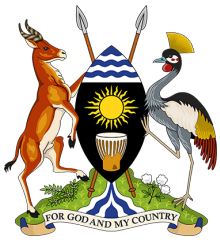

MINISTRY OF ICT & NATIONAL GUIDANCE

A Knowledge and Productive Society driven by ICT & National Ideology

National Broadband Baseline Survey and Infrastructure Blueprint

April 2022

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FOREWORD

The Government of Uganda has identified Information and Communication Technology (ICT) as a catalyst for social and economic development in line with the Uganda Vision 2040 that seeks to attain "A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country." The third National Development Plan, NDP III (2020/21 – 2024/25) identifies 18 programmes through which the Plan will be delivered, one of these being the Digital Transformation Programme that "aims to increase ICT penetration and use of ICT services for social and economic development". Key expected results include: increasing ICT penetration; reducing cost of ICT devices and services; creating more direct jobs in the sector; increasing ICT incubation; and increasing government services online".

While there has already been substantial development in fibre in the country through investment by both the Government and private operators, Uganda continues to experiences multiple challenges with regard to broadband, including duplication of infrastructure segments by different operators resulting into limited effective fibre backbone; inadequate penetration of the broadband network in the country, especially in rural and remote areas; high cost of broadband services compared to other countries and relative to income levels; limited applications and services; limited demand-side skills, limiting the affective use of the available broadband services; inefficient and inappropriate use and allocation of spectrum; and lack of a responsive policy, legal, regulatory and institutional framework.

These challenges demanded that the Government of Uganda develops a coherent plan for broadband infrastructure to achieve broadband for all by 2030 as set out in the Digital Economy for Africa (DE4A) Initiative: the National Broadband Baseline Study and Broadband Infrastructure Blueprint, has been developed to respond to this gap.

This study was supported through the World Bank's Regional Communications Infrastructure Programme (RCIP) that, among other things, intends to review, develop and implement relevant ICT policies, strategies, laws and technical regulatory frameworks to support a modern and vibrant ICT sector in the country. While this Report is not a statement of government policy or strategy, it is a timely and critical source document that will guide new initiatives.

It is my great pleasure and privilege to present the national broadband survey and infrastructure Blueprint which provides the sector with a core reference point for addressing gaps and challenges in the broadband ecosystem, and will enable the Ministry of ICT and National Guidance to effectively play its oversight role of shaping and guiding the growth of broadband in Uganda.

Hon. Dr. Chris Baryomunsi
Minister for ICT and National Guidance

Acknowledgements

The Ministry of ICT and National Guidance acknowledges with appreciation the work of the Consultants, a joint venture between Knowledge Consulting Ltd (Francis F Tusubira, Ali Ndiwalana, Grace Musoke Lwanga, Lisa Thornton) and Research ICT Solutions (Christoph Stork, Steve Esselaar, David Johnson) who carried out the study in collaboration with the Ministry and her agencies (with guidance from Geoffrey Agoi as the technical lead), to produce this landmark guiding document.

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Table of Abbreviations

Abbreviation	Definition
AoIP	Audio over internet protocol
BB	Broadband
BOU	Bank of Uganda
BPO	Business process outsourcing
CDN	Content distribution network
COMESA	Common market for Eastern and Southern Africa
DLG	District local government
eiDAS	Electronic identification and trust services
EU	European Union
FM	Frequency moderation
FTA	Free to air
GCI	Global Cybersecurity Index
GDP	Gross domestic product
GIS	Geographic information system
GNI	Gross national income
HCI	Human Capital Index
GSM	Global System for Mobile Communications
GSMA	GSM Association
ICT	Information communication technology
IEC	Information, education and communication
IFMIS	Integrated financial management information system IP Intellectual property
IPR	Intellectual property rights
IPTV	Internet protocol television
IR	Implementation roadmap
ITU	International Telecommunications Union
IXPs	Internet exchange points
JICM	Joint infrastructure coordination mechanism
KACITA	Kampala City Traders Association
KYC	Know-your-customer
MDAs	Ministries, departments and agencies

Table of Abbreviations

Abbreviation	Definition
MoICT&NG	Ministry of Information and Communications Technology and National Guidance
MoFPED	Ministry of Finance, Planning and Economic Development
MP	Member of parliament
MoWE	Ministry of Water and Environment
MoWT	Ministry of Works and Transport
NBP	National broadband policy
NCM	National coordination mechanism
NDP	National Development Plan
NITA-U	National Information Technology Authority – Uganda
NPA	National Planning Authority
NRA	National regulatory authorities
OPM	Office of the Prime Minister
OECD	Organisation for Economic Cooperation and Development
OS	Operating software
OSI	Online Service Index
OTT	Over-the-top (applications)
PCICTNG	Parliamentary Committee on Information and Communications Technology
	and National Guidance
PESTEL	Political, economic, social, technological, environmental, legal
RAN	Radio access network
REA	Rural Electrification Agency
RENU	Research and Education Network for Uganda
RoW	Right(s) of way
SDGs	Sustainable Development Goals
SMS	Short messaging service
SWOT	Strengths, weaknesses, opportunities, threats
TII	Telecommunication Infrastructure Index
TLD	Top-level domain
TV	Television
UBOS	Uganda Bureau of Statistics

Table of Abbreviations

Abbreviation	Definition
UCC	Uganda Communications Commission
UETCL	Uganda Electricity Transmission Company Limited
UN	United Nations
UNRA	Uganda National Roads Authority
URA	Uganda Revenue Authority
UNCITRAL	United Nations Commission on International Trade Law
VAT	Value-added tax
VoD	Video on demand
VSAT	Very-small-aperture terminal
WG	Working group
WDI	World Development Indicators

EXECUTIVE SUMMARY

The main objective of this study was to establish a national broadband baseline and to subsequently develop a 10-year National Broadband Infrastructure Blueprint (2022/23 - 2032/33). This study, commissioned by the Ministry of ICT and National Guidance (MoICT&NG), was funded through the World Bank's Regional Communications Infrastructure Program (RCIP).

Under the third National Development Plan (2020/21–2024/25) (NDPIII), Uganda has adopted a quasi-market approach in which 'government needs to increase efficient and planned participation in the economy in order to direct development'. The National Broadband Infrastructure Blueprint will provide MoICT&NG and its agencies as well as private and public sector stakeholders with a consistent and known framework for the policy, regulation, planning, deployment and management of broadband infrastructure, including its spectrum. A clear and consistent framework will be a major step in actualising the aspirations of the Digital Uganda Vision (2021), which include improved global competitiveness and attracting investments to enable universal access to broadband.

The study was framed in terms of the broadband value chain, enabling a more granular examination of what is at play at each stage of the value chain. This value chain splits the distinctive segments that include content rights, online services, enabling technologies, connectivity, user-interface and demand for broadband. This approach makes it easier to link gaps and strengthen weak links in the value chain to the broadband ecosystem so that better policy, institutional arrangements, laws and regulations can be designed. Using a consistent value chain approach also means that Uganda's current status can be benchmarked against that of other countries. Countries that employ best practice in parts of the value chain and ecosystem become points of reference as Uganda looks to refine its approach to broadband. Examples of such countries within Africa include Mauritius, South Africa and Ghana and, outside Africa, Korea, New Zealand and Australia, while much more advanced countries also provide good lessons.

Uganda's economy has been negatively affected by the COVID-19 pandemic, with lower production and consumption and a reduction in remittances. The COVID-19 pandemic, however, highlighted the importance of the information and communications technology (ICT) sector and demonstrated the efficiency gains that the digitalisation of work processes can bring. What sets the ICT sector apart is its role as an economic enabler. ICT processes can bring efficiencies to all other sectors of the economy, ranging from mining to e-government. Greater broadband penetration and use is linked to increased productivity, employment and economic growth.

Uganda urgently needs investment in order to drive the digital transformation across all facets of the economy. Investment requirements in Uganda range from better access to broadband infrastructure to cheaper smartphones to data centres. Because of the need for an increase in locally stored content and service provisioning with less reliance on out-of-country core services and related third parties, infrastructure planning (internet exchange points [IXPs], data centres, content distribution networks [CDNs]) is a critical piece of the broadband superstructure to allow online services to remain available in the event of internet blackouts.

THE BASELINE

The 'first mile', international connectivity to neighbouring countries, is adequate. The international bandwidth used, however, lags behind that of leading countries in the region, pointing to significant opportunity for growth in Uganda. Bandwidth usage is driven by content providers and internet backbone providers. Achieving parity with countries such as Kenya will require releasing Uganda from the inhibiting factors identified in this study.

The 'middle mile', comprising the key elements of national backbones, IXPs, CDN caches and data centres, still has many limitations. While fibre routes are an important indicator, access to fibre nodes (where users can be connected) is limited, with only 29% of the population living within 10 km of such nodes. Uganda has only one IXP and one carrier-neutral data centre. Raxio Data Centre is Uganda's first tier-III carrier-neutral data centre. Investment in national fibre routes and increased fibre node density will improve middle-mile connectivity and support wider and faster last-mile connectivity.

The 'last mile', where the Internet reaches the end-user through local access networks, faces multiple challenges. Mobile broadband is cheap in absolute terms but not affordable in relative terms. Uganda is the 12th least-expensive country in regards to 300 MB and 1 GB monthly usage out of 54 countries in Africa. However, expressed in terms of gross national income (GNI) per capita, Uganda ranks only 27th and 28th, respectively. Broadband adoption is low despite good broadband coverage and relatively fast download speeds. Various factors point to lack of affordability as one of the main obstacles to wider broadband adoption.

Smartphone penetration is low. Only 30% of phones in Uganda are smartphones (UCC, June 2021). Smartphone penetration is impacted by affordability, availability of fast mobile broadband and ability to charge phones at home. Demand for broadband is limited, pointing to a high growth potential. MTN Uganda's data for the financial year ending in December 2020 reveals that only one-third of mobile subscribers are active data users. Mobile is still mostly a voice and SMS market, and broadband services still have considerable growth potential.

The low rate of digitalisation of the Uganda economy and government administration point to environmental considerations not being a top priority. Globally, there is increased advocacy for institutions to carry out environmentally friendly operations, which has led to the increased use of digital transactions, such as paperless invoices, leading ultimately towards a cashless economy. Other examples include a focus on energy-efficient and environmentally conscious construction.

THE CHALLENGE OF COST

It is important for the government to see the ICT sector as an engine for growth and not as a mechanism to extract taxes. Companies in the ICT sector in Uganda pay more taxes than companies from other sectors. Excise duties on airtime, value-added services and mobile money all place a higher tax burden on the ICT sector relative to the rest of the economy. This distorts investment and slows down the digital transformation of the economy. A 10% increase in

broadband adoption would mean higher gross domestic product (GDP) and more tax revenues for the state. A 10% higher broadband penetration could add up to USD 916 million in GDP and USD 108 million in taxes through productivity gains across all sectors. Dropping excise duties altogether combined with a 10% increase in broadband penetration would raise more revenues for the state, and this does not even account for additional multiplier effects throughout the economy.

THE ECOSYSTEM

With two foundational policy documents (Vision 2040 and the Digital Uganda Vision) and more than 10 other sector or sub-sector policies and guidelines, the number of policy documents that relate to the broadband value chain in Uganda is overwhelming, and not necessarily always consistent, making rationalisation and consolidation urgent so that all stakeholders can refer to a single clear source that articulates policy. Where derived documents from the main one are generated, the linkage and the reason for such expansion should be clear. The Digital Uganda Vision is now the core reference document under Vision 2040, and most of the earlier policies, outside the need to evaluate and learn lessons from them, should be retired. Revisions should ensure that the National Strategy on 4IR and other key sectoral strategies and operational policies are parented by the Digital Uganda Vision. Competition, critical infrastructure and rights-of-way (RoW) for public utilities (including dig-once requirements) are major national-level policies that need to be developed/concluded and implemented urgently.

The alignment of policy objectives across government ministries is still a challenge that needs to be addressed. The most visible examples raised by stakeholders relates to the efforts within MoICT&NG to reduce access costs to ICT goods and services for users and, running counter to this, actions from the Ministry of Finance and Economic Planning to raise more revenue by imposing more or higher taxes on ICT goods and services.

There is need for better coordination and collaborative approaches among the institutions that set direction and provide policy and operational oversight in the sector and to ensure that the perennial underfunding compounded by high taxation across the ICT sector is addressed. To create a unity of purpose, MoICT&NG may need an internal review to eliminate mission drift and 'turf wars' among its departments and agencies. The private sector is a key stakeholder and should be more routinely included in policy and strategy discussions. MoICT&NG should also take the lead in the periodic assessment of the broadband value chain and its contribution to Uganda's socioeconomic transformation.

One of the challenges MoICT&NG and all other arms and levels of government face is the shortage of competent human resources due to competition for such people from the private sector. Measures, such as remuneration outside the standard civil service pay structure, should be implemented in order to retain the professional competences required to capacitate and service ministries, departments and agencies' (MDAs') transition to a fully integrated e-government system that is citizen-centric. The absence of adequate competent human resources in the ICT arena is especially acute across other ministries and district local governments (DLGs), the key points of delivery of e- services. The demands of the Parish-centric Socio-economic Development Model underscore the urgency of addressing this cross-cutting challenge.

While Uganda has come a long way in establishing the legal and regulatory environment to support broadband penetration and adoption, much still needs to be done to address various disabling gaps and barriers. It is important to create a more flexible and easy licensing regime that allows for more innovation and competition especially in the services markets and in areas that are underserved. The establishment of an efficient and fair regulatory regime for obtaining rights of way (RoW) in collaboration with all interested parties is also key. The sharing of facilities to reduce CAPEX and OPEX and resultant end-user prices needs to be more effectively enforced. Intellectual property rights (IPR) laws need to be reviewed keeping in mind the changes brought about by the broadband value chain and matters such as artificial intelligence and the importance of data, among others. Similarly, the legal and regulatory regimes that impact on the delicate balance of protecting rights of free speech and the surveillance mechanisms available should be reviewed. Finally, cross-cutting laws that extend beyond the ICT sector to ensure a more holistic approach to establishing a good ecosystem should be promulgated as a matter of urgency. These include laws addressing competition, consumer protection and critical infrastructure.

SPECTRUM

Uganda, through the Uganda Communications Commission (UCC), has developed a new frequency allocation table that is generally consistent with current international best practice. Moving ahead, it is important to provide an online version that is constantly kept up to date and contains all key notes, references and information to guide all stakeholders. Allocating a healthy spectrum mix for different applications creates opportunity for alternative approaches and technologies to ensure universal broadband access in different environments and different population densities. As an example, TV white space (TVWS) in the 470 to 694 MHz UHF band will also support the needs for coverage in low-density rural areas for alternative access models, such as wireless internet service providers (ISPs) and community networks. In addition, spectrum for WiFi in the 6 GHz band will provide valuable capacity for already-congested WiFi networks and allow offloading from congested mobile networks to WiFi networks. Guiding principles for spectrum allocation need to be established so that any approach used at any particular time ensures a balance among the desired outcomes of increasing broadband access at prices affordable to consumers, ensuring efficient utilisation, ensuring fair competition, encouraging innovation and eliminating hoarding. It should be particularly noted that auctions designed to maximise state revenues from spectrum can be counter-productive with respect to the other objectives of the guiding principles and will leave consumers at a disadvantage.

THE BROADBAND BLUEPRINT

The purpose of the Broadband Blueprint is to lay out a plan using a set of action points that need to be implemented to extend broadband access and use to all Ugandans. The table below summarises the key activities required to progress Uganda to the desired state of access and connectivity over the next 10 years. These are split into the three areas of improving the broadband ecosystem, establishing quality of service (QoS) requirements and expanding coverage. A cross- reference is made to the main report, where the full background and rationale leading to each action item is provided.

Intervention	Action item	Section	Time horizon
Improving the Broadband Ecosystem			
Broadband policies	Rationalisation of broadband policies to establish a single, clear policy source to which operational policies and strategies are parented	5.4	Short term: 1–2 years
	Support initiatives to ensure consistency in policy outcomes, e.g. that broadband policies are not contradicted by tax policies	5.4	Medium term: 3–5 years
	Develop a revised open data policy	5.4	Immediate
	Develop a cross-sector RoW policy and promulgate any necessary amendments to the communications and land laws	7.1.4	Immediate
	Adopt the Radio Spectrum Management Policy of 2019 (as guidelines)	7.1.5	Immediate
Legal and regulatory	Repeal of sector-specific taxation	3.1 & 3.2	Medium term: 3–5 years
	Review licensing guidelines (for services and spectrum) to include sandbox provisions that encourage more innovation in the sector and provisions setting out services that may be provided without a license	7.1.1	Short term: 1–2 years
	Enforce the competition regulations and finalise the competition and consumer protection law	7.1.2	Immediate
	Finalise the facilities sharing guidelines and begin consultations on cross-sector facilities sharing	7.1.3	Immediate
	Begin consultations on feasible RoW regulations	7.1.4	Short term: 1–2 years
	Enforce consumer protection regulations and finalise the competition and consumer protection law	7.1.7	Immediate
	Develop open data regulations targeting the UCC and infrastructure providers	5.4 & 7.6	Immediate
	Review laws and regulations related to content	7.8	Medium term: 3–5 years
	Develop Critical infrastructure Act to facilitate the protection of critical infrastructure across the board	7.10	Short term: 1–2 years
	Update the frequency table	8	Immediate

Intervention	Action item	Section	Time horizon
Institutional arrangements	If the development of the digital economy is a goal, line ministries need to receive adequate funding to fulfil their mandates.	6.1	Medium term: 3–5 years
	Clear targets for government departments to minimise inter- governmental conflict and stone-walling (e.g. getting data from UCC)	6.1	Short term: 1–2 years
	Develop internal skills within ministries and government departments	6.2	10 years
	Consultation with the private sector	6.3	Immediate
Establishing Quality of Service (QoS) Requirements			
	Design QoS requirements based on application/sector/purpose that takes into account the additional costs of higher QoS requirements for non- profitable areas	8	2 years
Improving Spectrum Management			
Spectrum	Design alternative spectrum models to encourage innovation (see, for e.g., the New Zealand case study)	8.6	Short term: 1–2 years
	Support community networks through tools such as license-exempt spectrum, especially in the 17 GHz, 24 Ghz and 60 GHz bands	8.6 & 8.9	Immediate
	License low earth orbit (LEO) technology to provide backhaul for small wireless operators	8.10	Short term: 1–2 years
	Pilot high altitude platform system (HAPS) technology to see if it is a feasible option to provide IMT services in remote regions	8.10	Short term: 1–2 years
	Create a social purpose international mobile telecommunications (IMT) spectrum license to support community-operated cellular networks in the 800 MHz, 2600 MHz and 3500 MHz bands	8.11	Short term: 1–2 years
Expanding Coverage			
Radio access network (RAN) sites	10-year investment plan to rollout fibre and RAN sites	9.3	10 years
Fibre			

The Uganda Broadband Portal (UBP) provides users with a single window to assess the current status of broadband access and plan interventions to expand broadband coverage. This portal enables the generation of an evolving picture as data are updated periodically and enables the planning of new fibre routes or RAN locations to ensure broadband access in identified locations. In addition to generating coverage maps, the portal also provides cost calculations. The portal can be made available to the licensees and the public.

A total of investment USD 70 million over the next 10 years is required to ensure that at least 90% of the population has access to either fixed or mobile broadband. There is a two-part strategy behind the 10-year investment plan to expand broadband coverage and quality.

The first part of the strategy is to invest USD 29 million in fibre first. New technologies such as 5G (and soon 6G) demand significant bandwidth that alternatives cannot supply. This is the estimated amount required to connect all district capitals to fibre. This investment will increase the backhaul capacity for RAN sites and incentivise 4G upgrades. The interventions add an additional 3,242 km of fibre, representing an increase of over 16% to the total amount of fibre available in Uganda. People living within a 10-km radius of a fibre node would be increased from 29% to 56%, and those living within 25 km from 67% to 94%.

The second part of the strategy is to subsidise the expansion of the RAN site rollout after the connection of all district capitals to fibre. Many potential locations for new RAN sites are commercially viable. By funding RAN sites only in year 6 of the investment plan, many (and hopefully most) commercially viable RAN sites would already be covered. The estimated subsidy required to increase the 4G population coverage from the current 72% to 92% is about USD 41 million. Uganda's universal access and service (UAS) fund, administered by the Rural Communications Development Fund (RCDF), will be responsible for this intervention. In total, 503 new RAN sites would be subsidised, bringing 4G coverage to 9 million more Ugandans.

It is evident that Uganda has all the underpinning requirements for an inclusive fully digitalised economy, provided there is consistent and coordinated political will and leadership to deal with the remaining barriers and gaps highlighted in this report. None of the gaps or challenges identified is insurmountable.

01

INTRODUCTION

The main objective of this assignment was to undertake a national broadband baseline study and subsequently develop a 10-year National Broadband Infrastructure Blueprint (2022/23 - 2032/33), which shall guide the planning, development, deployment and management of broadband infrastructure, including spectrum resources. This study is funded through the World Bank's RCIP.

Under NDPIII (2020/21–2024/25),[1] Uganda has adopted a quasi-market approach in which 'government needs to increase efficient and planned participation in the economy in order to direct development'. Uganda's Vision 2040 seeks 'A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country', and connectivity is recognised as one of the key enablers, with the specific statement that 'Uganda shall continuously build robust ultra-high speed, pervasive, intelligent and trusted high speed ICT infrastructure all over the country in line with the changing technologies'. It was observed as part of the development process of NDPIII that while Uganda has long relied on a purely private sector- led approach to development, the expected national outcomes were not being achieved, noting as one of the examples that 'Access to the Internet (specifically broadband) remains low due to limited coverage and the cost of accessing it remains high'.

The National Broadband Infrastructure Blueprint has been designed to provide MoICT&NG and its agencies as well as private and public sector players with a consistent and known framework for policy guidance, regulation, planning, deployment and exploitation within the broadband market. A clear and consistent framework will be a major step in actualising the aspirations of the Digital Uganda Vision (2021), which include attracting investments and improved global competitiveness.

1 - http://www.npa.go.ug/wp-content/uploads/2020/08/NDPIII-Finale_Compressed.pdf

The study was framed in terms of the broadband value chain, enabling a more granular examination of what is at play at each stage of the value chain and within the ecosystem, how this compares both to other countries and what is desirable and what actions need to be taken. This approach makes it easier to identify gaps and weak links in the value chain.

The analysis, recommendations and development of an online geographic information system (GIS)- based portal to guide the planning, implementation and monitoring of the development of broadband infrastructure was informed by:

- Extensive desk studies;
- Data provided by the UCC based on annual reporting from licensed service providers;
- Data provided by some of the licensed service providers;
- Internal documents from MoICT&NG and its agencies (UCC and the National Information Technology Agency-Uganda (NITA-U), including some policies and guidelines in development); and
- Stakeholder interviews (public and private sector).

A summary of the GIS portal – which is an easy-to-use interface that supports intervention planning, subsidy estimation and monitoring and evaluation – is presented up front in Chapter 2 because it has been used to generate the derived broadband coverage and fibre statistics used in this report. The portal is, however, discussed in more detail later in the report. Again as part of setting context, Chapter 3 discusses the political, economic, socio-cultural technological, legal and environment (PESTLE) factors of importance for investment and strategic management decisions, providing guidance for the chapters following.

Benchmarking in a regionally and globally competitive environment is important in terms of learning lessons and taking the steps required to position Uganda more competitively. Chapter 4 uses the broadband value chain to benchmark Uganda's performance, bringing out both the positive aspect and, very importantly, what Uganda needs to address. While this chapter focuses specifically on content rights, online services, connectivity (first, middle, last and invisible miles) as well as the user interface and demand for broadband, the following chapters delve more specifically into the ecosystem which can simultaneously have both enablers for and barriers to the achievement of national development aspirations.

Chapters 5, 6 and 7 analyse policies, strategies and guidelines that support broadband; institutional arrangements; and laws, regulations and other regulatory instruments. The approaches to spectrum management are a critical element in promoting or impeding the penetration and adoption of broadband, and Chapter 8 is devoted to this, using the updated (2021) National Frequency Table, drawing[2] on examples of good practice from several countries and also highlighting lessons related to spectrum auctions in a developing country context.

This leads into Chapter 9, the Broadband Blueprint. Drawing on all the discussions from the earlier chapters, the Blueprint provides a set of action points that need to be implemented to extend broadband access to all Ugandans, briefly outlining the methodology, the tools for the project and the recommendations of the study. The conclusions are given in Chapter 10, followed by references and various appendices.

2 - Pending formal approval and gazetting

02

THE MOICT&NG GEOGRAPHIC INFORMATION SYSTEM (GIS) PORTAL

The tool used to develop the Blueprint for broadband access and use in Uganda is a GIS portal developed for the Government of Uganda (GoU) by the consulting team. The UBP combines the following data sets into an easy-to-use interface that supports the intervention planning, subsidy estimation and monitoring and evaluation of UAS interventions:

• **Radio propagation model:** This is generated using CloudRF, using a -94dBm signal at a 12-km radius, based on tower locations obtained from the combined 4G coverage map received from UCC. It should be noted that increased accuracy could have been achieved if the engineering data for antenna elevation, power and radiation characteristics had been made available.

• **Spatial population data:** The population data are sourced from the Center for International Earth Science Information Network (CIESIN) at Columbia University. To create the high-resolution maps, machine learning techniques are used to identify buildings from commercially available satellite images. Then, general population estimates are overlaid based on publicly available census data and other population statistics. The resulting maps are the most detailed and actionable tools available for aid and research organisations.[3]

• **GIS administrative boundaries:** Uganda Bureau of Statistics (UBOS).

• **Survey data:** Uganda National Household Survey (UNHS; 2019/20).

3 - Centre for Humanitarian Data, Data Exchange v1.57.16, 2021. Webpage for Uganda: https://data.humdata.org/group/uga

Where needed by the reader or user of this report, the findings and recommendations of this report can be traced back to the source data and intermediate analyses through direct interaction with the UBP. The UBP is the investigative tool that brings together, sorts and analyses the data for the telecom sector.

All broadband coverage and fibre statistics used in this report are generated by this portal unless otherwise indicated. Statistics generated include geographic 4G coverage, 4G population coverage, an estimate of people not covered by 4G, the length of fibre routes and the number of people living within 10 km, 25 km and 50 km of a fibre node. The statistics are available for each sub-county, district, sub-region, region and Uganda as a whole. Figure 1 gives an example of a screen from the UBP and shows how broadband statistics can be explored by the different administrative units. Selecting a region will display the associated sub-regions in the box below. Selecting a sub-region will display the districts for that sub-region. The same applies for sub-counties within districts.

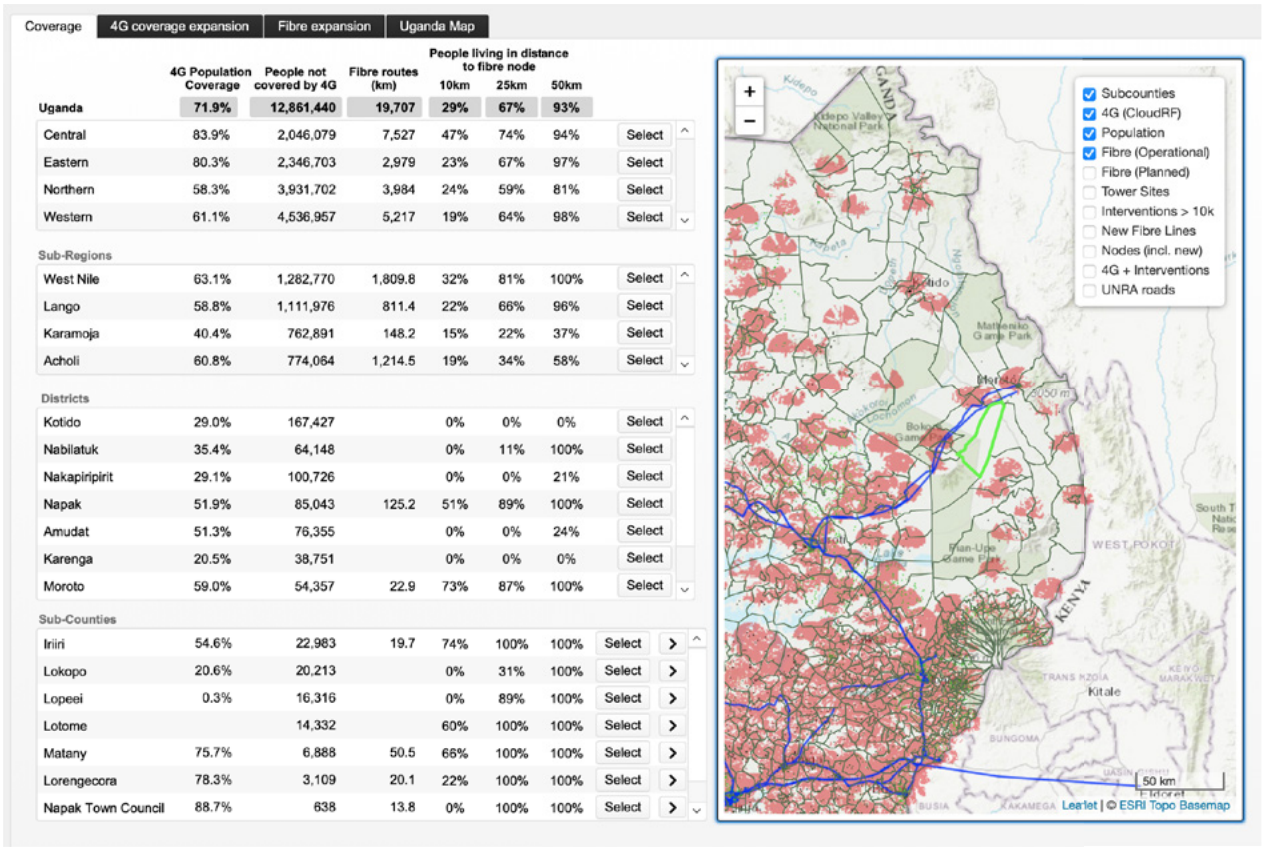
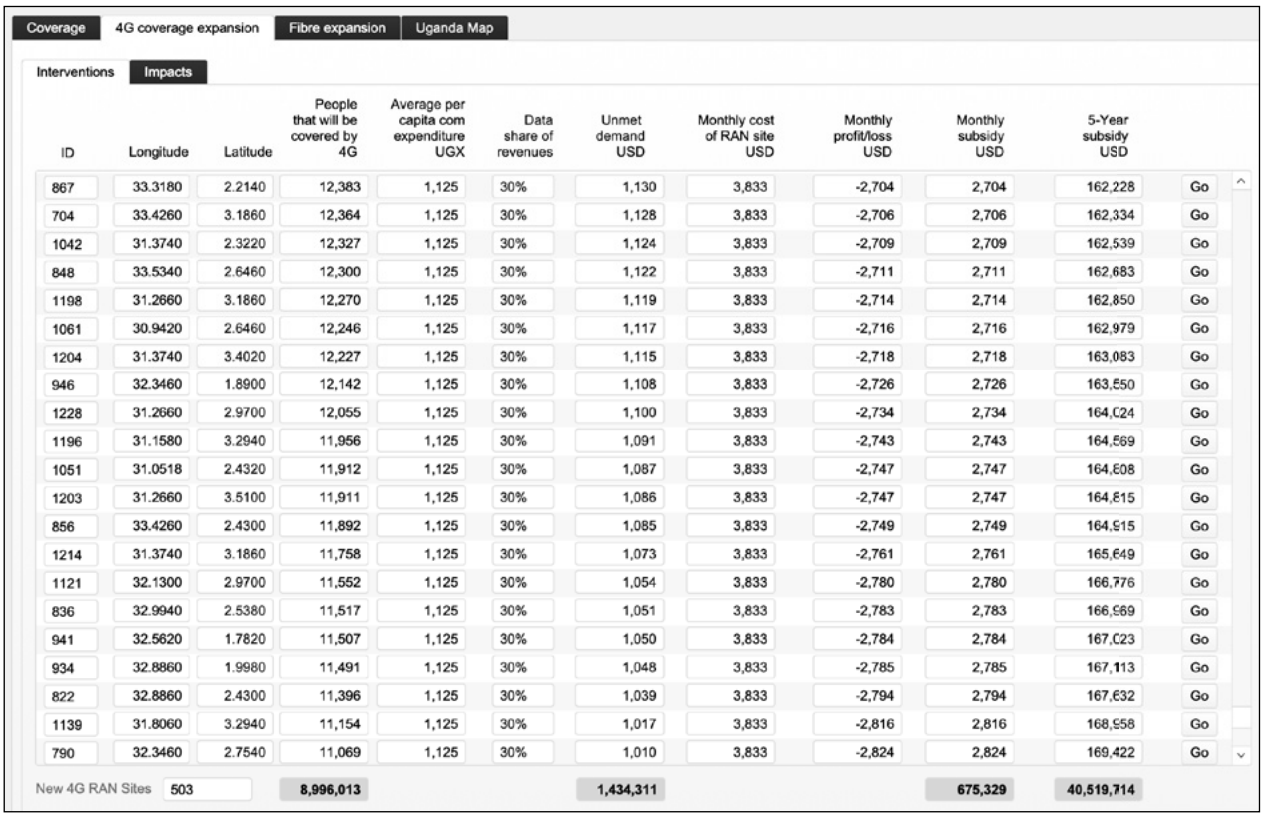


FIGURE 1: UBP – BROADBAND STATISTICS BY ADMINISTRATIVE BOUNDARIES

The portal systematically identifies locations for new RAN sites. It also estimates unmet demand, the cost of new RAN sites and the potential subsidy required to make a RAN site profitable. Figure 2 shows a screenshot of the identified interventions.



