a degree or any other award in any other University. Where works by other people have been used, references have been provided.

Student: **Margaret Gathoni Maina**

Admission Number: **G62/35039/2019**

Signature: 

Date: **6th December, 2021**

APPROVAL

This thesis titled **Is Kenya's regulatory framework ready for disruptions brought about by 5G?** has been done under my supervision and has been submitted to the University of Nairobi, Faculty of Law for examination with my approval as the candidate's supervisor.

Signed: 

Date: **December 6th, 2021**

Supervisor: **DR. KEN OBURA**

LIST OF CITED LEGAL INSTRUMENTS

A. Kenyan Regulatory Instruments

Kenyan Statutes

I. Kenya Communications (Amendment) Act, 2008

II. National Information and Communications Technology (ICT) Policy, 2019

III. Science Technology and Innovation Act, 2013

IV. The Competition Act of 2012

V. The Computer Misuse and Cybercrime Act, 2018

VI. The Constitution of Kenya, 2010

VII. The Data Protection Act, 2019

VIII. The Kenya Communications Act, 1998

IX. The Kenya Information and Communication Act (KICA), 2013

X. The Media Council Act, 2013

Kenyan Policy Framework

I. National Radio Frequency Spectrum Policy

II. Wireless Broadband Spectrum Policy

III. National Information, Communications and Technology (ICT) Policy

B. South African Regulatory Instruments

South African Statutes

I. Electronic Communications and Transactions Act Act No. 25 of 2002

II. Protection of Personal Information Act 4 of 2013

C. EU Regulatory Instruments

EU Regulations

I. EU Regulation 2015/2120125

II. EU Regulation 2020/1070

EU Policies

I. BEREC Guidelines

D. US Regulatory Instruments

USA Statutes

I. The 5G and Beyond Act

USA Policies

I. FCC 5G FAST Plan

E. South Korea Regulatory Instruments

South Korea statutes

I. Information and Communications Network Act

F. Singapore Regulatory Instruments

Singapore policies

I. Second Consultation on 5G Mobile Services and Networks of 7 May 2019

LIST OF CITED INTERNATIONAL LEGAL INSTRUMENTS

I. International Telecommunications Regulations, 1932

II. Constitution of the International Telecommunications Union, 2010

III. African Union Convention on Cyber Security and Personal Data Protection, 2014

IV. Constitution of the Africa Telecommunications Union, 1999

LIST OF CITED CASES

South Africa

Telkom SA Soc Limited and Another v Independent Communications Authority of South Africa and Others [2021] ZAGPPHC

Kenya

Communications Authority of Kenya v Okiya Omtata Okoiti & 8 Others [2020] eKLR

TABLE OF CONTENTS

Abstract

Communications value chain has grown tremendously. Commercialized mobile networks have shifted from 1G to 2G, to 3G, to 4G and currently to 5G. 5G technology has been lauded as being disruptive and revolutionary by many commentators. The regulatory realm is expected to be also disrupted by 5G technology. Identifying key regulatory elements is the first step in examining the regulatory implications of 5G technology. Access regulation, consumer protection, competition enforcement and economic regulation, intellectual property, privacy and data protection, resource management, network security, taxation, and universal service and accessibility are some of the general elements of mobile communication ecosystem regulation. It is evident that 5G regulation must be broadened or linked to areas that are currently unregulated or only lightly regulated but will become part of the developing industrial ecosystem.

This begs the question whether the current regulatory framework in Kenya will be disrupted by 5G technology thus occasioning reforms. This study analyses eight key strands of regulatory issues occasioned by 5G technology: Net neutrality; privacy and security; infrastructure sharing; deployment; spectrum allocation; mobile network standards; service diversification and bundling; and competition. These legal issues must be effectively addressed for efficient deployment of 5G networks. This study seeks to test the efficacy of the legal and institutional framework in Kenya in addressing these issues.

This study also seeks to draw lessons from five jurisdictions. These are: South Africa, South Korea, Singapore, the US and the EU. These lessons will be vital in the establishment of 5G Roadmap in Kenya. South Africa was the 5G trailblazer in Africa. This study reviews regulatory practices from developed countries to draw lessons.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

The main role of regulators is to promote the interests of customers, avoid market failure, provide safeguards to create effective competition and prevent anti-competitive practices. The end goal for a telecommunications regulator is effective communication, increase in ICT access, promotion of innovation and protection of consumers.

The present level of development globally cannot be sustained without growth in information and communication technology (ICT).[1] Development Communication is the art and science of communication applied to the major transformation of a country from impoverished to a dynamic condition of economic prosperity that allows for better economic and social equality, as well as greater human potential realization.[2]The internet as it is has revolutionized the world, but nothing prepared the world for 5G, the next frontier in innovation. 4G network - cellular network technology that provides broadband access - opened up possibilities in communications spheres empowering people to communicate faster, connect on a different level and transforming the way people do business globally. However, the above developments are mundane compared to the possibilities presented by 5G.

5G networks has ushered in a new era of communications globally. It allows people to appreciate advanced technologies including seamless video and conference calls, remote medicine, self-driving vehicles, drones, virtual reality, better and faster home broadband and other ground-breaking forms of technology including robotics. It brings together a system that connects billions of devices and sensors enabling advances in health care, education, resource management,

[1]Gatana Kariuki, 'Growth and Improvement of Information Communication Technology in Kenya' (2009) 5(2) International Journal of Education and Development using Information and Communication Technology 146, 153.

[2]Quebal, Nora C. 1971. Development Communication in the Agricultural Context, UPLB Department of Development Communication.

transportation, agriculture, and many other areas.[3] Suffice to say, 5G performance targets high data rate, reduce latency - allowing data to be transferred in real time, energy saving, cost reduction, high system capacity and massive device connectivity.[4]

The need for mobile communications is quickly increasing, and the development of 5G mobile technology standards, trials, and testbeds is generating a lot of interest around the world. As a result, it is critical for Kenya to grasp the true potential of present and future mobile technologies in new markets and application areas, as well as to ensure that developing technologies are planned and implemented to fulfil the needs of people in all societies. Locally, 5G use-cases promises to reduce poaching, detect faults and cracks in equipment and metals, and identify fake credentials. It will assist the Kenya Bureau of Standards in detecting counterfeit goods, since an engineer will just need to generate a reference with all of the data of the original product, and then scan all connected goods to identify counterfeits.

There is however, a great challenge in the rolling out of 5G.[5] According to Global mobile Suppliers Association (GSA), 5G services have been launched in 69 counties globally as at September 2021.[6] In these countries, base stations and routers are now available, 5G smart phones are also available as of 2019 and commercial deployments have commenced.

The major problem in making 5G a reality is updating and building networks capable of providing all of the services and capabilities we demand. With this great challenge, yet fully aware of the benefits that await us, anything that enables and eases implementation has to be welcome. Regulators have to work in partnership with industry stakeholders to ensure this innovation is not stifled. In Kenya, there needs to be a commercial roll out of 5G technologies. This study seeks to

[3]<https://www.brookings.edu/wp-content/uploads/2016/07/How-5G-tech-enables-health-iot-west.pdf>accessed 2/1/2020

[4]<https://community.fs.com/blog/5g-is-coming-the-new-wireless-revolution-to-change-our-life.html>accessed 2/1/2020

[5]*The Road to 5G Networks: Experience to date and future developments* OECD Digital Economy Papers No. 284, 2019

[6] '5G Market Snapshot - Member Report - November 2021' (*GSA*) <https://gsacom.com/paper/5g-market-snapshot-member-report-november-2021/> accessed 30 November 2021.

investigate what needs to be done from a policy and business perspective to meet the objective of delivering an all-inclusive 5G infrastructure.

5G technology is disruptive in all fronts including regulation. Article 11(2) of the Constitution recognizes the role of science and technology in the development of the nation. Freedom of scientific research has been grounded as a tenet of the freedom of expression.[7] Economic and social rights guaranteed in Article 43 of the Constitution are a watershed of technology and innovation. This study seeks to investigate whether statutory and policy regulatory mechanisms can sufficiently handle the disruptive nature of 5G.

Kenya's government is in the process of implementing the country's National Broadband Strategy (2023). The strategy's goal, according to the executive summary, is to turn Kenya into a globally competitive knowledge-based society with accessible, secure, and fast broadband connectivity. The NBS (2023) acknowledges that both the public and private sectors will be involved in funding broadband infrastructure, emphasizing the importance of government, private sector investments, and development partners in financing broadband projects, particularly by incentivizing infrastructure rollout in remote areas and in areas where broadband investments face challenges in terms of profitability. In the NBS, the objective is that 5G will be introduced by 2023. It is too early to assess whether the objective will be achieved.

The present policy is that the Communications Authority of Kenya (CA) will monitor access to information, technology, and communication infrastructure created with public funds, license operators, and regulate and price commercial access to such infrastructure. Kenyan private and commercial operators will be allowed to access the infrastructure on fair, cheap, and equal conditions, regardless of their size, location, or composition. A legislative framework will be designed to allow for a fair usage policy, in which one operator makes infrastructure available to others on reasonable commercial conditions.

[7] Article 33(1)(c), Constitution of Kenya, 2010, Laws of Kenya.

The Kenya Information and Communication Act[8] (KICA) establishes the Communication Authority (CA) of Kenya, the Regulator that facilitates the development of the information and communications sector including broadcasting, multimedia, cybersecurity, telecommunications and postal services, e-commerce, postal and courier services. The CA launched the Draft 5G roadmap in October 2021.[9] The Communications Authority of Kenya (CA) invited public input on the 5G Roadmap. This study will aim at contributing to the key provisions of the policy framework. The Science, Technology and Innovation Act, 2013[10] aims to facilitate the promotion, coordination and regulation of the progress of science, technology and innovation in Kenya. It also aims to entrench science, technology and innovation into the national production system. However, the National Innovation Agency is constrained by inadequate budgetary allocation.[11]

The Data Protection Act which was enacted in 2019 adopts global protection principles and regulates the processing of personal data, to ensure that the handling of personal data is guided by the overarching principles of data protection. This is crucial in the Internet of Things (IoT) where estimated millions of devices are connected online. The EU has warned that the arrival of 5G mobile broadband networks will raise the stakes for personal data and privacy.[12] According to the executive director of the Information Commissioner Office Simon McDougall, the ability to transfer large amounts of data at high speeds over constantly connected networks that can communicate with personal devices such as smartphones opens up a variety of marketing possibilities that could be "creepy" and "intrusive," as well as pose "dramatic challenges."[13]

[8]Kenya Information and Communication Act, 2013

[9] 'Public Consultation On The Roadmap For 5th Generation (5g) Mobile Communications In Kenya' (*Communications Authority of Kenya*, 12 October 2021) <https://www.ca.go.ke/public-consultation-on-the-roadmap-for-5th-generation-5g-mobile-communications-in-kenya/> accessed 30 November 2021.

[10] Act No. 28 of 2013, Kenya Law Reports

[11] 'Kenya Nationa Innovation Agency Strategic Plan: 2018 - 2022' (Kenya Nationa Innovation Agency, 2018).

[12] '5G Poses "dramatic Challenges" to Privacy and Personal Data' (*Marketing Week*, 1 March 2019) <https://www.marketingweek.com/5g-dramatic-challenges-privacy-personal-data/> accessed 30 November 2021.

[13] ibid.

However, a bigger question is whether disruptions and/or advancements in technology should discontinue regulation. Should Regulators always go back to the drawing board for every advancement? Is it possible to have regulations that are flexible enough not to require constant amendments? At the same time, the fact that 5G technology is ahead of the regulatory curve may be exactly what the innovator is seeking for, allowing them to deploy their innovations across the industry with complete freedom.

This study seeks to evaluate whether the regulatory environment in Kenya is ready for 5G deployment. One key objective of regulation is to redress the information imbalance that sometimes exists between consumers and service providers.[14] This is best resolved by establishing restrictions on telecommunication service providers that impose business behaviour standards. Furthermore, the degree of consumer protection influences the fairness of ICT markets. Overall, regulation aims to achieve a balance between safeguarding markets and suffocating genuine companies. This can be accomplished through avoiding or mitigating business failures. This is accomplished by the imposition of capital and internal control requirements, such as ensuring that entities have enough cash to meet their obligations.[15]

It is very clear that failing to keep pace with 5G advancements could see Kenya and Africa, in general lag behind the rest of the world. Nurturing an emerging technology like 5G is the very bedrock of faster and reliable communications, innovation and vibrant economies focus on the appetite for ICT in Africa as a driver of development and innovation explore and identify investment opportunities and best practices for socio-economic development through ICT. Some of the key discussion points will be on 5G for smarter digital development. It is the CAK's public service mandate, as a regulator, to ensure that Kenya is not left behind as the world is moving forward and embracing new technologies that will benefit consumers, business and government,

[14] Angela Anyango Lebu and University of Nairobi, 'Financial Services Regulation In Kenya: A Critical Analysis Of The Proposed Unified Financial Services Regulator' 110.
[15] Ibid.

hence should be involved and participating in forums and discussions as we look forward to the first commercial deployment of 5G in 2023.

5G is inevitable in Africa.[16] In 2019, South Africa launched Africa's first commercial 5G Network. Egypt, Nigeria, Senegal, Morocco and the Democratic Republic of Congo deployed 5G base stations in 2020. There is therefore, a great and urgent need for the government to lay out network spectrum and infrastructure in readiness for take-off. This revolutionary technology needs supportive infrastructure, a favourable ecosystem and the right policies to succeed.

Currently, only Safaricom that is testing 5G's feasibility in Kenya through its TubeStar Base Station.[17] Full 5G access will require close collaboration with the Communications Authority of Kenya, which ought to be at the forefront facilitating this innovation for early deployment. The gap in law in glaring. It is believed that they are leveraging on their current 4G network infrastructure to build a cost-effective 5G Network with wide coverage. This will allow Safaricom drive the costs of production down, enabling them offer affordable data products to Kenyans.

1.2 The Research Problem

Despite the fact that Kenya has a fairly new ICT Policy and a robust institutional framework for the telecommunications industry, nevertheless, the current regulatory framework and institutional settings are not adequate for the development and deployment of 5G Network in Kenya. The problem sought to be addressed in this study is whether the ICT Laws and Regulations as they are, are flexible enough for development and deployment of 5G in Kenya.

[16]GSMA, '5G in Sub-Saharan Africa: Laying the foundations accessed at <https://www.gsma.com/subsaharanafrica/resources/5g-in-sub-saharan-africa-laying-the-foundations> accessed on 18/11/2019

[17] 'Safaricom Trials New Base Stations for Urban Areas' <https://www.africanwirelesscomms.com/news-details?itemid=2415> accessed 30 November 2021.

This study aims to investigate the current legal framework regulating Mobile Network Operators (MNOs) to ascertain its readiness for 5G deployment and the future 5G use cases. This study will evaluate the legal framework to ascertain whether it has addressed 5G challenges such as:[18]

a) Spectrum allocation;
b) 5G networks deployment;
c) Infrastructure sharing;
d) Data protection;
e) Service diversification and bundling by MNOs;
f) Net neutrality; and
g) Consumer protection issues.

There is a need for adequate and detailed 5G regulation. It is essential to carry out development and deployment in a coordinated manner.

1.3 Objective of the Research

The general objective of the study is to examine the regulatory gaps in Kenya that may hamper development and deployment of 5G technology. The study will focus on the following specific objectives:

1. Examine the regulatory issues raised by a 5G Network
2. Analyse the adequacy of the current legal and institutional framework in Kenya in dealing with the legal challenges posed by a 5G Network
3. Identify regulation lessons from select jurisdictions already implementing the 5G network
4. Recommend on how to deal with regulatory gaps occasioned by 5G technology.

1.4 **Research Questions**

The questions sought to be answered by this study are:

[18] Setting the *the Scene for 5G: Opportunities and Challenges* ITU Publications on Regulation, Economics and Finance, 2018

1. What are the regulatory issues posed by the 5G Network?
2. Is the legal and institutional framework in Kenya adequate to deal with the 5G network challenges?
3. What regulation lessons can be learned from other jurisdictions already implementing the 5G network?
4. what are the recommendations on effective regulation of 5G technology in Kenya?

1.5 Research Hypothesis

The hypothesis of this study is that the current telecommunications laws and regulations, as they are, are not adequate or capable of getting Kenya ready for the development and deployment of 5G Network.

1.6 Literature Review

On a global scale, 5G deployments are ongoing, with the first applications focusing on providing high-capacity mobile broadband services.[19] Many countries are undertaking 5G research and specification initiatives.[20] Ahokangas *et al* sought to determine how regulatory and technological developments affect mobile communication ecosystems.[21] Mobile operators, mobile equipment and infrastructure vendors, regulatory bodies, content and application providers, network infrastructure developers, facility owners, and end users are all part of the 5G ecosystem, according to Matinmikko *et al*.[22] Solutions for a healthy coexistence among parties in the 5G ecosystem are implemented by regulatory authorities and standardization bodies.[23] According to Levi Osuagwu

[19] Marja Matinmikko-Blue, Seppo Yrjölä and Petri Ahokangas, 'Moving from 5G in Verticals to Sustainable 6G: Business, Regulatory and Technical Research Prospects' in Giuseppe Caso, Luca De Nardis and Liljana Gavrilovska (eds), *Cognitive Radio-Oriented Wireless Networks* (Springer International Publishing 2021).
[20] Carlos Renato Storck and Fátima Duarte-Figueiredo, 'A Survey of 5G Technology Evolution, Standards, and Infrastructure Associated With Vehicle-to-Everything Communications by Internet of Vehicles' (2020) 8 IEEE Access 117593.
[21] Petri Ahokangas and Marja Matinmikko-Blue, 'Introduction to Special Issue "Mobile Communications and Novel Business Models"' (2021) 13 Sustainability 674.
[22] Petri Ahokangas and others, 'Antecedents of Future 6G Mobile Ecosystems', *2020 2nd 6G Wireless Summit (6G SUMMIT)* (2020).
[23] Matteo Vincenzi, Elena Lopez-Aguilera and Eduard Garcia-Villegas, 'Timely Admission Control for Network Slicing in 5G With Machine Learning' (2021) 9 IEEE Access 127595.

et al, 7.4% of adult Sub Saharan Africans believe 5G technology was linked to the COVID-19 pandemic.[24] Such myths may slow the deployment of 5G technology in the African Continent. Levi Osuagwu *et al*, recommend public education on the 5G technology to aid its uptake.[25] Matinmikko *et al* observed that the mobile communications sector is undergoing disruption in the regulatory, business, and technology domains as 5G technologies, is being rolled out.[26] Herzog *et al* argue that despite the fact that 5G technologies are still in the early stages of development, they should be regulated to improve deployment.[27] According to Ahmand *et al*, better methods for accountability, data minimization, transparency, openness, and access control will be required for 5G.[28] As a result, robust privacy protections and legislation should be considered throughout the standardization of 5G.[29] All digitalization in our society is supported by modern communications networks, including 5G.[30] Access regulation, pricing regulation, competition regulation, privacy and data protection, and network and service authorization have all been explored by Ahokangas *et al*.[31]

There are three different types of regulatory approaches.[32] The first is government regulation, which mostly consists of country-specific privacy legislation enacted by governments and multi-national organizations such as the United Nations (UN) and the European Union (EU).[33] The second level is the industry level, where representatives from many industries and groups collaborate to develop the best principles and practices.[34] Third, regulations at the consumer level

[24] Uchechukwu Levi Osuagwu, Kingsley Agho and Emmanuel Abu, 'Factors Associated with the Myth about 5G Network during COVID-19 Pandemic in Sub-Saharan Africa' (2020) 4 Journal of Global Health Reports.
[25] Ibid.
[26] Ahokangas and Matinmikko-Blue (n 27).
[27] Uwe Herzog and others, 'Quality of Service Provision and Capacity Expansion through Extended-DSA for 5G' (2016) 27 Transactions on Emerging Telecommunications Technologies 1250.
[28] Ijaz Ahmad and others, '5G Security: Analysis of Threats and Solutions', *2017 IEEE Conference on Standards for Communications and Networking (CSCN)* (2017).
[29] ibid.
[30] Ahokangas and Matinmikko-Blue (n 27).
[31] Matinmikko-Blue, Yrjölä and Ahokangas (n 25).
[32] Ahmad and others (n 34).
[33] ibid.
[34] ibid.

ensure that desired privacy is protected by taking into account consumer needs.[35] Professor Sihanya proposes a multifaceted regulatory approach.[36] It encourages industry and government to play complementary roles.[37] The logic behind this is because industry actors typically have a lot more information about the business, and an approach like this might lead to regulatory competition or coordination.[38] According to Benseny *et al*, policymakers should use community commitment to establish market-driven regulations for 5G in order to boost demand-driven investment in commercially underserved areas.[39]

On paper, the 5G network's privacy challenges have been identified, as well as the goal of privacy protection.[40] According to a study undertaken by Stanley Chinedu, 84.6 per cent of the respondents believed that 5G networks are not secure.[41] The Draft Data Protection Regulations have not been passed.[42] These regulations were intended to enable practical implementation of the Data Protection Act of 2019.[43] This study will inform key 5G privacy concerns that should be incorporated in the Draft Data Protection Regulations.

Regulations at the national, regional, and international levels establish the operational conditions, and while there is considerable variance between national approaches, there is also substantial harmonization, such as in the 5G spectrum.[44] The success of 5G system deployment is primarily reliant on international and national regulatory agencies, which are in charge of providing

[35] ibid.
[36] B Sihanya, 'REGULATING INTERNET BUSINESS IN KENYA' <http://erepository.uonbi.ac.ke/handle/11295/86018> accessed 12 October 2021.
[37] ibid.
[38] ibid.
[39] Jaume Benseny and others, 'The Mitigating Role of Regulation on the Concentric Patterns of Broadband Diffusion. The Case of Finland' (2019) 41 Telematics and Informatics 139.
[40] Mamoona Humayun and others, 'Privacy Protection and Energy Optimization for 5G-Aided Industrial Internet of Things' (2020) 8 IEEE Access 183665.
[41] Stanley Chinedu Okoro, 'Factors Affecting Adoption of Modern Technology by Telecommunication Firms In Kenya: A Case Study of 5g Technology' (United States International University 2021).
[42] 'Kenya: Amend the Draft Data Protection Regulations' (*ARTICLE 19*) <https://www.article19.org/resources/kenya-amend-draft-data-regulations-2021/> accessed 12 October 2021.
[43] ibid.
[44] Matinmikko-Blue, Yrjölä and Ahokangas (n 25).

additional spectrum bands, defining frequency coordination mechanisms, and establishing operational standards for 5G implementation.[45] This study will explore regional and international cooperation mechanisms in 5G deployment to guide the Communications Authority on what steps it can take, albeit not being prescriptive.

According to a study by Oughton and Frias, 5G infrastructure costs are quite high, and the most cost-effective strategy to lower infrastructure costs is through infrastructure sharing and network virtualization.[46] According to Huang et al., the 5G networks will be multitenant, meaning that network operators and service providers will share the same physical infrastructure.[47] Each Mobile Service Provider in Kenya is required to develop or lease the infrastructure that it requires, despite the fact that their license permits them to share their infrastructure on a commercial basis.[48] Under formal agreements, only Safaricom Co. Ltd and Telkom Kenya Ltd have agreed to share ICT infrastructure in a select parts of Kenya.[49] Stanley Chinedu established that organizational factors contribute to 63 per cent of modern technology adoption.[50] Consequently, individual MNOs in Kenya are responsible for 5G deployment depending on their readiness index.[51] Telecommunication services are largely consumed by the private sector.[52] This Study will develop guiding principles of effective 5G infrastructure sharing by MNO in Kenya.

[45] Eva Lagunas and others, '5G Cellular and Fixed Satellite Service Spectrum Coexistence in C-Band' (2020) 8 IEEE Access 72078.
[46] Ibrahim Alhassan Gedel and Nnamdi Nwulu, 'Infrastructure Sharing for 5G Deployment: A Techno-Economic Analysis' (2021) 15 International Journal of Interactive Mobile Technologies (iJIM) 137.
[47] Xiaohu You and others, 'Towards 6G Wireless Communication Networks: Vision, Enabling Technologies, and New Paradigm Shifts' (2020) 64 Science China Information Sciences 110301.
[48] Peter Namisiko, Maurice Sakwa and Waweru Mwangi, 'Effects of Network Infrastructure Sharing Challenges on Open Information Communication Technology Infrastructure Sharing among Mobile Service Providers in Kenya' (2015) 7 International Journal of Information Engineering and Electronic Business 11.
[49] ibid.
[50] Okoro (n 47).
[51] Agrippina Mwangi, *Assessing the Readiness Index of the Private Sector to Effectively Use 5G Technology in the Urban and Peri-Urban Areas of Kenya* (2020).
[52] ibid.

It is necessary to allocate additional spectrum for 5G communication services in order to meet the corresponding wireless capacity demand.[53] The electromagnetic spectrum is a finite and reusable scarce resource.[54] Given the interdependence of spectrum and technology, with the former serving as a crucial facilitator and driver of the latter, spectrum is a requirement for technology access.[55] In order to improve access to technology for socioeconomic development in the information age, effective spectrum usage is required, which also improves access and equity.[56] This study will develop guidelines for spectrum allocation and pricing that may guide the Communication Authority.

The government exerts significant control over telecom companies by ensuring that their competitiveness is fair.[57] Benefits advancement may be the key to having government regulators, as customers risk being exploited by competitor firms if the regulator is not present.[58] Similarly, the government is always the arbitrator between corporations in either competition or when they have gone against customer requests, with the government emphasizing that lower costs of technical improvements will make government regulation easier.[59] More stringent government actions are recommended by Mugo and Macharia to curtail any sorts of cheating or violation that offer a corporation an unfair competitive advantage.[60]

This study will explore best practices in 5G deployment and regulation by analysing key regulatory issues that 5G networks pose. The investigation will then inform the best paths Kenya can take in

[53] M Majid Butt and others, 'Spectrum Matching in Licensed Spectrum Sharing' (2018) 29 Transactions on Emerging Telecommunications Technologies e3476.
[54] Linghui Zeng and Jianzhao Zhang, 'Multi-Agent Spectrum Access with Sensing Skipping Based on Reinforcement Learning' (2021) 32 Transactions on Emerging Telecommunications Technologies e4264.
[55] Patricia Kameri-Mbote, and others, 'Spectrum Management and Regulation in Kenya: Engendering Inclusive Access to Technology and Information' (International Environmental Law Research Centre 2016).
[56] Ibid.
[57] Peter Mugo and Jimmy Macharia, 'Technological Innovation and Competitive Advantage in Telecommunication Companies in Kenya' (2020) 9 International Journal of Research in Business and Social Science (2147- 4478) 38.
[58] Ibid.
[59] Ibid.
[60] Ibid.

5G deployment and regulation. It will also explore 5G use cases in order to form a body of knowledge that can form best regulatory approach to encourage innovation by exploring use cases of regulatory sandboxes.

1.7 Scope of the Study

The Study's focus will be on regulatory issues that may hamper 5G networks deployment and not individual 5G use-cases.

1.8 Justification of the Study

This study is justified on the main ground that 5G is a disruptive technology that needs re-evaluation of the current regulatory framework. The government needs to consider setting up a spectrum, policies and a conducive technology environment to enable 5G deployment. Players need to be aware of the permits and restrictions under the law. There is need to ensure that this disruptive technology is welcomed through appropriate policies, rules and regulations to facilitate the anticipated transformation.

This study is also justified on the ground that it intends to enrich local literature on the regulatory issues posed by 5G technologies. The literature developed from this study will aid in development and improvement of Kenya's 5G Roadmap.

The study seeks to make useful recommendations and proposals to the regulatory and institutional frameworks for successful 5G deployment.

1.9 Theoretical Framework

This study shall be underpinned by the theories on regulation.

1.9.1 Positive Theories of Regulation

These theories explore the reasons for regulation.[61] George Stigler and others propounded " the positive theory of regulation."[62] According to Günter Knieps, the positive theory of regulation examines the origin, transformation, and abolition of sector-specific regulation, as well as the institutional application of such regulation.[63] This study will explore regulation of MNOs though legal and institutional mechanisms with specific focus of 5G deployment. As a result, the critical question is how network firms are regulated.[64] In order to explain the behaviour of regulators, the influence exercised by firms, consumer interests, and the bureaucratic self-interest of the regulating agency must all be considered.[65] Regulators, according to Gunter, have substantial incentives to over-regulate, mix regulatory instruments in ineffective ways and argue for a heavy-handed approach to corporate supervision.[66]

1.9.2 Normative Theories of Regulation

According to Jayasuriyan and Malaimagal, normative regulatory theories examine the efficiency of a regulation.[67] This study will examine the efficacy of the regulatory framework in 5G deployment. According to Giandomenico Majone, regulation should be used to enhance efficiency.[68] Normative regulatory theories generally conclude that regulators should promote competition where possible, minimize costs of information asymmetries by obtaining information and providing operators with incentives to improve their performance, provide for price structures that improve economic efficiency, and establish regulatory processes that provide

[61] 'Theories of Regulation' <https://regulationbodyofknowledge.org/general-concepts/theories-of-regulation/> accessed 30 November 2021.
[62] Giandomenico Majone, 'The Rise of the Regulatory State in Europe' (1994) 17 West European Politics 77.
[63] Günter Knieps, 'The Positive Theory of Regulation' in Günter Knieps (ed), *Network Economics: Principles - Strategies - Competition Policy* (Springer International Publishing 2015) <https://doi.org/10.1007/978-3-319-11695-2_9> accessed 30 November 2021.
[64] ibid.
[65] ibid.
[66] Günter Knieps, 'Telecommunications Markets in the Stranglehold of EU Regulation: On the Need for a Disaggregated Regulatory Contract' (2005) 6 Competition and Regulation in Network Industries.
[67] B. Jayasuriyan and S. Malaimagal, 'A Critical Analysis on the Theories of Regulation' (2019) 8 International Journal of Innovative Technology and Exploring Engineering 2017.
[68] Majone (n 69).

for regulation under the law, as well as independence, transparency, predictability, legitimacy, and credibility for telecommunications operators.[69]

1.9.3 The Public Interest Theory of Regulation

The Public Interest Theory of regulation, according to Michael Hantke-Domas, states that regulation aims at protecting and benefit the general public.[70] Proponents of this theory assert that the regulatory process aids price competition by, for example, eliminating restrictive trade practices usually associated with monopoly power abuse.[71] This study will look at public interest issues raised by 5G networks and the efficacy of the regulatory regime in Kenya.

1.10 Research Methodology

This is a qualitative study. This study will employ desktop technique of research. It method will involve examination of textbooks; journal articles; conference papers; relevant reports of various bodies; statutes; case law and relevant internet materials.

1.11 Chapter Breakdown

This study will have five chapters:

Chapter One will be based on an introductory section whose focus is what 5G Network entails, its capabilities and benefits. It will question the viability of its deployment in Kenya, looking at timeframes.

Chapter Two will then discuss the regulatory issues raised by a 5G Network, some of which are spectrum allocation, facilitating network deployment, infrastructure sharing, service diversification and bundling by operators, privacy and security challenges.

Chapter Three shall be an analysis of the adequacy of the current legal and institutional frameworks in Kenya, in dealing with the challenges posed by the 5G Network.

---

[69] 'Theories of Regulation' (n 68).

[70] Michael Hantke-Domas, 'The Public Interest Theory of Regulation: Non-Existence or Misinterpretation?' (2003) 15 European Journal of Law and Economics 165.

[71] MB Adams and GD Tower, 'Theories of Regulation: Some Reflections on the Statutory Supervision of Insurance Companies in Anglo-American Countries' 23.

Chapter Four shall begin by identifying lessons from select jurisdictions already implementing the 5G Network. What is the regulatory practice in countries like South Africa and Singapore? How has Europe and USA prepared for deployment of the Network?

Chapter Five will finally focus on the findings of the study and a conclusion. The study shall have made various regulatory recommendations on how to deal with the legal challenges.

2.0 CHAPTER TWO: REGULATORY ISSUES RAISED BY A 5G NETWORK

2.1 Introduction

Throughout their brief but intensive history, the drivers of competition in mobile communications markets have evolved.[72] The communications value chain has advanced in tandem with the expansion of service features since the introduction of data services.[73] Mobile Network Operators (MNOs) have grown into new markets with each successive generation of mobile communication technology.[74] Shifting from 1G to 2G meant transitioning from analogue to digital systems in terms of technology, while in business terms meant shifting from corporate and affluent consumers to a general market.[75] Data-centric communication infrastructure was created as a result of the 2G to 3G transition, which compensated for falling sales from voice.[76] The transition from 3G to 4G shifted the focus from low data rates focus in 3G to high-speed internet mobile access in 4G..[77]

Albeit still in its early stages, 5G is expected to provide mobile consumers with a "fibre-like" experience, according to some authors.[78] In this aspect, 5G will undoubtedly provide superfast broadband as a progression of 4G services, as well as integrating low-latency and ultra-reliable features that will enable a large range of novel applications.[79] Instead of being a general purpose connectivity platform with limited differentiation functionalities across use cases, 5G aims to create an ecosystem that can meet the technical needs of 'vertical industries', such as healthcare, energy or automobile industries.[80]

The regulatory decisions adopted will determine how far 5G networks can achieve the big aspirations of altering industry and society, as well as changing the overall mobile communication

[72]Zoraida Frias and Jorge Pérez Martínez, '5G Networks: Will Technology and Policy Collide?' (2018) 42 Telecommunications Policy 612.
[73]ibid.
[74]ibid.
[75]ibid.
[76]ibid.
[77]ibid.
[78]ibid.
[79]ibid.
[80]ibid.

ecosystem.[81] National, regional, and global regulatory frameworks are all part of the legal regime.[82] While promoting competition, innovation, and the emergence of new services, it is important that regulations encourage profitable long-term investments for all key players including both newcomers and incumbents.[83] The goal of this study is to evaluate if the current regulatory framework can be matched with the technological advancements that this new technology will bring about, as well as the regulatory modifications that may be required to fit those changes.[84]

2.1 Regulatory revolution brought about by 5G Network

While the technological advances ushered in by 5G technology can aptly be described as a natural accelerated evolution of telecommunications technology; a more revolutionary change could occur in how electronic communications networks and services are regulated as a result of service provision and device capabilities, which are likely to have a profound impact on the electronic communications industry.[85] Identifying key regulatory elements is the first step in examining the regulatory implications of 5G technology.[86] Access regulation, consumer protection, competition enforcement and economic regulation, intellectual property, privacy and data protection, resource management, network security, taxation, and universal service and accessibility are some of the general elements of mobile communication ecosystem regulation.[87]

The term "access regulation" refers to the interconnection and interoperability obligations that require operators to provide connectivity to virtual operators and other operators who do not have access to the network.[88] Pricing regulation strives to provide a basic set of services to all end users at a reasonable cost, while also ensuring that wholesale and transfer pricing do not hamper

[81]MarjaMatinmikko and others, 'On Regulations for 5G: Micro Licensing for Locally Operated Networks' (2018) 42 Telecommunications Policy 622.
[82]ibid.
[83]ibid.
[84]Peter Alexiadis and Tony Shortall, 'The Advent of 5G: Should Technological Evolution Lead to Regulatory Revolution?' 13.
[85]ibid.
[86]Matinmikko and others (n 88).
[87]ibid.
[88]ibid.

competition.[89] The goal of competition regulation is to ensure that market competition does not stifle economic growth or innovation.[90] The terms "privacy and data protection" refer to safeguarding users' rights to data processing and privacy in order to protect service confidentiality and security.[91] Lastly, network and service authorization establishes the procedures for granting radio frequency rights and is critical to the growth of the market, the development of innovative products and services, the effective operation of competition, and the attainment of many societal aims.[92]

Mobile 5G networks cannot be deployed in isolation; they must be complemented by an equivalent upgrade to the fixed network.[93] Given that infrastructures will be able to adopt a multi-tenancy model, the nature of network ownership and operation as we know it will also inevitably transform in a 5G context.[94] Whereas the perceived significance of competitive telecommunications products has previously been seen as essential in and of itself, as well as providing a solid pricing foundations upon which other economic sectors in Kenya can thrive, 5G will create an environment in which the telecommunications service is itself interlinked into the majority of high-value main economic activities.[95] This is because 5G technology will enable communications within and among the Internet of Things (IoT).[96]

It is evident that 5G regulation must be broadened or linked to areas that are currently unregulated or only lightly regulated but will become part of the developing industrial ecosystem.[97] Standardization could assist create a more stable baseline, whether it is in terms of network fundamentals, interoperability, or access to services and resources.[98] To avoid losing the

[89]ibid.
[90]ibid.
[91]ibid.
[92]ibid.
[93]Alexiadis and Shortall (n 91).
[94]ibid.
[95]ibid.
[96]ibid.
[97]Matinmikko and others (n 88).
[98]ibid.

momentum of healthy competition based on 5G solutions and to reap its value, a sound regulatory framework for locally developed 5G networks is needed as a starting point for the governance of currently much less and unregulated areas.[99]

2.2 Legal Issues raised by 5G Network

A fabric of norms, coordinating mechanisms, and other supporting institutional arrangements, some of which may be provided through regulation, is required for well-functioning markets.[100] When a new generation of technologies arises, policymakers must decide whether the current legal and regulatory framework is adequate or whether a fresh market design would allow society enjoy the potential benefits.[101] When adopting a 5G development, policymakers should anticipate key challenges with rollout that could become major barriers if not addressed properly.[102]

2.2.1 Spectrum Allocation

Two regulatory issues influence the development of 5G in particular.[103] For the 5G market, these are spectrum allotment and competition policy.[104] Spectrum allocations, MNO assignments, and competition are inextricably intertwined in a singular body, as they are in all mobile cellular markets, because spectrum rights provide mobile market access. Markets are created by spectrum.[105]

Spectrum has been considered to be public property belonging to the commons.[106] Electromagnetic spectrum, on the other hand, is a non-depletable resource, unlike other natural resources.[107] The use of obsolete technology may cause it to be 'consumed,' as other users will be unable to access

[99]ibid.
[100]Johannes M Bauer and Erik Bohlin, 'The Role of Regulation in 5G Market Design' (Social Science Research Network 2019) SSRN Scholarly Paper ID 3421024 <https://papers.ssrn.com/abstract=3421024> accessed 5 August 2021.
[101]ibid.
[102]Simon Forge and Khuong Vu, 'Forming a 5G Strategy for Developing Countries: A Note for Policy Makers' (2020) 44 Telecommunications Policy 101975.
[103]ibid.
[104]ibid.
[105]ibid.
[106] Kameri-Mbote, and others (n 61).
[107] Ibid.

it.[108] As a result, despite its finite nature, spectrum utilization can achieve an equilibrium of "sustainable consumption" through technical innovation.[109]

Three frequency ranges are used in 5G spectrum allocation: The low-band spectrum covers frequencies below 1 GHz; the mid-band (typically the most preferred) encompasses frequencies from 1 to 6 GHz; and the high-band spectrum covers frequencies above 6 GHz up to 100 GHz, commonly known as mmWave.[110] Because the three bands have such a wide range of propagation qualities and transmission speeds, they tend to accommodate a variety of 5G applications.[111]

Lower band frequencies may have slower data throughput, but they offer the best propagation qualities, allowing signals to flow further using the inverse square law as well as through physical impediments such as ferro concrete structures that function better in harsh weather.[112] The lower frequency range is better suited to remote, rural areas where the cost of constructing massive fibre optic networks is impractical because of its economic viability.[113]

The data speed and latency of the mid and high-band spectrum ranges are superior, but propagation qualities quickly deteriorate.[114] This band's waves do not travel very far and are improbable to penetrate walls, physical impediments, rain, or moist foliage. As a result, a 5G network operating at the upper centimetric (for example, 24–30 GHz) and millimetric (for example, 30–300 GHz) frequencies will necessitate significant investments in cell densification to accommodate its users.[115] Unproven 5G use cases, such as connected vehicles, robotics, high-speed precision automation with high-volume data streams, micro-manipulation of remote objects, for example in surgery, and immersive training, could benefit from the use of the high-frequency spectrum.[116]

[108] Ibid.
[109] Ibid.
[110]Forge and Vu (n 109).
[111]ibid.
[112]ibid.
[113]ibid.
[114]ibid.
[115]ibid.
[116]ibid.