Coverage | 4G coverage expansion | Fibre expansion | Uganda Map

Interventions | Impacts

ID	Longitude	Latitude	People that will be covered by 4G	Average per capita com expenditure UGX	Data share of revenues	Unmet demand USD	Monthly cost of RAN site USD	Monthly profit/loss USD	Monthly subsidy USD	5-Year subsidy USD	
867	33.3180	2.2140	12,383	1,125	30%	1,130	3,833	-2,704	2,704	162,228	Go
704	33.4260	3.1860	12,364	1,125	30%	1,128	3,833	-2,706	2,706	162,334	Go
1042	31.3740	2.3220	12,327	1,125	30%	1,124	3,833	-2,709	2,709	162,539	Go
848	33.5340	2.6460	12,300	1,125	30%	1,122	3,833	-2,711	2,711	162,683	Go
1198	31.2660	3.1860	12,270	1,125	30%	1,119	3,833	-2,714	2,714	162,850	Go
1061	30.9420	2.6460	12,246	1,125	30%	1,117	3,833	-2,716	2,716	162,979	Go
1204	31.3740	3.4020	12,227	1,125	30%	1,115	3,833	-2,718	2,718	163,083	Go
946	32.3460	1.8900	12,142	1,125	30%	1,108	3,833	-2,726	2,726	163,550	Go
1228	31.2660	2.9700	12,055	1,125	30%	1,100	3,833	-2,734	2,734	164,024	Go
1196	31.1580	3.2940	11,956	1,125	30%	1,091	3,833	-2,743	2,743	164,569	Go
1051	31.0518	2.4320	11,912	1,125	30%	1,087	3,833	-2,747	2,747	164,808	Go
1203	31.2660	3.5100	11,911	1,125	30%	1,086	3,833	-2,747	2,747	164,815	Go
856	33.4260	2.4300	11,892	1,125	30%	1,085	3,833	-2,749	2,749	164,915	Go
1214	31.3740	3.1860	11,758	1,125	30%	1,073	3,833	-2,761	2,761	165,649	Go
1121	32.1300	2.9700	11,552	1,125	30%	1,054	3,833	-2,780	2,780	166,776	Go
836	32.9940	2.5380	11,517	1,125	30%	1,051	3,833	-2,783	2,783	166,969	Go
941	32.5620	1.7820	11,507	1,125	30%	1,050	3,833	-2,784	2,784	167,023	Go
934	32.8860	1.9980	11,491	1,125	30%	1,048	3,833	-2,785	2,785	167,113	Go
822	32.8860	2.4300	11,396	1,125	30%	1,039	3,833	-2,794	2,794	167,632	Go
1139	31.8060	3.2940	11,154	1,125	30%	1,017	3,833	-2,816	2,816	168,958	Go
790	32.3460	2.7540	11,069	1,125	30%	1,010	3,833	-2,824	2,824	169,422	Go
New 4G RAN Sites	503		8,996,013			1,434,311			675,329	40,519,714	

FIGURE 2: UBP – RAN SITE INTERVENTIONS FOR UGANDA

The portal also shows the current and planned fibre infrastructure. The user can identify fibre routes that would improve broadband speeds for 4G services. Figure 3 displays the map view of the portal, displaying fibre routes and 4G coverage. Interventions can be analysed within the sub-county framework. Figures 4 and 5 display the sub-county as a list and with a map. These views can be used to analyse the best placement of new RAN sites in more detail. Any view of the portal can be sorted by any field, such as by monthly subsidy required. The layout can also be searched for interventions that do not require a subsidy. Records can be searched by any field.

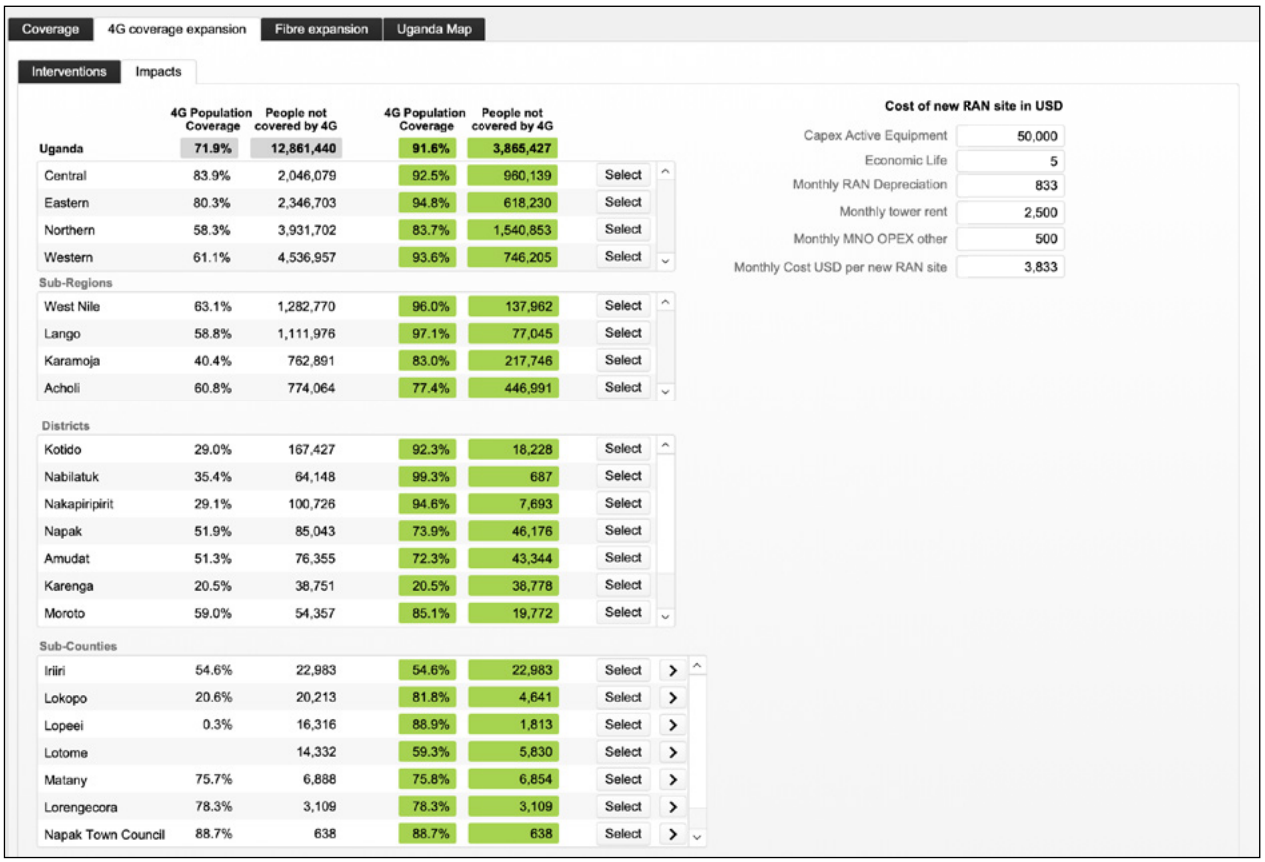


FIGURE 3: UBP – IMPACT OF RAN SITE INTERVENTIONS

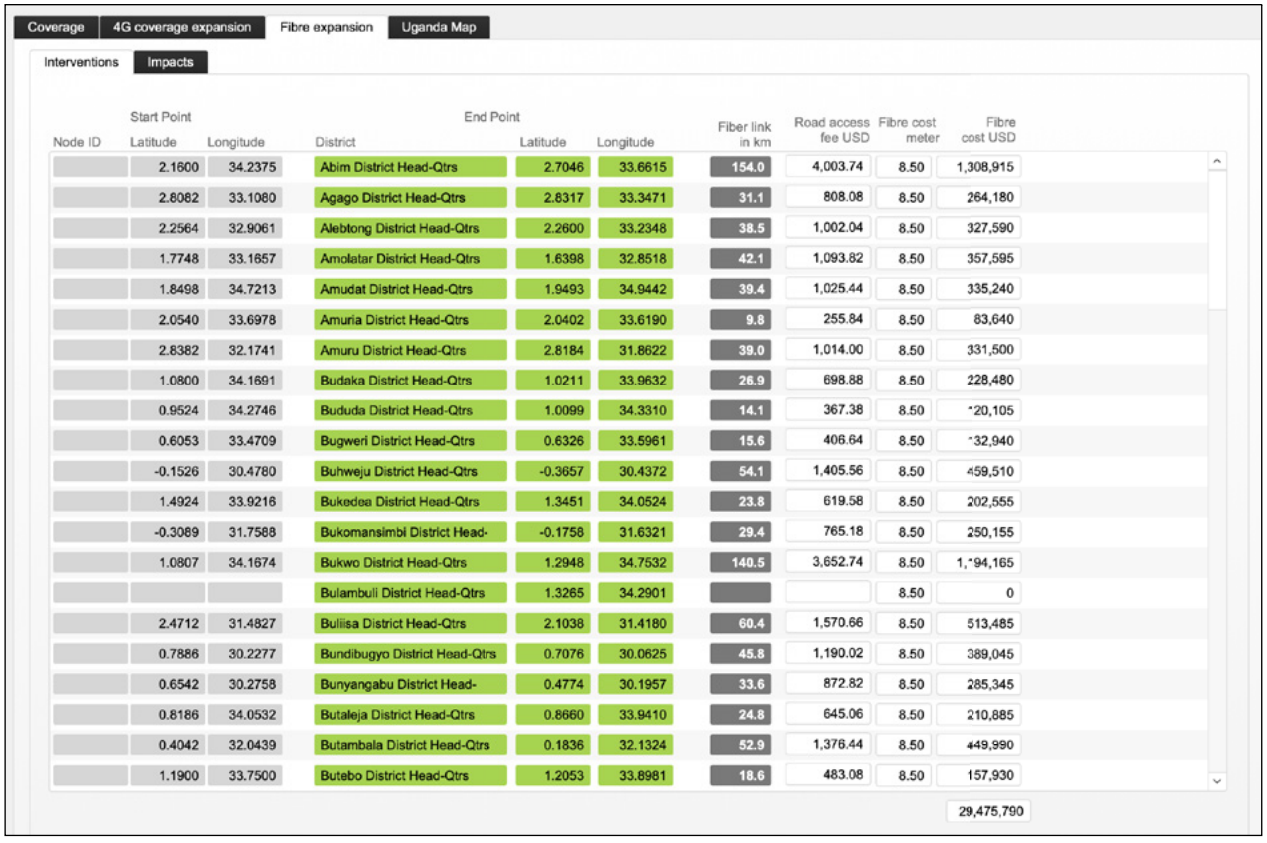


FIGURE 4: UBP – NEW FIBRE LINK INTERVENTIONS

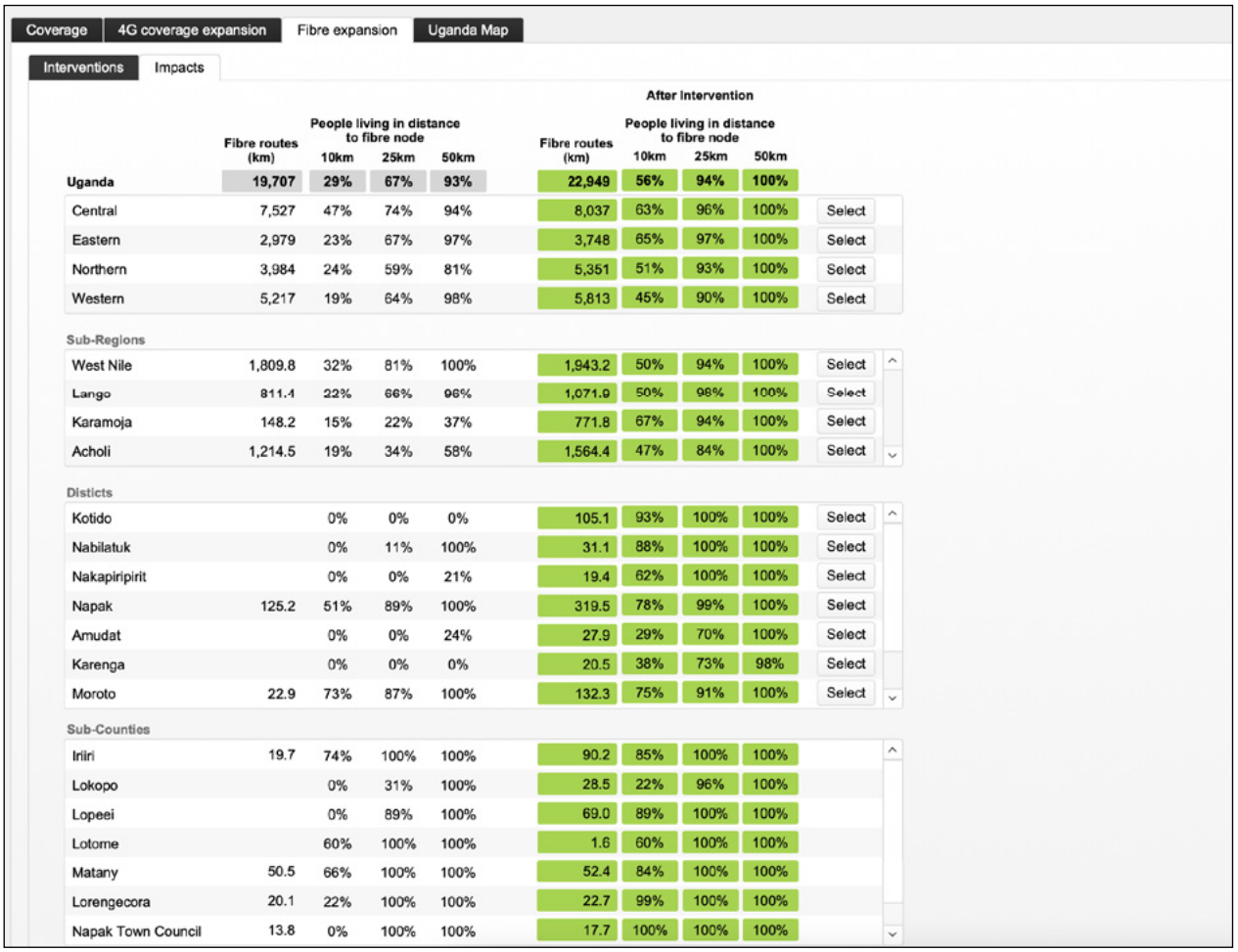


FIGURE 5: UBP – IMPACT OF NEW FIBRE LINK INTERVENTIONS

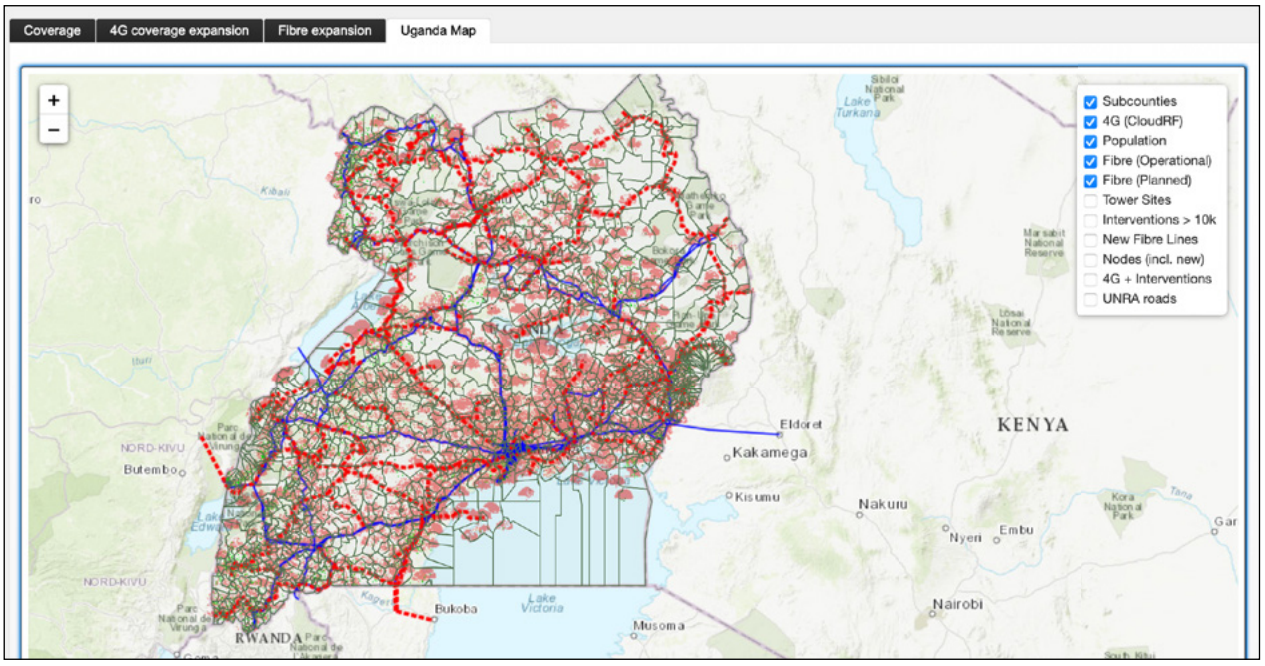


FIGURE 6: UBP – BROADBAND MAP OF UGANDA

Region	Sub Region	District	Sub-County	Population	Size square km	Population Density	Geographic 4G Coverage	Population 4G Coverage	People not covered by 4G	Population within distance of Fibre node 10km	25km	50km
Northern	Acholi	Gulu	Awach	25,636	311	83	20.6%	38.1%	15,868	0%	46%	100%
Northern	Acholi	Gulu	Bungatira	19,572	141	139	80.8%	96.0%	789	62%	100%	100%
Northern	Acholi	Gulu	Paicho	32,121	447	72	29.5%	44.0%	17,990	0%	38%	100%
Northern	Acholi	Gulu	Palaro	15,861	456	35	16.2%	49.4%	8,029	0%	1%	100%
Northern	Acholi	Gulu	Patiko	24,067	278	87	27.1%	39.8%	14,486	6%	69%	100%
Northern	Acholi	Gulu	Unyama	5,173	91	57	44.2%	65.2%	1,802	29%	100%	100%
Northern	Acholi	Kitgum	Kitgum Matidi	25,325	179	141	55.0%	65.8%	8,665	0%	0%	0%
Northern	Acholi	Kitgum	Labongo	19,128	272	70	30.5%	46.3%	10,279	0%	0%	0%
Northern	Acholi	Kitgum	Labongo	14,284	195	73	20.8%	36.2%	9,114	0%	0%	0%
Northern	Acholi	Kitgum	Labongo	13,886	116	120	72.9%	92.1%	1,097	0%	0%	0%
Northern	Acholi	Kitgum	Lagoro	18,974	292	65	17.2%	20.2%	15,143	0%	0%	0%
Northern	Acholi	Kitgum	Mucwini	25,894	542	48	34.1%	82.2%	4,598	0%	0%	0%
Northern	Acholi	Kitgum	Namokora	17,228	389	44	38.8%	21.9%	13,450	0%	0%	0%
Northern	Acholi	Kitgum	Omiya Anyima	25,130	313	80	27.2%	49.0%	12,827	0%	0%	0%
Northern	Acholi	Kitgum	Orom	32,765	1,820	18	9.2%	39.0%	19,978	0%	0%	0%

FIGURE 7: UBP – SUB-COUNTY-LEVEL BROADBAND STATISTICS

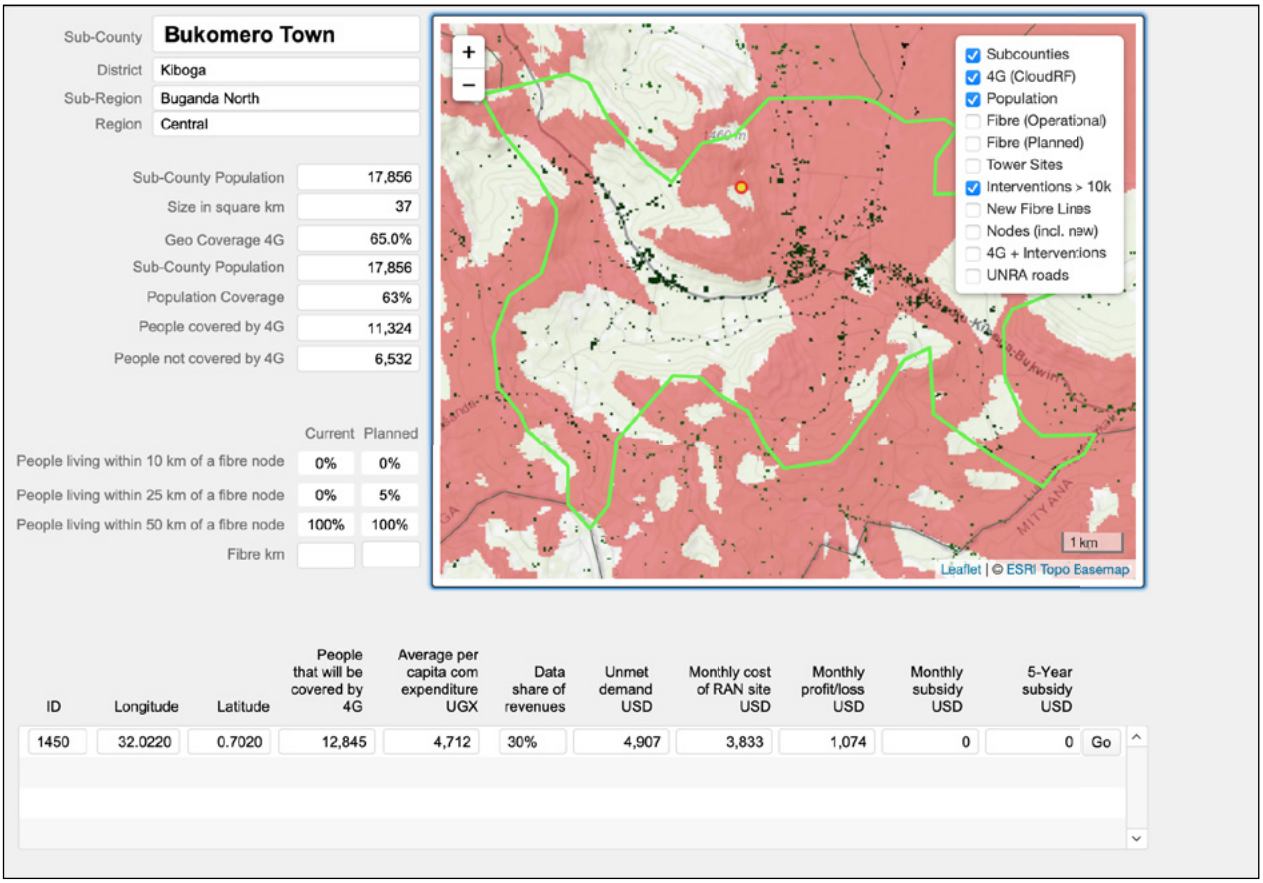


FIGURE 8: UBP – SUB-COUNTY-LEVEL INTERVENTION PLANNING

ID	Longitude	Latitude	Sub-County	District	Sub Region	People that will be covered by 4G	Average per capita com expenditure UGX	Data share of revenues	Unmet demand USD	Monthly cost of RAN site USD	Monthly profit/loss USD	Monthly subsidy USD	5-Year subsidy USD	
431	34.7220	1.8900	Moruita	Nakapiripirit	Karamoja	21,012	1,125	30%	1,917	3,833	-1,917	1,917	115,003	Go
891	33.4260	1.9980	Akeriau	Amuria	Teso	14,965	1,576	30%	1,912	3,833	-1,921	1,921	115,261	Go
1718	30.2940	-0.2700	Engaju	Buhweju	Ankole	12,468	1,889	30%	1,909	3,833	-1,924	1,924	115,441	Go
1383	30.9420	1.1340	Kabwoya	Kikuube	Bunyoro	12,379	1,889	30%	1,896	3,833	-1,938	1,938	116,263	Go
1787	30.1860	-0.8100	Ihunga	Ntungamo	Ankole	12,311	1,889	30%	1,885	3,833	-1,948	1,948	116,884	Go
1001	31.3740	1.5660	Kitoba	Hoima	Bunyoro	12,307	1,889	30%	1,885	3,833	-1,949	1,949	116,922	Go
413	34.7205	1.2547	Bukwo	Bukwo	Elgon	14,747	1,576	30%	1,884	3,833	-1,949	1,949	116,932	Go
1311	30.5100	0.1620	Kabambiro	Kamwenge	Tooro	12,288	1,889	30%	1,882	3,833	-1,952	1,952	117,094	Go
1303	30.2940	0.3780	Kasenda	Kabarole	Tooro	12,257	1,889	30%	1,877	3,833	-1,956	1,956	117,379	Go
874	33.1020	2.4300	Abia	Alebtong	Lango	20,545	1,125	30%	1,874	3,833	-1,959	1,959	117,560	Go
1306	30.4020	0.1620	Kamwenge	Kamwenge	Tooro	12,189	1,889	30%	1,867	3,833	-1,967	1,967	118,003	Go
1714	30.4020	-0.1620	Kicheche	Kitagwenda	Tooro	12,158	1,889	30%	1,862	3,833	-1,972	1,972	118,291	Go
808	32.5620	2.2140	Loro	Oyam	Lango	20,388	1,125	30%	1,860	3,833	-1,974	1,974	118,418	Go
354	34.0740	0.9180	Himutu	Butaleja	Bukedi	14,529	1,576	30%	1,857	3,833	-1,977	1,977	118,607	Go
878	33.1020	2.2140	Barr	Lira	Lango	20,270	1,125	30%	1,849	3,833	-1,984	1,984	119,065	Go
1233	30.9420	2.9700	Vurra	Arua	West Nile	20,229	1,125	30%	1,845	3,833	-1,988	1,988	119,291	Go
1192	30.9420	3.2940	Oleba	Maracha	West Nile	20,192	1,125	30%	1,842	3,833	-1,992	1,992	119,491	Go
1201	31.1580	3.4020	Lodonga	Yumbe	West Nile	20,121	1,125	30%	1,835	3,833	-1,998	1,998	119,883	Go
1197	31.1580	3.1860	Omugo	Terego	West Nile	20,088	1,125	30%	1,832	3,833	-2,001	2,001	120,062	Go

FIGURE 9: UBP – INTERVENTION LIST FOR NEW RAN SITES

Start Point		End Point			Fiber link in km	Road access fee USD	Fibre cost meter	Fibre cost USD	Comment
Latitude	Longitude	District	Latitude	Longitude					
0.4369	33.2029	Buvuma District Head-Qtrs	0.2732	33.2390	18.6	482.30	8.50	157,675	
0.9501	33.1118	Kayunga District Head-Qtrs	0.7171	32.8951	41.9	1,089.40	8.50	356,150	
0.9508	33.1114	Buyende District Head-Qtrs	1.1571	33.1637	29.2	760.24	8.50	248,540	
0.6053	33.4709	Luuka District Head-Qtrs	0.7668	33.3298	28.5	739.70	8.50	241,825	
0.6053	33.4709	Bugweri District Head-Qtrs	0.6326	33.5961	15.6	406.64	8.50	132,940	
0.7817	33.6139	Kaliro District Head-Qtrs	0.9158	33.4945	31.3	814.06	8.50	266,135	
1.4924	33.9216	Pallisa District Head-Qtrs	1.1695	33.7088	49.5	1,286.48	8.50	420,580	
0.7817	33.6139	Kibuku District Head-Qtrs	1.0466	33.8051	42.3	1,100.58	8.50	359,805	
1.0807	34.1674	Manafwa District Head-Qtrs	0.9524	34.2746	26.3	683.02	8.50	223,295	
1.0800	34.1691	Budaka District Head-Qtrs	1.0211	33.9632	26.9	698.88	8.50	228,480	
0.8186	34.0532	Butaleja District Head-Qtrs	0.8660	33.9410	24.8	645.06	8.50	210,885	
0.7817	33.6139	Namutumba District Head-Qtrs	0.8603	33.6869	19.3	501.02	8.50	163,795	
0.4720	34.0884	Namayingo District Head-Qtrs	0.3449	33.8721	36.0	935.74	8.50	305,915	
1.0807	34.1674	Namisindwa District Head-Qtrs	0.9071	34.3573	41.8	1,086.28	8.50	355,130	
0.9524	34.2746	Bududa District Head-Qtrs	1.0099	34.3310	14.1	367.38	8.50	120,105	
1.0807	34.1674	Bukwo District Head-Qtrs	1.2948	34.7532	140.5	3,652.74	8.50	1,194,165	

FIGURE 10: UBP – INTERVENTION LIST FOR FIBRE ROUTES

The portal can be made available to licensees and to the public. Many of the new RAN sites identified are commercially viable and would not require a subsidy. Making this information available to the public would provide facts for policymakers and regulators to encourage private licensees to identify profitable network extensions, thus providing 4G coverage without financial support through the universal service fund or via the state.

03

POLITICAL, ECONOMIC, SOCIO-CULTURAL, ENVIRONMENTAL AND LEGAL (PESTLE) FACTORS OF THE BROADBAND ECOSYSTEM

This section presents a PESTEL analysis of the factors of importance for investment and strategic management decisions. The PESTEL analysis is used in this chapter as a guide to the following chapters, which will analyse the various components in more detail. SWOT stands for strengths, weaknesses, opportunities and threats. It is used as another lens on the analysis of the data in addition to the PESTEL framework.

3.1. POLITICAL ASPECTS

NDPIII identifies the ICT sector as a strategic pillar for economic growth. The GoU developed NDPIII, which focuses on leveraging both government and private sector strengths for the socioeconomic growth of the country. NDPIII lists the key pillars required to achieve its objectives. One of the key pillars is ICT and innovation. It is important to note that this is the first time the GoU has considered ICT as a programme/key pillar in the national planning of the nation. Uganda's ICT policies will be discussed in more detail in Chapter 5.

Uganda has made some significant political decisions over the last 20 years that have led to significant increases in the growth of broadband penetration. These include the following:

• Opening up the sector to full competition in the early 2000s and at the same time introducing technology-neutrality in licensing;
• The policy decision on using the national budget to implement the national fibre backbone that triggered commercial providers to start rolling out their own national fibre networks for the first time. The new liberalisation policy also enabled non-telecom companies, such as power companies, to put their extensive fibre on the market;
• Recognising universal broadband as a national development priority in the National Vision 2040 and the related NDPs.
• Through the second and third NDPs, bringing together the ministries, agencies and other stakeholders to develop a coordinated approach to addressing sector priorities. This started with the ICT Sector Working Group (ICTSWG) under NDPII (2014/15–2019/20), which has now transitioned to the Digital Transformation Programme Working Group (DTPWG) under NDPIII (2020/21–2024/25).

Uganda, however, urgently needs investment in order to drive digital transformation across all facets of the economy. Because of the need for increased locally stored content and service provisioning with less reliance on out-of-country core services and related third parties, infrastructure planning is a critical piece of the broadband superstructure in order to allow for online services to continue running in the event of internet blackouts.

Investment is urgently needed in several components of the internet value chain. While international connectivity is adequate, usage lags behind other countries such as Kenya. Middle-mile infrastructure, such as fibre nodes, is too sparse, and only 29% of Ugandans are within 10 km of a fibre node. Uganda is one of the most expensive countries in Africa for a mobile operator. The high cost of operation is a contributing factor to the high cost of data, lowering usage and impacting along the value chain to the low international bandwidth usage. Chapter 4 contains a more in-depth analysis of the challenges facing the Ugandan ICT sector.

Companies in the ICT sector in Uganda pay more taxes than companies from other sectors. Apart from the levies and fees imposed by the regulator to fund the supervision of the sector, excise duties are collected on ICT services. Currently, a 12% excise duty is collected on airtime for mobile and landline use. The combination of the excise duty and value-added tax (VAT) means an effective tax rate of 30%. Value-added services are taxed at 20%, and there are mobile money fees; even the value of mobile money transactions is taxed.

April 2002	July 2014	July 2018	July 2018
Airtime 7%	12% on Airtime excl. data	12% on Airtime excl. data	12% on Airtime including data
	VAS 20%	VAS 20%	VAS 20%
	Landlines 5%	Landlines 12%	Landlines 12%
	MM fees 10%	MM fees 15%	MM fees 15%
		1% MM tax on transaction value of payments, transfers & withdrawals*	1% MM tax on transaction value of payments, transfers & withdrawals*
		OTT tax 200UGX per day or 6000 UGX per month	Removed

TABLE 1: ICT SECTOR TAXES IN UGANDA

In 2018, Uganda adopted a tax on over-the-top (OTT) social media services. The tax was a daily levy on consumers of UGX200. Effective 1 July 2021, according to The Excise Duty (Amendment) Act of 2021, the OTT tax was replaced with a 12% levy on the price of internet data, excluding data for the provision of medical and education services and on the price of value-added services. The change to a more general data tax was made in part because consumers were using virtual private networks (VPNs) to avoid paying the OTT tax. Payment of the data tax is made at the time of purchase. It is expected that the tax will raise Ushs 60 billion in the 2021/22 fiscal year. The negative impact of excessive taxation can be observed in the financial years 2018/19 and 2019/20, when revenues from excise duties initially increased by 50% and then declined.

		FY2015/16	FY2015/16	FY2015/16	FY2015/16	FY2015/16
Gross Revenues	**UGX billion**	**11,231**	**12,895**	**14,660**	**16,958**	**17,126**
Excise Duty Over The Top	UGX billion				49.5	59.7
	% of Gross revenues				0.29%	0.35%
Excise Duty Phone Talk Time	UGX billion	166.8	194.3	179.0	211.9	231.3
	% of Gross revenues	1.5%	1.5%	1.2%	1.2%	1.4%
VAT Phone Talk Time	UGX billion	181.9	205.3	213.4	200.3	154.8
	% of Gross revenues	1.6%	1.6%	1.5%	1.2%	0.9%
Levy on Mobile Money	UGX billion				157.2	100.6
	% of Gross revenues				0.9%	0.6%
Mobile money transfers	UGX billion	37.7	45.8	57.2	74.0	79.0
	% of Gross revenues	0.34%	0.36%	0.39%	0.44%	0.46%
Excise Duty International calls	UGX billion	34.2	34.0	33.3	34.9	27.1
	% of Gross revenues	0.30%	0.26%	0.23%	0.21%	0.16%
Total ICT sector- specific taxes + VAT	UGX billion	420.7	479.4	482.9	727.9	652.4
	YoY		14.0%	0.7%	50.7%	-10.4%
	% of Gross revenues	3.7%	3.7%	3.3%	4.3%	3.8%

TABLE 2: ICT SECTOR TAX AND EXCISE DUTY REVENUES

Our calculations show that 10% higher broadband penetration could add up to USD 916 million in GDP growth and USD 108 million in taxes through productivity gains across all sectors. Apart from these indirect gains, there would also be additional direct taxes from a flourishing ICT sector. It is important for the government to see the ICT sector as an engine for growth and not as a mechanism to extract taxes.

	Uganda	Sources
GDP 2020 USD million	37,370	WDI, 2021
Additional GDP USD million	919	Calculation based on ITU 2020 effect size for Africa of 2.46%
Tax to GDP ratio	11.7%	WDI, 2020
Additional tax USD million	107.93	Calculation

TABLE 3: IMPACT OF 10% HIGHER BROADBAND PENETRATION OF GDP GROWTH AND TAXATION

Dropping excise duties would lead to a 10% increase in broadband adoption, and then the state would have more, not less, tax revenues. In 2019/20, the OTT tax and the airtime excise duty (excluding data) of 12% raised UGX 290 billion for the state. A 10% increase in broadband penetration is likely to raise more in taxes, UGX 350 billion. It thus makes sense to tax the ICT sector as any other sector. This would lead to lower end-user cost and more investment and spur economic growth across the entire economy.

UGX billion	FY2019/20	Simulation
Excise duty over the top	59.7	
Excise duty phone talk time	231.3	
VAT phone talk time	154.8	154.8
Levy on mobile money	100.6	100.6
Mobile money transfers	79.0	79.0
Excise duty international calls	27.1	27.1
10% additional broadband penetration (USD 99.31 million)		350.3
Total ICT sector-specific taxes + VAT	652.4	711.8

TABLE 4: SIMULATION OF THE IMPACT OF DROPPING THE EXCISE DUTY ON AIRTIME

3.2. ECONOMIC ASPECTS

Uganda's economy has been negatively affected by the COVID-19 pandemic, with lower production and consumption and a reduction in remittances. The World Bank estimates that real GDP contracted by 1.1% in 2020 and that the services sector was particularly hard hit.[4] The COVID-19 pandemic also highlighted the importance of the ICT sector and demonstrated the efficiency gains that the digitalisation of work processes can bring. ICT has been identified as

4 - World Bank, 2021. Uganda Economic Update, 17th Edition, June 2021. https://openknowledge.worldbank.org/handle/10986/35689

one of the interventions to catalyse the recovery of the economy, such as promoting e-commerce, growing financial technology (fintech) penetration, leveraging the usage of e-services and the digitisation of manufacturing and agribusiness.

Uganda's liberalised approach to ICT infrastructure outlay creates opportunities for competition but also duplication. In Tanzania, for example, some broadband infrastructure rollouts are government-led, which reduces the capital expenditure from the telecommunications players and, in the short term, the end-user costs. However, this approach tends to lead to high prices over the medium to long term as well as subdued fibre rollout. Duplication of infrastructure creates redundancies for infrastructure disruptions through technical failure or natural disasters. The competition through duplicated infrastructure safeguards leads to market-related prices and efficient investments. Unnecessary duplication will be punished by the market as more efficient players will benefit and be able to charge lower prices.

The ongoing expansion and improvement of Uganda's broadband infrastructure is playing an important role in the country's economic development. In 2016, the Uganda Investment Authority published the ICT Sector Investment Profile, which listed the ICT sector as 'one of Uganda's fastest- growing sectors (at a speed of more than 25% in cumulative annual rate), recording double-digit growth over the last few years'. Since then, the over-taxation of the sector has led to a dramatic slow-down in investment and growth. Calculations based on UBOS data, presented in Table 5, shows that the direct contribution of the ICT sector to GDP decreased from 2.3% for the financial year 2015/16 to 1.8% in 2020/21 at current prices. In US dollar terms, the ICT sector contracted in 2014/15, 2016/17 and 2017/18. The sector growth in 2019/20 and 2020/21 was modest in US dollar terms.

	GDP at market prices		Contribution to GDP by ICT sector (ISIC J)				USD exchange rate
	Billion USD	Billion USD	Billion USD	%	Million USD	YoY	
2008/09	48,495	28.2	327	0.7%	190		1720
2009/10	54,117	26.7	482	0.9%	237	24.9%	2030
2010/11	64,760	29.7	707	1.1%	325	36.8%	2178
2011/12	69,825	27.7	993	1.4%	394	21.2%	2523
2012/13	74,924	29.9	1,382	1.8%	552	40.3%	2503
2013/14	82,771	32.0	1,812	2.2%	701	26.9%	2586
2014/15	91,582	35.2	1,748	1.9%	672	-4.0%	2600
2015/16	100,549	31.0	2,275	2.3%	701	4.3%	3246
2016/17	108,518	31.7	2,130	2.0%	623	-11.2%	3420
2017/18	120,485	33.4	1,965	1.6%	544	-12.6%	3611
2018/19	132,090	35.4	2,399	1.8%	644	18.3%	3728
2019/20	139,689	37.7	2,555	1.8%	690	7.2%	3704
2020/21	147,962	39.8	2,678	1.8%	720	4.4%	3718
Source:	UBOS	Calculations	UBOS	Calculations			BOU

TABLE 5: GROSS DOMESTIC PRODUCT BY ECONOMIC ACTIVITY CURRENT PRICES (BILLION SHILLINGS)

Accessible, reliable and affordable broadband internet is the foundation of the digital economy and digital inclusion. The economic literature states that improved broadband penetration is associated with substantial socioeconomic benefits, contributing to enhanced productivity, facilitating information exchange and improving service delivery across the economy.[5] Table 6 lists a range of studies that measure the macroeconomic effects of mobile broadband penetration, which range from 0.8% to 2.46% of additional GDP growth, for an increase of 10% in mobile broadband penetration (depending on a set of countries and the time period). The estimates for Africa are at the higher end, with 2.46% of additional GDP growth per 10% higher broadband penetration.

Authors	Countries	GDP growth, % for 10% higher broadband penetration
Czernich et al., 2009	OECD, 1996–2007	0.9–1.5
Koutroumpis, 2018	OECD, 2002–2016	0.82–1.4
OECD, 2011	EU countries, 1980–2009	1.1
Qiang et al., 2009	Low-income countries, 1980–2006	1.4
Scott, 2012	Low-income countries, 1980–2011	1.35
Endquist et al., 2018	Global, 2000–2015	0.6–2.8
ITU, 2020	Global	1.5
ITU, 2020	Africa	2.46

TABLE 6: IMPACT OF A 10% INCREASE IN MOBILE BROADBAND PENETRATION ON GDP GROWTH

The ICT sector's importance to the economy via productivity gains goes even further. A 10% increase in mobile broadband penetration in Uganda could lead to USD 846 million in additional GDP and USD 99.3 million in additional tax revenues per year based on the latest ITU (2020) modelling (Table 7).

Country	GDP 2019 USD million	Additional GDP USD million	Tax to GDP ratio %	Additional tax USD million
Malawi	7,667	189	17.3%	32.6
Kenya	95,503	2,349	15.6%	366.5
Rwanda	10,122	249	13.5%	33.6
Tanzania	63,177	1,554	11.8%	183.4
Uganda	34,387	846	11.7%	99.3
Zambia	23,065	567	15.2%	86.2
Sub-Saharan Africa	1,755,011	43,173	18.9%	8,159.7
Sources	WDI, 2020	Calculation based on ITU, 2020	Most recent available WDI, 2021	Calculation

TABLE 7: EFFECT OF A 10% INCREASE IN MOBILE BROADBAND PENETRATION ON SELECTED AFRICAN ECONOMIES

5 - International Telecommunications Union (2012). The Impact of Broadband on the Economy: Research to Date and Policy Issues. https://www.itu.int/ITU-D/treg/broadband/ITU-BB-Reports_Impact-of-Broadband-on-the-Economy.pdf

Realising the inevitability of broadband becoming a utility, many countries and cities have adopted policies to accelerate the penetration of broadband. A dig-once policy, for example, aims to have all major infrastructure programmes install fibre optic cables alongside other infrastructure channels. Austria, Belgium, Japan, New Zealand, the United Kingdom and the United States have already made significant strides in this area. In learning from other countries, Uganda needs to establish utility corridors starting with tunnels to be used by multiple utility providers and eventually task those providers to build fibre optic cables alongside utility construction.

Governments can further accelerate broadband adoption by making more spectrum available for broadband use. Ghana is currently revising its telecommunication licenses to provide more spectrum to mobile operators to lower data costs for consumers and increase broadband use.[6] Spectrum awarded temporarily during the COVID-19 pandemic by ICASA in South Africa demonstrated the effect that spectrum availability has on the cost of providing broadband.[7]

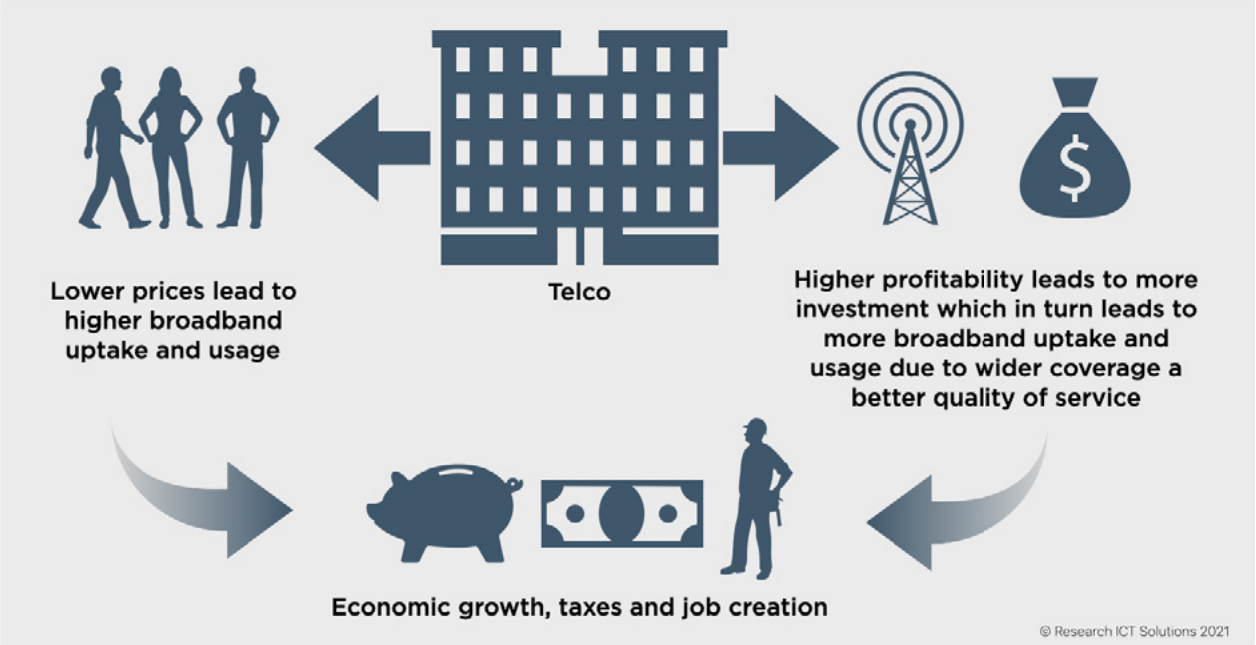


FIGURE 11: EASING OF ICT SECTOR-SPECIFIC TAXES TO BOOST THE ECONOMY

Often, the ICT sector is treated as a cash cow rather than a strategic sector for economic growth. Lowering taxes and regulatory fees also leads to the faster expansion of broadband services and wider usage. Ghana reduced its communication tax from 9% to 5% in September 2020 through the Communication Service Tax (Amendment) Act, 2020, Act 1025.[8] Tanzania recently scrapped excise duties on smartphones (HS code 8517.12.00).[9]

3.3. SOCIAL, TECHNOLOGICAL AND ENVIRONMENTAL ASPECTS

The COVID-19 global pandemic led to a drastic shift to digital for most organisations and businesses across both public and private sectors. This was driven mostly by the need to adhere to COVID-19 prevention measures, such as distancing and a reduction in person-to-person physical contact. Measures such as working from home created the drive for e-services. This has accelerated a mindset shift amongst users to digital as a key facet of their daily lives.

6 - https://globalfinancialdigest.com/ghana-moves-to-expand-Internet-access-to-relax-telecom-licensing-rules/
7 - https://www.iol.co.za/business-report/companies/icasa-warned-over-harm-to-economy-with-plans-to-wind-down- spectrum-bfd67392-4fca-4ec6-a249-059a96c21c1d
8 - https://www.ey .com/en_gl/tax-alerts/ghana-revises-communication-service-tax-rate
9 - https://taxnews.ey.com/news/2021-1261-tanzanias-parliament-passes-finance-bill-2021

Individuals 10 years +	Uganda	Rural	Urban	Male	Female
Internet use	6.1%	2.6%	15.4%	7.5%	4.8%
Computer use	2.5%	1.2%	6%	3.3%	1.7%
Source UBOS					

TABLE 8: UGANDA PANEL DATA SURVEY 2019/20 – INDIVIDUAL CHARACTERISTICS

The increase in use comes from a low base. A panel survey carried out by UBOS revealed that only 6.1% of individuals 10 years or older used the internet in 2019/20. The survey also revealed the rural/urban and gender divided in Uganda. Only 2.6% of rural inhabitants used the internet compared to 15.4% urban dwellers. Among men, 7.5% used the internet compared to only 4.8% of women. Social media is the main activity when Ugandans use the internet. A total of 83.6% of internet users used it for social networking, 39.9% for internet protocol (IP)-based telephony and only 2.7% for online shopping (UBOS, 2020).

Household Characteristics	Uganda	Rural	Urban
Main grid electricity	18.9%	5.2%	51%
Solar	38%	44%	44%
Firewood for cooking	73%	88%	29%
TV	19.2%	9.3%	42.6%
Radio	31.9%	33.4%	28.4%
Mobile phone	74%	68.8%	86.2%
Computer	2%	0.9%	4.6%
Source UBOS, p. 174			

TABLE 9: UGANDA PANEL DATA SURVEY 2019/20 – HOUSEHOLD CHARACTERISTICS

Computer use is even lower than internet use and displays the same rural and gender divides as internet use. The lower computer compared to internet use is because mobile is the predominant form of internet access in Uganda. A total of 85.7% of internet users access the internet on a mobile phone and only 11.9% on a computer, either at home or at work (UBOS, 2020). Other factors that drive low computer usage are the cost of ownership, the cost of internet access and the availability of electricity. Less than 19% of Ugandan households were connected to the main electricity grid in 2019/20 (UBOS, 2020).

The low rate of digitalisation of the Uganda economy and government administration point to environmental considerations not being a top priority. Globally, there is increased advocacy for institutions to carry out environmentally friendly operations, which has led to the increased use of digital transactions, such as paperless invoices, leading ultimately towards a cashless economy. Other examples include a focus on energy-efficient construction.

3.4. LEGAL ASPECTS

There are many laws and regulatory instruments that impact the rollout of broadband infrastructure in Uganda. These include the Constitution, which, among other things, provides for the protection of certain fundamental rights, such as the right to free speech. The most relevant legislation enacted by parliament impacting the rollout and use of broadband services in Uganda is the Uganda Communications Act, 2013 and the regulations and other regulatory instruments made under the Act by the UCC. In 2019, a set of 18 regulations was put forth to implement the Uganda Communications Act, revoking many of the regulations that were made in 2005. The regulations altered the market structure and the licensing framework and regulated issues that had previously been regulated, such as spectrum management, and some that had not, such as consumer protection. The following matters are significant to the broadband ecosystem and will be discussed in detail in Chapter 7:

- Licensing
- Interconnection, roaming, and sharing of infrastructure
- Universal service
- Tariffs
- Fair competition
- RoW to land
- Spectrum
- Consumer protection
- Numbering

Other laws impacting the adoption and use of broadband include the National Information Technology Authority, Uganda Act, 2009 and the various laws that the National Information Technology Authority – Uganda (NITA-U) is charged with implementing, including the Electronic Transactions Act, 2011, the Electronic Signatures Act, 2011, the Computer Misuse Act, 2011 and the Data Protection and Privacy Act, 2019. Other laws that may impact on broadband include those related to the protection of critical infrastructure, consumer rights, fair competition, access to banking and electronic payments and fair taxes.

The most urgent issues that can be effected by the UCC to facilitate a more robust broadband ecosystem are to

- Create a more flexible and easy licensing regime that allows for more innovation and competition, especially in the services markets and in areas that are underserved;
- Create an efficient and fair regulatory regime for obtaining RoW in collaboration with all interested parties;
- Effectively enforce a robust facilities-sharing regulatory regime; and
- Make changes to the spectrum planning and licensing regimes, as discussed in Chapter 8 in this report.

In addition, the IPR laws need to be reviewed keeping in mind the changes brought about the broadband value chain and matters such as artificial intelligence and the importance of data, among others. Similarly, the legal and regulatory regimes that impact the delicate balance of protecting rights of free speech and the surveillance mechanisms available should be reviewed. Finally, the following cross-cutting laws that extend beyond the ICT sector and ensure a more holistic approach to establishing a good ecosystem should be promulgated:

- Competition,
- Consumer protection and
- Critical infrastructure.

Uganda's legal and regulatory framework is complex and is analysed in more detail in Chapter 7 of this report.

3.5. CONCLUSION

The PESTLE analysis above can be summarised by the SWOT framework shown below. Uganda's strengths include its international connectivity, its location and its well-established governance framework. Its weaknesses are primarily in the middle and last miles, particularly around high prices. However, if Uganda is able to take advantage of the window of opportunity, there are several opportunities that could transform its economy, such as becoming a regional hub and driving information technology-enabled services (ITES). These opportunities come at a specific point in time: other countries are also investing in the digital sector and could surpass Uganda unless it acts quickly.

STRENGTH:

Uganda's strength lies in its connectivity to its neighbours and a well-established set of laws, rules, regulations and institutions. While not perfect, it means that the sector governance is in place and can be improved.

WEAKNESS:

Uganda's weaknesses include high prices for broadband, low broadband penetration, high taxation, low fibre rollout, multiple conflicting policy documents, poor coordination amongst government departments, a rigid licensing regime, lack of a RoW regime, lack of an infrastructure sharing regime and lack of a flexible spectrum regime.

OPPORTUNITY:

Broadband adoption and the digitalisation of the economy is still low in comparison to other African countries. This is an opportunity for the rapid expansion of broadband and thus increased economic growth and job creation. Specific opportunities include the following:

- Uganda could become a regional ICT hub for its landlocked neighbours, providing connectivity and data centre services.
- Once the African Continental Free Trade Agreement (ACFTA) is implemented, Uganda could export its digital services to other countries on the continent
- By transforming its digital sector, Uganda could take advantage of ITES and business process outsourcing (BPO) opportunities around the world.

THREAT:

There is a time-sensitive opportunity to be an ICT hub for East Africa. Other countries, such as Kenya and Rwanda, are rapidly improving their ICT infrastructure and investment climate. If these countries become more attractive, they will siphon investment away from Uganda, and the gap between Uganda and these countries will grow.
Other threats include the following:

- Global digital companies (Facebook, Google, Amazon, etc.) extract revenues from Uganda and do not pay taxes, reducing the funds available to support infrastructure rollout.
- Increased cyber threats stimulated by a broadband environment. Addressing these threats requires a coordinated legal, policy and technical response.

04

BENCHMARKING UGANDA'S BROADBAND VALUE CHAIN

The Uganda broadband benchmark draws on a broadband value chain model that was designed by AT Kearney[10] in 2010, and the study was updated in 2016 for the GSMA.[11] The study distinguishes between five segments of the internet value chain (GSMA, 2016b). The methodology for this study uses an expanded value chain concept by adding the broadband demand segment (Figure 12):

10 https://www.atkearney.com/communications-media-technology/article?/a/Internet-value-chain-economics
11 https://www.gsma.com/publicpolicy/wp-content/uploads/2016/05/GSMA_The-Internet-Value-Chain_WEB.pdf

FIGURE 12: BROADBAND VALUE CHAIN

Content rights: This includes premium rights with content that is produced professionally and that is distributed via the internet or other channels (e.g. TV) and is paid for by subscription fees or advertising-funded broadcasters. Content rights also include user-generated content that is made available via social media platforms, such as YouTube, Twitter, Instagram, Vimeo and Facebook.

Online services: This covers a wide range of services provided over the internet, including e-commerce, entertainment (gaming, gambling, video, music, publishing), search and reference services (Wikipedia, Google, Yahoo), social media and cloud services (Dropbox, online bookkeeping services, etc.).

Enabling technologies: This consists of essential services for the smooth running of the internet, such as the design and hosting of websites, payment platforms (credit cards, PayPal, MPESA), platforms enabling machine-to-machine (M2M)-based services, advertisement platforms (ad exchanges and brokers) and managed bandwidth and content delivery (wholesale interconnect).

Connectivity: This entails end-users access to the internet via mobile, fixed-wireless or wired broadband connections or satellite (VSAT). The connectivity segment of the internet value chain is the most common segment that falls under the jurisdiction of the national regulatory authorities (NRA).

User interface: Devices used by the end-user to access the internet include smart and feature phones; PCs, laptops and tablets; and digital TVs or digital set-top boxes. Operating software (OS) for these devices also falls into this segment as well as applications that run on top of the OS. NRAs in Africa typically accept type approvals from other larger jurisdictions, and access devices, such as iPhones, get automatic approval. This segment is mostly regulated based on the principle of forbearance.

Demand for broadband: The demand for broadband depends on many factors, including disposable income, the price of usage, skills and content. Content in particular is a main driver for broadband adoption and usage, driven by user-generated content through social media applications.

Each segment of the internet value chain is subject to its own laws, rules and regulations implemented by different bodies: Table 10 provides a very general overview, and countries may differ to some extent in their implementation. For any government, the internet poses legal and regulatory challenges. Goods and services are sold across borders; news content is watched from other jurisdictions, and applications may replicate regulated services, such as voice calls and SMS.