Range and coverage are closer to the low-frequency band in the mid-frequency spectrum, while higher-frequency benefits, such as better data speeds and lower latency, are limited.[117] In most countries, it has been chosen as the core band for the first phase of 5G deployments.[118]

When any of the components are restricted or fail, it can be difficult to ensure proper functioning without regulation.[119] The spectrum allocation, for example, is up for debate because some frequencies are currently used by Department of Defence applications in various countries.[120] For crucial vertical application areas, failures can be catastrophic.[121]

2.2.1.1 Mechanism for allocating spectrum

For a National Regulatory Agency to select operators for 5G spectrum allocations, there are two main competitive methods.[122] Although auctioning is the most typical method, Singapore has also employed managed competitive bids through a "call for proposal" (CFP).[123] A third option is to avoid licensing spectrum and instead use unlicensed spectrum, which is the foundation for the most widely used radio technology, Wi-Fi, which is a major competitor to 5G in both corporate and consumer bandwidth.[124] This is a realistic option, particularly in terms of cutting the cost of innovation and attracting newcomers.[125] Another alternative is shared spectrum, which is subject to licensing rules.[126]

The 5G era will be made up of a variety of heterogeneous wireless networks controlled by a variety of independent operators who will need to share spectrum in the same places and at the same

[117]ibid.
[118]ibid.
[119]Aaron Yi Ding and Marijn Janssen, 'Opportunities for Applications Using 5G Networks: Requirements, Challenges, and Outlook', *Proceedings of the Seventh International Conference on Telecommunications and Remote Sensing* (Association for Computing Machinery 2018) <https://doi.org/10.1145/3278161.3278166> accessed 5 August 2021.
[120]ibid.
[121]ibid.
[122]Forge and Vu (n 109).
[123]ibid.
[124]ibid.
[125]ibid.
[126]ibid.

times.[127] End-users, wireless networks, and devices will need to distribute spectrum more widely among heterogeneous users, uses, and networks in the 5G future.[128]

Spectrum can be shared in a number of ways.[129] It is impossible to protect yourself from interference or congestion caused by other unlicensed users when they are using the same spectrum.[130] Unlicensed users share spectrum in a non-cooperative manner, with access available to any user who complies with the rules.[131]

For previous mobile radio generations, the auction method has been successful in stimulating competition among bidders and, as a result, maximizing government income from spectrum allotment.[132] Yet, by using this technique, the winning operators risk devoting all of their resources to costly 5G deployment investments, despite a high amount of uncertainty surrounding their business models.[133] Incumbents may be able to buy all spectrum offered at auction in some countries, preventing new entrants and smaller competitors from entering the 5G market, thus closing it.[134]

Light licensing and spectrum sharing, where multiple systems operate in the same band under agreed-upon rules and conditions, have evolved from the traditional split between licensed and unlicensed approaches to spectrum regulatory developments.[135] MNOs have traditionally acquired individual licenses, which were awarded through auctions.[136] Given the limited carrier bandwidths available in a given frequency range, licenses are often issued to a limited number of operators and generally come with stringent coverage requirements.[137]

---

[127]William Lehr, Fabian Queder and Justus Haucap, '5G: A New Future for Mobile Network Operators, or Not?' (2021) 45 Telecommunications Policy 102086.
[128]ibid.
[129]ibid.
[130]ibid.
[131]ibid.
[132]Forge and Vu (n 109).
[133]ibid.
[134]ibid.
[135]MarjaMatinmikko and others, 'Micro Operators to Boost Local Service Delivery in 5G' (2017) 95 Wireless Personal Communications 69.
[136]ibid.
[137]ibid.

2.2.2 Facilitating Network Deployment

The 5G era has begun, and telecom companies are speeding up the deployment of 5G networks.[138] In the region where mobile network operators are about to deploy 5G mobile network services to users, mobile network operators must work in compliance with the 5G network technology standards that have been developed.[139] As a result, it is critical to recognize and comprehend 5G legislation in the country where they aim to implement 5G wireless networks, and to develop a 5G rollout roadmap in accordance with those regulations.[140] Development of standards will facilitate deployment of 5G networks in Kenya.

Network densification, which entails expanding available network capacity by adding more cell sites such as radio access networks, macro sites, in-building wireless, and small cell deployments, will be critical to a successful 5G deployment.[141] Because 5G services will operate in higher frequency bands than today's 3G and 4G networks, where signals do not travel as far or penetrate buildings as effectively, operators will need to install small cells.[142] These tiny cells are placed at a higher density than standard 4G macro cells, allowing for increased network coverage, capacity, and quality of service without any need for extra spectrum.[143]

Regulators can help by enacting rules that encourage the deployment of small cells.[144] For example, 21 state legislatures in the United States have passed small cell legislation that simplifies laws to make 5G small cell deployment easier.[145] These legislations all take into account the particular circumstances of their state and local ecosystem, but they all follow the same basic

[138]'5G Network Deployment Challenges | RantCell' <https://rantcell.com/5G-network-deployment-challenges.html> accessed 6 August 2021.
[139]ibid.
[140]ibid.
[141]'The 5G Bandwagon: Legal and Regulatory Implications' (2019) <https://eoasis.rajahtann.com/eoasis/lu/pdf/2019-04_5G-Legal-and-Regulatory-Implications.pdf> accessed 6 August 2021.
[142]ibid.
[143]ibid.
[144]ibid.
[145]ibid.

principles, such as streamlining applications for public rights-of-way access, imposing a cost and fee cap, and shortening the time it takes to consider and process cell siting applications.[146]

2.2.2.1 Creation of Standards of 5G Networks

The process of finding a solution to a matching problem is known as standardization.[147] The term "standard" refers to a specification or collection of specifications that ensures component compatibility.[148] This study will provide a brief overview to the setup of mobile networks in order to provide a better knowledge of the standardization procedures in these networks.[149] The first distinguishing feature of mobile network standards is that they are made up of numerous technologies that must be defined independently in technical specifications rather than a single specification that must be agreed upon.[150] Mobile networks are a body of complex systems.[151]

The benefit of having multiple subsystems in a single network is that evolution and advancement may be managed in a modular fashion.[152] Network and air interfaces may have different product lifecycles, so the next generation of a mobile network may be based on the air interface of the previous model while designing a brand-new network interface.[153] This can be translated into two paradigms in standards theory: revolutionary and evolutionary development.[154]

In terms of size, form, and function, 5G devices will be a complete revolution of current mobile phones.[155] The devices will be much intelligent, autonomous, and able to communicate actively.[156]

To begin with, new types of mobile hosts will emerge in next-generation systems such as wearable

[146]ibid.
[147]David Harborth and Maurice Pohl, 'Standardization of 5G Mobile Networks: A Systematic Literature Review and Current Developments' (2017) 15 International Journal of Standardization Research (IJSR) 1.
[148]ibid.
[149]ibid.
[150]ibid.
[151]ibid.
[152]ibid.
[153]ibid.
[154]ibid.
[155]Noman Islam and Ainuddin Wahid, '5G Networks: A Holistic View of Enabling Technologies and Research Challenges' (2019).
[156]ibid.

gadgets, sensors, smart wristwatches, and ovens, in addition to tablets and smart phones.[157]The devices will support a variety of access technologies. They will be able to operate on a variety of bands, including mmWave and radio frequency bands, and will be capable of using a variety of modulation schemes as well as full duplex communication.[158] The transceiver will be extremely complicated, with cognitive ability to dynamically swap the spectrum to a band that is available.[159] Each device will be outfitted antennas and ports.[160] Multidimensional antennas will be present on all of the gadgets.[161] The gadgets will include advanced signal processing capabilities to suppress various types of interference, such as self-interference or co-channel interference, as well as network support.[162]

Consumers may face significant switching costs if the revolutionary standardization strategy is used, and the evolutionary approach may fail to meet stakeholder requirements.[163] There will eventually be a trade-off between switching expenses and 5G's revolutionary performance.[164]

From regional to global standards, the industry has progressed.[165] The mobile services sector has been liberalized, and the government's position has shifted from that of a leader to that of a facilitator of industry growth.[166]

In a standards-driven sector like telecommunications, success is often assessed by the degree of adoption of the standard by firms and/or governments, the deployment of standard-compliant applications, and end-user buying of standard-compliant equipment.[167]

[157]ibid.
[158]ibid.
[159]ibid.
[160]ibid.
[161]ibid.
[162]ibid.
[163]Harborth and Pohl (n 154).
[164]ibid.
[165]Wolter Lemstra, 'Leadership with 5G in Europe: Two Contrasting Images of the Future, with Policy and Regulatory Implications' (2018) 42 Telecommunications Policy 587.
[166]ibid.
[167]ibid.

One of the primary actors in 5G standardization is the International Telecommunication Union (ITU).[168] Many telecommunications standards have been developed by the ITU in the past.[169] ITU did not establish standards for mobile communications; rather it focuses on technical performance standards, evaluation criteria, and methodologies in what is known as the IMT process.[170] The ITU has 193 member states and hence has a nearly global reach.[171] It however, does not have the authority to establish international standards and merely makes suggestions.[172]

2.2.3 Infrastructure Sharing

The concept of infrastructure sharing, which has arisen with 5G, is closely tied to the high costs of spectrum allocation and infrastructure investments.[173] Given the high amount of investment necessary for network densification, network sharing is projected to increase in the 5G era.[174]Individuals and businesses may communicate with each other, with the government, with markets, and with economic and social opportunities thanks to Internet access.[175] However, without universal Internet access, the potential of digital networking will not be completely realized.[176] To encourage inexpensive digital connectivity in emerging markets, a variety of business and regulatory measures has been implemented.[177] The introduction of pay-as-you-go programs, initiatives to foster retail market competition and the entry of new competitors, and price caps are among them.[178] However, focusing on the demand side has yielded mixed results.[179]

[168]Harborth and Pohl (n 154).
[169]ibid.
[170]ibid.
[171]ibid.
[172]ibid.
[173]'The 5G Bandwagon: Legal and Regulatory Implications' (n 148).
[174]ibid.
[175]Davide Strusani and Georges V Houngbonon, *Accelerating Digital Connectivity Through Infrastructure Sharing* (International Finance Corporation, Washington, DC 2020) <http://hdl.handle.net/10986/33616> accessed 5 August 2021.
[176]ibid.
[177]ibid.
[178]ibid.
[179]ibid.

Cost savings, balance sheet optimization, and competitiveness are all ways that shared infrastructure can make services more affordable.[180] Infrastructure sharing reduces redundancy and spreads the cost of growth and development across numerous market participants, resulting in significant capital expenditure savings for connectivity service providers, digital infrastructure providers, and IT infrastructure users throughout the economy.[181]

Among developed economies with adequate resources and purchasing power, infrastructure-based competition has resulted in significant competition and consumer benefits.[182] This model may not be suitable in developing economies where infrastructure costs and associated risks are relatively higher.[183] An alternative that is increasingly popular in both emerging markets and developed countries is shared infrastructure.[184]

Due to the specialized virtualization technologies available and the standardization of network slicing, we are seeing a renewed interest in sharing tactics with the introduction of 5G.[185] To serve different groups of users at different quality levels, the dynamic allotment of network resources and the specialization of services on different slices have been combined for the first time.[186] Accordingly, new players in vertical application domains are likely to become interested in serving as slice tenants and sharing the network infrastructure resources with others.[187] To reduce unnecessary construction and wasteful use of infrastructure resources, mobile network competitors often adopt policies that encourage infrastructure sharing.[188]

Unlike LTE-A, which is a progression from 3G, 5G necessitates significant changes in investment strategy as well as implementation.[189] Furthermore, 5G has substantially greater upfront

[180]ibid.
[181]ibid.
[182]ibid.
[183]ibid.
[184]ibid.
[185]Lorela Cano and others, 'On the Evolution of Infrastructure Sharing In Mobile networks: A Survey' (2020) 1 18.
[186]ibid.
[187]ibid.
[188]OvaseKazi and others, 'Infrastructure Sharing and Remedies in Next Generation Cellular Networks'.
[189]Forge and Vu (n 109).

investment costs, namely capex, and is more unclear in terms of commercialization of novel use applications.[190] This therefore underpins the necessity of infrastructure sharing.

Infrastructure sharing can be accomplished through legislation imposed by the government or through contractual agreements between network providers.[191] Vodafone UK and Telefonica UK (O2), for instance, have formed a new infrastructure-sharing partnership ahead of the much-anticipated 5G deployment.[192] The two companies already have a shared infrastructure agreement in place, which is operated by the Cornerstone Telecommunications Infrastructure Limited (CTIL) joint venture, and this agreement has been expanded to incorporate 5G at joint radio network sites.[193] The three mobile operators in South Korea stated in April 2018 that they would build a countrywide 5G network on a shared infrastructure structure, with the goal of minimizing redundant investments in 5G installations.[194]

Government intervention, either through law or any government funding or incentives offered for the building of 5G infrastructure, might also bring about 5G infrastructure sharing.[195]

2.2.4 Service diversification and bundling by operators

The mobile telecommunications business has seen substantial changes in recent decades as a result of both technological advancements and key regulatory developments.[196] While this process has exacerbated competition, it also has created new opportunities for new operators and resulted in a variety of new consumer offerings.[197]

Diversification is defined as a rise in the number of sectors in which a company operates.[198] Diversification incentives are based on new customer needs, new markets, and technological

[190]ibid.
[191]'The 5G Bandwagon: Legal and Regulatory Implications' (n 148).
[192]ibid.
[193]ibid.
[194]ibid.
[195]ibid.
[196]Nicoletta Corrocher and Laura Lasio, 'Diversification Strategies in Network-Based Services: The Case of Mobile Virtual Network Operators' (2013) 37 Telecommunications Policy.
[197]ibid.
[198]ibid.

opportunities derived from static and dynamic economies of scale in the use of existing technologies, as well as economies of scope derived from combining different technologies to create innovations and productive products.[199] Firms can execute diversification strategies that are consistent with their set of resources and abilities because of the interaction of technology-push and demand-pull variables.[200]

Due to the high expenses of developing 5G network infrastructure, it is anticipated that network operators will aim to broaden their service offerings from pure connection to utilities.[201] Network providers, for example, will move beyond merely providing mobile connectivity and data to also providing content that rides on these networks as well as value-added services like cyber-security that customers can purchase as a package.[202] Customers may experience a change in the contractual structure in respect to the services offered to them by the operator in this regard.[203] Operators must also examine the additional authorizations and regulations that they will need to provide the additional services.[204] As they begin to play across more segments of the value chain, operators will also have to be aware of potential competition regulatory concerns about service bundling, cross-subsidization, and margin squeezing.[205]

2.2.4.1 *Competitive and Non-Competitive Markets: Single versus Packaged Products*

When there are markets for each product and some customers buy or want to purchase products independently, the products are termed separate products.[206] Given the existence of independent markets for internet access, fixed line telephony, and video, telecommunication bundles easily fit

[199]ibid.
[200]ibid.
[201]'The 5G Bandwagon: Legal and Regulatory Implications' (n 148).
[202]ibid.
[203]ibid.
[204]ibid.
[205]ibid.
[206]Kyungbok Kim, Jeongil Choi and Sang-Myung Lee, 'Why Does Bundled Product in Telecommunication Service Market Matter? Evidence from South Korea' (2016) 9 International Journal of u- and e- Service, Science and Technology 209.

into this criterion.[207] While these telecommunication services are frequently provided as a package, there is still a large market for individual services.[208]

Because of the convergence environment, telecom operators must launch their products alongside related or unrelated items in order to be formidable, such as having a large market share with eclectic products.[209] Diversification is fundamentally linked to market power.[210]

2.2.5 Privacy and Security Challenges

Privacy, generally, refers to the safeguarding of personal data that could reveal or lead to the disclosure of personal data or actions pertaining to a specific user.[211] If any such information is not well protected, any intruder could use it to observe their everyday routines and, subsequently, harm them through numerous means.[212] The right to privacy does not require that the user protect all of his or her personal information in every scenario.[213] For example, under certain circumstances, authorized entities may be given access to personal information if certain requirements are met.[214] In addition, the level of privacy reflects how much control users have over their own personal data.[215]

The importance of privacy in 5G networks cannot be overstated, as the technology will lead to a host of new applications and access methods for digital services in the daily life of people.[216] Due to the fact that traditional mobile networks (3G, 4G) have different architectural and service requirements, 5G will also require stronger privacy policies and regulations.[217] The privacy of 5G

[207]ibid.
[208]ibid.
[209]ibid.
[210]ibid.
[211]Madhusanka Liyanage and others, '5G Privacy: Scenarios and Solutions', *2018 IEEE 5G World Forum (5GWF)* (2018).
[212]ibid.
[213]ibid.
[214]ibid.
[215]ibid.
[216]ibid.
[217]ibid.

users and other stakeholders will be critical to the entire ecosystem.[218] Privacy issues must be addressed in order for the 5G network to be fully accepted and adopted by the public.[219]

5G mobile networks will provide high-speed, ultra-reliable, massive, widely distributed, and always reachable connectivity at a global scale in the future Internet systems.[220] AI technologies will execute advanced data processing, and the billions of smart devices and sensors always connected in the Internet of Things will provide an enormous amount of data.[221] The convergence of these three technologies will enable the acquisition, storage, processing, and delivery of a diverse and large volume of Big Data.[222] In most cases, the collected data will be sensitive personal data that could be obtained without the consent of the subjects.[223]

With the rise of IoT devices and high-speed 5G connectivity, data about practically every aspect of a person's life might be recorded and communicated to the cloud in real time.[224] As a result, while adopting 5G, businesses must ensure that they comply with all applicable data privacy rules.[225] Individual customers are becoming increasingly aware of the risks and penalties associated with the compromise of their personal information.[226]

Because of the technology involved, 5G networks pose major privacy and security risks, notwithstanding their many potential benefits.[227] Users face a number of privacy risks, including the following:

2.2.5.1 5G mobile network privacy issues

2.2.5.1.1 End-to-end data privacy

[218]ibid.
[219]ibid.
[220]Enrico Del Re, 'Which Future Strategy and Policies for Privacy in 5G and Beyond?', *2020 IEEE 3rd 5G World Forum (5GWF)* (2020).
[221]ibid.
[222]ibid.
[223]ibid.
[224]'The 5G Bandwagon: Legal and Regulatory Implications' (n 148).
[225]ibid.
[226]ibid.
[227]Nicola Fabiano, 'Internet of Things and the Legal Issues Related to the Data Protection Law According to the New European General Data Protection Regulation' (2017) 3 ATHENS JOURNAL OF LAW 201.

Consumer data will be stored and used by a variety of heterogeneous service providers and operators in 5G, with or without their consent.[228] In order to provide various services, various stakeholders will be engaged in the 5G eco-system.[229] As a result, the consumer's personal information will pass through several hands during the process, necessitating safe procedures to assure data confidentiality from beginning to end.[230]

2.2.5.1.2 Responsibility as to the ownership of data

Mobile network operators, cloud service providers, and third-party application developers are all involved in 5G networks.[231] The uncertainty of distinct users' roles and obligations, on the other hand, can lead to legal disputes.[232] The loss of data ownership is akin to the ambiguity of responsibility.[233] By utilizing well-established, privacy-enabled service agreements, the ownership of user data should be clearly stated between network operators and other parties.[234]

2.2.5.1.3 Data movement across borders

Because of the growing global connectedness, it is critical to establish how data is stored, handled, and transferred outside of a country's borders.[235] Various countries, on the other hand, have distinct data protection mechanisms.[236] Law enforcement authorities in some countries have the capacity to intercept data in ways that are not permitted in other countries.[237] Furthermore, the privacy standards for personal data can vary greatly between legislations.[238] For example, sexual identity or religious beliefs that are uncontroversial in one place may be highly controversial in another.[239] Network operators will lose the physical boundaries of data storage if they use public clouds.[240]

[228]Liyanage and others (n 218).
[229]ibid.
[230]ibid.
[231]ibid.
[232]ibid.
[233]ibid.
[234]ibid.
[235]ibid.
[236]ibid.
[237]ibid.
[238]ibid.
[239]ibid.
[240]ibid.

2.2.5.1.4 Vulnerability to hackers

Telecommunication networks have been changed to an IP-based open design since 4G Long Term Evolution (LTE).[241] Consequently, contemporary telecommunication networks, such as 5G networks, are now susceptible to a wide range of IP and web-based cyberattacks, including hacking.[242] Furthermore, the increased reliance on cloud technology in 5G networks will raise the risk to hacker attacks, causing serious privacy problems for users.[243] Security should be implemented in such a way that a breach cannot compromise the entire system.[244]

2.2.5.1.5 Sharing or sale of data to third parties

Third parties who have access to IoT data tied to a specific person can utilize it for reasons that the user would reject if asked.[245] Fitbit data, for instance, might be useful to potential employers, who could draw conclusions about impulsivity and the inability to delay ratification based on one's exercise habits, which are linked to alcoholism and substance abuse, eating disorders, smoking habits, higher credit-card debt, and lower credit scores.[246] Sleeplessness, which a Fitbit monitors, has been connected to negative feelings including anger, depression, sadness, and fear, as well as poor psychological well-being, health issues, and poor cognitive performance.[247]

Third-party application developers will be able to leverage the telecommunication network in a new way thanks to 5G.[248] By leveraging their abilities to access 5G systems, these developers can share or sell personal data with third parties.[249] Furthermore, in a cloud-based technology, the data

[241]ibid.
[242]ibid.
[243]ibid.
[244]Ding and Janssen (n 126).
[245]Sandra Wachter, 'Normative Challenges of Identification in the Internet of Things: Privacy, Profiling, Discrimination, and the GDPR' (2018) 34 Computer Law & Security Review 436.
[246]ibid.
[247]ibid.
[248]Liyanage and others (n 218).
[249]ibid.

sharing principle could pose many privacy concerns.[250] The possibility for data to be used for unanticipated future uses could jeopardize privacy.[251]

2.2.6 Net Neutrality

Another distinguishing aspect of 5G is network slicing, which raises concerns about net neutrality regulation.[252] The relationships between network operators and players on various tiers of the ICT value system are governed by network neutrality rules.[253]

Network neutrality regulations have two primary positive or negative effects on the 5G complementary innovation system: they affect players' ability to appropriate rents from innovation and they affect players' coordination costs.[254] Whether these constraints are described as stringent or weak neutrality has an impact on the degree of these impacts.[255]They are also influenced by whether or not exceptions are permitted, and if so, what procedures must be followed to obtain one.[256] Regulators get directly involved in innovation decisions if an exemption is only given after previous regulatory approval.[257] Entrepreneurs and the market play a bigger role in driving innovation if the regulations allow differentiation unless some sort of harm is shown.[258]

Network slicing is a type of network virtualisation in which different services with varying needs can be supplied on a single physical network with different performance characteristics.[259] Voice, augmented reality, enormous IoT, vehicle-to-vehicle, and emergency service communications are examples of these services.[260] Because of the numerous use cases and innovative services that 5G will offer, network slicing is anticipated to play a major role in 5G networks.[261]

---

[250]ibid.
[251]ibid.
[252]'The 5G Bandwagon: Legal and Regulatory Implications' (n 148).
[253]Bauer and Bohlin (n 107).
[254]ibid.
[255]ibid.
[256]ibid.
[257]ibid.
[258]ibid.
[259]'The 5G Bandwagon: Legal and Regulatory Implications' (n 148).
[260]ibid.
[261]ibid.

As a result, network slicing is inconsistent with the regulatory principle of net neutrality, which states that Internet Service Providers (ISPs) must treat all Internet communications equally and not discriminate or charge differently depending on the client, content, website, platform, usage, type of device, or mode of communication.[262]

Many countries have passed or are considering net neutrality legislation that ban or limit ISPs' ability to discriminate between different types of traffic.[263] The EU, for example, has adopted a Regulation that empowers Internet access service providers to offer services other than Internet access services that are optimized for specific content, uses, or services, or a combination, where the optimization is required to meet the content, uses, or services' specifications for a specific level of quality.[264] National regulatory authorities shall verify that the optimization within the specialized service is objectively essential under the Regulation.[265]

Considering the foregoing, it needs to be seen whether network slicing is compatible with net neutrality, and whether differentiated network access should be permitted due to the net economic benefits of expanding the flexibility of 5G networks and their capacity to offer numerous services.[266] Several operators, in particular, have lobbied European authorities to loosen net neutrality laws in the context of 5G services, claiming that the legislation might stymie the deployment of mission-critical uses.[267]

2.3 Conclusion

5G telecommunications networks have the potential to transform the digital economy by enabling new industrial-scale applications that require ultra-fast connectivity.[268] This means that many of these new applications (such as self-driving cars and telemedicine) will be able to take advantage

[262]ibid.
[263]ibid.
[264]ibid.
[265]ibid.
[266]ibid.
[267]ibid.
[268]'Securing 5G Networks' (*Council on Foreign Relations*) <https://www.cfr.org/report/securing-5g-networks> accessed 18 August 2021.

of advances in artificial intelligence (AI), and the 5G networks themselves will be AI-enabled as well.[269] As a new technology, 5G is still in its inception, and there is still a lot to learn.[270] A new set of regulatory challenges will emerge as the world gradually embraces 5G.

Regulation is expected to play a significant role in influencing the 5G deployment.[271] Not only must regulators ensure appropriate spectrum is available in the relevant bands, in sufficient quantities, and with appropriate license terms, but also there may be other regulatory decisions that aid or hinder 5G deployment.[272]

By prioritizing certain features, network slicing can be utilized with 5G to construct virtual networks with certain performance characteristics.[273] Differentiated services aimed at different categories of users will be possible as a result.[274]

Because of the utilization of small cells, 5G is also likely to result in a lot more infrastructure sharing.[275] There may be physical limitations to the number of separate networks that can be accommodated at a given location.[276]Regulators must monitor excessive concentration as a result of infrastructure sharing.[277]

[269]ibid.
[270]'5G to Raise Privacy Challenges and Opportunities' <https://iapp.org/news/a/5g-to-raise-privacy-challenges-and-opportunities/> accessed 18 August 2021.
[271]'Study on Implications of 5G Deployment on Future Business Models' (DotEcon Ltd and Axon Partners Group 2018) BEREC/2017/02/NP3.
[272]ibid.
[273]ibid.
[274]ibid.
[275]ibid.
[276]ibid.
[277]ibid.

CHAPTER THREE: REGULATORY FRAMEWORK ON 5G IN KENYA

3.1 Introduction

Kenya's robust digital infrastructure has spurred innovation, enterprise, and investment in the larger ICT sector, propelling the country to the forefront of mobile and internet technology innovation globally.[278] Indeed, the WEF's NRI has Kenya listed among the top ten performing African countries, based on how successfully economies are utilizing ICTs to promote competitiveness and well-being.[279] The country's ICT sector has grown at an exponential rate in the recent decade, thanks in large part to liberalization and a strong regulatory environment under CA.[280] Despite significant investment in ICT infrastructure, the Ministry of ICT is concerned that there is a huge "digital divide" in access to Internet services in Kenya.[281]

5G is the Holy Grail of mobile communication, but it will take five to ten years before it is commercially available in Africa.[282] For numerous reasons, few carriers in Africa are racing to invest in this breakthrough broadband, and this is understandable.[283] To begin with, laying down 5G is an expensive undertaking.[284] As per GSMA Intelligence, corporations throughout the world might spend about Sh100 trillion on 5G upgrades over the next five years.[285] This entails the acquisition of new spectrum or the improvement of 4G macro networks.[286] Consumers must also migrate to a 5G environment, which necessitates the purchase of 5G-enabled devices.[287] In the global market, a 5G-enabled phone starts at Sh40, 000, but in Kenya, the same gadget would cost

[278]'Kenya Digital Economy Assessment' (The World Bank Group 2019) <https://thedocs.worldbank.org/en/doc/345341601590631958-0090022020/original/DE4AKenyasummarypaperfinal.pdf> accessed 8 August 2021.
[279]ibid.
[280]Sigmund Peak, 'The National Broadband Strategy' 139.
[281]ibid.
[282]Monday May 31 2021, 'Hype about 5G Shouldn't Ruin Mobile Connectivity' (*Business Daily*, 31 May 2021) <https://www.businessdailyafrica.com/bd/opinion-analysis/columnists/hype-about-5g-shouldn-t-mobile-connectivity-3419708> accessed 8 August 2021.
[283]ibid.
[284]ibid.
[285]ibid.
[286]ibid.
[287]ibid.

over double that amount, compared to a 4G-enabled smartphone, which starts at Sh10, 000.[288] Notwithstanding several broadband successes, millions of individuals in sections of the country have poor or non-existent internet connectivity, and even those who do have access often do not use it due of financial constraints, perceived value, and capacity to use it.[289]

The main takeaway from the world's 5G pioneers is that their policy and regulatory approaches are drawn from and connected with their national 5G strategic goals.[290] The main strategic decision concerns deciding which stage of the 5G value chain Kenya plans to participate in.[291] Is Kenya interested in being a manufacturer or a consumer of 5G technologies?[292] Kenya will majorly be a consumer of 5G technology rather than a producer. Kenya's position cannot be that of a manufacturer of 5G technology at this time, given our considerably poorer R&D capabilities, notably in the high-tech industry.[293]

Experts have cautioned that strict licensing regulations and exorbitant prices will stall the country's rollout of 5G mobile Internet technology.[294] According to the Senate Committee on Information and Communication Technology (ICT), the government must immediately develop a policy framework that addresses these issues if the full benefits of 5G are to be realized.[295]

3.2 Legal and Policy Regulation of issues brought about by 5G networks

3.2.1 Deployment of 5G Networks Regulation

From the 28th of October to the 22nd of November 2019, the CA participated in the WRC-19 in Sharm El-Sheikh, Egypt, where it was resolved to allocate more spectrum to mobile services in

[288]ibid.
[289]ibid.
[290]kictanetadmin, '5G Policy Brief. Which Way for Kenya? - KICTANet Think Tank' (20 January 2021) <https://www.kictanet.or.ke/mdocs-posts/5g-policy-brief-which-way-for-kenya/> accessed 8 August 2021.
[291]ibid.
[292]ibid.
[293]ibid; ibid.
[294]'Stiff Licensing Regulations Could Hinder 5G Rollout, Experts Warn' (*People Daily*, 13 August 2020) <https://www.pd.co.ke/business/economy-and-policy/stiff-licensing-regulations-could-hinder-5g-rollout-experts-warn-48101/> accessed 8 August 2021.
[295]ibid.

the frequency ranges 24.25-27.5 GHz, 37- 43.5 GHz and 66–71 GHz in Kenya for the deployment of 5G networks.[296] The Kenya National ICT Policy outlines the policy guidelines for the deployment of ICT that includes 5G networks.

The Kenya National ICT Policy advocates for infrastructure sharing because 5G deployment is a capital-intensive undertaking. The National Government will develop a National Integrated Infrastructure Plan.[297]Each county government will develop a County Integrated Infrastructure Plan.[298] Multiple stakeholders will be able to benefit from reasonable, cost-effective, sustainable, and easy-to-maintain ICT infrastructure thanks to these integrated strategies.[299] To maintain service reliability and availability, the government will carefully enforce quality of service regulations.[300] The government will provide equal access to publicly owned infrastructure to industry actors.[301] The government will also be receptive to, promote, and encourage the creation of new business models that allow for infrastructure sharing or service provision in underserved and unserved regions.[302]

Issues such as rights of way, way leaves, permits, and clearances have long hampered the deployment of cabling plant, towers, and other infrastructure.[303] To address these concerns, the government will: Collaborate with county governments to adopt harmonised way leave norms and charges that protect ICT infrastructure, optimize usage, protect the environment and roads, and avoid repeated charges; Take immediate corrective action to protect against way-leave encroachment by developers, particularly landowners whose properties front major highways and

[296]'Frequency Spectrum Management Report 2nd Quarter 2019/20 (October- December 2019)' (The Communications Authority of Kenya 2019) <https://ca.go.ke/wp-content/uploads/2020/04/Frequency-Spectrum-Management-Report-Q2-2019-2020.pdf> accessed 18 August 2021.
[297]'National Information, Communications and Technology (ICT) Policy' (Ministry of Information, Communications and Technology 2019) <https://www.ict.go.ke/wp-content/uploads/2019/12/NATIONAL-ICT-POLICY-2019.pdf> accessed 18 August 2021.
[298]ibid.
[299]ibid.
[300]ibid.
[301]ibid.
[302]ibid.
[303]ibid.

other access roads; and require infrastructure sharing on new builds as a pre-requisite condition for licensing where there are no pre-existing ducts.[304]

Kenya became the second African country, after South Africa, to begin trials for the ground-breaking 5G technology, heralding new potential for individual users and businesses.[305] Safaricom's 5G trials will first be offered in Nairobi, Kisumu, Kisii, and Kakamega, with plans to expand to 150 locations across nine municipalities over the next 12 months.[306] It will be interesting to see how the Communications Authority addresses the regulatory challenges occasioned by 5G networks.

3.2.2 Regulation of net neutrality in light of 5G Deployment in Kenya

Licenses and regulations, according to the National Radio Frequency Spectrum Policy, should be service and technology neutral, meaning they should not impose or discriminate against any particular technology or service.[307] Spectrum efficiency is aided by technology and service neutrality.[308] Neutrality allows users of radio frequency spectrum to employ a variety of technologies and create services with higher economic value.[309] The process of spectrum reframing will be aided by technology-neutral licensing.[310]

Technology and service neutrality will be supported where appropriate, according to the Wireless Broadband Spectrum Policy.[311] Any restrictions on the use of the technology and service neutrality

[304]ibid.
[305]'Kenya Launches Trials for 5G Technology' (*Communications Authority of Kenya*, 29 March 2021) <https://ca.go.ke/kenya-launches-trails-for-5g-technology/> accessed 18 August 2021.
[306]ibid.
[307]'National Radio Frequency Spectrum Policy' (Ministry of ICT, Innovation and Youth Affairs 2020) <https://ict.go.ke/wp-content/uploads/2021/03/Draft-National-Spectrum-Policy-for-stakeholder-validation.pdf> accessed 18 August 2021.
[308]ibid.
[309]ibid.
[310]ibid.
[311]'Wireless Broadband Spectrum Policy' (Ministry of Information, Communications and Technology 2016) <https://www.ict.go.ke/wp-content/uploads/2016/03/DRAFT-WIRELESS-BROADBAND-SPECTRUM-POLICY-Final.pdf> accessed 18 August 2021.

principles in any given band must be specified.[312] Comprehensive policy guidelines on net neutrality under 5G networks needs to be developed.

3.2.3 Spectrum Allocation Regulation

Kenya's Communications Authority (CA) regulates all telecommunications, e-commerce, broadcasting, postal /courier services, and cybersecurity.[313] The Authority is in charge of administering the country's numbering and frequency spectrum resources, as well as ensuring the safety of ICT service users.[314] The Draft National Spectrum (2020) policy explicitly says that the convergence of telecommunications, media, and computing is shattering the traditional association of spectrum to specific applications, such as the distinction between broadcasting and telecommunications spectrum, and changing the demand for spectrum among services, such as fixed and mobile voice communication.[315] This has resulted in significant technical and economic inefficiencies, an enormous regulatory load on all parties, and technological innovation roadblocks.[316] To stay up with the fast-changing technological landscape and legislative changes around the world, existing spectrum policy concepts, practices, and strategies must be reviewed on a regular basis to ensure that they are in line with these new global developments.[317]

The National Communication Secretariat's role is to advise the government on the implementation of a communication policy that encourages the government to make full and efficient use of telecommunication resources, including effective use of the radio spectrum for the public good.[318] Policy actions have the ability to inform, regulate, and incentivize.[319] Currently, there is no clear

[312]ibid.
[313]'Licensing and Shared Spectrum Framework for Community Networks' (The Communications Authority of Kenya 2021) <https://ca.go.ke/wp-content/uploads/2021/05/Licensing-and-Shared-Spectrum-Framework-for-Community-Networks-May-2021.docx.pdf> accessed 18 August 2021.
[314]ibid.
[315]kictanetadmin (n 297).
[316]ibid.
[317]'National Radio Frequency Spectrum Policy' (n 314).
[318] Kenya Information and Communications Act, CAP. 411A
[319]'National Information, Communications and Technology (ICT) Policy' (n 304).

policy framework that can guide various stakeholders on 5G spectrum available for allocation, the auctioning process and costs and the licensing of 5G providers. The CA must therefore avail the requisite spectrum resources in appropriate frequency bands to enable implementation of 5G.

3.2.4 Service Diversification and Bundling Regulation in Kenya

The presence of diversified business groups is a frequent element of the industrial landscape of most emerging economies.[320] Diversification is helpful in emerging economies since there is unavailability of well-established product markets.[321] Competition among operators, the unification of licenses, and the use of new technologies in the mobile market sector have resulted in the operators diversifying their services, lowering tariff rates, and making communication services more affordable to a broad audience.[322] In order to assess market power, the CA considers product and/or service diversification (for example, bundled products or services).[323] The Communications Authority of Kenya is now in charge of regulating mobile phone service providers. MNOs delivering 5G services will be required to diversify and bundle their services, according to the policy guidelines that will be developed by the regulator.[324]

3.2.5 Data Privacy Regulation

The right to privacy is guaranteed under Kenya's 2010 Constitution.[325] The Data Protection Act of 2019 was enacted and came into force on November 25, 2019, giving effect to this constitutional right under Article 31(c) and (d).[326] The Act establishes the office of the Data

[320]Mary Achuti, 'Application of Diversification Strategies at Safaricom Limited, Kenya' 63.
[321]ibid.
[322]OmaeMalack, Langat Philip and Ndung'u Edward, 'Mobile Subscription, Penetration and Coverage Trends in Kenya's Telecommunication Sector' (2015) 4 International Journal of Advanced Research in Artificial Intelligence <http://thesai.org/Publications/ViewPaper?Volume=4&Issue=1&Code=ijarai&SerialNo=1> accessed 18 August 2021.
[323]Stéphane Piot, Philip Bates and Kerron Edmunson, 'Telecommunication Competition Market Study in Kenya' 47.
[324]Maureen Murugi Njoroge, 'Effect of Strategic Management Practices on Performance of Selected Mobile Service Providers in Nairobi- Kenya' 98.
[325]Article 31, Constitution of Kenya 2010, Laws of Kenya.
[326]Act No. 24 of 2019, Laws of Kenya.