Internet Value Chain	National Institutions	Laws
Content rights	• Broadcasting regulator • Film and publication board • Registration of copyright • Courts • Competition commission	• Broadcasting code • Patent/copyright/trademark laws
Online services	• Courts • Competition commission • Consumer protection agencies • Data protection agencies • Central banks & other financial supervisory bodies • Revenue authorities	• Consumer protection laws • Data protection laws • Hate speech laws • Privacy laws • Cyber security laws • Patent/copyright/trademark laws • Gambling legislation • Tax laws • Banking laws
Enabling technologies & services	• Courts • Competition commission	• Privacy laws • Cyber security laws • Financial sector regulation & laws
Connectivity	• Telecommunication regulator • Communications, science & technology agencies • Courts • Competition commission • Local authorities & municipalities	• Communication laws • Competition laws • Local authority laws
User interface	• Telecommunication regulator • Consumer protection agencies	• Consumer protection laws • Type approval from telecom regulation

TABLE 10: DIFFERENT INSTITUTIONS AND LAWS SHAPING THE INTERNET VALUE CHAIN

ITU's Global ICT Regulatory Outlook 2020 tracks regulatory progress across 193 countries worldwide using a combination of data submitted by regulators and a survey.[12] The index uses four pillars, each of which encompasses a number of indicators, as follows:

- Regulatory authority (focuses on the functioning of the separate regulator) – 10 indicators/score of 20
- Regulatory mandates (who regulates what) – 11 indicators/score of 22
- Regulatory regime (what regulations exist in major areas) – 15 indicators/score of 30
- Competition framework (level of competition in the main market segments) – 14 indicators/score of 28

In the 2020 edition, scores are based on the combination of the ICT Regulatory Tracker (Generations 1 to 4) and the Benchmark for Collaborative Regulation (Generation 5), which ITU incorporated to take into account the reality that ICT sector regulators need to work with other sector regulators in order to fully harness the potential of ICTs for the development of the country.

	Regulatory Authority (20)	Regulatory Mandate (22)	Regulatory Regime (30)	Competition Framework (28)	Overall Score (100)	Generation of Regulator (G1 to G5)
Uganda	17	20	22	27	86	G4
Tanzania	20	21	19	25	85	G4
Zambia	19	18	15	19.7	71.7	G3
Rwanda	20	20	18	24.3	82.3	G4
Kenya	18	21.5	21	27	87.5	G5
South Korea	18	22	20	21.7	81.7	
South Africa	17	17	24	13.3	71.3	G3
Mauritius	18	20.5	15	27.3	80.8	G3
Source: Global ICT Regulatory Outlook, 2020, from the ITU						

TABLE 11: PERFORMANCE IN ICT REGULATORY OUTLOOK

Uganda was the first African country to reach G4, back in 2009. But it has yet to make the transition to G5, which requires more collaborative regulation across different sectors. Uganda performed best in the competition framework, followed by regulatory mandates and regulatory authority, with regulatory regime coming last. Some of the reasons for the poor performance under regulatory regime include the lack of a license-exempt regime, lack of permission for secondary trading in spectrum and the availability and enforcement of number portability for consumers from both fixed-line and mobile operators. Under regulatory authority, the reasons for poor performance included the lack of a competition policy or law and that competition regulations are not enforced and the fact that two different entities have to approve UCC's budget

12 - https://gen5.digital/about-the-ict-regulatory-tracker/

and appoint its board and also require reporting, impacting on its accountability.[13] Under the G5 benchmark, UCC has no collaboration with regulators in the energy and transport sectors, and the country did not have implementation mechanisms for the digital strategy. Uganda has also yet to sign or ratify some important international digital instruments, such as the Budapest Convention on Cybersecurity and international agreements determining jurisdiction and managing cross-border flows on data privacy. The lack of any cross-sector (ICT and other) infrastructure sharing or fibre co-deployment regulations/agreements/promotion initiatives in the country was also cited as an impediment for collaborative regulation.[14] Kenya is the highest-ranked country in Africa and is the only African country in the lead group of G5 regulators, ranked eighth in the world. The second-ranked country in Africa is Ghana, at the 48th position in the world. Uganda is ranked fourth in Africa and 56th in the world.

4.1. CONTENT RIGHTS IN UGANDA

Content rights include premium rights with content that is produced professionally and that is distributed via the internet or other channels (e.g. TV) and is paid for by subscription fees or advertising-funded broadcasters. Content rights also include user-generated content that is made available via social media platforms, such as YouTube, Twitter, Instagram, Vimeo and Facebook.

UCC had licensed 202 FM radio stations to serve different regional audiences and languages as of December 2020. These radio stations belong to about 150 entities because an entity is required to have a license that serves a particular region, on a particular frequency. In addition, 40 free-to-air (FTA) channels are licensed and carried on the SIGNET platform. SIGNET Uganda Limited is the government- owned sole distributor of digital terrestrial television signals across the country.[15] Listenership figures indicate that radio is the most popular medium in Uganda. There were 1.6 million pay-TV subscribers as of June 2021. UCC reports indicate that subscription numbers change seasonally, particularly in relation to football league seasons in Europe, such as the Premier League.[16] Currently, there are seven licensed content aggregators using a combination of satellite, cable and digital terrestrial networks to serve the pay-TV market. These include Dstv (satellite, from South Africa), Zuku TV (satellite, from Kenya), Azamtv (satellite, from Tanzania), Gotv (digital terrestrial, Dstv subsidiary), StarTimes (digital terrestrial, Startimes subsidiary) and SimbaTV (cable).

The use of global online video and music streaming services such as YouTube, Netflix and Amazon Prime is still limited by the lack of reliable uncapped internet access in Uganda. Local streaming services and content aggregators in partnerships with the major communications providers, such as MTN's YoTVChannel[17] and Airtel TV, have emerged.[18,19] The linkage with communication providers is important because they can offer tailored internet bundles that allow subscribers unlimited access to these platforms for specific time-limits that range from one hour to one month. This helps to address the challenge of accessing unlimited internet, allowing subscribers to consume media without worrying about their conventional data bundles.

13 - https://app.gen5.digital/tracker/country-cards/Uganda
14 - https://app.gen5.digital/benchmark/country-cards/Uganda
15 - UCC Market Performance Report 2Q21
16 - UCC Market Performance Report 2Q21
17 - https://yotvchannels.com/
18 - https://pctechmag.com/2020/02/mtn-yotv-data-bundles/
19 - https://pctechmag.com/2020/02/airtel-uganda-launch-es-airtel-tv/

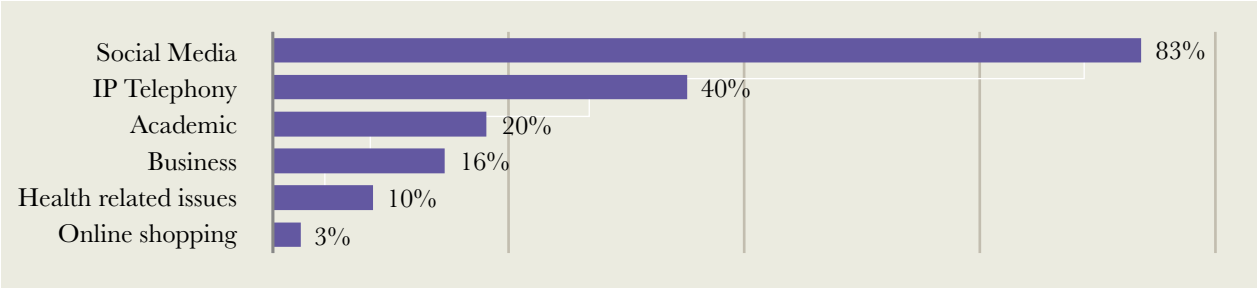


FIGURE 13: INTERNET USE IN UGANDA (UNHS 2019/20)

Social media is the predominant use of the internet in Uganda, according to the UNHS 2019/20, with 83% of internet users engaged with social media. While UCC reports a total of 21.9 million internet subscriptions as of June 2021,[20] the number of social media users is much smaller, estimated at about 3.4 million (or 7.3% of the total population) as of January 2021.[21] This perhaps reflects that a smaller number of devices connected to the various networks are actually smartphones. The most popular social media platforms in Uganda as of September 2021 are:[22] Twitter, at 51%; Pinterest, at 24.8%; YouTube, at 10%; Facebook, at 8.2%; Instagram, at 2.8%; and Tumblr, at 1.8%. Facebook is much lower in terms of popularity compared to global trends because access to Facebook is still officially blocked.[23]

Local content production by end-users increased as result of the COVID-19 pandemic. While most internet users tend to be content consumers, the number of content generators has increased particularly from the entertainment industry as a result of COVID-19 pandemic lockdowns, which have prohibited large gatherings and shows.[24,25] Content creators including but not limited to creators of blogs, online television programmes, online radio programmes, online newspapers, audio over IP (AoIP), internet protocol TV (IPTV), video on demand (VoD), digital audio radios and televisions, internet/web radio and internet/web television are categorised as online data communication providers by UCC and are now required to obtain authorisation from UCC before providing such services to the public.[26]. There are currently 86 authorised online data communication providers.[27] This includes the two major daily newspapers, New Vision and Monitor, which provide online content using a variety of channels.

The most popular social media platforms in Uganda as of September 2021 are: Twitter, at 51%; Pinterest, at 24.8%; YouTube, at 10%; Facebook, at 8.2%; Instagram, at 2.8%; & Tumblr, at 1.8%.

20 - UCC Market Performance Report 2Q21
21 - https://datareportal.com/reports/digital-2021-uganda
22 - https://gs.statcounter.com/social-media-stats/all/uganda
23 - https://pctechmag.com/2021/07/effect-of-the-facebook-ban-on-business-in-uganda/ 24 - https://socialblade.com/YouTube/top/country/ug
25 - https://stats.video/top/most-subscribed/YouTube-channels/uganda/of-all-time
26 - https://www.ucc.co.ug/reminder-to-providers-of-online-data-communication-and-broadcasting-services-to-obtain- authorisation/
27 - https://www.ucc.co.ug/wp-content/uploads/2021/01/LIST -OF-online-data-COMMUNICATION-PROVIDERS-LICENSED-1st-January-2021.pdf

Uganda's legal and institutional framework provides protection of IPR. The Uganda Registration Services Bureau was established in 2004[28], Trademarks Act passed in 2010[29] and a National Intellectual PropertyPolicywasissuedinMay2019.[30] However,Uganda'senforcementmechanismsareconsidered to be weak.[31] Uganda is also an active member of the World Intellectual Property Organization (WIPO).[32]

4.2. ONLINE SERVICES IN UGANDA

Online services cover a wide range of services provided over the internet, including e-commerce, entertainment (gaming, gambling, video, music, publishing), search and reference services (Wikipedia, Google, Yahoo), social media and cloud services (Dropbox, online bookkeeping services, etc.). As of 31 December 2019, Uganda had only 7,430 domains registered under irs ccTLD (.ug) compared to 1,235,257 for South Africa, 95,122 for Kenya, and 17,444 for Tanzania.[33] This is partly due to the high cost of domain registration in Uganda. ccTLDs in South Africa and Kenya, for example, are about $7 per year, while Uganda is $48 per year.[34]

The United Nations Department of Economic and Social Affairs publishes an E-Government Development Index that provides a comparative analysis of the state of e-government development across member states. Now in its 11th edition (2020),[35] it is a normalised composite index that include a Telecommunication Infrastructure Index (TII), a Human Capital Index (HCI) and an Online Service Index (OSI). Uganda has a low TTI, reflecting the poor development and coverage of ICT infrastructure across the country. Despite this, Uganda, along with Rwanda and Tanzania, offers online services at levels that are above the average. Its success is partly attributed to having comprehensive digital government strategies supported by forward-looking digital government plans aligned with national policies and the UN's Sustainable Development Goals (SDGs).

	Online Service Index	Telecom Infrastructure Index	Human Capital Index	Score	World Ranking (out of 193
Uganda	0.5824	0.2278	0.5395	0.4499	137
Tanzania	0.5529	0.243	0.4659	0.4206	152
Zambia	0.2588	0.3394	0.6745	0.4242	148
Rwanda	0.6176	0.2931	0.5261	0.4789	130
Kenya	0.6765	0.3402	0.5812	0.5326	116
South Korea	1	0.9684	0.8997	0.956	2
South Africa	0.6891	0.7471	0.5832	0.7371	78
Mauritius	0.7	0.6677	0.7911	0.7196	63

TABLE 12: PERFORMANCE IN E-GOVERNMENT INDEX IN THE UN E-GOVERNMENT SURVEY

28 - https://ursb.go.ug/about-ursb/
29 - https://www.aripo.org/wp-content/uploads/2018/12/thetrademark2010.pdf
30 - Nhttps://ursb.go.ug/wp-content/uploads/2019/09/National-IP-Policy-Uganda-May-2019.pdf
31 - https://www.trade.gov/country-commercial-guides/uganda-ecommerce
32 - https://www.wipo.int/directory/en/details.jsp?country_code=UG
33 - https://media.nominet.uk/wp-content/uploads/2019/12/The-Online-World-2019.pdf
34 - https://www.icann.org/en/system/files/files/africa-dns-market-study-final-06jun17-en.pdf
35 - https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E- Government%20Survey%20(Full%20Report).pdf

Uganda's global ranking for e-participation is 95, which means that 94 countries in the world have a higher rate of e-participation. Uganda scores better than Tanzania and Zambia but lower than Kenya. E-participation revolves around the use of ICT to engage people in public decision making, administration and service delivery. The UN defines e-participation as the 'process of engaging citizens through ICT in policy, decision-making, and service design and delivery in order to make it participatory, inclusive, and deliberative'.[36]

	Online	World Ranking (out of 193)
Uganda	0.5714	95
Tanzania	0.5595	98
Zambia	0.631	158
Rwanda	0.6176	82
Kenya	0.5952	90
South Korea	1	1
South Africa	0.75	57
Mauritius	0.6429	80

TABLE 13: PERFORMANCE IN E-PARTICIPATION INDEX IN THE UN E-GOVERNMENT SURVEY

A wide range of e-government services are available in Uganda. Uganda's centralised portal for e-government services[37] shows that there are about 60 online services provided by different MDAs, ranging from the centralised financial management system (IFMIS) to the MoFPED to the e-business one- stop centre of the Uganda Investment Authority meant to facilitate doing business. The list also includes whole-of-government shared services, such as a payment gateway, an SMS gateway and a unified messaging and collaboration suite from NITA-U, which are designed to power a wide range of services from both public and private entities.

Though loosely regulated and informal, e-commerce continues to grow rapidly. Growth in Uganda is due to the widespread use of mobile money and the growing number of mobile phones. While there were only 5.5 million bank accounts in Uganda as of the end of June 2021, there were about 31 million mobile money accounts.[38] E-commerce sellers typically market their goods and services online, with consumers and sellers connecting first by phone and then meeting physically to complete a transaction. E-commerce shopping can be largely divided up into the following three categories:

- Online purchases from local stores based in Uganda;[39]
- Online purchases from international stores, where sellers can ship directly into Uganda (e.g. Amazon and eBay); and
- Online entities that combine both shopping and shipping services so that individuals in Uganda can procure products from international sellers that do not offer shipping to Uganda.[40]

36 - https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E- Government%20Survey%20(Full%20Report).pdf, p. 250.
37 - https://www.ecitizen.go.ug/
38 - UCC Market Performance Report 2Q21
39 - https://www.dignited.com/22167/online-shopping-shipping-websites-uganda/
40 - https://www.dignited.com/22167/online-shopping-shipping-websites-uganda/

Only 1.7% of Ugandans made an online purchase in 2017.[41] Of these, 89.3% were men, and only 10.7% were women. Most of the online purchases (81.5%) that individuals made were from domestic sellers, located within Uganda, mostly for clothing, footwear, sporting goods or accessories (48.7%), followed by cars/automobiles, spare parts and accessories (25.5%) and travel products (25.0%).

4.3. ENABLING TECHNOLOGIES AND SERVICES IN UGANDA

Enabling technologies consist of essential services for the smooth running of the internet, such as the design and hosting of websites, payment platforms (credit cards, PayPal, MPESA), platforms enabling M2M-based services, advertisement platforms (ad exchanges and brokers) and managed bandwidth and content delivery (wholesale interconnect). Compared to Eastern and Southern Africa, Uganda performs very poorly, with only 34.4 secure internet servers compared to 1,310 per 1 million people for the region.

	2015	2016	2017	2018	2019	2020
Uganda	3.0	3.9	20.4	20.2	22.0	34.4
Tanzania	3.3	5.7	22.7	27.3	39.1	38.2
Zambia	5.7	8.9	42.4	41.2	36.3	40.5
Rwanda	7.4	12.8	18.3	36.5	71.3	81.9
Kenya	12.9	19.2	36.6	217.2	248.2	239.5
South Korea	557.7	721.0	1198.9	2065.1	4543.8	5945.4
South Africa	272.8	917.6	9429.2	12031.6	14353.1	14421.8
Sub-Saharan Africa	19.0	68.6	577.9	735.3	806.3	799.5
Africa Eastern & Southern	29.6	95.0	894.6	1,164.6	1,322.7	1,310.2
World	573.4	1,267.4	3,518.8	6,171.4	9,989.0	11,515.6
Source: https://data.worldbank.org/indicator/IT.NET.SECR.P6						

TABLE 14: SECURE INTERNET SERVERS (PER 1 MILLION PEOPLE)

Mobile money has seen significant growth. Between 2017 and 2020, the number of transactions grew by a compound annual growth rate (CAGR) of 26%. However, the growth figure hides the drop in the value of transactions between 2018 and 2019. The average value of mobile money transactions declined by more than 52% because of a transaction tax introduced in July 2018.[42] In the initial formulation of the tax, a 1% excise duty was charged for every transaction, such as withdrawals, payments and deposits. The rate was then adjusted in September 2018 to 0.5% on withdrawals only.

41 - https://nita.go.ug/media/ministry-ict-and-national-guidance-and-nita-u-release-findings-national-it-survey-20172018
42 - https://www.parliament.go.ug/cmis/views/79fcf1d6-c038-4f41-b2b0-14748e0ca9e4%253B1.0

Year Ending		June 2019	June 2020	Share % in June 2020
Active number of cards/users (millions)	Debit cards	2.4	2.4	56%
	Credit cards	0.009	0.010	0%
	Internet banking	0.56	0.76	18%
	Mobile banking	0.7	1.1	26%
	Total	3.7	4.3	
Volume of payments or fund transfers (millions)	Debit cards	3.4	13.1	27%
	Credit cards	0.16	0.19	0%
	Internet banking	2.2	3.6	7%
	Mobile banking	23.1	32.5	66%
	Total	28.9	49.4	
Value of payments or fund transfers (UGX billion)	Debit cards	670.3	3,188.2	8%
	Credit cards	56.4	67.5	0%
	Internet banking	21,400	32,700	84%
	Mobile banking	1,100	2,830	7%
	Total	23,226.7	38,785.7	

TABLE 15: ELECTRONIC BANKING IN UGANDA

The mobile money excise duty had a negative impact on growth. The United Nations Capital Development Fund (UNCDF)[43] interviewed multiple parties on the impact of the initial July tax and found the following:

- Yo! Uganda, a payment aggregator, saw a decline of 33% in value and 39% in volume;
- Pay-as-you-go solar providers saw a 10 to 15% reduction in volume; and
- School Pay, a mobile money school fee payment platform, saw a 10-fold reduction in value, from USD 14 million to USD 1.4 million between June and July.

Tax revenues during the 2018/19 financial year were USD 44.8 million compared to USD 27.9 million in 2019/20.[44] While mobile money growth has rebounded, it was from a significantly lower base.[45]

The School Pay, a mobile money school fee payment platform, saw a 10-fold reduction in value, from USD 14 million to USD 1.4 million

43 - https://www.uncdf.org/article/3892/understanding-the-consequences-of-mobile-money-taxes-in-uganda
44 - https://www.theeastafrican.co.ke/tea/business/unpopular-mobile-money-excise-duty-pricks-uganda-coffers-3502518
45 - https://researchictsolutions.com/home/wp-content/uploads/2019/01/Unleash-not-squeeze-the-ICT -sector-in-Uganda.pdf

Year Ending			June 2017	June 2018	June 2019	June 2020
Mobile Money	Number of transaction	Billion	1.1	1.3	2.5	3.1
		Change (%)		18.2%	92.3%	24.0%
	Value of transactions	UGX. trillion	52.8	73.1	66.9	79.8
		Change (%)		38.4%	-8.5%	19.3%
	Average value per transition	UGX	48,000	56,231	26,760	25,742
		Change (%)		17.1%	-52.4%	-3.8%
	Escrow	UGX. billion	323.2	496	632.7	960.2
		Change (%)		53.5%	27.6%	51.8%

TABLE 16: MOBILE MONEY TRANSACTION TRENDS

Launched in 2018, the Mobile Money Regulatory Index [46] measures the effectiveness of the mobile money regulatory framework in a participating country by assigning a score between 0 and 100. The Index encompasses the following six dimensions (across 26 indicators):

- Authorisation: eligibility, authorisation instruments, capital requirements and international remittances
- Consumer protection: safeguarding of funds, consumer protection rules and deposit insurance
- Transaction limits: entry-level transaction limits, entry-level monthly limits, entry-level balance limits, maximum transaction limits, maximum monthly limits and maximum balance limits
- Know-your-customer (KYC): permitted identifications, KYC requirements and KYC proportionality
- Agent networks: agent eligibility, agent authorisation, agent activities and agent liability
- Infrastructure and investment environment: financial inclusion strategy, affordability, ID verification infrastructure, interoperability, settlement access and interest payments.

The index analyses the quantitative impact of various indicators on regulation. A higher score denotes enabling regulation, while non-enabling regulation limits its usability for both the regulator and mobile money providers.

	Authorisation	Consumer protection	KYC	Transaction Limits	Agent network	Infrastructure and investment environment	Index score
Uganda	84	80	32	100	94	22.0	77.40
Tanzania	100	80	92	100	100	39.1	91.80
Zambia	80	80	52	100	100	36.3	78.50
Rwanda	100	100	92	100	100	71.3	97.50
Kenya	100	100	32	100	100	248.2	85.50
South Africa	84	80	60	44.44	90	4543.8	76.37

TABLE 17: PERFORMANCE IN MOBILE MONEY REGULATORY INDEX (2020)[47]

46 - https://bit.ly/3vp6D5x
47: https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/10/Mobile-Money-Regulatory-Index-2021.pdf

Uganda performed best on the transaction limits and agent network dimensions but performed worst on the KYC and infrastructure and investment environment dimensions.

Under KYC, Uganda performed poorly on permitted identifications (only the national ID is permitted) and KYC proportionality. Under Infrastructure and Investment Environment, Uganda performed poorly on affordability and interest payments on deposits. Uganda imposed a mobile money tax in 2019, joining Congo, Côte d'Ivoire, Kenya, Tanzania and Zimbabwe.

Uganda's social media market is relatively undeveloped compared to Kenya. Table 12 shows that Uganda lags behind Tanzania but especially behind Kenya in regards to Facebook.[48] Uganda's lower Facebook penetration is to be expected because access to Facebook is still officially blocked.[49] It should be noted that there are costs associated with blocking social media. Facebook, for example, runs Facebook Marketplace,[50] which claims to have over 1 billion users around the world, over 1 million shops and over 250 million users interacting with these storefronts per month.[51] Part of the appeal of the Marketplace is that it is easy to set up: it requires only a Facebook account, and anyone is able to buy and sell goods. For the storefronts, Facebook has a service that catalogues products from Instagram accounts for free.[52] Facebook Marketplace is a very easy way, at zero cost, to get onto an e-commerce platform. There are, of course, disadvantages, There is no payment gateway, and transactions have to happen on either WhatsApp or Facebook Messenger. But cataloguing products and setting up a payment gateway can be a very expensive undertaking, and Facebook Marketplace is one innovative way around the problem.

	Uganda	Tanzania	Kenya
Estimated Facebook audience (million)	2.6	4.5	10.3
Population (million)	44.3	58.0	52.6
Facebook audience (%)	5.9%	7.8%	19.6%
Source: Facebook Marketing API			

TABLE 18: ESTIMATED FACEBOOK USERS IN UGANDA IN 2021

48 - Subscriber numbers per country are only publicly available for Facebook.
49 - https://pctechmag.com/2021/07/effect-of-the-facebook-ban-on-business-in-uganda/
50 - https://www.facebook.com/marketplace
51 - https://www.engadget.com/facebook-q-1-2021-earnings-marketplace-1-billion-232537001.html
52 - https://www.engadget.com/facebook-instagram-new-shopping-features-171051648.html

4.4. CONNECTIVITY

This section provides diagnostic findings on the state of the development of high-speed internet in Uganda. The key constraints along the broadband value chain are analysed based on the integrated framework of the 2016 World Bank World Development Report on Digital Dividends (World Bank, 2016), starting from the first mile (the point where the internet connects a country to international networks), through the middle mile (national backbone and intercity network, including IXPs), to the last mile (reaching the end-user through local access networks). The framework also identifies an invisible mile (the enabling policy and legal and regulatory environment facilitating the intangible parts of the network, such as spectrum, licensing, taxation, competition and cybersecurity), which could constrain or promote broadband access.

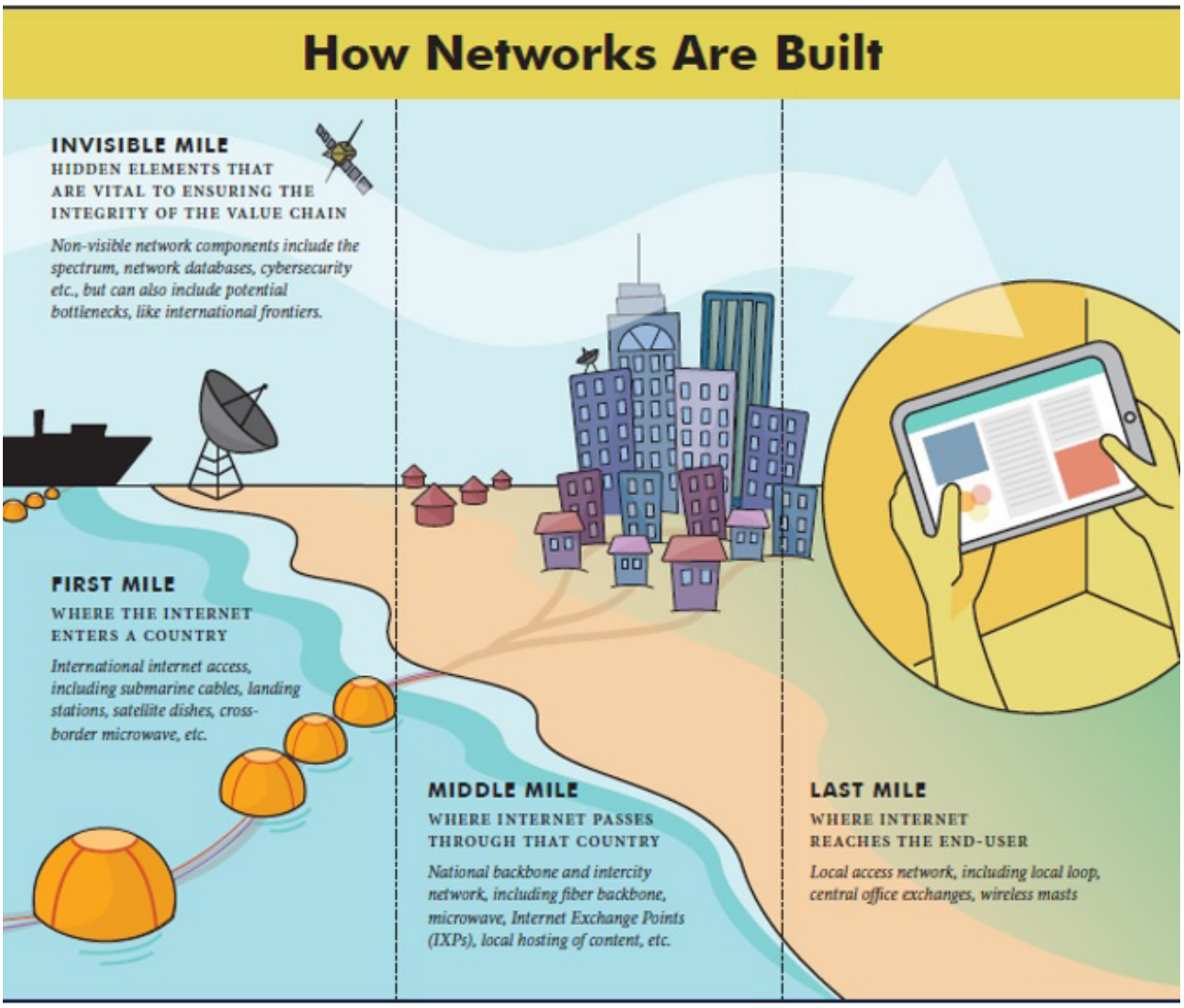


FIGURE 14: APPROACH TO THE ANALYSIS OF THE CONNECTIVITY SEGMENT OF THE INTERNET VALUE CHAIN[53]

53 - World Bank graphic used for the Digital Dividends 2016 report presentations, https://www.worldbank.org/en/publication/wdr2016 https://www.worldbank.org/en/publication/wdr2016

4.4.1

First Mile: International Connectivity

International connectivity to neighbouring countries is adequate. There are eight cables going to neighbouring countries. In Figure 15 the dark blue lines represent existing fibre connections and the dotted red lines planned fibre routes. Most of the planned national fibre is from Liquid, UETCL and NITA.