Protection Commissioner under Section 5.[327] The Office's responsibilities include, among others, overseeing the implementation of the Act and being responsible for its enforcement; establishing and maintaining a register of data controllers and data processors; exercising oversight over data processing operations; and conducting an assessment on the initiative of a public or private body or at the request of a private or public body for the purpose of determining whether the Act has been violated.[328]

The technological implications of the act include: reporting of any unauthorised breach;[329] data subjects will have new rights to opt out of and object to online profiling and tracking;[330] when the data controller or processor has adopted sufficient security protections, such as encryption of affected personal data, notification of a breach to the data subject is not needed.;[331] and organisations mandated to enshrine privacy in their technologies during deployment and also during the normal course of their businesses.[332]

3.3 Institutional Review

3.3.1 The Communications Authority of Kenya

In Kenya, CA is the major actor in spectrum management and regulation.[333] It is involved in spectrum planning, spectrum licensing, and spectrum monitoring.[334] While carrying out this mandate, the CA is expected to ensure that it complies with the ITU's requirements and standards for Kenya, ensure efficient spectrum utilization in a sustainable manner that meets current and future needs, develop a national radio frequency plan that takes stock of current and future likely

[327] The Data Protection Act, Act No. 24 of 2019, Laws of Kenya.
[328]Section 8(1), The Data Protection Act, Act No. 24 of 2019, Laws of Kenya.
[329]Section 43, The Data Protection Act, Act No. 24 of 2019, Laws of Kenya.
[330]Section 35, The Data Protection Act, Act No. 24 of 2019, Laws of Kenya.
[331]Section 43(6), The Data Protection Act, Act No. 24 of 2019, Laws of Kenya.
[332]Section 41, The Data Protection Act, Act No. 24 of 2019, Laws of Kenya.
[333] Kameri-Mbote, and others (n 61).
[334] Ibid.

spectrum use, and encourage efficiency in spectrum use to encourage the introduction of innovative communication technologies.[335]

The CA was accused of battering and attacking the right to privacy.[336] In *Communications Authority of Kenya v Okiya Omtata Okoiti & 8 Others*,[337] the CA sought to install the Device Management System (DMS), which would allegedly provide the CA access to specific information about mobile service subscribers, including call data logs. The court found that the right to privacy of consumers was threatened. The CA may erode public confidence if their practices are in contrast with legal provisions such as those which are in breach of fundamental rights and freedoms. In 5G rollout, the CA needs to be cautious in its practices so as not to jeopardize the right to privacy of consumers.

The CA launched the Draft 5G Roadmap and invited public participation in October 2021. Although Kenya is a trailblazer regionally in 5G deployment, the activities of the CA are slow compared to the pace of technological advancements. 6G technologies are already in development.[338] China aims to commercialize it by 2030.[339] The activities of the CA ought to be swift to take care of interests of various parties.

3.3.2 The ICT Authority (ICTA)

This is a government-run institution tasked with overseeing publicly funded ICT infrastructure projects on behalf of the government.[340] The open access Wireless Broadband Network, which is based on spectrum, is an example of such an ICT initiative.[341] The ICTA will be crucial in 5G deployment especially in state funded deployment activities to improve internet access.

---

[335] Ibid.
[336] Bett Rickcard, 'In Pursuit of Solitude: Reviewing the Impacts of Communications Authority of Kenya v Okiya Omtatah' (Social Science Research Network 2021) SSRN Scholarly Paper ID 3785862 <https://papers.ssrn.com/abstract=3785862> accessed 1 December 2021.
[337] [2020] eKLR
[338] 'What Is 6G Mobile Communications Technology » Electronics Notes' <https://www.electronics-notes.com/articles/connectivity/6g-mobile-wireless-cellular/technology-basics.php> accessed 1 December 2021.
[339] 'China Aims to Commercialize 6G by 2030: White Paper - Global Times' <https://www.globaltimes.cn/page/202106/1225478.shtml> accessed 1 December 2021.
[340] Kameri-Mbote, and others (n 61).
[341] Ibid.

Government funding may be needed to ensure that 5G networks are available in rural areas. This Agency is plagued by the challenge of inadequate resources due to low budgetary allocations.[342] This may derail 5G deployment nationally since 5G networks are capital intensive.

3.3.3 The Competition Authority of Kenya

Market actors' unbridled usage of spectrum increases competition problems since private entities can abuse their market positions.[343] The CA's mandate is to investigate cases of market dominance.[344] The Competition Act of 2012, on the other hand, is relevant to spectrum regulation because it empowers Competition Authority of Kenya (CAK) to ensure fair market competition. In the event of a disagreement between the Act and those other laws dealing with competition law concerns, section 5 of the Competition Act 2012 asserts primacy over other sectoral statutes.

The possibility for a conflict between the CA and the CAK in resolving competition law disputes is resolved by section 4 (2) of the Fair Competition and Equality of Treatment Regulations 2010, which states that if matters fall concurrently under the jurisdiction of another statutory agency responsible for competition matters, the CA must cooperate with that agency.[345] The Fair Competition Regulations were revised by the Miscellaneous Amendments Act of 2015,[346] which now requires CA to consult CAK before evaluating whether or not a market participant is dominant.

3.4 Conclusion

According to Kenya's Communications Authority, the number of mobile data customers grew to 43.7 million in December from 30.6 million in September 2017.[347] With the increased uptake of internet services, 5G arrives at an opportune time to meet the growing demand. By the end of the

[342] 'ICT Authority Strategic Plan 2020-2024' (Information and Communication Technology Authority, 2020).
[343] Kameri-Mbote, and others (n 61).
[344] Ibid.
[345] Ibid.
[346] No. 25 of 2015 Laws of Kenya
[347] Tuesday April 06 2021, 'Airtel Connects 5G in Battle with Safaricom' (*Business Daily*, 6 April 2021) <https://www.businessdailyafrica.com/bd/corporate/technology/airtel-connects-5g-in-battle-with-safaricom-3350898> accessed 18 August 2021.

year, Safaricom intends to increase the number of fifth-generation (5G) sites by up to 17 times, making ultrafast services available to more users in metropolitan areas.[348] The major telco, which introduced 5G technology with 15 locations in March, says it plans to expand to 250 locations and bring super-fast internet to nine towns.[349] As the telecoms operator prepares to compete with Safaricom for a larger piece of the fast-growing data market, Airtel Kenya has upgraded some of its sites with fifth-generation (5G) mobile Internet services.[350] Airtel Kenya controls 26.5 percent of the mobile data market in Kenya.[351]

This chapter sought to probe whether the regulatory framework in Kenya is ready for the 5G network deployment and its subsequent use cases. Despite the fact that Kenya's legal, policy, and regulatory frameworks are sophisticated, the country lacks a national 5G strategy.[352] According to the study, Kenya is still not ready to deploy and profit from 5G technology, especially from a strategic, policy, and regulatory standpoint. It suggests actual steps that should be made to address the problem.

The study aids in raising awareness and laying the groundwork for a strong 5G strategy and policy debate.[353] It is not intended to be prescriptive; rather, it offers and highlights key debate issues that will serve as a working paper for those developing Kenya's 5G Strategy and Policy.[354]

[348]Friday May 28 2021, 'Safaricom Eyes 250 Sites for 5G by End of Year' (*Business Daily*, 28 May 2021) <https://www.businessdailyafrica.com/bd/corporate/companies/safaricom-eyes-250-sites-r-5g-by-end-of-year-3416566> accessed 18 August 2021.
[349]ibid.
[350]April 06 2021 (n 354).
[351]ibid.
[352]kictanetadmin (n 297).
[353]ibid.
[354]ibid.

CHAPTER FOUR: LESSONS ON 5G REGULATION FROM OTHER JURISDICTIONS

4.1 Introduction

This chapter examines the regulation of 5G in the US, Singapore, South Korea and South Africa with the aim of borrowing lessons from them. It focuses on 6 key strands of regulatory issues occasioned by 5G networks in these jurisdictions: Net neutrality; privacy and security; infrastructure sharing; deployment; spectrum allocation; and mobile networks standards.

Considering the enormous range of economic and connectivity benefits that 5G might provide, several countries are eager to be early leaders in 5G technology development, deployment, and adoption.[355] The United States, China, the United Kingdom, and Singapore are just a few of these countries.[356] South Africa was the leader in Africa followed closely by Kenya and Nigeria in this race of 5G adoption. Failure to gain a "first mover advantage" may have strategic consequences for governments.[357] A number of wireless technology companies ceased operations or were acquired as a result of the United States' failure to promote a rapid rollout of the 2G and 3G generations in the 2000s.[358] During the 4G era, the same phenomenon occurred, with the first movers capturing virtually the entire 4G ecosystem.[359] Given the economic and technological consequences of 5G adoption, it is no surprise that countries have prioritised the rapid adoption and deployment of 5G networks.[360] However, 5G networks comes with its own disruptive regulatory implications.

Because of the heterogeneity, flexibility, and automation inherent in the architecture of 5G networks, they differ from prior generations.[361]Although the first rollout of 5G will rely on existing networks, the full potential of the technology will not be realized until dedicated infrastructure is

[355]Chris Alden and Kenddrick Chan, 'The Infrastructures of Global Connectivity: 5G Networks' 12.
[356]ibid.
[357]ibid.
[358]ibid.
[359]ibid.
[360]ibid.
[361]'5G in Sub-Saharan Africa: Laying the Foundations' (GSM Association 2019) <https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=45121572&file=2796-160719-5G-Africa.pdf> accessed 10 August 2021.

in place.[362] Full roll out of 5G networks will be disruptive of on the current regulatory framework since 5G network is *sui generis* in nature. Understanding the level of future market demand is the main challenge with 5G.[363] Market definitions and demand levels, overall infrastructure costs, challenges of a dense deployment infrastructure, and technical complexity are just a few of the unknowns associated with 5G networks.[364] This, however, does not always deter governments from pursuing a 5G initiative.[365]

The current and future regulatory implications present a regulatory conundrum to countries that are aiming to adopt 5G networks. This emphasizes the imperative of taking case studies of 5G leaders in order to borrow or take lessons from them.

4.2 Lessons from five jurisdictions

4.2.1 South Africa

The Independent Communications Authority of South Africa (ICASA) approved the temporary allocation of high-value 4G and 5G spectrum frequencies to mobile operators in April 2020 to meet increased traffic on their networks and to assist with increased demand for spectrum by consumers because of the Covid-19 pandemic's effects.[366] Six firms have applied to participate in the multi-band spectrum auction, according to the ICASA.[367] Cell C, Rain Networks, Vodacom, Telkom, Liquid Telecom, and MTN are among the operators who have submitted applications.[368] Qualifying applicants were assigned frequencies in the 700 MHz, 800 MHz, 2600 MHz, and 3500 MHz bands by ICASA.[369] Vodacom, a South African carrier, claimed to have deployed Africa's

[362]'China and the United States Are Locked in a 5G Race' (2018) oxan-db Emerald Expert Briefings <https://doi.org/10.1108/OXAN-DB230073> accessed 10 August 2021.
[363]Forge and Vu (n 109).
[364]ibid.
[365]ibid.
[366]'5G Regulation and Law in South Africa | CMS Expert Guides' <https://cms.law/en/int/expert-guides/cms-expert-guide-to-5g-regulation-and-law/south-africa> accessed 10 August 2021.
[367]'South African Regulator Gets Six Applications for 5G Spectrum Auction' (*RCR Wireless News*, 31 December 2020) <https://www.rcrwireless.com/20201231/spectrum/south-african-regulator-gets-six-applications-5g-spectrum-auction> accessed 10 August 2021.
[368]ibid.
[369]ibid.

first live 5G mobile network in May 2021.[370] Johannesburg, Pretoria, and Cape Town were the first cities to receive 5G service.[371] MTN, a competitor, launched its 5G network in the country in July 2021, with the initial deployment of 100 5G sites.[372]The network, initially covered Johannesburg and Cape Town, as well as Bloemfontein and Port Elizabeth.[373]

Under Section 31 of the Electronic Communications Act, the ICASA must first award a license for the relevant spectrum before the 5G technology can be deployed in South Africa.[374] However, the plans for spectrum allocation by ICASA were at first thwarted after MNOs challenged the fairness of the auction. TN, Telkom, and Etv sued the regulator, claiming that some portions of the auction procedure were unfair.[375] They said the process was defective and demanded that ICASA resolve their concerns before moving forward with the high-demand spectrum allocation.[376] In *Telkom SA Soc Limited and Another v Independent Communications Authority of South Africa and Others*,[377] Telkom sought to stop ICASA from enforcing the licensing and auctioning of spectrum in the IMT 700, IMT 800, IMT 2600, and IMT 3500 bands, which were issued by ICASA on October 2, 2020. The IMT 700 and IMT 800 bands of spectrum were unavailable because they were used in analogue radio waves and the digital conversion process was not complete. Sections 30 and 31 of the ECA give ICASA the authority to award licenses for available spectrum. As a result, these bands were unavailable, and ICASA acts were in violation of the ECA Act. The High Court in South Africa's Guateng division issued an injunction prohibiting the ICASA from examining or adjudicating any applications received pursuant to the ITA for spectrum licensing in the IMT 700, IMT 800, IMT 2600, and IMT 3500 bands.

[370]ibid.
[371]ibid.
[372]ibid.
[373]ibid.
[374] Electronic Communications Act 37 of 2007, Laws of Kenya.
[375]Sibahle Malinga, 'Spectrum Policy Flaws "Will Alienate Millions of South Africans"' (*ITWeb*, 14 April 2021) <https://www.itweb.co.za/content/lwrKxv3KadXvmg1o> accessed 11 August 2021.
[376]ibid.
[377] [2021] ZAGPPHC 120

Cybersecurity is a key concern that arises with the deployment of 5G networks. Criminal acts committed via computers, electronic communication networks, information systems, and/or the publication of illegal content over electronic media are all considered cybercrime.[378] Cybercrime is typically carried out on computer-related platforms and relies heavily on computer-related technologies to be successful.[379] Cyberwarfare, cyber espionage, industrial espionage, and cyber fraud are examples of computer-related cybercrimes.[380] The IoT that will be supported by 5G networks imply that data protection needs to be more stringent.

The Electronic Communications and Transactions Act (ECTA) outlaws cybercrime in South Africa.[381] Any unauthorized access to, interception of, or manipulation of data is prohibited.[382] The ECTA also forbids anyone from unlawfully producing, selling, offering to sell, procuring for use, designing, adapting for use, distributing, and/or possessing any device or computer program with the intent of circumventing data protection security measures or gaining unauthorized access to data.[383] These laws are most likely targeted at combatting cyber-related offenses involving unauthorized access to data by anyone.[384] However, the ECTA's unspecified fines and sentence terms for cybercrimes are insufficiently robust and deterrent.[385] It also does not expressly provide for the use of 5G to detect and curb cybercrime.

The Protection of Personal Information Act (POPIA) aims to safeguard all individuals and/or data subjects from cyber-attacks involving their personal and private information.[386] The Information Regulator is established under the POPIA. [387] The Information Regulator has the authority to

[378]Howard Chitimira and Princess Ncube, 'The Regulation and Use of Artificial Intelligence and 5G Technology to Combat Cybercrime and Financial Crime in South African Banks' (2021) 24 Potchefstroom Electronic Law Journal 1.
[379]ibid.
[380]ibid.
[381]Act No. 25 of 2002
[382] Section 86, Electronic Communications and Transactions Act
[383] Section 86(3), Electronic Communications and Transactions Act
[384]Chitimira and Ncube (n 385).
[385]ibid.
[386]ibid.
[387]Section 39, Protection of Personal Information Act 4 of 2013

investigate complaints about violations of data subjects' personal data protection, and it has the authority to summon individuals to appear before it to receive evidence, conduct private interviews, and enter and search any premises with a search warrant to seize articles linked to the commission of an offence in a data subject's personal information.[388] All relevant people are required by the POPIA to protect and promote the integrity and confidentiality of personal information by implementing adequate, reasonable technical and organizational measures to prevent unauthorized access.[389]

Sharing infrastructure includes anything from ducts, poles, towers, and masts to unused fibre-optic cables and frequency spectrum.[390]Telecom operators, with different implications in terms of risk sharing, access, ownership, and funding, use diverse types of infrastructure sharing.[391] Vertically integrated network operators (those who own the network as well as provide retail services) can form a joint venture to pool their cash resources to fund a fibre optic network or a tower firm.[392] In South Africa, the duct sharing agreement between Neotel (Liquid), MTN, and Vodacom to deploy their transmission network is an example.[393]

4.2.2 Singapore

In 2014, Singapore's government launched the smart nation program, which aims to encourage large-scale information and communication technologies (ICTs) to address complex urban issues and generate supporting sectors.[394] The Smart Nation Program Office (SNPO), which is part of the Prime Minister's Office, is in charge of the effort (PMO).[395] This endeavour is the pinnacle of the Singapore government's past efforts to digitalize numerous public-sector services.[396]

[388]Chitimira and Ncube (n 385).
[389]ibid.
[390]Strusani and Houngbonon (n 182).
[391]ibid.
[392]ibid.
[393]ibid.
[394]Michael Yit Lin Chew and others, 'Evaluating the Roadmap of 5G Technology Implementation for Smart Building and Facilities Management in Singapore' (2020) 12 Sustainability 10259.
[395]ibid.
[396]ibid.

The Singapore government's Infocomm Media Development Authority (IMDA) is a statutory board under the Ministry of Communications and Information.[397] To help expedite Singapore's 5G application nation-wide intelligent transformation, various firms are expanding their 5G, cloud, and AI capabilities to local government agencies, SMEs, and institutes of higher learning in response to the Singapore government's push for industrial transformation.[398] 5G technology is widely regarded as the next big jump in mobile and wireless communications, with new business models and advanced applications expected to emerge, supporting business innovation and driving economic growth.[399] The revolutionary impact that 5G provides is intended to benefit communities, businesses, and industries.[400] Singapore has set aside S$40 million to develop a 5G ecosystem that is open and inclusive.[401]

There has been an increasing focus on the fifth generation of mobile technology in Singapore due to the rapid growth in mobile data traffic and consumer demand for improved mobile broadband experiences.[402] Policy-wise, the IMDA published the Second Consultation on 5G Mobile Services and Networks on 7 May 2019, which outlines Singapore's overall 5G vision and strategy, along with the proposed policy design and regulatory frameworks to facilitate the deployment of 5G networks.[403]

The IMDA planned to assign the spectrum through a call for proposals (CFP) procedure.[404] MNOs shall compete on the merits of their solutions to deliver future-ready 5G networks that satisfy

[397]ibid.
[398]ibid.
[399]ibid.
[400]ibid.
[401]ibid.
[402]'Fifth Generation Mobile Networks ("5G")' (*Infocomm Media Development Authority*) <http://www.imda.gov.sg/regulations-and-licensing-listing/spectrum-management-and-coordination/spectrum-planning/5g-technology> accessed 12 August 2021.
[403]ibid.
[404]'Second Consultation on 5g Mobile Services and Networks' (Infocomm Media Development Authority (IMDA) 2019) <https://www.imda.gov.sg/-/media/Imda/Files/Regulation-Licensing-and-Consultations/Consultations/Consultation-Papers/Second-Public-Consultation-on-5G-Mobile-Services-and-Networks/Second-5G-Public-Consultation-7-May-2019-Final.pdf> accessed 12 August 2021.

IMDA's policy goals.[405] IMDA is proposing using a one-envelope CFP technique to assign the 3.5 GHz and mmWave bands.[406]

Because of the spectrum limits in the early years, IMDA encourages MNOs to share infrastructure in order to achieve more cost-effective network construction.[407] The passive facilities, radio access network ("RAN"), backhaul, spectrum, and core network elements are all significant elements that could be shared within a mobile network.[408]

4.2.3 South Korea

Research and development (R&D) capabilities, skilled workers, and funding are already in place in the Korean mobile sector.[409] It is important to note, however, that even in countries with a mature and self-sufficient mobile industry, governments play an important role in facilitating 5G deployment.[410] A national vision for 5G was created, regulatory barriers were removed, and multistakeholder collaboration was encouraged, including a wide range of government bodies, telecoms, vendors, researchers, and civil society.[411] As other countries prepare to roll out 5G in the coming years, Korea's early experience can provide valuable insights.[412]

SKT, KT, and LGU+, the three major Korean MNOs, have been investing in 5G networks aggressively since the launch of B2C commercial services in April of this year.[413] The goal is to complete the national deployment of 5G networks in 2022.[414] As of December 2020, Seoul had 80 percent 5G coverage, and six major cities were projected have 30 percent coverage.[415] The government is offering a 3% tax credit for 5G investments, with an additional 3% tax credit for increases over the average of the preceding three years' spending, to incentivize investment and

[405]ibid.
[406]ibid.
[407]ibid.
[408]ibid.
[409]Dr Een-Kee Hong, Je Myung Ryu And Elyse Jee Hyun Lee, 'Entering The 5g Era: Lessons From Korea' 25.
[410]ibid.
[411]ibid.
[412]ibid.
[413]ibid.
[414]ibid.
[415]ibid.

accelerate network rollout.[416] It also undertakes a biannual service inspection to guarantee that the quality and coverage of the service is maintained.[417]

The Korean government has placed a heavy emphasis on 5G security measures in order to provide the safest user experience in a hyperconnected society.[418] With approximately 50 members from the public and corporate sectors, the 5G Cyber Security Council will give institutional direction on cybersecurity policy, technologies, and standards.[419]

To support location-based services, the government has introduced regulatory sandboxes and eased restrictions on location data to create a flexible regulatory framework for 5G convergence services.[420] Another high priority is addressing cyber threats posed by widespread connectivity through a comprehensive security regime.[421] With the amendment of the Information and Communications Network Act, the government designates core 5G facilities as important information and communications infrastructure and builds an ICT convergence protection system.[422] The government changed the permit system for facilities-based telecoms business entities with a registration system to reduce hurdles for new entrants in order to prepare for the rapid growth of IoT devices.[423]

To speed up the national network deployment, maximize investment, and increase 5G access in rural regions, the Korean government is pushing collaborative infrastructure construction and network sharing.[424]

When the Korean government started a formal evaluation of 5G spectrum planning in 2017, there was a lot of confusion about the government's 5G strategy, regulatory approach, and the private

[416]ibid.
[417]ibid.
[418]ibid.
[419]ibid.
[420]ibid.
[421]ibid.
[422]ibid.
[423]ibid.
[424]ibid.

sector's return on investment.[425] There were distinct considerations and new obstacles to consider in assigning the 5G spectrum, as opposed to prior generations of mobile networks' spectrum assignments.[426]

To begin with, the 3.5 GHz and 28 GHz frequency bands had never been assigned to mobile use before.[427] For example, in terms of coverage, diffraction, and blockage, the mmWave spectrum bands, which are extremely high-frequency bands between 30 and 300 GHz that enable super-fast speeds up to 1 Gbps per user, vary markedly from the lower bands.[428] Furthermore, the frequency bandwidth in question was substantially greater, up to seven times wider than the total spectrum used by 2G/3G/4G networks.[429] As a result, the parameters used to determine technical qualities and economic worth of spectrum in past auctions were generally inapplicable to the 5G spectrum auction.[430]

4.2.4 United States of America

There's no doubt about it: 5G offers new opportunities for economic growth, with a profound influence on education, employment, transportation, etc.[431] Specifically, the Federal Communications Commission (FCC) in the United States believes that spectrum, infrastructure, and the backhaul network should be prioritised.[432] There are nearly 11 GHz of high frequency spectrum available for fixed and mobile broadband applications after the FCC voted in July 2016 to free up and open that spectrum.[433] There are 3.85 GHz of licensed spectrum available in the 27.5 to 28.35GHz and 37 to 40 GHz bands and 7 GHz of unlicensed spectrum in the 64 to 72GHz band.[434] According to the FCC, its purpose was to offer investors in the telecoms industry with

[425]ibid.
[426]ibid.
[427]ibid.
[428]ibid.
[429]ibid.
[430]ibid.
[431]'5G: Issues & Challenges' <https://www.arcep.fr/uploads/tx_gspublication/Report-5G-issues-challenges-march2017.pdf> accessed 19 August 2021.
[432]ibid.
[433]ibid.
[434]ibid.

assurance and transparency.[435] The FCC auctioned off the first mm-Wave spectrums, 24GHz and 28GHz, in 2019, and plans to make spectrum commercially available in 2020.[436] The auction of the 37GHz, 39GHz, and 47GHz bands in March netted $4.47 billion, making it the largest spectrum auction in US history.[437] The FCC recently opened licenses for the 3.5-3.6 MHz bands, making premium mid-band spectrum available for the first time.[438]

According to the FCC, A robust infrastructure network capable of handling existing high traffic volumes that are expected to grow enormously in the coming years must support 5G.[439] Traditional towers with macro cells and small cell deployments, as well as dispersed antenna systems, will interact in a hybrid approach.[440] The FCC decided to lessen, or abolish in some situations, regulatory limits on establishing facilities and antennae that will have very little impact "on historic properties" in order to facilitate the deployment of new towers.[441] In terms of the infrastructure target, the FCC is attempting to speed up small cell approval at the federal, state, and municipal levels to allow for quicker deployment of 5G.[442]

Following the completion of the federal government's Cyberspace Policy Review, US cybersecurity policy has sought to: create or improve shared situational awareness of network vulnerabilities, threats, and events, as well as the ability to act quickly to reduce current vulnerabilities and prevent intrusions; enhance US counterintelligence capabilities, and increase the security of the supply chain for key intel sources; and improve the security of the supply chain for key intel sources.[443] The FCC has stated that one of its main aims is to "strengthen the

[435]ibid.
[436]'Video: Who Is Driving the 5G Transition in North America? | Wilson Center' <https://5g.wilsoncenter.org/video/video-who-driving-5g-transition-north-america> accessed 12 August 2021.
[437]ibid.
[438]ibid.
[439]'5G: Issues & Challenges' (n 438).
[440]ibid.
[441]ibid.
[442]Milo Medin and Gilman Louie, 'The 5G Ecosystem: Risks & Opportunities for DoD' 33.
[443]Matthew T Murchison, *The Technology, Media and Telecommunications Review* (11th edn, Law Business Research Ltd, London 2020) <https://www.lw.com/thoughtLeadership/the-technology-media-and-telecommunications-review-11th-edition> accessed 19 August 2021.

protection of essential communications infrastructure," which is in line with these goals.[444] The FCC has focused on educating consumers and small companies on the importance of cybersecurity, as well as developing cybersecurity best practices in collaboration with industry leaders, to achieve this goal.[445]

Whereas the FCC's 5G FAST Plan was a ground-breaking domestic program, subsequent initiatives have focused on 5G security, supply chains, and global leadership.[446] In 2019, the Executive Order on "Securing the Information and Communications Technology and Services Supply Chain" proclaimed a national emergency, forbidding any financial transactions involving ICT "in which any foreign country or a national thereof has any interest." Furthermore, any technology or service “designed, developed, manufactured, or supplied” by a foreign enemy that poses an unreasonable or unacceptable danger to US ICT or national security is included in the ban.[447]

At last, the 5G and Beyond Act of 2020 mandates that the president develop a wireless network strategy to ensure the security of 5G and future generations of wireless technologies in the United States, as well as provide technical assistance to mutual defence treaty allies, strategic partners, and other countries.[448] The 5G and Beyond Act also aims to boost American competition by stressing the private sector's involvement and encouraging participation in standard-setting bodies and processes that ensure security and privacy needs are satisfied.[449] It acknowledges FCC leadership, but identifies a much broader range of responsible parties, including the President, Commerce Secretary and Homeland Security Secretary and Director of National Intelligence Director.[450]

---

[444]ibid.
[445]ibid.
[446]‘Video: Who Is Driving the 5G Transition in North America? | Wilson Center’ (n 443).
[447]ibid.
[448]ibid.
[449]ibid.
[450]ibid.

4.2.5 The European Union

As a game-changing technology for European industry and society, 5G has been identified as the next phase in wireless connection.[451] The digitalization of the industrial sector, the linking of private, public and industrial items to the internet, and the requirement for moving large amounts of data between the cloud, edge and billions of end devices of all kinds will require massive connectivity capacities.[452] Individuals and industrial players alike will benefit from 5G's seamless, omnipresent network, which will be able to meet their expanding connectivity requirements.[453]

Small-area wireless access point deployment should be supported through a permit-exempt deployment regime, according to Commission Implementing Regulation (EU) 2020/1070.[454] Any operator who deploys small-area wireless access points of Classes E2 or E10 in compliance with the characteristics laid out in this Regulation should notify the competent authority about the installation in a timely manner in order to allow supervision and monitoring by the competent authorities, particularly in cases of multiple adjacent or co-located small-area wireless access points.[455] Regulation (EU) 2020/1070 provides the regulatory framework for the deployment of 5G networks across all EU member states.

EU Regulation 2015/2120125 and the BEREC Guidelines outline the laws governing traffic treatment in the EU.[456] The laws apply uniformly to all 28 EU member states.[457] This regulations article 3 is devoted to protecting open internet access.[458] Article 3(3), which deals with traffic management procedures, lays down important guidelines for prioritizing traffic types within the

[451]European Investment Bank. and Innovation Finance Advisory., 'Accelerating the 5G Transition in Europe: How to Boost Investments in Transformative 5G Solutions: Main Report.' (Publications Office 2021) <https://data.europa.eu/doi/10.2867/252427> accessed 19 August 2021.
[452]ibid.
[453]ibid.
[454]Commission Implementing Regulation (EU) 2020/1070 of 20 July 2020 on specifying the characteristics of small-area wireless access points pursuant to Article 57 paragraph 2 of Directive (EU) 2018/1972 of the European Parliament and the Council establishing the European Electronic Communications Code (Text with EEA relevance) 2020 (OJ L).
[455]ibid.
[456]'Study on Implications of 5G Deployment on Future Business Models' (n 278).
[457]ibid.
[458]ibid.

IAS.[459] This is important for some future 5G services. Article 3(5) is especially relevant to the 5G issue because these "specialized services" may be delivered across network slices, allowing operators to satisfy specific demands to some users separately from the main IAS offering.[460] "Network-slicing in 5G networks may be employed to supply specialized services," according to the BEREC Guidelines.[461] Specialized services may be given under the Net Neutrality regulations if the optimization is objectively necessary to fulfil the needs of the services.[462]

4.3 Conclusion

This chapter has shown how different countries have responded to the ongoing discussion on 5G regulation based on economic, technical, and strategic factors. Due to its early spectrum auction and overall dedication to wireless technology, South Korea is closely following China in terms of 5G maturity.[463] South Korea is well positioned in the 5G industry and will likely remain a leader in the future as its major telecoms carriers make use of newly auctioned spectrum bandwidth.[464] The US delayed its deployment of 5G networks due to security concerns that were associated with Huawei. Some analysts are concerned that cyberattacks or military/industrial espionage could be carried out via loopholes in Chinese technology.[465] According to these experts, vulnerabilities were established because of many Chinese enterprises' bad business practices.[466] They do warn, though, that vulnerabilities might be implemented on purpose for nefarious purposes. "Any organization and citizen shall, in line with the law, support, provide aid, and collaborate in national intelligence work, and maintain the confidentiality of any national intelligence work that they are aware of," according to China's National Intelligence Law, established in June 2017.[467]

[459]ibid.
[460]ibid.
[461]ibid.
[462]ibid.
[463]Medin and Louie (n 449).
[464]ibid.
[465]John R Hoehn and Kelley M Sayler, 'National Security Implications of Fifth Generation (5G) Mobile Technologies' 3.
[466]ibid.
[467]ibid.

Singapore is one of the Asian tigers spearheading adoption of 5G technology. South Africa was the trailblazer in the African continent while Kenya and Nigeria followed closely. The EU was considered in this chapter to provide insight on how 5G can be regulated at a regional level. Deliberations and consultations are ongoing in several countries over 5G laws, therefore it's crucial that all stakeholders in this arena work together to create efficient regulatory framework and make it conducive to 5G deployment as early as possible.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The environment in Kenya is ripe for 5G deployment. However, it is necessary to have a clear roadmap of 5G deployment nationally. The Draft 5G Roadmap presented by the CA is still raw. It has not yet incorporated comments of key stakeholders. This study has established that infrastructure sharing and government investment are key to the deployment of 5G networks.

On protection of the right to privacy, the Data Protection Act 2019 incorporates global standards of data protection. However, Data Protection Regulations that are intended to give effect to key provisions of the Data Protection are yet to be enacted. On the other hand, competition laws are efficient in regulating MNOs. This study has established that entry into the market by new players is easier since infrastructure investment in terms of 5G technologies need an overhaul of the previous networks. Kenya's 5G Roadmap needs to address protection of new players in the MNO market.

The CA is well positioned to facilitate 5G deployment. The CA needs to review and adopt standards by the ITU in consultation with relevant stakeholders. This study has established that the current statutory and policy frameworks on spectrum allocation can sufficiently propel 5G deployment. The CA must therefore avail the necessary spectrum to MNOs for allocation. This study has also established that the CA needs to develop comprehensive network neutrality rules.

5.2 Conclusion

The nervous system of the twenty-first century economy is communication networks.[468] 5G will be critical to everything we do and will be inextricably linked to it.[469]We have already arrived in some senses.[470] During the COVID-19 crisis, what had been an abstract concept for most became

[468]'Open Future' <https://www.cnas.org/publications/reports/open-future> accessed 19 August 2021.
[469]ibid.
[470]ibid.

all too real.[471] The relevance of communication networks has been highlighted by the coronavirus pandemic: they are essential to our daily lives as well as our ability to function economically and as a community.[472] Due to the closure of workplaces, schools, and stores, people have had to rely on apps to work, learn, and shop.[473] To acquire the most up-to-date information and guidance on combating the virus, frontline medical personnel and vaccine researchers conferred with colleagues via teleconference.[474] Connectedness entails resiliency, coping, and survival. It is all the more important to get 5G correctly.[475]

Two regulatory issues influence the deployment of 5G in particular. For the 5G market, these are the spectrum allotment and competition policies.[476] The low-band spectrum covers frequencies below 1 GHz; the mid-band includes frequencies from 1 to 6 GHz; and the high-band spectrum includes frequencies above 6 GHz up to 100 GHz, commonly known as mmWave.[477] As regulators assess the requirements for spectrum licensing, they should consider three spectrum policy issues: 5G and shared access algorithms should be exempt from licensing; Designated 5G frequencies; Spectrum allocation processes such as auctions and other awards based on merit (or 'beauty competitions'); and Spectrum pricing, including license or operational restrictions, including licence length.[478]

The development of the 5G market and ecosystem is dependent on appropriate regulatory concepts.[479] This is based on three fundamental principles: effective competition, security by design, and technological neutrality. Regulators should pay attention to all of them.[480]

[471]ibid.
[472]ibid.
[473]ibid.
[474]ibid.
[475]ibid.
[476]Forge and Vu (n 109).
[477]ibid.
[478]ibid.
[479]ibid.
[480]ibid.

Regulators can use competition as a strategic lever to ensure that operators enhance the pricing, performance, and coverage of mobile networks, as well as service innovation.[481]At least three providers in most countries, with four having better pricing, competitively offer most mobile services.[482] This holds true for 5G services as well. The industry has made several interesting proposals to promote the concept of "collaborative competition."[483] For example, ST Engineering recommends that the regulator "adopt a more innovative regulatory framework and attitude toward non-MNOs and non-MVNOs arrangements, and allow private 5G for 5G Enterprise services, to boost competition in the 5G Enterprise market" in the Singapore CFP.[484] In this vein, the GSMA underlines the significance of allowing licensed, unlicensed, and shared spectrum to be used.[485] This method, it asserts, promotes the creation of a balanced spectrum ecosystem, which encourages investment and efficient spectrum use while also encouraging competition to improve consumer experience.[486]

Because security and resilience are vital to the proper operation of the 5G ecosystem, they should be treated as a core governing principle.[487] The 5G network architecture and operation are anticipated to comply with international standards and best practices to meet the security-by-design requirement.[488]

Multiple technologies can coexist in a strong 5G ecosystem, and MNOs and other owners or operators should be able to deploy cutting-edge technology and services in a flexible manner to suit market demand.[489] Regulators should apply the "technology neutral" principle to all spectrums given to MNOs, not just 5G, but also previous generations of mobile technology.[490] Because 5G

[481]ibid.
[482]ibid.
[483]ibid.
[484]ibid.
[485]ibid.
[486]ibid.
[487]ibid.
[488]ibid.
[489]ibid.
[490]ibid.

would rely on the LTE-A core network for a long time, this principle would allow spectrum for 5G to be used initially for LTE-A in the near future, and then to gradually build out the 5G RAN as 5G technology evolves and prices fall.[491]

5.3 Recommendations

This chapter highlights strategic policy recommendations for consideration in light of global trends and the Kenyan situational analysis. This study roots for developing a National 5G Strategy Policy. Technological advancements have in the past-elicited views of new technology being faster versions of the previous ones, however, 5G is disruptive as it is a novel advancement that necessitates us to rethink the regulatory framework that guided the telecommunication sector previously. The kind of dynamism in the telecommunications sector often leaves regulators and competition authorities to make regulatory errors. As more inventions are built and value is created on telecommunication platforms, the importance of these platforms grows as does the temptations for some regulators to exercise greater governmental power through heavy-handed regulation. Heavy-handed regulation does not encourage risk taking and investment in infrastructure.

The national government should establish a roundtable commission. This Commission should be comprised of multiple stakeholders including: The Communications Authority, Mobile Network Operators, Members of Academia, the Private Sector, all Government Ministries and potential players in the telecommunications markets that may be created or may explode due to 5G networks. Successful 5G rollout necessitates not just easy coordination among market players, but also strong institutional cooperation.[492]

The following are some of the ways that a 5G National Strategy might streamline regulatory constraints to make 5G deployment easier:

[491] ibid.