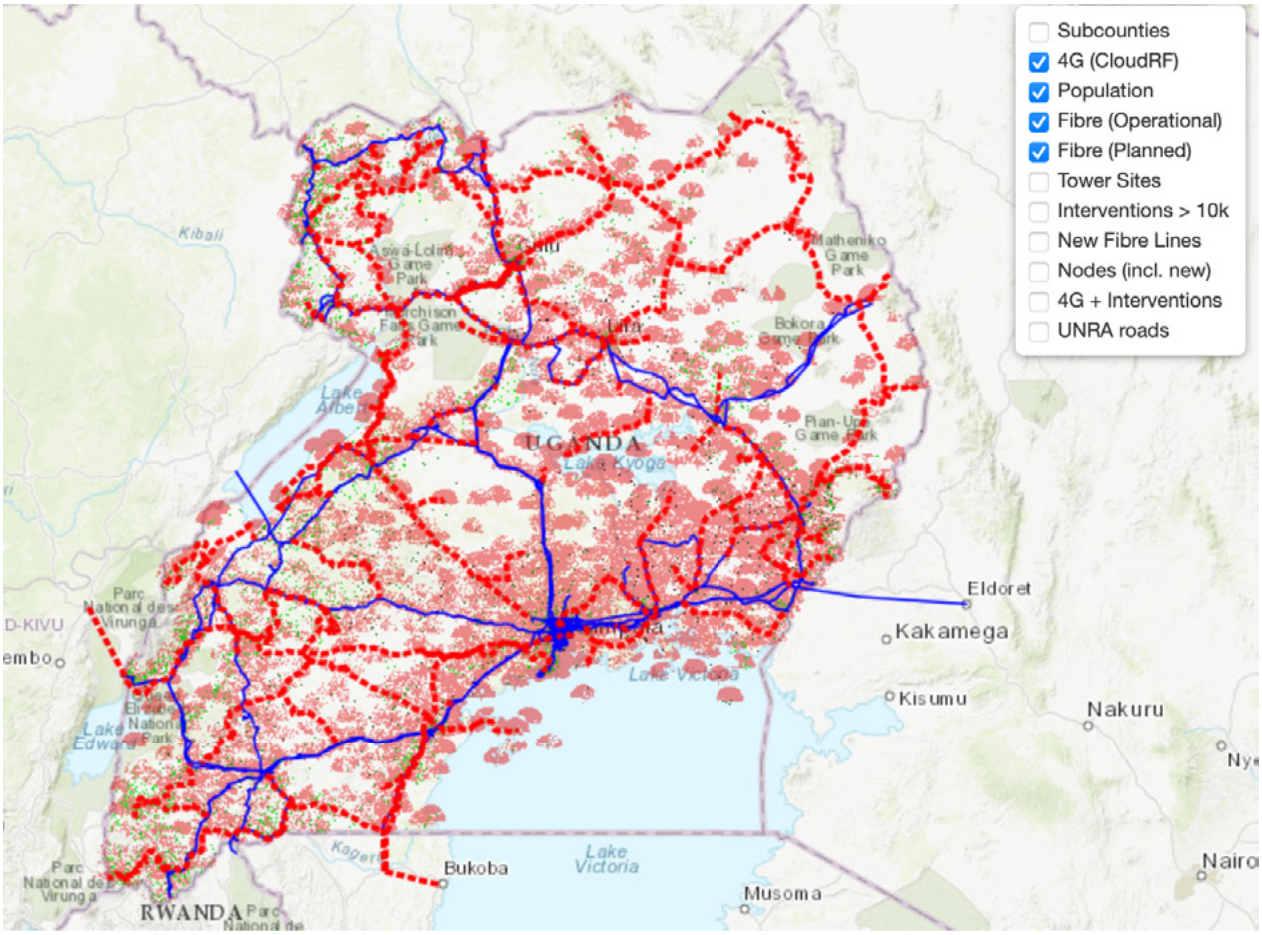


FIGURE 15: OPERATIONAL (BLUE) AND PLANNED (RED) FIBRE ROUTES AND 4G COVERAGE (SOURCE: UCC)[54]

The international bandwidth used lags behind leading countries in the region. Kenya uses more than four times the Gbps per million population compared to Uganda (Table 20). The disparity between Kenya and Uganda in terms of international bandwidth used is one indication that there is significant opportunity for growth in Uganda. Bandwidth usage is driven by content providers and internet backbone providers.[55] Content providers include companies such as Google, Facebook and Amazon. Globally, between 2016 and 2020, the compound annual growth rate (CAGR) for bandwidth was 66%.[56] Getting Uganda up to par with Kenya means releasing Uganda from inhibiting factors such as sector-specific taxation.

54 - https://d2srqv2tsfke29.cloudfront.net/9a07beb5cb7be1a7e828f1228baf23ab.html
55 - Telegeography, https://blog.telegeography.com/the-mystery-of-international-bandwidth- demand?utm_source=comms_update&__hstc=243507930.ac08c07ce770b89305cf735a0dc7a231.1614176975862.16333 40462870.1633431495554.177&__hssc=243507930.7.1633431495554&__hsfp=1429352095
56 - Ibid.

	Used international bandwidth by country (Gbps) 2020	Human Capital Index	World Ranking (out of 193
South Africa	7,944	58.6	135.6
Botswana	100	2.3	43.5
Kenya	2,204	52.6	41.9
Zambia	394	17.9	22.0
Rwanda	137	12.6	10.9
Uganda	**420**	**44.3**	**9.5**
Tanzania	376	58.0	6.5
Mozambique	189	30.4	6.2
Malawi	42	18.6	2.3
Source	Telegeography, 2020	WDI, 2021 (2019 data)	Calculation

TABLE 19: USED INTERNATIONAL BANDWIDTH

4.4.2

Middle Mile: National Backbone

Uganda's IXP currently has 29 peering networks that also access content from CDN caches such as Google. Regional carriers, such as Bandwidth & Cloud Services (BCS), Internet Solutions, Liquid Telecom and SEACOM, also improve the quality of peers at the UIXP. Pre-COVID-19 lock-down, peak traffic in 2020 reached 18 Gbps, saving the country expensive international bandwidth connectivity. Traffic went down as more users shifted to mobile internet usage, which has less of an impact on the IXP because mobile operators have on-network CDN cache nodes. Traffic has since rebounded.[57]

Access to fibre is a challenge. While fibre routes are an important indicator, so is access to a fibre node. A node is a central point in the neighbourhood where users can connect to fibre. In Kenya, 41% of the population is within 10 km of a fibre node. In comparison, in Uganda, 29% are within 10 km of a fibre node. As more fibre is rolled out and new nodes are built into the network, this figure will improve substantially, but it needs investment from operators to roll out the fibre as well as a reduction of obstacles, such as RoW negotiations, that slow down the rollout of fibre.

In Kenya, 41% of the population is within 10 km of a fibre node. In comparison, in Uganda, 29% are within 10 km of a fibre node.

57 - UIXP statistics https://portal.uixp.co.ug/public-statistics/public and UIXP blog, 2020 http://blog.uixp.co.ug/2020/04/new-uptime-record-new-traffic-record.html

Country	Population in millions	Area in 1,000 km²	Operational fibre routes			Population within reach of a fibre node		
			Km	Per 1,000 km²	Per million inhabitants	% within 10 km	% within 25 km	% within 50 km
Mozambique	31.3	786.4	47,601	61	1,521	30.1	49.6	78
South Africa	59.3	1,213.1	265,696	219	4,481	67.9	92.2	100
Uganda	44.3	200.5	19,707	98	445	29	67	93
Tanzania	59.7	885.8	29,303	33	491	22.8	39.9	64
Zambia	18.4	743.4	13,835	19	752	36.5	46.2	66
Kenya	52.6	569.1	29,287	51	557	41	81	96
Sources	WDI, 2021 (2019 data)		Hamilton Research, 2020/UCC, 2021					

TABLE 20: NATIONAL FIBRE ROUTES

Data Centres are another important component of the broadband ecosystem. NITA-U built and operates the National Data Centre in Kampala (and a backup in Jinja), which is used by government MDAs. Raxio Data Centre, Uganda's first tier-III carrier-neutral data centre, in Namanve Industrial Park, became operational in 2021.[58] The UIXP has signed a deal to extend its peering network into the Raxio Data Centre, allowing it to attract new peers, providing redundancy for the networks that rely on the UIXP and making large-scale content and cloud deployments more viable in Uganda.

	IXP (number)	Peering networks (number)	Carrier-neutral data centres (number)	Submarine landing stations (number)
South Africa	6	1023	21	11
Botswana	1	-	0	0
Kenya	3	75	7	6
Zambia	1	2	0	0
Rwanda	1	11	0	0
Uganda	1	16	1	0
Tanzania	5	48	1	3
Mauritius	1	12	10	4
Mozambique	1	17	0	2
Malawi	1	9	0	0
Sources: peerdingdb.com, datacentermap.com, submarinecablemap.com				

TABLE 21: NUMBER OF IXPS AND DATA CENTRES

58 RAXIO Data Centre, www.raxio.co.ug

4.4.3 **Mobile broadband for low monthly usage is cheap in absolute terms but not affordable in relative terms.** Uganda was the 12th cheapest country for 300 MB and 1GB monthly usage. However, expressed in terms of GNI per capita, Uganda only ranks 27th and 28th, respectively, in Africa, out of 54 countries. For 20GB monthly usage, 28 African countries were cheaper.

Last-Mile Indicators			Uganda	African Rank	Source
Affordability	Price of 300-MB data use per month	USD	1.09	12	RIS Q1, 2021
		% GNI per capita per month	1.7	27	
	Price of 1-GB data use per month	USD	1.91	12	
		% GNI per capita per month	2.9%	28	
	Price of 20-GB data use per month	USD	13.06	29	
		% GNI per capita per month	20	27	
Adoption	SIM per 100 inhabitants		57.4	35	ITU, Dec 2020
	Mobile broadband SIM per 100 inhabitants		32.4	27	
Infrastructure	4G population coverage		85	10	
	Average mobile download speed (Mbps)		5.16	14	cable.co.uk, 2020

TABLE 22: LAST-MILE KEY PERFORMANCE INDICATORS[59]

Broadband adoption is low despite good broadband coverage and relatively fast download speeds. In total, 34 Countries in Africa had a higher SIM card penetration in 2020 compared to Uganda, and 26 countries in Africa have higher broadband SIM penetration. This is despite 85% population coverage, which ranks Uganda in the top 10 in terms of 4G coverage in Africa. Download speeds are reasonable. At an average of 5.16 Mbps, Uganda ranked 14th in Africa in 2020. These factors point to affordability as the primary obstacle to wider broadband adoption.

4.4.4 **MTN provides detailed revenue and expense data for each financial year.** Government and regulatory costs as a share of total expenses more than doubled in 2019 and 2020 compared to 2017 and 2018. Network and IS maintenance declined as a share of expenses from 32.9% in 2018 to 25% in 2020.

59 More details on the price and affordability benchmarking can be found here: https://researchictsolutions.com/ict-evidence-portal-africa/ict_evidence_portal_africa.php

MTN Uganda	2017		2018		2019		2020	
	R(m)	%	R(m)	%	R(m)	%	R(m)	%
Handsets and other accessories	121	3.6	84	2.4	87	2.5	69	1.6
Interconnect	282	8.3	226	6.6	245	6.9	291	6.9
Roaming	22	0.6	40	1.2	50	1.4	30	0.7
Commissions	939	27.6	901	26.2	1,034	29.1	1,111	26.5
Government and regulatory costs	72	2.1	77	2.2	234	6.6	238	5.7
VAS/digital revenue share	47	1.4	42	1.2	77	2.2	184	4.4
Network and IS maintenance	1,026	30.2	1,134	32.9	859	24.2	1,048	25.0
Marketing	115	3.4	130	3.8	163	4.6	143	3.4
Staff costs	292	8.6	310	9.0	401	11.3	448	10.7
Other OPEX	292	14.2	499	14.5	400	11.3	632	15.1
Total cost	3,399		3,443		3,550		4,194	

TABLE 23: MTN UGANDA OPERATING EXPENSES BREAKDOWN (RM)

MTN's cost per GB of data traffic is about USD 2.5. The cost per GB has come down from USD 6.2 in 2017, to USD 3.7 in 2018 to USD 2.5 in 2019 and 2020. When allocating the entire cost of the MTN operation, not just the network and maintenance costs, the cost per GB would be around USD 10 in 2020, half of its 2017 value of USD 20.7.

MTN Uganda	2017	2018	2019	2020
Data revenue share	9.6%	11.2%	15.4%	18.1%
Network and IS maintenance R(m)	1,026	1,134	859	1,048
Total cost R(m)	3,399	3,443	3,550	4,194
MBs per active user	763	1,162	1,090	1,237
Active users in 1,000	1,546	2,236	3,402	3,666
Total billable traffic GB	1,179,598	2,598,232	3,708,180	4,534,842
Total cost per GB in ZAR	275	149	148	167
Network and IS maintenance per GB in ZAR	83	49	36	42
FX	13.31	13.25	14.45	16.47
Cost per GB in USD	20.7	11.3	10.2	10.2
Network and IS maintenance per GB in USD	6.2	3.7	2.5	2.5

TABLE 24: MTN COST PER GB

Data prices for MTN Uganda are the second most expensive amongst MTN's Africa operations. All MTN operations for which detailed annual financial information is available were compared. The implied price per GB was calculated by dividing total data revenue by the total billable GBs. This gives an indication of the average price per GB in a country. Only South Africa has a higher implied price. The implied price per GB was USD 20.15 for MTN Uganda and USD 21.51 for South Africa. MTN Uganda's implied price per GB is more than three times the prices of MTN Ghana and MTN Sudan.

MTN Uganda's network cost is the highest amongst its peer countries. MTN Uganda's cost is three times higher than that of MTN Ghana and more than double that of MTN Cote d'Ivoire but cheaper than that of MTN Cameroon. The high cost of running MTN's network in Uganda means that it requires high prices to make a profit.

MTN 2020	Uganda	Côte d'Ivoire	Nigeria	Cameroon	Ghana	South Africa	Susan
FX ZAR per USD	16.47	16.47	16.47	16.47	16.47	16.47	16.47
MB per active user	1,237	1,924	2,555	2,058	4,256	2,617	4,567
Active data subscribers 4Q20 in 1,000	3,666	4,665	32,560	3,935	10,786	15,705	2,898
Billable GB million	4.5	9.0	83.2	8.1	45.9	41.1	13.2
Data revenues % of total	18.1%	18.7%	24.8%	27.4%	29.4%	32.0%	37.5%
Data revenue R(m)	1,505	1,645	14,360	1,834	5,066	14,565	1,240
Implied price per GB in ZAR	332	183	173	226	110	354	94
Implied price per GB in USD	20.15	11.13	10.48	13.75	6.70	21.51	5.69
Network cost R(m)	1,048	863	12,668	1,450	1,779	4,174	745
Implied network cost per GB in ZAR	41.8	18.0	37.7	49.1	11.4	32.5	21.1
Implied network cost per GB in USD	2.54	1.09	2.29	2.98	0.69	1.97	1.28
Network profit margin per GB	17.61	10.03	8.19	10.77	6.01	19.54	4.41

TABLE 25: MTN'S OPERATIONS COMPARED

Uganda is still primarily a voice and SMS market. MTN Uganda had the lowest proportion of data revenues to total revenues in its peer group in 2020. Data revenues made up 37.5% of revenues in Sudan, 32% in South Africa and only 18.1% in Uganda.

MTN's financial figures show that Uganda is one of the most expensive countries for a mobile operator in Africa. The high cost of operation requires high prices. To improve broadband access and affordability, the government needs to find ways to reduce the cost of operation. The good news is that this is something in the control of the government and the

regulator. The government can drop excise duties that discriminate disproportionately against the ICT sector. Similarly, the regulator must consider ways of reducing the cost of operation, such as optimising spectrum allocation and establishing and enforcing effective regulatory frameworks for flexible licensing, RoW and infrastructure sharing.

4.5. USER INTERFACE

Devices used by the end-user to access the internet include smart and feature phones and PCs, laptops and tablets as well as digital TVs or digital set-top boxes. OS for these devices also falls into this segment as well as applications that run on top of the OS. NRAs in Africa typically accept type approvals from other larger jurisdictions, and access devices such as iPhones get automatic approval. This segment is mostly regulated based on the principle of forbearance.

According to the UNHS 2019/20,[60] 74% of all households reported owning at least one mobile phone. Only 3% of Ugandans had used a computer in the previous three months prior to the survey. As of the end of June 2021, UCC reported that there were 32 million devices connected to public communication networks, a 9% growth compared to one year earlier in June 2020. Of these, 12.3% were basic mobile phones, 57.5% were feature phones and 30.2% were smartphones. The low number of smartphones indicates that most devices connected to public communication networks still lack the advanced capabilities required to harness the true potential of broadband connectivity. The most common operating systems in Uganda for the year ending September 2021, as measured from the perspective of devices accessing the internet, include[61] Android, at 50.78%; Windows, at 23.59%; Unknown, at 17.6%; iOS, at 4.13%; OS X, at 1.84%; and Linux, at 1.16%. This highlights the dominance of mobile devices as the primary channel to access the internet in Uganda. This is corroborated by the UNHS, which indicated that 86% of internet users reported that they used the internet at any location via a mobile phone.

4.6. DEMAND FOR BROADBAND

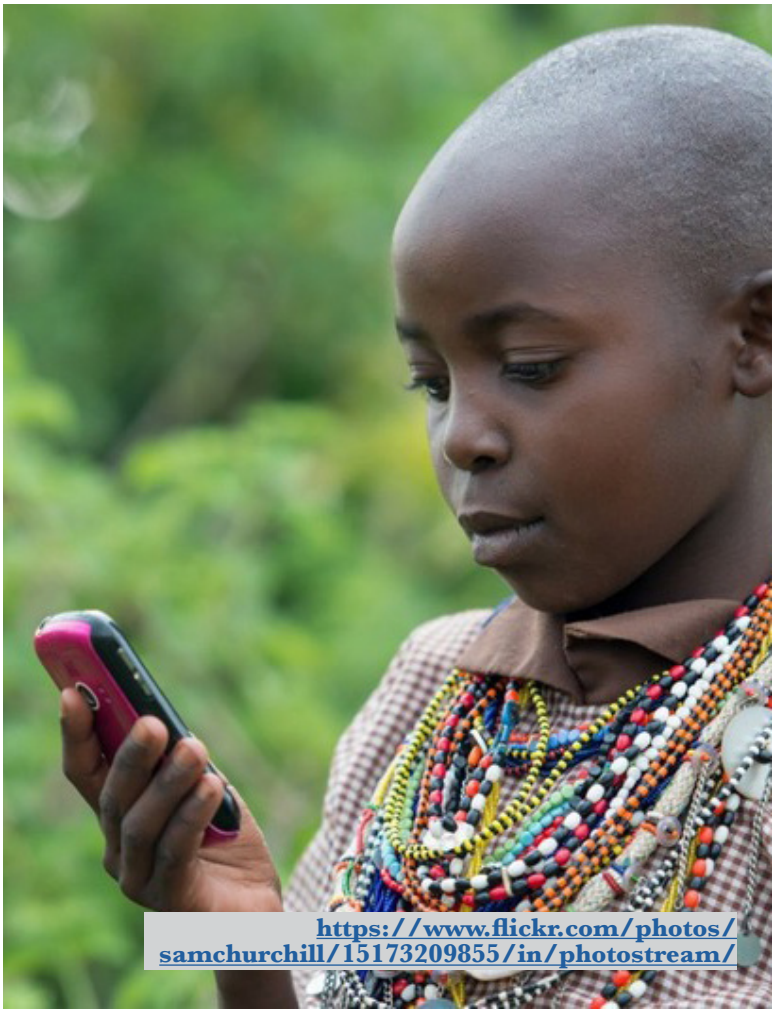
MTN's data for the financial year ending in December 2020 reveal that only a third of mobile subscribers are active data users. MTN classifies any SIM card that uses more than 5 MB per month as an active user. Of its mobile subscribers, 32% were active data users and 23% smartphone owners. This means that mobile is still mostly a voice and SMS market and that broadband services still have considerable growth potential.

> **only a third of mobile subscribers are active data users.**

60 - https://www.ubos.org/wp-content/uploads/publications/09_2021Uganda-National-Survey-Report-2019-2020.pdf
61 - https://gs.statcounter.com/os-market-share/all/uganda/monthly-202004-202102

MTN	MB/ active user	Share of 4G sites	Subscribers	Active data subscribers		Smartphones	
			('000)	('000)	% of total	('000)	% of total
Ghana	4,256	45.0%	24,399	10,786	44%	10,540	43%
Benin	2,862	35%	5,783	2,190	38%	2,274	39%
South Africa	2,617	96.0%	32,002	15,705	49%	20,998	66%
Nigeria	2,555	90.0%	76,548	32,560	43%	35,111	46%
Rwanda	2,228	0%	6,076	1,628	27%	1,213	20%
Zambia	2,082	57%	8,203	2,555	31%	2,529	31%
Cameroon	2,058	45%	10,251	3,935	38%	4,228	41%
Côte d'Ivoire	1,924	46%	13,223	4,665	35%	5,380	41%
Uganda	**1,237**	**56.0%**	**14,198**	**4,586**	**32%**	**3,328**	**23%**

TABLE 26: MTN KEY PERFORMANCE INDICATORS FOR MTN Q4 2020



https://www.flickr.com/photos/samchurchill/15173209855/in/photostream/

In Uganda, the high cost of smart phones appears to be a considerable factor in the low usage of data. Contrast this to South Africa, where there are fewer active data users than there are smartphone owners. Of MTN's South African SIM cards, half were active data users, and 66% were smartphone owners. This implies that the limitation in South Africa is more the high price of data than the high price of smartphones. The share of both active data subscribers and smartphone ownership is low in Uganda compared to Ghana, Benin, South Africa, Nigeria, Zambia, Cameroon and Ivory Coast. Only MTN Rwanda has fewer active data subscribers than Uganda.

4.7. BROADBAND VALUE CHAIN CONCLUSION

The table below summarises the findings from the benchmarking of the broadband value chain.

	Problem	Recommendations
Broadband ecosystem	Lack of collaboration between sector regulators.	Memorandums of understanding between the telecom, energy and transportation sectors.
Content rights	Enforcement mechanisms are weak.	Ensure funding for institutions enforcing intellectual property.
Online services	• Only 1.7% of Ugandans purchased online in 2017. • High excise duties, such as those on mobile money and internet data, result in declines in transaction value and volume and disproportionately affect the poor.	• Lower or remove excise duties. • Improve the affordability of broadband. • Facilitate the adoption of electronic payment systems.
Enabling technologies and services		
Connectivity	Used international bandwidth is low.	Reduce obstacles to data usage, such as prices.
	Access to fibre: 29% of the population are within 10 km of a fibre node compared to 41% in Kenya.	Remove obstacles to fibre rollout.
	High data prices: As a % of GNI per capita per month, Uganda is ranked 27th in Africa for 300 MB.	Lower the cost of operating a network in Uganda by removing obstacles to spectrum and lowering excise duties as well as other factors such as RoW.
User interface	High cost of smartphones.	Lower import duties, VAT and excise duties on smartphones.
Demand for broadband	Only a third of mobile subscribers are active data users.	Lower the cost of data and smartphones.

TABLE 27: SUMMARY OF BROADBAND VALUE CHAIN BENCHMARKING

05

BROADBAND POLICIES AND STRATEGIES

Uganda has a multiplicity of policy- and-strategy level documents that impact different segments of the broadband value chain. They can be grouped into

• Foundational policies and strategies;

• Policies, strategies and guidelines that provide high-level sector guidance; and

• Subject-specific policies, strategies and guidelines.

5.1. FOUNDATIONAL POLICIES AND STRATEGIES

Foundational documents are developed and overseen by the National Planning Authority in consultation with all stakeholders. Such policies and strategies require national-level approval by both the cabinet and parliament. These include the following:

• The Uganda Vision 2040[62], which provides overall policy direction and sets national-level goals to guide national-level planning and strategies. It places the focus on ICT as a development enabler.

• NDPIII 2020/21–2024/25,[63] like the other five-year plans through which Vision 2040 is to be achieved, sets specific development targets and strategies for achieving such targets during the period 2020/21– 2024/25. NDPIII brought on board programmatic approaches to planning and budgeting, as discussed in more detail in Chapter 6.

62 - http://www.npa.go.ug/uganda-vision-2040/
63 - http://www.npa.go.ug/wp-content/uploads/2020/08/NDPIII-Finale_Compressed.pdf

5.2. POLICIES THAT PROVIDE HIGH-LEVEL GUIDANCE

Documents that provide high-level guidance to the growth of the digital economy are developed and overseen by MoICT&NG or other ministries. Such documents and strategies require cabinet approval, but implementation is vested in the ministries. These include the following:

• The National ICT Policy (2014)[64] (MoICT&NG), which was guided by Uganda Vision 2040. A review of this policy shows that it is predicated on the framework of the Millennium Development Goals that are now dated, a national institutional framework that is now dated, and baseline data that are now almost 10 years old. In addition, what was achieved up to 2017/18 was used as the baseline for both the National Broadband Policy (NBP; 2018) and the Digital Uganda Vision (2021). Indeed, the Digital Uganda Vision states that 'the current policies and legislations are outdated and not matching with current times'. It is recommended that the National ICT Policy (2014) be retired. It is not referenced any further in this study.

• The ICT Sector Strategic and Investment Plan (2015/16–2019/20)[65] (MoICT&NG), with the tag-line ConnectedUgand@2020, was developed to guide a strategic approach to the delivery of the ministry's mandate under NDPII. It led to the establishment of an ICTSWG, the initial steps in rationalising institutional arrangements to address the reality of convergence and the development of the NBP (2018).

• The NBP (2018)[66] (MoICT&NG) was developed to bring a harmonised policy approach to the development of the broadband ecosystem, requiring 'high speed Internet (Broadband) infrastructure to be defined and planned for, like any other public good (roads, railways, oil pipeline, power lines...'.

• The Digital Uganda Vision (2021)[67] (MoICT&NG) is the most recent policy and strategy document that takes into account what was achieved in earlier iterations of policies and strategies and sets a path for achieving the NDPIII's objectives. The principal aim of Digital Uganda Vision is 'to align ICT investments in the various sectors in a manner that will improve the country's Global ICT indices for purposes of attracting investors. The ministry will define digital milestones in order to avert duplication and ensure agglomeration benefits from the investments in ICTs'.

• The National Strategy on Fourth Industrial Revolution (2020)[68] (MoICT&NG) has as its stated mission 'to transform and accelerate Uganda's development into a creative, innovative, productive and competitive society using 4IR technologies by 2040'. It addresses all aspects of the broadband value chain with a focus on exploiting the opportunities opened by 4IR.

• The National Competition and Consumer Protection Policy [69] (Ministry of Trade, Industry and Cooperatives) provides a clear rationale and basis for the enactment of the required legal instruments as well as the establishment a Competition and Consumer Protection Commission. The preamble to the policy recognises the provisions made under both the UCC and NITA-U Acts with respect to competition and consumer protection but also points out the gaps that need to be addressed at the national level, giving examples of anti-competitive behaviour within the sector. It appears that the Competition Bill has been before parliament for some years now but has never been enacted into law.

64 - https://ict.go.ug/wp-content/uploads/2018/11/ICT_Policy_2014.pdf
65 - https://ict.go.ug/2020/02/03/ict-sector-strategic-and-investment-plan-2015-16-2019-20/
66 - https://www.ict.go.ug/wp-content/uploads/2018/10/NATIONAL-BROADBAND-POLICY-2018.pdf
67 - https://ict.go.ug/initiatives/digital-uganda-vision/
68 - https://ict.go.ug/wp-content/uploads/2020/10/Executive-Summary-Ugandas-National-4IR-Strategy.pdf
69 - https://www.mtic.go.ug/wp-content/uploads/2019/08/National-Competition-Policy .pdf

5.3. SUBJECT-SPECIFIC POLICIES AND STRATEGIES

There are several regulatory policies and guidelines developed by different governmental agencies that guide regulation within the sector and impact on different components of the broadband value chain. Such policies are approved by MoICT&NG, but development and implementation is vested in different agencies. These include the following:

- Rural Communications Development Policy (Referred to as the Rural Communications Fund Operational Guidelines 2017/18–2021/22 (RCDFIII[70]) (UCC);
- National Spectrum Policy[71] (UCC);
- National Information Security Policy (2014) (NITA-U);
- Policy for Transition from IPv4 to IPv6 (2010);[72]
- National Intellectual Property Policy (2019)[73] (Uganda Registration Service Bureau);
- National Information Security Policy[74] (NITA-U);
- Draft National Post Code and Addressing System Policy (2019);[75]
- Proposed Radio Spectrum Management Policy (2019; UCC);
- E-Waste Management Policy[76] (NITA-U); and
- Proposed Guidelines on Communications Infrastructure Deployment and Sharing (2021)[77] (UCC) (public consultation stage concluded).

A discussion of the related laws, regulatory policies and guidelines and regulatory instruments is presented in Chapter 7.

Table 28 links the key documents among these to the different segments of the broadband valuation, and Table 29 provides comments on the documents and identifies gaps that need to be addressed.

70 - https://www.ucc.co.ug/wp-content/uploads/2017/09/RCDF-Operational-Guidelines.pdf
71 - https://ict.go.ug/2018/06/17/national-spectrum-policy-for-uganda/
72 - https://researchictafrica.net/countries/uganda/MoICT_Transition_from_internet_protocol_v4_to_internet_protocol_v6_policy_2 010_(draft).pdf
73 - https://ursb.go.ug/wp-content/uploads/2019/09/National-IP-Policy-Uganda-May-2019.pdf
74 - https://www.nita.go.ug/sites/default/files/publications/National%20Information%20Security%20Policy%20v1.0_0.pdf
75 - https://ict.go.ug/2019/05/22/national-postcode-and-addressing-system-policy/
76 - https://www.ict.go.ug/wp-content/uploads/2018/06/Electronic-Waste-Management-Policy-for-Uganda.pdf
77 - https://www.ucc.co.ug/wp-content/uploads/2021/03/Guidelines-on-Infrastructure-Deployment-and-sharing-consultation.pdf

	Content Rights	Online Services	Enabling Technologies & Services	Connectivity				User Interface	Demand for Broadband
				First Mile	Middle Mile	Last Mile	Invisible Mile		
Uganda Vision 2040									
NDPIII	✓	✓	✓	✓	✓	✓	✓	✓	✓
The ICT Sector Strategic and Investment Plan (2015/16 – 2019/20)		✓	✓	✓	✓	✓	✓	✓	✓
National Broadband Policy (September 2018)		✓	✓	✓	✓	✓	✓	✓	✓
Digital Uganda Vision		✓	✓	✓	✓	✓	✓	✓	✓
National Strategy on Fourth Industrial Revolution	✓	✓	✓	✓	✓	✓	✓	✓	✓
National Spectrum Policy for Uganda (under development with support from the government of Korea)			✓		✓	✓	✓		
The National Intellectual Property Policy (2019)	✓								
National Competition and Consumer Protection Policy (2014)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Draft National Post Code and Addressing System Policy (2017)							✓		
Policy for Transition from IPv4 to IPv6 (2010)				✓	✓	✓	✓		
E-Waste Management Policy (2012)							✓		
National Information Security Policy (2014)		✓	✓	✓	✓	✓	✓	✓	✓
Policy Framework for the Management of the .UG Top Level Domain (2014)		✓	✓	✓	✓	✓			
Rural Communication Development Policy (2017)		✓	✓		✓	✓	✓	✓	✓
Draft Open Data Policy (2017)	✓	✓	✓						✓
Guidelines on Infrastructure Deployment and Sharing (2021) – public consultation stage concluded			✓	✓	✓	✓			

TABLE 28: LINK BETWEEN UGANDA'S ICT POLICIES AND THE BROADBAND VALUE CHAIN

	Comments/Recommendations
Uganda Vision 2040	'Knowledge and ICT' is one of the nine identified areas of action (abundant labour force; minerals, oil and gas; agriculture; tourism; knowledge and ICT; industrialisation; water resources; geographical location; and trade) in strengthening fundamentals for harnessing development opportunities. Broken down into 17 elements, 'Knowledge and ICT' provides a comprehensive vision for the development and exploitation of broadband. One of these is the specific focus on connectivity: 'Uganda shall continuously build robust ultra-high speed, pervasive, intelligent and trusted high speed ICT infrastructure all over the country in line with the changing technologies'.
NDPIII	NDPIII provides a comprehensive policy context covering all elements of the broadband value chain. NDPIII highlights the national concern about the limited access to broadband and high costs, stating that: 'Access to the Internet (specifically broadband) remains low due to limited coverage and the cost of accessing it remains high'. The cost target set to be achieved by 2025, however, does not address this – reducing the unit cost of 1 Mbps/month of internet on the retail market from USD 237 to USD 70 by 2025 is not sufficiently aggressive to break the cost barrier to usage of broadband, which will then disable the usage targets under NDPIII and the Uganda Digital Transformation Programme. This needs to be addressed at the earliest during the life of the Plan.
The ICT Sector Strategic and Investment Plan (2015/16–2019/20)	While this ICT Investment Plan was targeted at the implementation of NDPII, it remains an important reference document. This plan should be evaluated in terms of outputs and outcomes as well as lessons learned to inform the new iteration – which is the Digital Uganda Vision. It is recommended that once this is done, the Plan be retired to reduce the multiplicity of reference documents in the sector.
NBP (September 2018)	The Broadband Policy was driven by the need to achieve the objectives of NDPII (2014/15–2019/20) and indeed has goals as set in that plan. While the objectives focus on broadband connectivity for all affordable broadband digital inclusion as well as increasing the rollout and uptake of e-government services available through the network, the policy should explicitly address how content rights, online services, enabling technologies and services and user interface can be protected as these critical aspects are supported and availed to citizens through broadband provisioning. Beyond NDPII, this policy has several key provisions, such as with respect to National Operator licenses, which need to be carried forward. The situation of the National ICT Policy (2014) and the NBP (2018), both of which were developed in response to NDPI and NDPII, respectively, points to the pitfall in linking major policies to the NDPs: NDPs are essentially five-year strategic tools and should not be the basis for long-term policy. Key policies of this nature should link directly to the National Vision 2040, with provision for continuing iterations that still keep focus on the long term (minimum 10 years). Such policies should guide the NDPs, not the other way round.

	Comments/Recommendations
Digital Uganda Vision	The Digital Uganda Vision is now taken as the key policy guiding the implementation of NDPIII. It is specifically stated on the MoICT&NG website that this is 'a National Policy and Strategic Framework that reviews, integrates, consolidates, and improves all the existing ICT strategies, policies and plans into one overarching digital Vision for Uganda by providing a unified direction for ICT development and an Integrated ICT project implementation approach'. A current challenge, and the consultants have noted this during the review of the various documents, is the multiplicity of policies and strategies to which stakeholders – public, private and civil society – need to refer in order to understand the national policy direction. This is compounded by inconsistent targets. For example: • NBP: The target is to deliver a minimum of 4 Mbps to end-users for internet access. • ICT Sector Strategic Investment Plan 2014/15–2019/20: The target is to improve broadband access from 512Kbps to 5Mbps and 30Mbps for rural and urban households respectively. • Digital Uganda Vision: Does not define broadband. • National Strategy on Fourth Industrial Revolution: National broadband at 100% geographical coverage at a minimum speed of 4 Mbps and 80% population coverage at a minimum speed of 8 Mbps by 2025. A notable gap is that while the document sets targets for broadband coverage and cost as a percentage of income, broadband is not defined either quantitatively or qualitatively. At a minimum, a qualitative definition that enables the ministry to set targets adaptively should be used. Where quantitative targets are used, these should be made aspirational in recognition of the rapid evolution of the capability of data network technologies: aiming for very high capacity bandwidth (as opposed to the current modest levels) leads to the added benefit of lowering costs due to economies of scale in bandwidth provisioning.
National Strategy on 4th Industrial Revolution	While not yet formally approved beyond MoICT&NG, it is the latest entry into the key documents overseen by the ministry. Critical enablers are identified as connectivity; regulatory agility with focus on data regulation; up-skilling; e-government and cybersecurity; and resource mobilisation and investment promotion.

	Comments/Recommendations
National Strategy on 4th Industrial Revolution	The draft Spectrum Management and Licensing Policy revised and consolidated the existing spectrum management framework in order to allocate the spectrum efficiently, optimise its use, realise its true value and ensure that adequate spectrum is preserved for security, emergency, aeronautical and maritime travel and science. The policy should consider specifying core government directives in spectrum management, such as spectrum allocation and assignment, license renewal and surrender, re-farming and dispute resolution. Guiding principles for spectrum allocation need to be established so that any approach used at any particular time ensures a balance among the desired outcomes of increasing broadband access at prices affordable to consumers; ensuring efficient utilisation; ensuring fair competition; encouraging innovation; and eliminating hoarding.
The National Intellectual Property Policy (2019)	The National Intellectual Property Policy was developed to address the following three key gaps: • The lack of appropriate IP infrastructure to support innovation and creativity, • Inadequate human capital development for the IP value chain and • Inadequate utilisation of the IP system. The policy recommends a process for applying for patents that is laborious and needs to be simplified. From an operational perspective, awareness of IP policy is limited, resulting in few Ugandans registering patents for their systems, applications and content.
National Competition Policy (2014)	The National Competition Policy provides a strong basis and reasonable framework for the establishment of a Competition and Consumer Protection Commission. The Situational Analysis recognises that both the communications and information technology sectors have fairly detailed provisions for ensuring fair competition and consumer empowerment and protection but also places emphasis on key gaps that need to be addressed at a nationally consistent level.
National Competition Policy (2014)	The Draft National Post Code and Addressing System Policy aims to meet the challenge of national identity, which requires location references of persons and businesses. The policy should be reviewed to provide for the addressing of properties and street naming and numbering. There is especially a need to take into consideration how to address the last- mile (e.g. rural areas), geospatial mapping and data management, maintenance of the national addressing database and compliance and enforcement issues in cases where stakeholders do not adhere to the national policy.

	Comments/Recommendations
Policy for Transition from IPv4 to IPv6 (2010)	The national Policy for Transition from IPv4 to IPv6 was aimed at paving the way for the transition to IPv6 due to the relatively small address space in IPv4 for the current and future size of the internet. The policy needs to be reviewed to take into consideration aspects of the value chain, such as user interface, that predominantly support the rate of the adoption of IPV6 as well as further guidance on adoption, capacity, mobility and security issues.
E-Waste Management Policy (2012)	The E-Waste Management Policy covers all the aspects that are deemed necessary to mitigate the impact of e-waste in Uganda in the long term. The policy should provide direction on how e-waste should be managed at different levels of the value chain.
National Information Security Policy (2014)	This policy seeks to support the enhancement of IP infrastructure capacity for the generation, protection, commercialisation and enforcement of IP. The policy recommends a process for applying for patents that is laborious and may need amendments to simplify it especially for the fast-moving technological space.
Policy Framework for the Management of the .UG Top Level Domain (2014)	The framework for management of the .UG ccTLD was aimed at formalising the administration of the Country Code Top Level Domain and providing guidelines on its management. This policy is consistent with the International Telecommunications Union guidelines for the reassignment of the administration of ccTLD and governance models and structures to be used for the ccTLD's management. The full implementation of this policy needs to be actualised as ease and cost of access to domains is an important factor in usage penetration. It is not clear why this policy has not been implemented over the last seven years.
Rural Communication Development Policy (2017)	The fundamental aim of this policy is to ensure inclusiveness in the digital economy through connectivity and access to relevant content and services. Target groups are mostly the often marginalised (rural; women; youth; people with disabilities; refugees; elderly; MSMEs; urban poor). The policy should evaluate a shift from providing what is considered the minimum acceptable to implementing equitable strategies until equality of connectivity and opportunity across the country is achieved. It should especially be noted that COVID-19 has led to the development of nomadic work-styles across the entire public and private sectors.
Guidelines on Infrastructure Deployment and Sharing (2021) – public consultation stage concluded	The intent of these guidelines is: encouraging a strategic, forward-looking approach to the deployment and provision of communications facilities with the aim of realising the benefits of forward planning; facilitating coordination among the different stakeholders in the rollout of ICT infrastructure; facilitating joint construction, co-location, sharing and access to existing networks; minimising the amount and cost of civil works and associated social costs such as visual impacts, public nuisance, traffic congestion and impacts on roads; and promoting technical and market efficiency in the provision of communications infrastructure. A key outcome is a general lowering of the cost of services to consumers.

	Comments/Recommendations
Draft Open Data Policy (2017)	The draft Open Data Policy is intended to ensure that public sector data are available for access and use (e.g. by non-government organisations, businesses and industry, academia, innovators and civil society) to facilitate participatory governance, innovation, new products and services and transparency and accountability as well as learning, feedback and adding data for development. Benchmarking with similar policies indicates that the open data policy takes all the good practices into account and covers the key ingredients of open government data. However, the policy needs to be clear on how data can be designated, whether open or not – for example, there is a need to introduce an Open Data Criteria Assessment Checklist. The policy also needs to be clear on ownership and the responsibilities of the government in respect to open data (i.e. who is accountable for what).

TABLE 29: COMMENTS AND/OR RECOMMENDATIONS ON KEY POLICIES AND STRATEGIES

5.4. BROADBAND POLICY RECOMMENDATIONS

Table 28 shows that the number of policy documents that relate to the broadband value chain in Uganda is overwhelming, and not necessarily always consistent. There is an urgent need to rationalise these so that all stakeholders (including MDAs) can refer to a single clear source that establishes policy (and the related strategy – which needs to be revised from time to time). Where derived documents from the main one are generated, the linkage and the reason for such expansion should be clear. If the Digital Uganda Vision is now the core reference document under Vision 2040, most of the earlier policies, outside the need to evaluate and learn lessons from them, should be retired. Revisions should ensure that the National Strategy on 4IR is parented by the Digital Uganda Vision.

The SMART Rwanda Master Plan (2015–2020), while it had its own flaws, provides a good illustrative example of structure: This plan includes the policy orientation for the Broadband Policy, the Cyber Security Policy, the Private Sector Development Policy, the e-Waste Policy and the Open Data Policy. The Australian Digital Economy Strategy 2030 [78] is an excellent and newer reference for linking all core policies and strategies that drive national digital agenda to one source. As stated in the Strategy, 'The Digital Economy Strategy brings together policies and programs across government to ensure a clear path to 2030'. This kind of anchoring ensures alignment as well as consistency of objectives.

The Australian Digital Economy Strategy 2030 78 is an excellent and newer reference for linking all core policies and strategies that drive national digital agenda to one source.

The following major gaps raised by stakeholders during interviews also need to be addressed at the policy level, leading to appropriate laws and institutions:

78 - https://digitaleconomy.pmc.gov.au/sites/default/files/2021-07/digital-economy-strategy.pdf

- National Policy on Critical Infrastructure (of which critical ICT infrastructure is a subset). A national-level approach is required to ensure safety, security and compliance around any infrastructure or assets that would have significant social or economic impact if damaged or compromised.
- RoW for public utilities (of which ICT infrastructure is now a recognised subset). Severe delays and very high costs of compensation or lease are major challenges for both public and private entities rolling out infrastructure – even when local governments are the owners.
- It is not immediately apparent what the main cause is, but there are key policies that for a long time have not progressed to full implementation, and this needs to be examined. These include the policies addressing the national top-level domain (MoICT&NG) and the national competition policy (MTIC).

Alignment of policy objectives across government ministries is still a challenge that needs to be addressed. The programme working groups (WGs) as set up under NDPIII were supposed to address this alongside other objectives. The most visible example raised by stakeholders relates to the efforts within MoICT&NG and its associated agencies to reduce access costs to ICT goods and services for users and, running counter to this, action from the Ministry of Finance and Economic Planning to raise more revenue by imposing taxes on ICT goods and services. The most recent example is the 12% excise duty on data.

The situation of the National ICT Policy (2014) and the NBP (2018) points to the pitfall in linking major policies to the NDPs. NDPs are essentially five-year strategic tools and should not be the basis for policy. Key policies of this nature should link directly to the National Vision 2040, with provision for continuing iterations that still keep focus on the long term (minimum 10 years). Such policies should guide the NDPs, not the other way round.

Some gaps and recommendations identified in Table 20 that need to be addressed include the following:

- NDPIII: A more aggressive cost of access target to consumers is needed – reducing the unit cost of 1Mbps/month of internet on the retail market from USD 237 to USD 70 by 2025 is not sufficiently aggressive to break the cost barrier to the usage of broadband, which will then disable the usage targets under NDPIII and therefore the Uganda Digital Transformation Programme.
- Digital Uganda Vision: While the document sets targets for broadband coverage and cost as a percentage of income, broadband is not defined either quantitatively or qualitatively. At a minimum, a qualitative definition that enables the ministry to set targets adaptively should be used. Where quantitative targets are used, these should be made aspirational in recognition of the rapid evolution of the capability of data network technologies.
- National Intellectual Property Policy: The policy recommends a process for applying for patents that is laborious and needs to be amended, especially taking into account the rapid evolution of technology.
- Draft National Postcode and Addressing System Policy: The policy should be reviewed to provide addressing of properties and street naming and numbering. There is especially a need to take into consideration how to address the last mile (e.g. rural areas), geospatial mapping and data management, maintenance of the national addressing database and compliance and enforcement issues in cases where stakeholders do not adhere to the national policy.
- Draft Open Data Policy: The policy needs to be clear on how data can be designated, whether open or not – for example, there is a need to introduce an Open Data Criteria Assessment Checklist. The policy also needs to be clear on ownership and the responsibilities of the government in respect to open data (i.e. who is accountable for what).

Table 30 summarises the key actions that are required with respect to policy as part of the Broadband Blueprint.

Challenge/gap	Action required
The number of policy documents that relate to the broadband value chain in Uganda is overwhelming, and not necessarily always consistent.	• Rationalise all policies under MoICT&NG so that all stakeholders can refer to a single clear source that establishes policy. The Digital Uganda Vision is now the core reference document under Vision 2040, most of the earlier policies, outside the need to evaluate and learn lessons from them, should be retired. Revisions should ensure that the National Strategy on 4IR is parented by the Digital Uganda Vision. • Where derived documents from DUV are generated, the linkage and the reason for such expansion should be clear.
Policy gaps relating to key elements that impact on the broadband value chain.	Address the following major gaps at the policy level so that appropriate laws can be developed and implemented: • National Policy on Critical Infrastructure (of which critical ICT infrastructure is a subset). • RoW for public utilities (of which ICT infrastructure is now a recognised subset). • It is not immediately apparent what the main cause is, but there are key policies that for a long time have not progressed to full implementation, and this needs to be examined. These include the policies addressing the national top-level domain (MoICT&NG) and the national competition policy (MTIC).
Policies to support NDPs are always out of synch with the NDP, starting several years into the NDP and extending into the next one.	NDPs are essentially five-year strategic tools and should not be the basis for policy. Key policies of this nature should link directly to the National Vision 2040, with provision for continuing iterations that still keep focus on the long term (minimum 10 years). Such policies should guide the NDPs, not the other way round.
Misaligned policy objectives across MDAs leading to contradicting outcomes, especially increased access to ICT goods and services vis-à-vis taxation.	MoICT&G and the Ministry of Finance and Economic Planning, through the agency of the Prime Minister's Office, to address the contradictions.

Challenge/gap	Action required
Gaps (in various policy documents) that impede or are likely to impede the rollout and exploitation of broadband.	Modify the following policies as indicated: • NDPIII: Set a more aggressive cost of access target for. • Digital Uganda Vision: Define broadband either quantitatively or qualitatively. A qualitative definition that enables the ministry to set targets adaptively should be used. If quantitative targets are used, these should be made aspirational in recognition of the rapid evolution of the capability of data network technologies. • National Intellectual Property Policy: The policy recommends a process for applying for patents that is laborious and needs to be amended, especially taking into account the rapid evolution of technology. • Draft National Postcode and Addressing System Policy: The policy should be reviewed to provide addressing of properties and street naming and numbering. There is especially need to take into consideration how to address the last mile (e.g. rural areas), geospatial mapping and data management, maintenance of the national addressing database and compliance and enforcement issues in cases where stakeholders do not adhere to the national policy. • Draft Open Data Policy: The policy needs to be clear on how data can be designated, whether open or not – for example, there is a need to introduce an Open Data Criteria Assessment Checklist. The policy also needs to be clear on ownership and the responsibilities of the government in respect to open data (i.e. who is accountable for what).

TABLE 30: BROADBAND POLICY RECOMMENDATIONS

06

INSTITUTIONAL ARRANGEMENTS

This section presents a PESTEL analysis of the factors of importance for investment and strategic management decisions. Broadband institutional arrangements are defined as the formal and informal cooperation structures that support and link public and private organisations to help fulfil their respective mandates and which are used to establish the legal, organisational and productive frameworks to allow for the sustainable management of Uganda's broadband ecosystem in particular and the digital economy in general. These arrangements are an important component of the 'invisible mile' and also embrace the policies, systems and processes that organisations use to legislate, plan and manage their activities efficiently and to effectively coordinate with others in order to fulfil their respective mandates. Institutional arrangements include the responsible organisations and their human resources, funding, equipment and supplies, leadership and effectiveness and the communication links between and among organisations.

The guiding principles for the establishment of good, mutually reinforcing institutional arrangements include the following:[79]

• **Mandate specification:** ensuring the clear definition and delineation of the different roles, responsibilities and terms of reference of each player in the ICT industry, paying attention to avoid ambiguity, overlaps, lacunas and misinterpretation.

• **Effective coordination:** enhancing the voluntary or forced alignment of the tasks and efforts of relevant stakeholders within a national setting to avoid mission drift and the duplication of infrastructure, roles and responsibilities while fostering efficiencies across the sector.

• **Collaboration:** encouraging productive, mutually beneficial linkages among key stakeholders to facilitate improvements in the development, regulation, servicing, management and use of the broadband ecosystem.

• **Agility and adaptiveness:** the ability to move quickly, address and take advantage of institutional, technological and other advancements in support of the development and delivery of industry products and services.

• **Participation, inclusion and partnership:** empowering through representation in government and other mechanisms; facilitating free, active and meaningful participation in decision-making processes; the meaningful and free participation of stakeholders, including citizens, in decision-making processes could contribute to the overall adaptability and stability of institutions and promote innovative policy dialogues.

• **Economy (performance):** improving the overall efficiency of the national broadband ecosystem to avoid expensive and unnecessary operations.

• **Transparency and accountability:** identifying and sharing relevant information to create a clear understanding of the national broadband ecosystem and facilitating trust amongst different stakeholders as well as timely accountability for the resources employed.

“the meaningful and free participation of stakeholders, including citizens, in decision-making processes could contribute to the overall adaptability and stability of institutions

The governance and institutional framework of the broadband ecosystem and overall ICT sector in Uganda can be viewed from four main perspectives. These include:

• Oversight function,
• Policy formulation and coordination,
• Policy implementation and
• Enabling regulation.

The last aspect (enabling environment) is discussed separately. We limit the discussion here to focus on the first three aspects since the legal and regulatory perspective is covered in detail under a separate section. The figure below shows the key actors in Uganda’s broadband ecosystem.

79 - Adopted from the UN’s National Institutional Arrangements: Instruments, Principles and Guidelines, UN Committee of Experts on Global Geospatial Information Management, 2017.

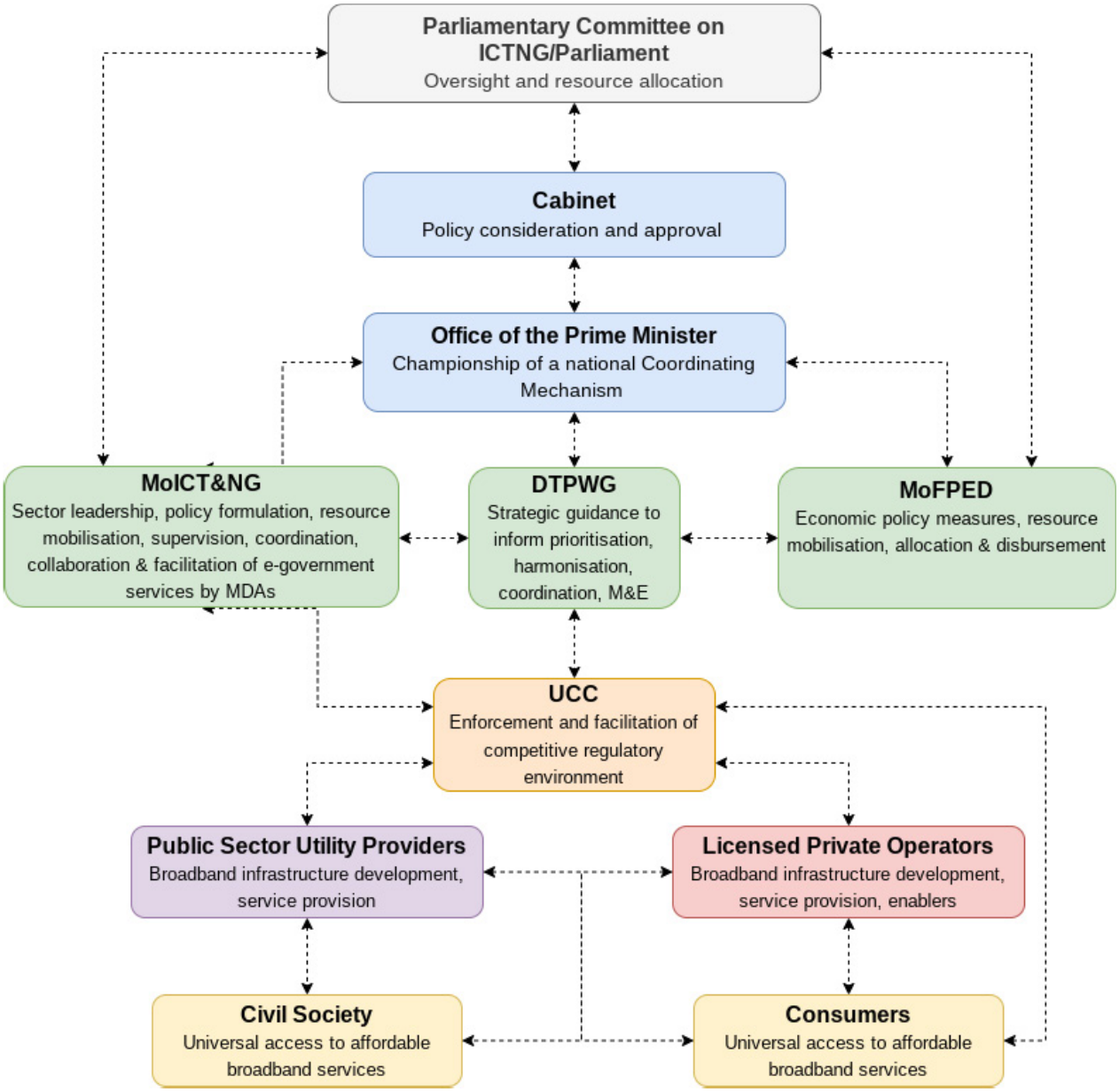


FIGURE 16: A RATIONALISED INSTITUTIONAL FRAMEWORK FOR UGANDA'S BROADBAND ECOSYSTEM

6.1. OVERSIGHT FUNCTION

Parliament exercises its constitutional oversight responsibility over MoICT&NG through the Parliamentary Committee on Information, Communications Technology and National Guidance (PCICTNG). The Minister is required by law to table MoICT&NG's Annual Policy Statement and Budget Estimates before parliament for consideration and approval. The Minister also appears before parliament to respond to policy and any performance-related matters, as may be so summoned by the House Speaker from time to time.

The current PCICTNG of the 11th Parliament was only recently constituted, following the general elections that were held in January 2021. As a standing committee, its tenure lasts only for one parliamentary session. The Committee currently comprises 29 members of parliament (MPs) and is primarily concerned with ensuring accountability for the proper use of public resources to provide required services. A major risk associated with this committee, as with all political organs, is for members to approach their mandate using 'political lenses 'which may diminish the objectivity

of their decisions. A possible welcome development, however, is the fact that the 11th Parliament is comprised largely of youthful representatives of the people who are likely to appreciate the digital economy more than their predecessors. One of the challenges in other countries has been the pace of technological progress and MPs' stagnant knowledge. One cannot do oversight without a full understanding of the progress made in the sector. At the same time, an ICT professional was recently appointed by the President to be the new Permanent Secretary (PS) of MoICT&NG. This should augur well for the strategic leadership towards digitalisation of Uganda.

MoICT&NG exercises functional oversight over Uganda's broadband ecosystem. MoICT&NG was established in June 2006, taking over the communications docket previously under the erstwhile Ministry of Works, Transport and Communications (MoWTC) and, some years later, the functions under the previous Ministry of Information. As the lead ministry, it is formally mandated to monitor and evaluate the performance of sector actors as well as sector performance and provide strategic and technical leadership, overall coordination and support and advocacy on all matters of policy, laws, regulations and strategy for the ICT sector. It is important, however, to underscore the need for the ministry to play its oversight and strategic leadership responsibility within the context of a quasi-market economic policy environment, as stated in NDPIII. This awareness should enable the ministry to chart out and align its mission to that of other actors in the broadband ecosystem.

Regrettably, neither MoICT&NG nor the agencies under its supervision ever receive the funding required to execute their annual work plans. For FY 2020/21, the ICT & National Guidance sector received only UGX 162.9 billion (0.36% of the overall national budget amounting to UGX 45.5 trillion). Inadequate funding and human resource provision adversely impact capacity to fulfil institutional mandates. NITA-U, for instance, has operated with less than 50% of the approved staff establishment. Skills gaps remain in core technical areas, such as information/cyber security, cloud computing, networking, etc., where there is dependency on costly expatriates.

6.2. POLICY FORMULATION AND COORDINATION

MoICT&NG is also responsible for national policy formulation and coordination for the ICT industry. Policy formulation is the development of effective and acceptable courses of action for addressing what has been placed on the policy agenda. Policy is formulated as a high-level strategic intervention but has to be understood and operationalised at lower levels to guide the planning, development decisions and actions by other stakeholders at different levels. A conducive policy platform should anticipate significant changes in the business environment and set high standards of compliance by the different sector players.

The National Planning Authority (NPA) is an important player in policy formulation given its responsibility for championing integrated national planning to set priority areas and the shift from sector-centric planning (operational under NDPII) to programme-based planning (NDPIII). Under NDPIII, MoICT&NG is the Lead for the DTPWG. This has replaced the former ICTSWG, which previously was expected to play a role in harmonising, coordinating, monitoring, evaluating and reporting on the sector vision and goals, policy frameworks, plans and performance of all sector actors. The sector approach was discarded apparently because of its failure to promote the synergies and complementarities that could be derived from a more holistic approach.

Institutions	Function	Overseen by
Parliament	Legislation, oversight and resource allocation	Citizenry
Cabinet	Executive decision making around national priorities and programmes	The President
Office of the Prime Minister (OPM)	Leader of government business charged with coordination of the activities of all MDAs	President
National Planning Authority (NPA)	Integrated national planning to set priority areas and the shift from sector-centric planning (operational under NDPII) to programme-based planning (NDPIII)	MoFPED
Ministry of Information and Communications Technology & National Guidance (MoICT&NG)	Strategic and technical leadership in terms of setting national broadband and national digital transformation priorities; overall coordination; fostering stakeholder collaboration; monitoring and evaluation; and support and advocacy on all matters of policy, laws, regulations and strategy to increase digital penetration in accordance with NDPs	Parliament
Digital Transformation Programme Working Group (DTPWG)	Provide strategic guidance and checks and balances	MoICT&NG
NITA-U	Coordinate e-government services by MDAs	MoICT&NG

TABLE 31: INSTITUTIONS RESPONSIBLE FOR POLICY FORMULATION AND COORDINATION

Policy should be sufficiently broad and as far-sighted as possible to anticipate and provide for innovative responses to emerging opportunities. The policy process is normally conceptualised as sequential parts or stages comprising i) problem emergence, ii) agenda setting, iii) consideration of policy options, iv) decision making, v) implementation and vi) evaluation.[80] A good policy formulation process seeks to engage as many stakeholders as possible to enhance acceptance, ownership and likelihood of successful implementation.

Coordination is the process of organising industry actors so that they work together harmoniously and ensure horizontal coherence across the different actors (MDAs, private sector and other stakeholders) and vertical coherence across government levels (national and local). Organisation theory posits that coordination mechanisms work by generating three integrating conditions of accountability (clarity about task responsibilities), predictability (clarity about which, when and how tasks will be accomplished) and common understanding (shared perspectives about tasks based on transparency). In the broader context of this study, effective coordination is most likely to be achieved when each actor in the ICT industry

- Is clear and knowledgeable about their mandate,
- Feels adequately empowered with authority and resources to execute their mandate and
- Shares in a common binding interest to which the actor is held accountable.

80 - Jordan and Adelle (Editors): Environmental Policy in the EU-Actors, Institutions and Processes, 2012.

Areas for coordination within the country's broadband ecosystem should include the following:

• Formulation of conducive policy and regulatory frameworks to harmonise the strategic interests of key stakeholders, promote healthy competition and support sustainable policy implementation towards the achievement of shared goals.
• Securing RoW calls for harmonising levels of understanding as well as levelling the interests of key MDAs (Works and Transport, Lands, Housing and Urban Development, MoICT&NG, Water and Environment, UNRA, UCC, NITA-U, UETCL, National Parks, etc.), local government authorities, land owners and communities.
• Infrastructure development to eliminate or at least minimise multiple/repeated digging up and interference with the existing infrastructure of roads, railways/ports, water and electricity by the public utilities agencies, on one hand, and private sector developers including mobile network operators, on the other hand – also, the harmonisation and utilisation of available capacity to eliminate redundancies and promote efficiencies within the system or sector.
• Economic decision making on major economic policy measures (such as the determination of tariffs, taxation and pricing) that have significant impact on supply and demand for broadband and internet services.