[492] Ricardo Martínez Garza, Enrique Iglesias Rodríguez and Antonio García Zaballos, 'Digital Transformation: Infrastructure Sharing in Latin America and the Caribbean' (Inter-American Development Bank 2020).

a) Transparency and market incentives should be the focus of regulatory policies.[493] The race to 5G is dependent on extensive build-out of fibre networks. The incentives for efficient deployment of 5G include the removal of administrative barriers; tax incentives; and government support in securing infrastructure where the small cells will be mounted, wayleaves and deployment of 5G infrastructure in rural areas in Kenya.

b) The policies that are developed should encourage competition.[494] The relevant market definition should be updated in order to define competition rather than using retrospective definition of the market. There are dangers in defining product markets too narrowly, since this could stifle future pro-competitive partnerships in the context of continuously changing markets and services. It is in the public interest to provide consumers with a variety of 5G MNO options. If we do not change our views about the market, we risk the government becoming a barrier to competition. It is a dynamic area, and technology and telecom are becoming increasingly vital in our lives, how we provide for our families, enable our children learn, and communicate with one another. Regulators must promote competition rather than inadvertently stifling it. Regulators should also make it easier for new players to enter into the market since they may be more willing to invest in 5G infrastructure. Established MNOs providing3G and 4G services may be unwilling to invest heavily on 5G infrastructure since they have not realised the return on investment of the infrastructure that will be rendered obsolete by 5G. These large ISPs are highly leveraged and they are cutting back on their investment.

c) Innovation should be encouraged through the policies that are developed.[495] Regulators should maintain operators' flexibility to meet the connectivity requirements of future

[493]'Securing 5G Networks' (n 275).
[494]Richard Adler, 'Preparing for a 5G World' (The Aspen Institute 2016) <https://www.aspeninstitute.org/wp-content/uploads/2016/11/AIRS-2015-Final.pdf> accessed 21 August 2021.
[495]ibid.

services made feasible by 5G in order to realize the full economic potential of 5G.[496] Instead of having an overly restricted view of the network's logical architecture, regulators should interpret the open internet principle in a way that supports flexible and efficient networks.[497] Services other than mass-market consumer internet access services should remain outside of open internet conduct standards where they exist.[498] Regulators should also revisit outdated regulatory regimes and revise regulatory frameworks to reflect the changing industry reality.[499]

d) Policies should be devised to ensure that there is enough spectrum to sustain continued growth.[500] Furthermore, the government and regulator should avoid inflating 5G spectrum prices (for example, through exorbitant reserve prices or annual fees) because this could constrain network investment and raise service costs.[501] MNOs are in the difficult position of having to make major new investments for the launch of 5G without knowing how or when they will have return on investment. [502] Governments should take serious steps to relieve the economic burden encountered by the MNOs in delivering 5G services, in support of their own digital policy goals.[503]

e) Harmonization of land-use regulations for the deployment of passive infrastructure for cellular telephony is a key component in facilitating 5G connectivity expansion.[504] The land use regulatory framework should have provisions on location and distances between towers, communication infrastructure wayleaves, infrastructure sharing, prompt

[496]'The 5G Guide: A Reference for Operators' (GSMA Intelligence 2019) <https://www.gsma.com/wp-content/uploads/2019/04/The-5G-Guide_GSMA_2019_04_29_compressed.pdf> accessed 21 August 2021.
[497]ibid.
[498]ibid.
[499]ibid.
[500]Adler (n 501).
[501]kictanetadmin (n 297).
[502]'The 5G Guide: A Reference for Operators' (n 503).
[503]ibid.
[504]Garza, Rodríguez and Zaballos (n 499).

administrative review periods, granting of licenses and permits for micro cells or use of urban structures and public participation.[505]

[505]ibid.

BIBLIOGRAPHY

Books

1. Colin Blackman and Lara Srivastava, Telecommunications Regulation Handbook (The International Bank for Reconstruction and Development / The World Bank, InfoDev, and The International Telecommunication Union, 2011)
2. Contandios Mavromoustakis, George Matorakis and Jordi Bartala (eds) '*Internet of Things (IoT) in 5G Mobile Technologies: Modeling and Optimizing in Science and Technologies'* (Vol. 8, Springer International Publishing Switzerland 2016)
3. Matinmikko-Blue M, Yrjölä S and Ahokangas P, 'Moving from 5G in Verticals to Sustainable 6G: Business, Regulatory and Technical Research Prospects' in Giuseppe Caso, Luca De Nardis and Liljana Gavrilovska (eds), *Cognitive Radio-Oriented Wireless Networks* (Springer International Publishing 2021)
4. Melody, W H (Ed) (1997) Telecom Reforms: Principles, Policies and Regulatory Practices. Lyngby. Technical University of Denmark, Den Private Ingeniorfond
5. Mwangi A, *Assessing the Readiness Index of the Private Sector to Effectively Use 5G Technology in the Urban and Peri-Urban Areas of Kenya* (2020)

   Orji, Uchenna, *International Telecommunications Law and Policy*. (2018).

Journal Articles

1. Butt MM and others, 'Spectrum Matching in Licensed Spectrum Sharing' (2018) 29 Transactions on Emerging Telecommunications Technologies e3476
2. Butt MM and others, 'Spectrum Matching in Licensed Spectrum Sharing' (2018) 29 Transactions on Emerging Telecommunications Technologies e3476
3. Cano L and others, 'On The Evolution Of Infrastructure Sharing In Mobilenetworks: A Survey' (2020) 1 18

4. ‘China and the United States Are Locked in a 5G Race’ (2018) oxan-db Emerald Expert Briefings <https://doi.org/10.1108/OXAN-DB230073> accessed 10 August 2021
5. Ding AY and Janssen M, ‘Opportunities for Applications Using 5G Networks: Requirements, Challenges, and Outlook’, *Proceedings of the Seventh International Conference on Telecommunications and Remote Sensing* (Association for Computing Machinery 2018) <https://doi.org/10.1145/3278161.3278166> accessed 5 August 2021
6. European Investment Bank. and Innovation Finance Advisory., ‘Accelerating the 5G Transition in Europe: How to Boost Investments in Transformative 5G Solutions : Main Report.’ (Frias Z and Pérez Martínez J, ‘5G Networks: Will Technology and Policy Collide?’ (2018) 42 Telecommunications Policy 612
7. Hong DE-K, Ryu JM and Lee EJH, ‘Entering The 5g Era: Lessons from Korea’ 25Lehr W, Queder F and Haucap J,
8. ‘5G: A New Future for Mobile Network Operators, or Not?’ (2021) 45 Telecommunications Policy 102086
9. Lemstra W, ‘Leadership with 5G in Europe: Two Contrasting Images of the Future, with Policy and Regulatory Implications’ (2018) 42 TelecoMalack O, Philip L and Edward N, ‘Mobile Subscription, Penetration and Coverage Trends in Kenya’s TelMatinmikko-Blue M, Yrjölä S and Ahokangas P, ‘Moving from 5G in Verticals to Sustainable 6G: Business, Regulatory and Technical Research Prospects’ in Giuseppe Caso, Luca De Nardis and Liljana Gavrilovska (eds), *Cognitive Radio-Oriented Wirel*Murchison MT, *The Technology, Media and Telecommunications Review* (11th ed‘Open Future’ <https://www.cnas.org/publications/reports/open-future> accessed 19 August 2021
10. ‘Study on Implications of 5G Deployment on Future Business Models’ (DotEcon Ltd and Axon Partners Group 2018) BEREC/2017/02/NP3

11. ‘On Regulations for 5G: Micro Licensing for Locally Operated Networks’ (2018) 42 Telecommunications Policy 622
12. ‘The Positive Theory of Regulation’ in Günter Knieps (ed), *Network Economics: Principles - Strategies - Competition Policy* (Springer International Publishing 2015) <https://doi.org/10.1007/978-3-319-11695-2_9> accessed 30 November 2021
13. ‘5G in Sub-Saharan Africa: Laying the Foundations’ (GSM Association 2019) <https://data.gsmaintelligence.com/api-web/v2/research-file-download?id=45121572&file=2796-160719-5G-Africa.pdf> accessed 10 August 2021
14. ‘5G Market Snapshot - Member Report - November 2021’ (*GSA*) <https://gsacom.com/paper/5g-market-snapshot-member-report-november-2021/> accessed 30 November 2021
15. ‘5G Network Deployment Challenges | RantCell’ <https://rantcell.com/5G-network-deployment-challenges.html> accessed 6 August 2021
16. ‘5G Regulation and Law in South Africa | CMS Expert Guides’ <https://cms.law/en/int/expert-guides/cms-expert-guide-to-5g-regulation-and-law/south-africa> accessed 10 August 2021
17. ‘5G to Raise Privacy Challenges and Opportunities’ <https://iapp.org/news/a/5g-to-raise-privacy-challenges-and-opportunities/> accessed 18 August 2021
18. ‘5g: Issues & Challenges’ <https://www.arcep.fr/uploads/tx_gspublication/Report-5G-issues-challenges-march2017.pdf> accessed 19 August 2021
19. ‘China Aims to Commercialize 6G by 2030: White Paper - Global Times’ <https://www.globaltimes.cn/page/202106/1225478.shtml> accessed 1 December 2021
20. ‘China and the United States Are Locked in a 5G Race’ (2018) oxan-db Emerald Expert Briefings <https://doi.org/10.1108/OXAN-DB230073> accessed 10 August 2021

21. ‘Fifth Generation Mobile Networks (“5G”)’ (*Infocomm Media Development Authority*) <http://www.imda.gov.sg/regulations-and-licensing-listing/spectrum-management-and-coordination/spectrum-planning/5g-technology> accessed 12 August 2021
22. ‘Frequency Spectrum Management Report 2nd Quarter 2019/20 (October- December 2019)’ (The Communications Authority of Kenya 2019) <https://ca.go.ke/wp-content/uploads/2020/04/Frequency-Spectrum-Management-Report-Q2-2019-2020.pdf> accessed 18 August 2021
23. ‘ICT Authority Strategic Plan 2020-2024’ (Information and Communication Technology Authority, 2020)
24. ‘Kenya Digital Economy Assessment’ (The World Bank Group 2019) <https://thedocs.worldbank.org/en/doc/345341601590631958-0090022020/original/DE4AKenyasummarypaperfinal.pdf> accessed 8 August 2021
25. ‘Kenya Launches Trials for 5G Technology’ (*Communications Authority of Kenya*, 29 March 2021) <https://ca.go.ke/kenya-launches-trails-for-5g-technology/> accessed 18 August 2021
26. ‘Kenya National Innovation Agency Strategic Plan: 2018 - 2022’ (Kenya Nationa Innovation Agency, 2018)
27. ‘Kenya: Amend the Draft Data Protection Regulations’ (*ARTICLE 19*) <https://www.article19.org/resources/kenya-amend-draft-data-regulations-2021/> accessed 12 October 2021
28. ‘Licensing and Shared Spectrum Framework for Community Networks’ (The Communications Authority of Kenya 2021) <https://ca.go.ke/wp-content/uploads/2021/05/Licensing-and-Shared-Spectrum-Framework-for-Community-Networks-May-2021.docx.pdf> accessed 18 August 2021

29. ‘National Information, Communications and Technology (ICT) Policy’ (Ministry of Information, Communications and Technology 2019) <https://www.ict.go.ke/wp-content/uploads/2019/12/National-ICT-Policy-2019.pdf> accessed 18 August 2021
30. ‘National Radio Frequency Spectrum Policy’ (Ministry of ICT, Innovation and Youth Affairs 2020) <https://ict.go.ke/wp-content/uploads/2021/03/Draft-National-Spectrum-Policy-for-stakeholder-validation.pdf> accessed 18 August 2021
31. ‘Open Future’ <https://www.cnas.org/publications/reports/open-future> accessed 19 August 2021
32. ‘Public Consultation On The Roadmap For 5th Generation (5g) Mobile Communications In Kenya’ (*Communications Authority of Kenya*, 12 October 2021) <https://www.ca.go.ke/public-consultation-on-the-roadmap-for-5th-generation-5g-mobile-communications-in-kenya/> accessed 30 November 2021
33. ‘Safaricom Trials New Base Stations for Urban Areas’ <https://www.africanwirelesscomms.com/news-details?itemid=2415> accessed 30 November 2021
34. ‘Second Consultation on 5g Mobile Services and Networks’ (Infocomm Media Development Authority (IMDA) 2019) <https://www.imda.gov.sg/-/media/Imda/Files/Regulation-Licensing-and-Consultations/Consultations/Consultation-Papers/Second-Public-Consultation-on-5G-Mobile-Services-and-Networks/Second-5G-Public-Consultation-7-May-2019-Final.pdf> accessed 12 August 2021
35. ‘Securing 5G Networks’ (*Council on Foreign Relations*) <https://www.cfr.org/report/securing-5g-networks> accessed 18 August 2021
36. ‘South African Regulator Gets Six Applications for 5G Spectrum Auction’ (*RCR Wireless News*, 31 December 2020) <https://www.rcrwireless.com/20201231/spectrum/south-african-regulator-gets-six-applications-5g-spectrum-auction> accessed 10 August 2021

37. ‘Stiff Licensing Regulations Could Hinder 5G Rollout, Experts Warn’ (*People Daily*, 13 August 2020) <https://www.pd.co.ke/business/economy-and-policy/stiff-licensing-regulations-could-hinder-5g-rollout-experts-warn-48101/> accessed 8 August 2021
38. ‘Study on Implications of 5G Deployment on Future Business Models’ (DotEcon Ltd and Axon Partners Group 2018) BEREC/2017/02/NP3
39. ‘The 5G Bandwagon: Legal and Regulatory Implications’ (2019) <https://eoasis.rajahtann.com/eoasis/lu/pdf/2019-04_5G-Legal-and-Regulatory-Implications.pdf> accessed 6 August 2021
40. ‘The 5G Guide: A Reference for Operators’ (GSMA Intelligence 2019) <https://www.gsma.com/wp-content/uploads/2019/04/The-5G-Guide_GSMA_2019_04_29_compressed.pdf> accessed 21 August 2021
41. ‘Theories of Regulation’ <https://regulationbodyofknowledge.org/general-concepts/theories-of-regulation/> accessed 30 November 2021
42. ‘Video: Who Is Driving the 5G Transition in North America? | Wilson Center’ <https://5g.wilsoncenter.org/video/video-who-driving-5g-transition-north-america> accessed 12 August 2021
43. ‘What Is 6G Mobile Communications Technology » Electronics Notes’ <https://www.electronics-notes.com/articles/connectivity/6g-mobile-wireless-cellular/technology-basics.php> accessed 1 December 2021
44. ‘Wireless Broadband Spectrum Policy’ (Ministry of Information, Communications and Technology 2016) <https://www.ict.go.ke/wp-content/uploads/2016/03/Draft-Wireless-Broadband-Spectrum-Policy-Final.pdf> accessed 18 August 2021
45. Achuti M, ‘Application Of Diversification Strategies At Safaricom Limited, Kenya’ 63
46. Adams MB and Tower GD, ‘Theories of Regulation: Some Reflections on the Statutory Supervision of Insurance Companies in Anglo-American Countries’ 23

47. Adler R, ‘Preparing for a 5G World’ (The Aspen Institute 2016) <https://www.aspeninstitute.org/wp-content/uploads/2016/11/AIRS-2015-Final.pdf> accessed 21 August 2021
48. Ahmad I and others, ‘5G Security: Analysis of Threats and Solutions’, *2017 IEEE Conference on Standards for Communications and Networking (CSCN)* (2017)
49. Ahokangas P and Matinmikko-Blue M, ‘Introduction to Special Issue “Mobile Communications and Novel Business Models”’ (2021) 13 Sustainability 674
50. Ahokangas P and others, ‘Antecedents of Future 6G Mobile Ecosystems’, *2020 2nd 6G Wireless Summit (6G SUMMIT)* (2020) Garza RM, Rodríguez EI and Zaballos AG, ‘Digital Transformation: Infrastructure Sharing in Latin America and the Caribbean’ (Inter-American Development Bank 2020)
51. Ahokangas P and others, ‘Antecedents of Future 6G Mobile Ecosystems’, *2020 2nd 6G Wireless Summit (6G SUMMIT)* (2020)
52. Alden C and Chan K, ‘The Infrastructures of Global Connectivity: 5G Networks’ 12
53. Alexiadis P and Shortall T, ‘The Advent of 5G: Should Technological Evolution Lead to Regulatory Revolution?’ 13
54. April 06 2021 T, ‘Airtel Connects 5G in Battle with Safaricom’ (*Business Daily*, 6 April 2021) <https://www.businessdailyafrica.com/bd/corporate/technology/airtel-connects-5g-in-battle-with-safaricom-3350898> accessed 18 August 2021
55. Bauer JM and Bohlin E, ‘The Role of Regulation in 5G Market Design’ (Social Science Research Network 2019) SSRN Scholarly Paper ID 3421024 <https://papers.ssrn.com/abstract=3421024> accessed 5 August 2021
56. Benseny J and others, ‘The Mitigating Role of Regulation on the Concentric Patterns of Broadband Diffusion. The Case of Finland’ (2019) 41 Telematics and Informatics 139

57. Bernard Sihanya (1997), *Regulating Internet Business in Kenya*, in Mgombelo, Telecommunications for Business in Africa 125 (H.R. Mgombelo& M.C.M Werner eds.
58. Butt MM and others, 'Spectrum Matching in Licensed Spectrum Sharing' (2018) 29 Transactions on Emerging Telecommunications Technologies e3476
59. Cano L and others, 'On The Evolution Of Infrastructure Sharing In Mobilenetworks: A Survey' (2020) 1 18
60. Chew MYL and others, 'Evaluating the Roadmap of 5G Technology Implementation for Smart Building and Facilities Management in Singapore' (2020) 12 Sustainability 10259
61. Chitimira H and Ncube P, 'The Regulation and Use of Artificial Intelligence and 5G Technology to Combat Cybercrime and Financial Crime in South African Banks' (2021) 24 Potchefstroom Electronic Law Journal 1
62. Commission Implementing Regulation (EU) 2020/1070 of 20 July 2020 on specifying the characteristics of small-area wireless access points pursuant to Article 57 paragraph 2 of Directive (EU) 2018/1972 of the European Parliament and the Council establishing the European Electronic Communications Code (Text with EEA relevance) 2020 (OJ L)
63. Corrocher N and Lasio L, 'Diversification Strategies in Network-Based Services: The Case of Mobile Virtual Network Operators' (2013) 37 Telecommunications Policy
64. Del Re E, 'Which Future Strategy and Policies for Privacy in 5G and Beyond?', *2020 IEEE 3rd 5G World Forum (5GWF)* (2020)
65. Ding AY and Janssen M, 'Opportunities for Applications Using 5G Networks: Requirements, Challenges, and Outlook', *Proceedings of the Seventh International Conference on Telecommunications and Remote Sensing* (Association for Computing Machinery 2018) <https://doi.org/10.1145/3278161.3278166> accessed 5 August 2021
66. European Investment Bank. and Innovation Finance Advisory., 'Accelerating the 5G Transition in Europe: How to Boost Investments in Transformative 5G Solutions : Main

Report.' (Publications Office 2021) <https://data.europa.eu/doi/10.2867/252427> accessed 19 August 2021

67. Fabiano N, 'Internet of Things and the Legal Issues Related to the Data Protection Law According to the New European General Data Protection Regulation' (2017) 3 Athens Journal Of Law 201
68. Forge S and Vu K, 'Forming a 5G Strategy for Developing Countries: A Note for Policy Makers' (2020) 44 Telecommunications Policy 101975
69. Frias Z and Pérez Martínez J, '5G Networks: Will Technology and Policy Collide?' (2018) 42 Telecommunications Policy 612
70. Garza RM, Rodríguez EI and Zaballos AG, 'Digital Transformation: Infrastructure Sharing in Latin America and the Caribbean' (Inter-American Development Bank 2020)
71. Gatana Kariuki, 'Growth and Improvement of Information Communication Technology in Kenya' (2009) 5(2) International Journal of Education and Development using Information and Communication Technology 146, 153.
72. Gedel IA and Nwulu N, 'Infrastructure Sharing for 5G Deployment: A Techno-Economic Analysis' (2021) 15 International Journal of Interactive Mobile Technologies (iJIM) 137
73. Hantke-Domas M, 'The Public Interest Theory of Regulation: Non-Existence or Misinterpretation?' (2003) 15 European Journal of Law and Economics 165
74. Harborth D and Pohl M, 'Standardization of 5G Mobile Networks: A Systematic Literature Review and Current Developments' (2017) 15 International Journal of Standardization Research (IJSR) 1
75. Herzog U and others, 'Quality of Service Provision and Capacity Expansion through Extended-DSA for 5G' (2016) 27 Transactions on Emerging Telecommunications Technologies 1250