Key parameters in ensuring effective coordination include:

• Proactive, confident and credible leadership;
• A coordination framework built on a foundation of generally accepted principles (discussed in an earlier section);
• Willingness to share (mindset);
• Human and financial resources;
• An enabling policy and regulatory environment; and
• A culture of transparency and accountability.

The OPM is mandated, under the Constitution, to be the leader of government business and should, therefore, be championing efforts designed to promote harmonisation, coordination and collaboration in Uganda's broadband ecosystem in liaison with MoICT&NG. Regrettably, the country currently lacks a strong coordination mechanism to harmonise the decisions and actions of key actors in the country's broadband ecosystem, resulting in duplication, wastage and, ultimately, unnecessarily high cost of access to internet services by consumers.

The OPM has not been able to formulate and operationalise an effective national coordination mechanism (NCM) that binds MDAs as well as private sector players to common standards of compliance and accountability in a digital economy. The OPM has a large number of political leaders (9 in all) as well as a Directorate responsible for Strategic Coordination & Implementation. It is not clear whether this failure reflects lack of political will or lack of resources (financial and technical).

MoICT&NG has not invoked its administrative and position authority, including having senior- level representatives on the boards of UCC and NITA-U as well as servicing the DTPWG, to ensure effective coordination of the broadband ecosystem. Instead, senior ministry officials seem to think that there is a need for the enactment of an enabling law to empower them to execute this role. The Consultant does not concur with this view, believing instead that the current policy already empowers the supervising ministry to ensure harmonisation, coordination and collaboration in the broadband ecosystem.

The tendency for senior-level representatives on the DTPWG to delegate junior officers to sit in for them at the meetings of the WG undermines the capacity of this organ to influence strategic issues such as coordination and collaboration.

6.3. POLICY IMPLEMENTATION

NBP implementers include UCC (the regulator), NITA-U (e-government services), public sector utility providers (UNRA, UETCL, REA, NWSC) and private telecommunications providers. A major challenge is bridging the significant gap between good policies and their effective and efficient implementation. Ideally, the public sector actors should be focused on catalysing the broadband ecosystem and on creating the appropriate enabling environment for private sector growth. NDPIII, however, calls for implementation reforms along the following lines:

- Government should take the lead in the coordination of ICT infrastructure development and deployment so as to cure the silo-based approach to the planning and development of infrastructure.
- Government should digitalise and roll out e-services to all sectors, MDAs and local governments to be able to harness the potential of ICT. All sectors, MDAs and LGs will adopt new ways of delivering services and re-engineer their business processes, ensuring that they are simplified, streamlined and optimised and develop e-solutions such as e-health, e-education and e-extension services, among others.
- Government should investigate the rationalisation of agencies under the ICT sector to remove duplications and overlaps of mandates.

As noted earlier, the major challenges experienced by stakeholders emanate from the absence of an effective coordination mechanism that can facilitate harmonisation and collaboration in broadband infrastructure development. UCC has recently developed draft Guidelines on Infrastructure Deployment and Sharing.[81] The objective of these Guidelines is to foster the efficient provision and utilisation of communications infrastructure by:

- Encouraging a strategic, forward-looking approach to the deployment and provision of communications facilities with the aim of realising the benefits of forward planning;
- Facilitating coordination among the different stakeholders in the rollout of ICT infrastructure;
- Facilitating joint construction, co-location, sharing and access to existing networks;
- Minimising the amount and cost of civil works and associated social costs, such as visual impacts, public nuisance, traffic congestion and impacts on roads; and
- Promoting technical and market efficiency in the provision of communications infrastructure.

All operators of telecommunication services will be obliged to comply with the regulations once approved. This is a very welcome development.

Inter-ministry conflict impacted institutional performance. Within the ministry itself, the resolution of cases of inter-departmental mission drift is part of the challenges that the new Permanent Secretary has started to address. Furthermore, there has been conflict extending to the agencies under the ministry, about who should make which decisions or run which projects. A major motivation for this tendency may be related to a desire to control the often-significant budgets of these projects as well as a desire to remain professionally engaged and relevant. Regardless of the causes, the impact is negative.

81 - The Uganda Communications Commission Guidelines on Infrastructure Deployment and Sharing, Draft of February 2021.

Mission drift can result in undesirable consequences. First, it is likely to generate conflicts of interest when the ministry responsible for policy guidance is also an implementer of programmes, in competition with, say, the regulator. The oversight and supervisory functions will most likely suffer on account of a lack of objectivity likely to emerge within the ministry. Secondly, some technical personnel in the implementing agencies may get frustrated and opt to leave for 'other pastures', including going abroad, thereby compounding the already-challenging staffing situation in these agencies. Furthermore, the limitations of the civil service culture may undermine the focus on timeliness, urgency and value-for- money considerations that underpin good business practices. A case in point is the pervasive expectation by civil servants, at all levels, that they must be induced and remunerated to attend official meetings that otherwise are entirely within their normal job descriptions. Many civil servants feel obligated to supplement their salaries and wages with extra-official commercial pursuits that are often undertaken at the expense of their formal contracts and time. The inevitable outcome of letting the policymaking organs get involved in project implementation is that the quality-of-service delivery is likely to decline, much to the frustration of industry actors and consumers. There has also been conflict between UCC and NITA-U as well as within NITA-U itself, reflecting divergent understandings of the institutional and organisational mandates as well as personality issues.

Consolidation of government ministries is taking place. The government commissioned a review of 157 MDAs with the objective of rationalising the number and mandates of the public sector agencies, improving performance and reducing the cost of service delivery. Accordingly, the cabinet, on the 22nd of February, 202l, took a decision to merge, mainstream and rationalise 18 ministries and up to 77 government agencies, commissions, authorities and public expenditures to facilitate efficient and effective service delivery. The cabinet also approved an Implementation Roadmap (lR) for the implementation process, to be spread over a period of two years (FYs 2021/22–2022/23). NITA-U is among the agencies to move back to MoICT&NG. The new ministry structure is yet to be determined by the Public Service Ministry but the ministry acknowledges that some NITA-U staff may not be retained due to redundancy, while other technical personnel may opt for 'greener pastures' elsewhere. In the energy sector, the Uganda Electricity Generation Company Limited, Uganda Electricity Transmission Company Limited and Uganda Electricity Distribution Company Limited will be consolidated to form one electricity company. The Rural Electrification Agency (REA) has already moved back to the Ministry of Energy and Mineral Development as a department. The main objective of the reform is to eliminate structural and functional duplications and overlaps and wasteful expenditures and realise resultant short- term and long-term savings, in line with the approved IR.[82]

Corruption amongst local government authorities is a challenge. A major problem that infrastructure developers have to confront is the attitude of local government authorities, who often see the proposed broadband infrastructure investment in their areas of jurisdiction as an opportunity to generate some tax income for the authorities as well as 'side income' for the individuals involved (corruption). On the positive side, UECTL has availed its excess aerial fibre optical capacity to a number of private mobile telecommunications operators, contributing to uninterrupted communications within Uganda as well as across borders (Kenya and Rwanda). UCC also reported that it was now receiving reports from infrastructure developers such as the Uganda National Roads Authority (UNRA) in a timelier manner. This now enables UCC to link up with the contractors to harmonise the development of the ICT infrastructure, especially in digging ducts and laying fibre. UCC has also collaborated with Posta Uganda to leverage the latter's countrywide network and expand internet access by rural communities. At the data network level, the collaborative efforts by the university-led Research and Education Network for Uganda (RENU) has resulted in a dramatic

82 - Ministry of Public Service: Ministerial Statement on Rationalization of Government Agencies, 11 Aug. 2021.

> **Since RENU's inception, the unit cost of international bandwidth to RENU member institutions has dropped from more than USD 3,300 per Mbps per month in 2006 to as low as USD 20 per Mbps per month**

reduction of the cost of international bandwidth and improvement in the quality of connectivity for its member institutions. Since RENU's inception, the unit cost of international bandwidth to RENU member institutions has dropped from more than USD 3,300 per Mbps per month in 2006 to as low as USD 20 per Mbps per month depending on the bandwidth capacity consumed by a particular institution. This kind of collaboration is very welcome and should be a model for putting in place a sustainable national Broadband Blueprint.

Consultation by the government with the private sector is minimal. Another area of concern is the generally little consultation of the private sector ICT stakeholders by government officials to inform major economic decisions. Local assemblers and manufacturers of ICT devices, for instance, are also complaining that despite the devices being assembled in-country, they are still being taxed. The taxes, in turn, are passed on to the consumers, resulting in higher prices for devices, thereby constraining access and usage. Interest groups representing civil society play an important role in moderating government policies and the implementation of programmes with a view to promoting wider access to affordable internet services by consumers.

6.4. RECOMMENDATIONS

The overall aim of the recommendations below is to provide the government with a framework for enhancing the functionality of the institutional arrangements to support a rationalised, coordinated and collaborative broadband ecosystem that will help propel the country into a competitive digital economy.

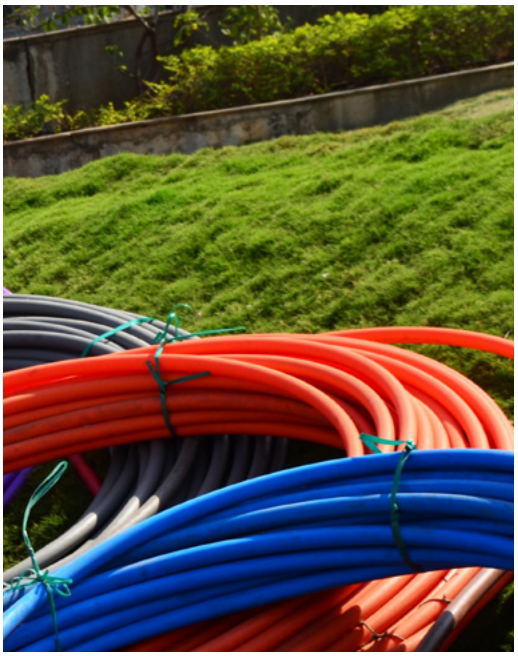
Problem to be addressed	Comments/Recommendations
Weak institutional oversight	The Parliamentary Commission, in liaison with her agencies and development partners, should organise orientation and periodic sensitisation programmes for all members of parliament to sensitise legislators to the imperatives of the digital economy, including emerging opportunities and challenges, to enable the country to grow and develop competitively while providing employment to the millions of its youthful population.

Problem to be addressed	Comments/Recommendations
Inadequate financial resource allocation	MoICT&NG, the Ministry of Finance, Planning & Economic Development and parliament need to work closely together to i) increase budget allocation to ICT infrastructure development and to MDAs mandated to champion the country's transition into a digital economy and ii) reduce the cost of ICT devices and internet access and usage. Increased usage (volume) should be the anchor for expanding the tax base in the ICT industry.
Mission drift	While MoICT&NG should remain focused on policy formulation and oversight, it will need, by virtue of the requirements of NDPIII, to be more closely involved in implementation coordination, working with and through its agencies. This should not take attention away from the principal ministry functions of policy formulation and oversight, providing innovative policy guidance for project coordination and mobilising resources to grow the digital economy. The ministry would also provide the lead in the monitoring and evaluation roles, including the periodic assessment of the IT value chain and its contribution to Uganda's socioeconomic transformation. To these ends, the structure of the ministry and the departmental mandates may need to be reviewed to minimise overlaps, eliminate mission drift and avoid turf wars. Important alongside these actions is greater information sharing within the ministry and its agencies and the formalisation of channels for horizontal collaboration among the ministry and its agencies.
Rationalisation of NITA-U's role	The restructured Directorate of ICT Support in MoICT&NG would concentrate on ensuring the availability of quality ICT resources and services across ministries and DLGs through planning, development, resource standardisation and acquisition, capacity building and control and maintenance processes that are customer-oriented. In moving NITA-U back as a directorate in MoICT&NG, measures should be taken to retain and energise the professional competences required to capacitate and service MDAs' transition to a fully integrated e-government system that is citizen-centric. Government will need to offer 'personal-to-holder' terms and conditions of employment designed to attract and retain specialised IT personnel. The directorate would also collaborate with the private sector to train businesses and business owners on how to adopt digital transformation (a welcome development reported recently in the press was the call by the Kampala City Traders Association (KACITA) upon the government to provide the business community with the necessary support that will enable them to embrace e-commerce and, in particular, the e-government procurement that has been introduced by the Public Procurement and Disposal of Public Assets Authority. More specifically, KACITA asked the government to make the infrastructure to support e-procurement available for the local business community to effectively embrace it.

Problem to be addressed	Comments/Recommendations
Weak internal capacity of MDAs to support e-government services	The internal e-service capacity of ministries and DLGs should be strengthened preferably by the establishment of a senior position of Chief ICT Officer in each ministry and at the DLG level to work closely with the Directorate of ICT Support in MoICT&NG. This collaboration is imperative in light of the recent adoption of the Parish-centric Socio-economic Development Model.
Poor coordination and collaboration in broadband infrastructure development and service provision	Government, through joint collaboration between the Ministry of Works and Transport and MoICT&NG, should lead the rollout of broadband infrastructure across the country with a view to reducing cost, improving competition among service providers and expanding access to broadband services across the country. UCC should expedite the approval and operationalisation of the draft Guidelines on Infrastructure Deployment and Sharing so as to rationalise, harmonise and introduce efficiencies in the broadband value chain. OPM, in liaison with NPA, needs to put in place a functional NCM and capacitate it to support execution of OPM's crucial constitutional mandate of coordinating all government policies and programmes at both the national and local government levels. The NCM must have competent leadership and experience and the authority to act. The DTPWG should play an important role in promoting harmonisation, coordination and collaboration in digital infrastructure development to ensure efficiencies and affordable internet access. OPM should establish clear rules of engagement to ensure that all MDAs participate in WG meetings at the right level of responsibility and authority to realise the objectives of the WGs. The agenda for the DTPWG must reinforce the strategic leadership of the ICT sector and go beyond merely listening to project reports. MoICT&NG, in liaison with UCC, should establish and manage a Joint Infrastructure Coordination Mechanism (JICM) to promote harmonisation, coordination and collaboration in ICT infrastructure planning and development by all sector players. MoICT&NG, in liaison with the Ministry of Works and Transport, should expedite the establishment of the planned Spatial Data Infrastructure for the ICT Sector (SDI4ICT) to provide a reliable and transparent information platform for long-term planning and development in the digital economy. MoICT&NG, in collaboration with UCC, needs to strengthen its information, education and communication (IEC) capability to be able to publicise and link stakeholders in Uganda's digital economy, with special attention being given to energising the country's predominantly young population through appropriate interventions, including the vigorous promotion of BPO e-services.

Problem to be addressed	Comments/Recommendations
Poor coordination and collaboration in broadband infrastructure development and service provision	MoICT&NG and UCC might wish to institute a more regular Stakeholders' Consultative Forum (SCF) that brings together broadband developers/ investors and internet operators and users to share on operational matters that impact the effectiveness, efficiency and sustainability of the ICT sector in Uganda.

TABLE 32: SUMMARY OF RECOMMENDATIONS



07

LAWS, REGULATIONS AND OTHER REGULATORY INSTRUMENTS

There are many laws and regulatory instruments that impact on the rollout of broadband infrastructure in Uganda. Above all laws, of course, is the Constitution (1995), which establishes Uganda as a republic with executive, legislative and judicial branches of government. The Constitution also provides for local government at the district level. Chapter Four concerns the protection of fundamental and human rights, such as equality, life and personal liberty. Of particular relevance to the broadband value chain are the following articles:

• Article 26 provides for the protection from the deprivation of property. This is relevant to the rollout of broadband infrastructure especially in relation to the acquisition of RoW over land and the requirements for interconnection, roaming and facilities sharing, discussed below. Chapter 15 of the Constitution comprises specific provisions relating to land. Article 237(2)(a) provides that 'the Government or a local government may, subject to article 26 ... acquire land in the public interest' on the conditions of acquisition as prescribed by parliament.

• Article 29 provides for the protection of, amongst others, freedom of speech and expression, which includes the freedom of the press and other media.

• Articles 30 and 34 provide rights in respect to education.

• Article 41 provides for the right of access to information in the possession of the state, subject to laws made by parliament.

The most relevant law enacted by parliament impacting the rollout and use of broadband services in Uganda is the Uganda Communications Act, 2013 and the regulations and other regulatory instruments made under the Act. Other relevant laws, discussed below, include the National Information Technology Authority, Uganda Act, 2009 and the various laws that NITA-U is charged with implementing. Other laws that may impact on broadband may include those related to the protection of critical infrastructure, consumer rights, fair competition, access to banking and electronic payments and fair taxes.

7.1. THE UGANDA COMMUNICATIONS ACT, 2013

The Uganda Communications Act, 2013, which replaced the Uganda Communications Act, Cap. 106 and the Electronic Media Act, Cap. 104, provides for the establishment and operation of the UCC, which is responsible for regulating the communications industry. The Act concerns the licensing of communications service providers (including telecommunications, broadcasting and postal providers as well as video and cinema operators); the management and use of spectrum; and the regulation of other issues, such as competition and interconnection. The objectives of the Act are 'to develop a modern communications sector, which includes telecommunications, broadcasting, radio communications, postal communications, data communication and infrastructure' by, inter alia,

- Enhancing the national coverage of communications services;
- Reducing the role of government as an operator and minimising subsidies paid by the government;
- Encouraging the participation of the private sector; and
- Enabling competition through licensing and regulations to achieve rapid network expansion, competition and competitively priced quality services.

The Act also establishes the RCDF.

The Uganda Communications Act provides that the minister may make regulations. It also provides that any statutory instrument made under the repealed Electronic Media Act and Uganda Communications Act remain in force until revoked. In 2019, a set of 18 regulations was made to implement the 2013 Uganda Communications Act revoking many of the regulations that were made in 2005. The regulations altered the licensing framework and dealt with issues that had previously been regulated, such as spectrum management, and some that had not, such as consumer protection. The following matters are significant to the broadband ecosystem and are discussed in the following sections

- Licensing and market structure
- Fair competition
- Interconnection, roaming, and sharing of facilities
- RoW to land
- Spectrum
- Universal service
- Consumer protection
- Type approval
- Tariffs
- Numbering

7.1.1

Licensing and Market Structure

In 2019, the minister, in consultation with the UCC, reviewed the licensing framework after the passage of the National Broadband Policy 2018. After the review, the minister published the Uganda Communications (Licensing) Regulations 2019 and then the Revised Application Guidelines for Telecom Sectors. The following licenses are now available:

- National Telecommunications Operator – Licensee must cover 90% of the geographic area of Uganda and deploy internet access of at least 8 Mbps.
- Public Infrastructure Provider – License to roll out infrastructure either nationally or regionally.
- Public Service Provider – License to provide services either nationally or regionally. Also, the license

will specify one of two types of services, namely voice and data services or capacity resale services.

- Communal Access Operator – License to provide communal access services.

The terms of the licenses are fairly standard, setting out the term of the license, license fees and universal service obligations, amongst others. There are some provisions, however, that have been used to disrupt the provision of broadband services in Uganda during both the 2016 and 2021 election cycles. These provisions resulted in the UCC ordering licensees to interrupt access to certain social media sites and in one instance resulted in a total blackout.

The 2019 Licensing Regulations provide the UCC with the power to designate other telecommunications licenses for 'services or operations for public pay, communications network services and private networks or any other telecommunications services or operations'. No other licenses have yet been designated.

In 2019, the Uganda Communications (Fees and Fines) Regulations, 2019 were made, setting out, amongst other things, license fees. These regulations were amended twice in 2020.

Recommendations: It is recommended that the UCC review its licensing guidelines to encourage innovation and allow more flexibility in the licensing of services and in the imposition of fees. This may be accomplished by exercising the power set out in the Licensing Regulations that empowers the UCC to designate other licenses for any other telecommunication services or operations. An example in this regard might be the designation of research or education broadband network licenses in support of research and education in Uganda. The guidelines might also include procedures so that interested parties may request the designation of new and innovative types of licenses. This is often referred to as 'regulatory sandboxes'.[83] The need for regulatory flexibility is also discussed below in section 8.6 in the chapter on spectrum. Employing regulatory flexibility will facilitate innovation in the industry and allow the UCC to respond to such innovations in real time. This, in turn, will help drive the supply and demand sides of the broadband ecosystem.

The licensing guidelines should provide for the other specific types of services, such as satellite services. See Nigeria's commercial satellite communications guidelines for the licensing and type approval of space services as a good example reference.[84]

83 - See, for example, Regulatory Sandboxes and Innovation Testbeds, Inter-American Development Bank, 2020. https://publications.iadb.org/publications/english/document/Regulatory-Sandboxes-and-Innovation-Testbeds-A-Look-at- International-Experience-in-Latin-America-and-the-Caribbean.pdf

84 - Nigerian Communications Commission Commercial Satellite Communications Guidelines (Nov 2018). https://www.ncc.gov.ng/docman-main/legal-regulatory/guidelines/819-guidelines-on-commercial-satellite-communications-2018/file

The licensing guidelines should also include a listing of categories of license-exempt activities along with standards. See South Africa's regulations in respect to spectrum license exemptions as a good example reference.[85]

Finally, it is recommended that license conditions be amended to make shutdowns of services unavailable or provide more robust conditions for such shutdowns. It was noted in a report prepared for the World Bank[86] in respect to broadband connectivity for higher education institutions in Africa, '[t]he partial or total shutdown of selected services and quite often the Internet severely disrupts operations and, where it occurs periodically, is a disincentive for investment: it leads to loss in revenue that cannot necessarily be recovered without taking governments to court'.[87]

7.1.2

Fair Competition

The Uganda Communications (Competition) Regulations, 2019 were made to provide clarity on what acts constitute fair and unfair competition and merger control and to provide for enforcement procedures in respect to unfair competition. The competition regulations are quite comprehensive; however, there appears to have been little enforcement since they were placed before Parliament in 2020.

Recommendations: From many of the comments received in consultations, it seems that the regulator has not yet dealt with the concentration of two dominant players in the telecommunications market in Uganda. This failure has resulted, in the past, in players exiting the market as well as the perpetuation of an anti-competitive environment that does not allow smaller competitors to thrive.

The first recommendation is that the UCC begin to aggressively enforce the fair competition regulations. This includes the determination of those competitors who are dominant and have significant market power as well as the initiation of proceedings to investigate anticompetitive conduct.

The second recommendation is the fast-tracking of a general competition law. This should be followed by the establishment of an effective and efficient competition law enforcing organisation.

7.1.3

Interconnection, Roaming and Sharing of Facilities

The compulsory interconnection of networks is essential to the broadband ecosystem. Compulsory roaming on networks and the sharing of network facilities is also essential to ensure a competitive market. This, in turn, facilitates greater investment in broadband networks and services while at the same time avoiding the underutilisation of networks and services that are overlapping.

85 - Independent Communications Authority of South Africa Annexure B to the Radio Frequency Spectrum Regulations (Dec 2021). https://www.gov.za/sites/default/files/gcis_document/202112/45690gen737.pdf

86 - World Bank and Knowledge Consulting Ltd. (2021). Feasibility Study to Connect All African Higher Education Institutions to High-Speed Internet. https://openknowledge.worldbank.org/handle/10986/36042

87 - See also Marchant, E., & Stremlau, N. (2019). Africa's Internet Shutdowns: A Report on the Johannesburg Workshop. Programme in Comparative Media Law and Policy (PCMLP), University of Oxford. http://pcmlp.socleg.ox.ac.uk/wp- content/uploads/2019/10/Internet-Shutdown-Workshop-Report-171019.pdf and Collaboration on the International ICT Policy for East and Southern Africa (Feb 2019). Despots and Disruptions: Five Dimensions of Internet Shutdowns in Africa. https://cipesa.org/2019/03/despots-and-disruptions-five-dimensions-of-Internet-shutdowns-in-africa/

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The regulations also provide that licensees who own or control infrastructure, such as ducts and trenches and lines, poles and masts and international submarine cable and gateways, must share facilities with other operators.

The Uganda Communications (Interconnection and Access) Regulations, 2019 apply to interconnection between telecommunications operators and the sharing of communications infrastructure and services, inter alia. The regulations provide an obligation to interconnect on an unbundled basis. More stringent provisions may be imposed where the UCC determines that a licensee has significant market power. The regulations also provide for interconnection at the quality determined by the UCC and on just, reasonable and non-discriminatory terms. The regulations also provide that licensees who own or control infrastructure, such as ducts and trenches and lines, poles and masts and international submarine cable and gateways, must share facilities with other operators. Physical colocation for interconnection and local loop access is also mandated. The regulations also provide for compulsory interconnection with mobile virtual network operators.

In addition to the making of regulations by the minister, the Communications Act also provides for the making of guidelines by the UCC. One of the functions of the UCC is ‘to encourage and promote infrastructure sharing amongst licensees and to provide regulatory guidelines’. It also provides that the ‘Commission shall issue minimum guidelines in accordance with which telecommunications operators shall negotiate interconnection agreements’.

The UCC published The Uganda Communications Commission Guidelines on National Roaming, 2019. These guidelines require mobile operators to offer national roaming services to other licensees engaged in the provision of mobile communications services.

In March 2021, the UCC published a Consultation on the Proposed Guidelines on Communications Infrastructure Deployment and Sharing. The proposed Guidelines are aimed at establishing a framework that will guide and foster the deployment and sharing of communications infrastructure in Uganda. The guidelines require that every operator

- Coordinate and share infrastructure with other operators and on fair, reasonable and non- discriminatory terms;
- Accept a request from another operator for the co-construction of physical infrastructure on fair and reasonable terms; and
- Provide access to or co-location with infrastructure on fair, reasonable and non-discriminatory terms. The guidelines also require rollout plans and for concluded leasing and sharing agreements to be submitted to the UCC.

Section 17 of the Proposed Guidelines requires that the UCC collaborate with other Government MDAs to establish procedures for the consideration of applications for civil works within the scope of infrastructure deployment and sharing. If land, buildings and infrastructure are owned by the government, including MDAs and local government, and an access request fails, joint operators may request assistance from the UCC. Although these provisions in the Proposed Guidelines recognise the issue that there is little necessary coordination amongst providers of public infrastructure, they do not address the outstanding issues in a comprehensive manner. In this regard, some recommendations are made below. The Guidelines have not been finalised as of the date of this report.

Recommendations: Many operators, especially those who are not dominant, have commented that there is a lack of an effective and efficient regulatory framework for interconnection and, especially, facilities sharing. It is also clear that there is little effective enforcement of the regulations and guidelines in place.

First, it is recommended that the finalisation and implementation of the Proposed Guidelines on infrastructure sharing be made a priority. The following should be included:

- Clear and strict regulation of the pricing of infrastructure sharing, interconnection and roaming to ensure the facilitation of more competition;
- An effective dig once rule, forcing network licensees to cooperate; and
- The establishment of a database of infrastructure ensuring efficient and transparent processes.

Second, it is also recommended that regulations and/or guidelines for the sharing of infrastructure with other sectors be promulgated. This infrastructure includes towers, ducts, poles and buildings owned by persons in other sectors, such as broadcasting, roads and other public works. The regulations and/or guidelines should be made in consultation with the Ministries of Lands, Housing and Urban Development; Works and Transport; Water and Environment; Local Government; and Finance, Planning and Economic Development as well as government agencies such as the Civil Aviation Authority, Electricity Regulatory Authority, UNRA, National Planning Authority and local governments, amongst others. To facilitate this, a cross-sector infrastructure committee or WG may be established.

Third, it is recommended that the UCC effectively regulate the pricing of interconnection, roaming and sharing. This will include the imposition of asymmetric call termination rates, among other things, and the enforcement of cost-based wholesale pricing to service providers, such as mobile virtual network operators (MVNSs), to facilitate more robust competition.

Finally, the development of a critical infrastructure law (including a critical information infrastructure law), discussed more fully below, should be undertaken.

7.1.4 RoW to Land

Telecommunications network operators, those who roll out broadband networks, require, in some instances, the right to use the land of other persons. Sometimes this is public land, such as RoW adjacent to roads or railways that are already owned by the government, and sometimes it is private land, where there may be no current RoW, or there may be an exclusive RoW granted to a single network operator.

Under the 2013 Communications Act, there is no guarantee for a RoW for any network operator in Uganda. There also are no regulations or guidelines in place to guide the various interested parties in these matters. What exists is a patchwork of various laws and regulatory frameworks that network operators must wade through in order to be able to roll out broadband infrastructure. These include negotiating the use of an existing public RoW, if any, negotiating use of private RoW with private owners where necessary, conducting environmental assessments and obtaining building permits from local authorities. This is not only time consuming but also costly. It is also not unusual. Most countries have rules for negotiating RoW by telecommunications operators that involve similar regulatory frameworks. However, in Uganda, there are changes that can be made to the legal and regulatory environments that will make the rollout of broadband infrastructure quicker and less costly while at the same time protecting the rights of land owners and others who have an interest in that land, such as local communities.

No provisions in regard to RoW found their way into the Uganda Communications Act. This is contrasted to the Uganda Communications Act of 1997, repealed by the current 2013 Act, which provided for the designation of a public operator who had a host of rights and responsibilities in respect to the placement of telecommunications lines on private and public lands.

Section 42 of the Land Act 1988 provides for the acquisition of land by the government or a local government in accordance with constitutional provisions articles 26 and 237(2). Section 71 provides that all 'land ... shall be subject to all existing public RoW which shall be reserved to and vested in the Government on behalf of the public; and all such RoW shall be maintained by the public uninterrupted unless they are terminated or altered by the direction of the Minister in writing'. And section 73 provides that where it is necessary to execute public works, on any land, an authorised undertaker shall enter into mutual agreement with the occupier or owner of the land in accordance with the Land Act and that where no agreement is reached, the minister responsible for land may compulsorily acquire land in accordance with section 42. Unfortunately, however, the definition of public works does not include telecommunications network facilities.