76. Hoehn JR and Sayler KM, ‘National Security Implications of Fifth Generation (5G) Mobile Technologies’ 3
77. Hong DE-K, Ryu JM and Lee EJH, ‘ENTERING THE 5G ERA: LESSONS FROM KOREA’ 25
78. Humayun M and others, ‘Privacy Protection and Energy Optimization for 5G-Aided Industrial Internet of Things’ (2020) 8 IEEE Access 183665
79. Islam N and Wahid A, ‘5G Networks: A Holistic View of Enabling Technologies and Research Challenges’ (2019)
80. Jayasuriyan B and Malaimagal S, ‘A Critical Analysis on the Theories of Regulation’ (2019) 8 International Journal of Innovative Technology and Exploring Engineering 2017
81. Kameri-Mbote, P and others, ‘Spectrum Management and Regulation in Kenya: Engendering Inclusive Access to Technology and Information’ (International Environmental Law Research Centre 2016)
82. Kazi O and others, ‘Infrastructure Sharing and Remedies in Next Generation Cellular Networks’
83. Kim K, Choi J and Lee S-M, ‘Why Does Bundled Product in Telecommunication Service Market Matter?: Evidence from South Korea’ (2016) 9 International Journal of u- and e-Service, Science and Technology 209
84. Knieps G, ‘Telecommunications Markets in the Stranglehold of EU Regulation: On the Need for a Disaggregated Regulatory Contract’ (2005) 6 Competition and Regulation in Network Industries
85. Lagunas E and others, ‘5G Cellular and Fixed Satellite Service Spectrum Coexistence in C-Band’ (2020) 8 IEEE Access 72078
86. Lebu AA and Nairobi UO, ‘Financial Services Regulation In Kenya: A Critical Analysis Of The Proposed Unified Financial Services Regulator’ 110

87. Lehr W, Queder F and Haucap J, ‘5G: A New Future for Mobile Network Operators, or Not?’ (2021) 45 Telecommunications Policy 102086
88. Lemstra W, ‘Leadership with 5G in Europe: Two Contrasting Images of the Future, with Policy and Regulatory Implications’ (2018) 42 Telecommunications Policy 587
89. Levi Osuagwu U, Agho K and Abu E, ‘Factors Associated with the Myth about 5G Network during COVID-19 Pandemic in Sub-Saharan Africa’ (2020) 4 Journal of Global Health Reports
90. Liyanage M and others, ‘5G Privacy: Scenarios and Solutions’, *2018 IEEE 5G World Forum (5GWF)* (2018)
91. Majone G, ‘The Rise of the Regulatory State in Europe’ (1994) 17 West European Politics 77
92. Malack O, Philip L and Edward N, ‘Mobile Subscription, Penetration and Coverage Trends in Kenya’s Telecommunication Sector’ (2015) 4 International Journal of Advanced Research in Artificial Intelligence <http://thesai.org/Publications/ViewPaper?Volume=4&Issue=1&Code=ijarai&SerialNo=1> accessed 18 August 2021
93. Malinga S, ‘Spectrum Policy Flaws “Will Alienate Millions of South Africans”’ (*ITWeb*, 14 April 2021) <https://www.itweb.co.za/content/lwrKxv3KadXvmg1o> accessed 11 August 2021
94. Matinmikko M and others, ‘Micro Operators to Boost Local Service Delivery in 5G’ (2017) 95 Wireless Personal Communications 69
95. Matinmikko-Blue M, Yrjölä S and Ahokangas P, ‘Moving from 5G in Verticals to Sustainable 6G: Business, Regulatory and Technical Research Prospects’ in Giuseppe Caso, Luca De Nardis and Liljana Gavrilovska (eds), *Cognitive Radio-Oriented Wireless Networks* (Springer International Publishing 2021)

96. May 28 2021 F, ‘Safaricom Eyes 250 Sites for 5G by End of Year’ (*Business Daily*, 28 May 2021) <https://www.businessdailyafrica.com/bd/corporate/companies/safaricom-eyes-250-sites-r-5g-by-end-of-year-3416566> accessed 18 August 2021
97. May 31 2021 M, ‘Hype about 5G Shouldn’t Ruin Mobile Connectivity’ (*Business Daily*, 31 May 2021) <https://www.businessdailyafrica.com/bd/opinion-analysis/columnists/hype-about-5g-shouldn-t-mobile-connectivity-3419708> accessed 8 August 2021
98. Medin M and Louie G, ‘The 5G Ecosystem: Risks & Opportunities for DoD’ 33
99. Mugo P and Macharia J, ‘Technological Innovation and Competitive Advantage in Telecommunication Companies in Kenya’ (2020) 9 International Journal of Research in Business and Social Science (2147- 4478) 38
100. Murchison MT, *The Technology, Media and Telecommunications Review* (11th edn, Law Business Research Ltd, London 2020) <https://www.lw.com/thoughtLeadership/the-technology-media-and-telecommunications-review-11th-edition> accessed 19 August 2021
101. Namisiko P, Sakwa M and Mwangi W, ‘Effects of Network Infrastructure Sharing Challenges on Open Information Communication Technology Infrastructure Sharing among Mobile Service Providers in Kenya’ (2015) 7 International Journal of Information Engineering and Electronic Business 11
102. Njoroge MM, ‘Effect of Strategic Management Practices on Performance of Selected Mobile Service Providers in Nairobi- Kenya’ 98
103. Omar de Leon, ‘Innovation and Regulation in ICT: Keys for Development’ 2014/43 *Ibei Working Papers*
104. Peak S, ‘The National Broadband Strategy’ 139

105. Piot S, Bates P and Edmunson K, ‘Telecommunication Competition Market Study in Kenya’ 47

106. Quebal, Nora C. 1971. Development Communication in the Agricultural Context, UPLB Department of Development Communication.

107. Rickcard B, ‘In Pursuit of Solitude: Reviewing the Impacts of Communications Authority of Kenya v Okiya Omtatah’ (Social Science Research Network 2021) SSRN Scholarly Paper ID 3785862 <https://papers.ssrn.com/abstract=3785862> accessed 1 December 2021

108. Sihanya B, ‘Regulating Internet Business In Kenya’ <http://erepository.uonbi.ac.ke/handle/11295/86018> accessed 12 October 2021

109. Storck CR and Duarte-Figueiredo F, ‘A Survey of 5G Technology Evolution, Standards, and Infrastructure Associated With Vehicle-to-Everything Communications by Internet of Vehicles’ (2020) 8 IEEE Access 117593

110. Storck CR and Duarte-Figueiredo F, ‘A Survey of 5G Technology Evolution, Standards, and Infrastructure Associated With Vehicle-to-Everything Communications by Internet of Vehicles’ (2020) 8 IEEE Access 117593

111. Strusani D and Houngbonon GV, *Accelerating Digital Connectivity Through Infrastructure Sharing* (International Finance Corporation, Washington, DC 2020) <http://hdl.handle.net/10986/33616> accessed 5 August 2021

112. *The Road to 5G Networks: Experience to date and future developments* OECD Digital Economy Papers No. 284, 2019

113. Vincenzi M, Lopez-Aguilera E and Garcia-Villegas E, ‘Timely Admission Control for Network Slicing in 5G With Machine Learning’ (2021) 9 IEEE Access 127595

114. Vincenzi M, Lopez-Aguilera E and Garcia-Villegas E, ‘Timely Admission Control for Network Slicing in 5G With Machine Learning’ (2021) 9 IEEE Access 127595

115. Wachter S, ‘Normative Challenges of Identification in the Internet of Things: Privacy, Profiling, Discrimination, and the GDPR’ (2018) 34 Computer Law & Security Review 436
116. Wachter S, ‘Normative Challenges of Identification in the Internet of Things: Privacy, Profiling, Discrimination, and the GDPR’ (2018) 34 Computer Law & Security Review 436
117. You X and others, ‘Towards 6G Wireless Communication Networks: Vision, Enabling Technologies, and New Paradigm Shifts’ (2020) 64 Science China Information Sciences 110301
118. You X and others, ‘Towards 6G Wireless Communication Networks: Vision, Enabling Technologies, and New Paradigm Shifts’ (2020) 64 Science China Information Sciences 110301
119. Zeng L and Zhang J, ‘Multi-Agent Spectrum Access with Sensing Skipping Based on Reinforcement Learning’ (2021) 32 Transactions on Emerging Telecommunications Technologies e4264
120. Zeng L and Zhang J, ‘Multi-Agent Spectrum Access with Sensing Skipping Based on Reinforcement Learning’ (2021) 32 Transactions on Emerging Telecommunications Technologies e4264

Dissertations and Thesis

1. Dr. Jacob Enyia, ‘*International Regulatory Best Practices in Telecommunications Industry: Issues and Prospects’* (2018) University of Calabar.
2. Charles O. Dulo ‘*Telecommunications Regulation in Kenya: A case for generic reform due to convergence in ICT’* (2006) University of Nairobi, LLM Program

3. Okoro SC, 'Factors Affecting Adoption of Modern Technology by Telecommunication Firms In Kenya: A Case Study of 5g Technology' (United States International University 2021)

Publications

1. Shaping Kenya's digital future through positive legislation, *the Above Standard",* a publication of TRIPLEOKLAW advocates, Issue 003 Dec 2018; *https://ihub.co.ke/blogs/33832/shaping-kenya-s-digital-future-through-positive-legislation*
2. *Setting the Scene for 5G: Opportunities and Challenges* ITU Publications on Regulation, Economics and Finance, 2018
3. *Study on Implication of 5G deployment on Business Models*DotEcon Limited and Axon Partners Group, 2018
4. *Role of Regulation in 4G and 5G Implementation* ITU Publications, 2016

   5G Applications: Requirements, Challenges and Outlook Delft University of Technology, Netherlands, 2018

Internet Articles

1. C. Blackman and L. Srivastava, ed. *Telecommunications Regulation Handbook,* p.vii, Infodev Documents, Accessed7/1/2019
2. Detecon International Amman 'Introduction int 5G Regulation' 2019 accessed at http://www.emergonline.org/wp content/uploads/2018/12/Introduction_to_5G_Amman.pdf 6/11/2019
3. https://www.brookings.edu/wp-content/uploads/2016/07/How-5G-tech-enables-health-iot-west.pdf accessed 2/1/2020
4. https://community.fs.com/blog/5g-is-coming-the-new-wireless-revolution-to-change-our-life.html accessed 2/1/2020

5. GSMA, '5G in Sub-Saharan Africa: Laying the foundations' accessed at https://www.gsma.com/subsaharanafrica/resources/5g-in-sub-saharan-africa-laying-the-foundations on 18/11/2019
6. ITU, '*5G Basics'* accessed at https://www.itu.int/dms_pub/itu-t/opb/tut/T-TUT-IMT-2017-1-PDF-E.pdf on 18/11/2019
7. 'Open Future' <https://www.cnas.org/publications/reports/open-future> accessed 19 August 2021
8. '5G Market Snapshot - Member Report - November 2021' (*GSA*) <https://gsacom.com/paper/5g-market-snapshot-member-report-november-2021/> accessed 30 November 2021
9. '5G Poses "dramatic Challenges" to Privacy and Personal Data' (*Marketing Week*, 1 March 2019) <https://www.marketingweek.com/5g-dramatic-challenges-privacy-personal-data/> accessed 30 November 2021
10. 'China and the United States Are Locked in a 5G Race' (2018) oxan-db Emerald Expert Briefings <https://doi.org/10.1108/OXAN-DB230073> accessed 10 August 2021
11. 'Fifth Generation Mobile Networks ("5G")' (*Infocomm Media Development Authority*) <http://www.imda.gov.sg/regulations-and-licensing-listing/spectrum-management-and-coordination/spectrum-planning/5g-technology> accessed 12 August 2021
12. 'Frequency Spectrum Management Report 2nd Quarter 2019/20 (October- December 2019)' (The Communications Authority of Kenya 2019) <https://ca.go.ke/wp-content/uploads/2020/04/Frequency-Spectrum-Management-Report-Q2-2019-2020.pdf> accessed 18 August 2021
13. 'Kenya Digital Economy Assessment' (The World Bank Group 2019) <https://thedocs.worldbank.org/en/doc/345341601590631958-0090022020/original/DE4AKenyasummarypaperfinal.pdf> accessed 8 August 2021

14. ‘Kenya Launches Trials for 5G Technology’ (*Communications Authority of Kenya*, 29 March 2021) <https://ca.go.ke/kenya-launches-trails-for-5g-technology/> accessed 18 August 2021
15. ‘Kenya: Amend the Draft Data Protection Regulations’ (*ARTICLE 19*) <https://www.article19.org/resources/kenya-amend-draft-data-regulations-2021/> accessed 12 October 2021
16. ‘Licensing and Shared Spectrum Framework for Community Networks’ (The Communications Authority of Kenya 2021) <https://ca.go.ke/wp-content/uploads/2021/05/Licensing-and-Shared-Spectrum-Framework-for-Community-Networks-May-2021.docx.pdf> accessed 18 August 2021
17. ‘National Radio Frequency Spectrum Policy’ (Ministry of ICT, Innovation and Youth Affairs 2020) <https://ict.go.ke/wp-content/uploads/2021/03/Draft-National-Spectrum-Policy-for-stakeholder-validation.pdf> accessed 18 August 2021
18. Piot S, Bates P and Edmunson K, ‘Telecommunica‘Public Consultation On The Roadmap For 5th Generation (5g) Mobile Communications In Kenya’ (*Communications Authority of Kenya*, 12 October 2021) <https://www.ca.go.ke/public-consultation-on-the-roadmap-for-5th-generation-5g-mobile-communications-in-kenya/> accessed 30 November 2021
19. ‘Second Consultation on 5g Mobile Services and Networks’ (Infocomm Media Development Authority (IMDA) 2019) <https://www.imda.gov.sg/-/media/Imda/Files/Regulation-Licensing-and-Consultations/Consultations/Consultation-Papers/Second-Public-Consultation-on-5G-Mobile-Services-and-Networks/Second-5G-Public-Consultation-7-May-2019-Final.pdf> accessed 12 August 2021
20. ‘Securing 5G Networks’ (*Council on Foreign Relations*) <https://www.cfr.org/report/securing-5g-networks> accessed 18 August 2021

21. ‘South African Regulator Gets Six Applications for 5G Spectrum Auction’ (*RCR Wireless News*, 31 December 2020) <https://www.rcrwireless.com/20201231/spectrum/south-african-regulator-gets-six-applications-5g-spectrum-auction> accessed 10 August 2021
22. ‘Stiff Licensing Regulations Could Hinder 5G Rollout, Experts Warn’ (*People Daily*, 13 August 2020) <https://www.pd.co.ke/business/economy-and-policy/stiff-licensing-regulations-could-hinder-5g-rollout-experts-warn-48101/> accessed 8 August 2021
23. ‘The 5G Bandwagon: Legal and Regulatory Implications’ (2019) <https://eoasis.rajahtann.com/eoasis/lu/pdf/2019-04_5G-Legal-and-Regulatory-Implications.pdf> accessed 6 August 2021
24. ‘The 5G Guide: A Reference for Operators’ (GSMA Intelligence 2019) <https://www.gsma.com/wp-content/uploads/2019/04/The-5G-Guide_GSMA_2019_04_29_compressed.pdf> accessed 21 August 2021
25. ‘Video: Who Is Driving the 5G Transition in North America? | Wilson Center’ <https://5g.wilsoncenter.org/video/video-who-driving-5g-transition-north-america> accessed 12 August 2021
26. ‘Wireless Broadband Spectrum Policy’ (Ministry of Information, Communications and Technology 2016) <https://www.ict.go.ke/wp-content/uploads/2016/03/Draft-Wireless-Broadband-Spectrum-Policy-Final.pdf> accessed 18 August 2021
27. April 06 2021 T, ‘Airtel Connects 5G in Battle with Safaricom’ (*Business Daily*, 6 April 2021) <https://www.businessdailyafrica.com/bd/corporate/technology/airtel-connects-5g-in-battle-with-safaricom-3350898> accessed 18 August 2021
28. Bauer JM and Bohlin E, ‘The Role of Regulation in 5G Market Design’ (Social Science Research Network 2019) SSRN Scholarly Paper ID 3421024 <https://papers.ssrn.com/abstract=3421024> accessed 5 August 2021

29. Ding AY and Janssen M, ‘Opportunities for Applications Using 5G Networks: Requirements, Challenges, and Outlook’, *Proceedings of the Seventh International Conference on Telecommunications and Remote Sensing* (Association for Computing Machinery 2018) <https://doi.org/10.1145/3278161.3278166> accessed 5 August 2021
30. European Investment Bank. and Innovation Finance Advisory., ‘Accelerating the 5G Transition in Europe: How to Boost Investments in Transformative 5G Solutions : Main Report.’ (Publications Office 2021) <https://data.europa.eu/doi/10.2867/252427> accessed 19 August 2021
31. kictanetadmin, ‘5G Policy Brief. Which Way for Kenya? - KICTANet Think Tank’ (20 January 2021) <https://www.kictanet.or.ke/mdocs-posts/5g-policy-brief-which-way-for-kenya/> accessed 8 August 2021
32. Malack O, Philip L and Edward N, ‘Mobile Subscription, Penetration and Coverage Trends in Kenya’s Telecommunication Sector’ (2015) 4 International Journal of Advanced Research in Artificial Intelligence <http://thesai.org/Publications/ViewPaper?Volume=4&Issue=1&Code=ijarai&SerialNo=1> accessed 18 August 2021
33. Malinga S, ‘Spectrum Policy Flaws “Will Alienate Millions of South Africans”’ (*ITWeb*, 14 April 2021) <https://www.itweb.co.za/content/lwrKxv3KadXvmg1o> accessed 11 August 2021
34. May 28 2021 F, ‘Safaricom Eyes 250 Sites for 5G by End of Year’ (*Business Daily*, 28 May 2021) <https://www.businessdailyafrica.com/bd/corporate/companies/safaricom-eyes-250-sites-r-5g-by-end-of-year-3416566> accessed 18 August 2021
35. May 31 2021 M, ‘Hype about 5G Shouldn’t Ruin Mobile Connectivity’ (*Business Daily*, 31 May 2021) <https://www.businessdailyafrica.com/bd/opinion-

analysis/columnists/hype-about-5g-shouldn-t-mobile-connectivity-3419708> accessed 8 August 2021

36. Murchison MT, *The Technology, Media and Telecommunications Review* (11th edn, Law Business Research Ltd, London 2020) <https://www.lw.com/thoughtLeadership/the-technology-media-and-telecommunications-review-11th-edition> accessed 19 August 2021
37. Sihanya B, 'Regulating Internet Business In Kenya' <http://erepository.uonbi.ac.ke/handle/11295/86018> accessed 12 October 2021
38. Strusani D and Houngbonon GV, *Accelerating Digital Connectivity Through Infrastructure Sharing* (International Finance Corporation, Washington, DC 2020) <http://hdl.handle.net/10986/33616> accessed 5 August 2021