Recommendations: Many of the licensees consulted have concerns about the lack of a coordinated regulatory framework for RoW. Licensees, of course, want a guaranteed (and cheap or free) RoW. However, there are valid competing concerns from local governments, other government agencies, land and building owners and communities.

In carrying out these recommendations, it is important that all parties be consulted. These parties include the Ministries of Lands, Housing and Urban Development; Works and Transport; Water and Environment; Local Government; and Finance, Planning and Economic Development as well as government agencies such as the Civil Aviation Authority, Electricity Regulatory Authority, UNRA, National Planning Authority and NITA-U and also local governments, land owners, local communities and any other interested parties.

The first recommendation is that The Uganda Communications Act should be amended to include a variation of the provisions set out in Part VIII of the 1997 Uganda Communications Act. The provisions will have to be adapted to apply to a competitive market. The Act should also provide for the prompt payment of fair and adequate compensation and a right of access to a court of law by any person who has an interest in or right over the property. This is required by the Constitution.

The second recommendation is that The Land Act be amended to include telecommunications network facilities in the definition of public works. The time has come to recognise broadband as a public work on par with, for example, water and electricity.

The third recommendation is that the minister, in consulting with the UCC, make regulations setting out a comprehensive regulatory framework for the negotiation of RoW. The regulations should make the process streamlined, quick and easy. They should also include protections and obligations for operators on one hand, and other affected parties, such as local governments, land owners and communities, on the other. The regulations or guidelines should provide for the following in consultation with the Ministries of Lands, Housing and Urban Development; Works and Transport; Water and Environment; Local Government; and Finance, Planning and Economic Development.

- Require all public works, including networks operators and other public works providers, to share RoW, subject to the regulations and guidelines;
- Clear and strict regulation of the pricing of new RoW and the use of existing RoW;
- Ban the granting of exclusive RoW by private or public land owners;
- An effective dig once rule, forcing network licensees and other public works providers to cooperate;
- The establishment of a database of all public works infrastructure and existing RoW ensuring efficient and transparent processes;
- The establishment of simple, easy and consistent procedures that will be used by local authorities in respect to building permits;
- Rules for the acquisition of RoW where land is public, including rules for reasonable compensation; and
- Rules for acquiring use rights to public RoW, such as public roads, railways and other public works.

7.1.5

Spectrum

The following regulatory instruments govern spectrum management and use in Uganda:

- In accordance with now-repealed Uganda Communications Act of 1997, regulations were made in 2005. These regulations included the Communications (Radio) Regulations, 2005, which are still in effect.
- In 2009, the UCC published the Radio Spectrum Policy Guidelines for Uganda as a guide for the use of the spectrum in a proper manner.
- In 2010, the UCC also issued Guidelines on Radio Spectrum Hoarding to discourage radio spectrum hoarding and ensure compliance with license conditions.
- In 2010, the UCC developed a Radio Station Inspection Framework in Uganda, outlining the technical procedures to be followed in the implementation of radio station inspections to determine spectrum user compliance in accordance with the Uganda Communications Act, the Uganda Communications (Radio) Regulations, 2005 and the Spectrum Policy Guidelines.
- In 2017, the UCC published The Uganda Communications Commission Radio Spectrum Management Guidelines to set out the objectives, principles and associated proclamations to guide the UCC in the management of the spectrum in order to extract maximum social-economic value for Uganda.
- In 2017, the UCC published the New License Framework, Fees and Fines, setting out new license fees, spectrum charges and fines for implementation from the date of the notice, 3 Nov. 2017.
- In 2019, the UCC published the Framework for Spectrum Assignment to Telecommunications Services in Uganda, 2019. The Framework highlights the approaches to be used in assigning spectrum to telecommunications services and proposed terms and conditions for radio spectrum authorisation to telecommunication operators.

• In 2019, the UCC published the Proposed Radio Spectrum Management Policy for Uganda. This proposed policy seeks to set out the key objectives and principles that will guide the management of the radio frequency spectrum over a five-year period. This policy was not finalised as of the date of this report.

The UCC has issued the following regulatory instruments to facilitate the introduction and use of different technologies in Uganda:

- Technical Requirements for the use of the 863-870 MHz (868 MHz) Band for Industrial, Scientific and Medical (ISM) in Uganda, 2008;
- Guidelines for the use of wireless Short-Range Devices in Uganda, 2010; and
- Standard for TV White Spaces Access and Use in Uganda, 2019.

Recommendations: One of the most important regulatory issues for the rollout of mobile broadband in 2022 is the efficient and effective management and use of spectrum.

It is recommended that the Proposed Radio Spectrum Management Policy, published for public for comment in 2019, be considered, amended as appropriate, adopted and implemented as a matter of urgency (as UCC guidelines rather than policy).

It is also recommended that the current spectrum license fees and charges be reviewed to ensure that the fees and charges do not act to unduly inhibit the rollout and use of broadband in Uganda.

Further specific recommendations regarding spectrum policy and regulation are set out in Chapter 8.

7.1.6 Universal Service

The RCDF was established in terms of the now repealed Uganda Communications Act of 1997.

The following regulatory instruments were also adopted.

- Communications (Establishment and Management of the Rural Communications Development Fund) Instrument, 2002 and
- Communications (Establishment and Management of the Rural Communications Development Fund) (Amendment) Instrument, 2002.

In 2019, regulations regarding universal service were enacted, which also revoked the regulatory instruments listed above. The Uganda Communications (Universal Service and Access Fund) Regulations, 2019 establishes the Universal Service and Access Fund. The fund is funded by gross annual revenues collected from licensees in terms of the Communications Act. Recently, the UCC called for expressions of interest for the provision of consultancy services to develop the Uganda Communications Universal Service Access Fund Strategic Plan.

The Uganda Communications (Universal Service) Regulations, 2019 provide the UCC with the power to impose universal service obligations on licensees. The only obligations imposed in respect to universal service currently is the 90% geographical area in the license conditions for National Telecommunications Operator licenses. For spectrum authorisations, obligations in respect to average speeds have been imposed in some bands.

Recommendations: The Uganda Communications Universal Service Access Fund Strategic Plan, which has been contemplated by the UCC, should be developed. The Plan should include projects and programmes that will impact the most positively on the broadband ecosystem. This might include supply side measures, such as providing broadband infrastructure in key access points such as schools and hospitals. It may also include programmes and projects on the demand side, such as providing support for local innovations to ensure local and relevant content and the service and training and education required to support the use of broadband services.

7.1.7 Consumer Protection

The Uganda Communications (Consumer Protection) Regulations, 2019 set out the procedures that allow consumers to file complaints and set out certain prohibited practices, such as unsolicited telemarketing calls and denials of access or service by licensees. The regulations also require the equality of treatment and protection of consumer information as well as protections of harmful content and protection of minors. There is no general consumer protection law in Uganda.

Recommendations: It has been mentioned in consultations that there has been little enforcement of these regulations.

It is recommended that the regulations that are in place be implemented efficiently and effectively. It is also recommended that the government consider enacting a general consumer protection law.

7.1.8 Type Approval

There are both regulations and guidelines for the type approval of all telecommunications terminal equipment and radio communications equipment intended to be connected to communications networks, as follows:

- The Uganda Communications (Equipment Type Approval) Regulations, 2019 and
- Guidelines on Type Approval of Telecommunications and Radio Communications Equipment in Uganda.

Recommendations: The regulations appear to be sufficient to cover all types of equipment, including end-user equipment. However, there appears to be an issue of end-user equipment that is not type approved entering the country.

It is recommended that the UCC consult with the National Bureau of Standards (which issues certificates of conformity in respect to imported equipment) to investigate where enforcement mechanisms may need to be enhanced.

7.1.6

Tariffs

The Telecommunications (Tariffs and Accounting) Regulations, 2005 apply to the pricing of telecommunications services and accounting by telecommunications operators.

7.1.6

Numbering

The UCC has published the Uganda National Numbering Plan Guidelines. It has not, however, regulated number portability.

Recommendations: The issue of number portability should be addressed by the UCC to enhance competition in the industry.

7.2. NATIONAL INFORMATION TECHNOLOGY AUTHORITY, UGANDA ACT, 2009

The National Information Technology Authority, Uganda Act, 2009 provides for the establishment and operation of NITA-U. The main object of NITA-U is to provide information technology services to the government. It also is tasked to

- Promote standardisation in the planning, acquisition, implementation, delivery, support and maintenance of information technology equipment and services to ensure uniformity in the quality, adequacy and reliability of information technology usage throughout Uganda;
- Provide guidance and other assistance as may be required to other users and providers of information technology;
- Promote cooperation, coordination and rationalisation among users and providers of information technology at the national and local levels so as to avoid duplication of efforts and ensure optimal utilisation of scarce resources;
- Promote and be the focal point of cooperation for information technology users and providers at the regional and international levels; and
- Promote access to and utilisation of information technology by special interest groups.

NITA-U has a wide array of functions and powers spelt out in the Act related to both coordinating IT usage in the government and the facilitation of e-government as well as regulating IT services in Uganda. It does so by, inter alia, regulations made in terms of the Act by the minister, which include, amongst others, the following:

- National Information Technology Authority, Uganda (Authentication of Information Technology Training) Regulations, 2016 – These Regulations provided for the authentication of IT training providers, which is required to provide IT training.
- National Information Technology Authority, Uganda (Certification of Providers of Information Technology Products and Services) Regulations, 2016 – These Regulations provide for the certification of IT products and services providers, which is required to provide IT services and products.

• National Information Technology Authority, Uganda (e-government) Regulations, 2015 – These Regulations are designed to promote e-government. In furtherance of this, NITA-U must establish a national data centre and a government web portal. The Regulations also provide for all public bodies to use the national data transmission backbone and electronic government infrastructure.
• National Information Technology Authority, Uganda (National Databank) Regulations, 2019 – These regulations provide for the establishment and operation of a national databank, and require every data controller to link its database to the national databank.
• NITA-U also has responsibilities set out in other legislation, such as the Electronic Transactions Act, Electronic Signatures Act, Computer Misuse Act and the Data Protection and Privacy Act.

7.3. ELECTRONIC TRANSACTIONS ACT, 2011

The Electronic Transactions Act, 2011 was passed to provide the regulatory framework to facilitate electronic transactions, providing the legal certainty and public confidence in the use of such transactions. It was modelled, in part, on the UNCITRAL Model Law on Electronic Commerce. Part II of the Act provides the basic framework for the legal recognition of electronic transactions, signatures and documents. Part III makes the Act applicable to government services. Part IV provides for protections for consumers, and Part V provides for the limitation of liability for service providers in respect to third- party activity. It also provides a mechanism for persons who have a problem regarding such third-party activity to make a complaint to the service provider, and if a service provider fails to act on a complaint, the complainant can appeal to NITA-U under the Electronic Transaction Regulations, 2013.

The Electronic Transactions Act and Regulations of 2013 are sufficient to provide legal certainty for the recognition of electronic transactions. Many countries have more recently amended their electronic transaction legislation taking into account the Regulation on Electronic Identification and Trust Services (eiDAS) of the European Parliament and the Council Regulation 910/2014 on electronic identification and trust services for electronic transactions and the new Electronic Identification and Trust Services for Electronic Transactions Act of 2016. The Regulation and Act provide a common foundation for secure electronic interaction between citizens, businesses and public authorities and simpler and more secure transactions as well as consolidate the traditional electronic transactions and digital signature acts.

Recommendations: It may be time to review this legislation, along with the Electronic Signatures Act, in line with international best practices. Other benchmarking instruments might include the UNCITRAL Model Law on Electronic Transferable Records (2017), the East Africa Community Electronic Transactions Act and the Common Market for Eastern and Southern Africa (COMESA) Model Law on Electronic Transactions.

7.4. ELECTRONIC SIGNATURES ACT, 2011

The Electronic Signatures Act, 2011 provides the legal framework for the use of electronic and digital signatures. It outlines how such signatures are to be created and secured and what the requirements are for a compliant electronic signature. The Act gives digital and handwritten signatures equal legal recognition and sets an obligation for all public and private institutions to accept digitally signed documents. The Electronic Signatures Regulations, 2013 were made in terms of the Electronic Signatures Act and concern the licensing and conduct of certification service providers. The Electronic Signatures Act and Regulations operate in tandem with the Electronic Transactions Act and Regulations.

Recommendations: The Electronic Signature Act and Regulations may need to be amended as discussed above. Furthermore, it may be that the two Acts should be consolidated to form a unified legal and regulatory framework for electronic transactions and signatures.

7.5. COMPUTER MISUSE ACT, 2011

The Computer Misuse Act, 2011 sets out offences, such as the unlawful access, abuse or misuse of information systems, and sets out procedures for investigating and prosecuting such offences. This Act is important for the protection of, inter alia, the right to privacy guaranteed by the Constitution.

Recommendations: While most of the provisions of the Computer Misuse Act are sufficient, it may be timely to review the provisions taking recent international best practices into consideration. The Budapest Convention on Cybercrime and related Additional Protocol to the Convention on Cybercrime could inform such a review.

7.6. ACCESS TO INFORMATION ACT, 2005

The Access to Information Act, 2005 and related Access to Information Regulations adopted in 2011 require all MDAs to appoint information officers to handle requests for public information. These provisions apply to NITA-U and the UCC as well as all other MDAs. It is reported that there have been difficulties in the implementation of this regulatory framework since its inception.[88] In addition, there is no existing open data policy adopted, as discussed above in Chapter 5 of this document. As discussed above, it is recommended that such a policy be adopted as a matter of urgency, followed by its implementation, which will include specific initiatives discussed herein, such as access to spectrum data, data about RoW and data about existing and planned broadband infrastructure.

7.7. DATA PROTECTION AND PRIVACY ACT, 2019

The Data Protection and Privacy Act, 2019 supports the privacy protections enshrined in the Constitution, Article 27, which provides for the protection of privacy in a person's home, correspondences, communications or other property. The Act focuses on the protection of privacy by regulating the collection, processing and storage of personal data. It largely is modelled on the privacy legislation in the UK. The Data Protection and Privacy Regulations, 2021 are intended to implement the principles set out in the Act and provide specifics for the manner for objecting

88 - World Bank, 'Open Data Readiness Assessment - Prepared for the Government of Uganda'. http://opendatatoolkit.worldbank.org/docs/odra/odra_uganda.pdf

to the collection and processing of data and compliant procedures, among others. The Act and Regulations will be operationalised by the Personal Data Protection Office, which is an independent office under NITA-U.

7.8. CONTENT

Many laws and regulations have the potential to impact on content delivered through the broadband ecosystem. Regulations include the Uganda Communications (Content) Regulations, 2019, which applies to all content in telecommunications and radio communications and broadcasting and postal services. The regulation of content is overseen by the Contents Committee of the UCC established in terms of the Communications Act. The Contents Committee is required, among other things, to enforce the Broadcasting Code. The regulations have extensive provisions relating to what content is prohibited, including content using offensive language, presenting sexual matters and depicting violence in an offensive manner. It also details provisions relating to political elections, the promotion of local content, the coverage of public events, protections for children and procedures for complaint handling.

The Uganda Communications (Text and MultiMedia Messaging) Regulations, 2019 prohibit unsolicited messages. They also make the transmission of prohibited third-party content the responsibility of operators. Prohibited content includes content objectionable on the grounds of public interest, public morality, public order, public security, national harmony or otherwise prohibited by law. The regulations also detail matters such as providing information to customers, privacy and an opt-out right.

The UCC has adopted a number of regulatory instruments related to content, including

- Standards for General Broadcast Programming in Uganda,
- Advertising Standards,
- Standards for Religious Broadcast Programming in Uganda,
- Best Practice Guidelines for Electronic Media Broadcasters for: Coverage and Broadcast of Live Events and
- Guidelines on the use of media during the general elections and campaigns 2021.

The regulations have extensive provisions relating to what content is prohibited, including content using offensive language, presenting sexual matters and depicting violence in an offensive manner.

The Press and Journalists Act, 1995 provides for the right to publish subject to its provisions. It establishes a Media Council to license and regulate the media and journalists. It has extensive provisions limiting press freedom. However, a recent decision of the Constitutional Court dismissed a petition filed challenging provisions as both vague and a violation of fundamental rights, such as the right to free speech.

Other legislation that might impact on electronic content include the regulation of electronic payment systems. The legislation that has the biggest impact on electronic banking and payment systems in Uganda is the National Payment Systems Act, 2020. The Act gives the Bank of Uganda powers and functions in the regulating, supervising, licensing and oversight of payment systems to ensure safety and efficiency. Payment systems and payment services must be licensed by the Bank of Uganda in accordance with the National Payment Systems Regulations, 2021. Other regulatory instruments include

- The National Payment Systems (Agents) Regulations, 2021;
- The National Payment Systems (Sandbox) Regulations, 2021;
- The National Payment Systems Oversight Framework, June 2021; and • Mobile Money Guidelines, 2013.

Other laws that might impact on content include intellectual property laws. These include the Trade Marks Act, 2010; Copyright and Neighbouring Rights Act, 2006; Geographical Indications Act, 2013; Plant Varieties Act, 2014; and Industrial Property Act, 2014. More recently, the National Intellectual Property Policy was published in 2019, identifying a number of difficulties with the promotion and protection of property rights in Uganda, including weak enforcement mechanisms. Also, although Uganda has a number of laws protecting intellectual property rights, there are no specific laws that relate to, for example, disputes regarding the registration of domain names or dealing with issues such as peer- to-peer file sharing.

Recommendations: It may be time for Uganda to conduct a holistic review of the legislation regulating content to ensure greater protection of fundamental rights keeping in mind the nature of, among other things, the broadband value chain. It has also been suggested that too much regulation (prohibition) of content is counter to the promotion of the growth of the content sector in Uganda. It is therefore recommended that the UCC review its various content regulations and other regulatory instruments to ensure that it is facilitating the growth of the content sector in Uganda.

7.9. INTERCEPTION AND MONITORING

The Regulation of Interception of Communications Act, 2010 sets out the prohibition of the interception of communications over telecommunications or radio systems. It also sets out exceptions to the prohibition. It provides for the establishment of a monitoring centre, which is able to monitor and intercept communications. Monitoring and interception is to be carried out under a warrant of interception granted in terms of the Act. The Act also requires UCC licensees to provide assistance, including making sure their networks can be monitored and to store certain information. And it requires the registration of SIM cards.

The following regulations have been made under the Uganda Communications Act:

- The Uganda Communications (Intelligent Network Monitoring System) Regulations, 2019;

• The Uganda Communications (Emergency Response) Regulations, 2019; and
• The Uganda Communications (Centralised Equipment Identification Register) Regulations, 2019.

Other legislation that gives powers of monitoring and interception include the following:

• The Anti-Terrorism Act, 2002 gives security officers powers to intercept communications of persons suspected of terrorist activities.
• The Anti-Pornography Act, 2014 criminalises the production, trafficking, publishing, broadcast, procurement, import, export, selling or abetting of any form of pornography. This Act anticipates that all ISPs will install software to monitor and filter pornography. A recent decision of the Constitutional Court of Uganda declared certain provisions of the Act unconstitutional and in particular found that the definition of pornography was not sufficiently precise, leading to inconsistent application. Provisions relating to the powers of the Pornography Control Committee relating to search and seizure without judicial oversight were also declared unconstitutional.

Recommendations: It may be time for Uganda to conduct a holistic review of legislation allowing monitoring and interception to ensure greater protection of fundamental rights.

7.10. CRITICAL INFRASTRUCTURE

There is key infrastructure in Uganda that must be protected. This includes infrastructure that is essential to the protection of the sovereignty of the people of Uganda as well as to essential services, such as water and electricity supplies. It also includes the infrastructure that entails the broadband ecosystem. One of the comments made by licensees in consultations is that their physical infrastructure is compromised by acts of vandalism and theft. While it is important to protect the physical infrastructure, it is also important to protect the information infrastructure.

Recommendations: The ministry has made regulations creating a computer emergency response team, The Uganda Communications (Computer Emergency Response Team) Regulations, 2019. However, there is no comprehensive policy and law in Uganda that will facilitate the protection of critical infrastructure and critical information infrastructure.

It is recommended that comprehensive policy and law be developed in line with best practices to protect critical infrastructure in Uganda.

7.11. RECOMMENDATIONS

There are a number of recommendations made to the legal and regulatory frameworks currently in place in Uganda that will either remove some roadblocks to or facilitate a more robust broadband ecosystem. The most urgent include the following that can be affected by the UCC:

• Create a more flexible licensing regime that allows for more innovation and competition, especially in the services markets and in areas that are underserved;
• Create an efficient and fair regulatory regime for obtaining RoW in collaboration with all

interested parties, including those in other sectors;
• Effectively enforce the facilities sharing regulatory regime; and
• Make changes to the spectrum plan and licensing regimes, as more fully discussed in Chapter 8 below.

In addition, the intellectual property rights laws need to be reviewed keeping in mind the changes brought about by the broadband value chain as well as matters such as artificial intelligence and the importance of data, among others. Similarly, the legal and regulatory regimes that impact on the delicate balance of protecting rights of free speech, amongst others, and the surveillance mechanisms available, should be reviewed.

Finally, the following laws should be promulgated as a matter of urgency:

• Competition, • Consumer protection, and • Critical infrastructure.

Problem to be addressed	Recommendations
Inflexible licensing regime	It is recommended that the UCC review its licensing guidelines to encourage innovation and allow more flexibility in the licensing of services and in the imposition of fees. An example in this regard may be a request by RENU for a special license for its broadband network in support of education in Uganda. Another example might include a more flexible regulatory regime in respect to community networks. The regulatory framework should also include a listing of categories of license-exempt activities along with standards. Employing this regulatory flexibility will facilitate innovation in the industry and allow the UCC to respond to such innovations in real time. This, in turn, will help drive the supply and demand sides of the broadband ecosystem.
Shutdown of services by the UCC	As stated in a report to the World Bank Group, '[t]he partial or total shutdown of selected services and quite often the Internet severely disrupts operations and, where it occurs periodically, is a disincentive for investment: it leads to loss in revenue that cannot necessarily be recovered without taking governments to court'. Therefore, It is recommended that license conditions be amended to make such shutdowns unavailable or very difficult to impose.
Unfair competition	It seems that fair competition regulations have not resulted in an alteration of the concentration of two dominant players in the telecommunications market in Uganda. This failure has resulted in players exiting the market as well as the perpetuation of an anti- competitive environment that does not allow smaller competitors to thrive. The first recommendation is that the UCC aggressively enforce the fair competition regulations. The second recommendation is to consider the fast-tracking of competition law policy and the enactment of a comprehensive competition law. This will be followed by the creation of an effective and efficient competition law enforcing organisation as a matter of urgency.

Problem to be addressed	Recommendations
Regulatory framework for interconnection and facilities sharing	There is a lack of an effective and efficient regulatory framework for interconnection and, especially, facilities sharing. It is also clear that there is little effective enforcement of the regulations and guidelines in place. Therefore, it is recommended that the finalisation and implementation of the guidelines on infrastructure sharing be made a priority. The following should be included: • Clear and strict regulation of the pricing of infrastructure sharing, interconnection and roaming to ensure the facilitation of more competition; • An effective dig once rule, forcing network licensees to cooperate; • The establishment of a database of infrastructure ensuring efficient and transparent processes. It is also recommended that regulations and/or guidelines for the sharing of infrastructure with other sectors be promulgated. The infrastructure includes towers, ducts, poles and buildings owned by persons in other sectors, such as broadcasting, roads and other public works. The regulations and/or guidelines should be made in consultation with the Ministries of Lands, Housing and Urban Development; Works and Transport; Water and Environment; Local Government; and Finance, Planning and Economic Development and with government agencies such as the Civil Aviation Authority, Electricity Regulatory Authority, UNRA, National Planning Authority and local governments, amongst others. The passage of a critical infrastructure law along with a critical information infrastructure law, discussed more fully below, should also be considered.
Regulatory framework for RoW	There is a lack of a coordinated regulatory framework for RoW. Licensees, of course, want a guaranteed (and cheap or free) RoW. However, there are valid competing concerns from local governments, other government agencies, land and building owners and communities. Therefore, it is recommended that in carrying out these recommendations that all parties be consulted. These include the Ministries of Lands, Housing and Urban Development; Works and Transport; Water and Environment; Local Government; and Finance, Planning and Economic Development and with government agencies such as the Civil Aviation Authority, Electricity Regulatory Authority, UNRA and National Planning Authority as well as local governments, land owners, local communities and any other interested party. The first recommendation is that the Uganda Communications Act should be amended to include a variation of the provisions that were set out in Part VIII of the 1997 Uganda Communications Act. The Act should also provide for the prompt payment of fair and adequate compensation and a right of access to a court of law by any person who has an interest in or right over the

Problem to be addressed	Recommendations
	property. This is required by the Constitution. The second is that the Land Act should be amended to include telecommunications network facilities in the definition of public works. The third recommendation is that the minister, in consultation with the UCC, make regulations and/or guidelines setting out a comprehensive regulatory framework for the negotiation of RoW. The regulations should make the process streamlined, quick and easy. They should also include protections and obligations for operators, on one hand, and other affected parties, such as local governments, land owners and communities, on the other. The regulations or guidelines should provide for the following: • Require all public works, including networks operators and other public works providers, to share RoW, subject to the regulations and guidelines; • Clear and strict regulation of the pricing of new RoW and the use of existing RoW; • Ban the granting of exclusive RoW by private or public land owners; • An effective dig once rule, forcing network licensees and other public works providers to cooperate; • The establishment of a database of all public works infrastructure and existing RoW ensuring efficient and transparent processes; • The establishment of simple, easy and consistent procedures that will be used by local authorities in respect to building permits; • Rules for the acquisition of RoW where land is private, including rules for reasonable compensation; • Rules for the acquisition of RoW where land is public, including rules for reasonable compensation; and • Rules for acquiring use rights to public RoW, such as public roads, railways and other public works.
Spectrum planning and licensing	One of the most important regulatory issues for the rollout of mobile broadband in 2021 is the efficient and effective management and use of spectrum. It is recommended that the Proposed Radio Spectrum Management Policy, published for public for comment in 2019, be adopted and implemented (as guidelines). Specific recommendations regarding spectrum policy and regulation are set out in Chapter 8 below.
Universal service and access	It is recommended that the Uganda Communications Universal Service Access Fund Strategic Plan be developed urgently. The Plan should include projects and programmes that will impact the most positively on the broadband ecosystem. This might include supply side measures, such as providing broadband infrastructure in key access points such as schools and hospitals. It may also include programmes and projects on the demand side, such as providing support for local innovations to ensure local and relevant content and service and training and education required to support the use of broadband services.

Problem to be addressed	Recommendations
Protection of consumers	There has been little enforcement of the UCC's consumer protection regulations. It is recommended that the regulations in place be implemented efficiently and effectively. It is also recommended that the government consider enacting a general consumer protection law.
Number portability	The issue of number portability should be addressed by the UCC to enhance competition in the industry.
Update to the electronic transactions and signatures legislation	It may be time to review the Electronic Transactions Act and the Electronic Signatures Act in line with international best practices. Benchmarking instruments might include the UNCITRAL Model Law on Electronic Transferable Records (2017), the East Africa Community Electronic Transactions Act and the COMESA Model Law on Electronic Transactions.
Update to cybercrime legislation	While most of the provisions of the Computer Misuse Act are sufficient, it may be timely to review the provisions taking recent international best practices into consideration. The Budapest Convention on Cybercrime and related Additional Protocol to the Convention on Cybercrime could inform such a review.
Review of laws impacting content production and protection	It may be time for Uganda to conduct a holistic review of legislation regulating content to ensure greater protection of fundamental rights.
Review of laws impacting interception and monitoring	It may be time for Uganda to conduct a holistic review of legislation allowing monitoring and interception to ensure greater protection of fundamental rights.
Protection of critical infrastructure	The ministry has made the regulations creating a computer emergency response team – the Uganda Communications (Computer Emergency Response Team) Regulations, 2019. However, there is no comprehensive law in Uganda that will facilitate the protection of critical infrastructure and critical information infrastructure. It is recommended therefore that such as law be developed in line with best practices.

TABLE 33: SUMMARY OF LEGAL AND REGULATORY RECOMMENDATIONS

08

SPECTRUM MANAGEMENT

Spectrum is not a scarce resource, such as minerals or metals, and there is no economic benefit from not using it. Problems only arise if several parties try to use the same spectrum at the same time and location. Regulatory authorities thus assign spectrum to users and require a spectrum fee for the management of the spectrum and as a disincentive against spectrum hoarding. However, this may also be used to limit competition in a particular market segment. The GSMA released its position on spectrum pricing in 2021 (GSMA, 2021) and made the following suggestions:

• 'High spectrum prices can harm consumers through lower quality mobile broadband services
• Governments should prioritise improved mobile broadband services – above revenue maximisation – when awarding spectrum
• Avoid limiting the supply of mobile spectrum (e.g. through set-asides), publish long-term spectrum award plans and hold open consultations
• Set modest reserve prices and annual fees, and rely on the market to determine spectrum prices
• Avoid creating unnecessary risks that put operators' current or future services in jeopardy
• Consult with industry on license terms and conditions and take them into account when setting prices
• Auctions must be well designed and implemented to be an effective award mechanism
• There is no single best approach to estimating the value of spectrum and international benchmarks should be used with caution
• Spectrum pricing decisions should be made by an independent regulator in consultation with industry
• The rise in the total cost of spectrum is a threat to mobile broadband growth – especially 5G'.

This chapter reviews how spectrum is allocated and assigned in Uganda, benchmarks these factors against other selected countries and provides a set of spectrum management recommendations. The spectrum review takes into account the latest Ugandan Radio Frequency Spectrum Master Plan.

8.1. THE UCC FREQUENCY TABLE

This section examines the current structure of Uganda's table of frequency allocations. The specific frequency allocations and suggested additions or modifications are based on trends in other African countries, ITU region 1 and past and upcoming World Radio conferences. The current table structure used in Uganda's December 2020 Table of Frequency Allocations improves on the 2017 Table of Frequency Allocations by adding Uganda-specific footnotes. The below table has the following headings: (i) ITU Region 1 allocations, (ii) Uganda table of allocations and (iii) national use; an example for 890-942 MHz is provided.

ITU Region 1 allocations	Uganda table of allocations	National use
890-942 FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 Radiolocation 5.323	890-942 FIXED MOBILE Radiolocation	Used as follows: For mobile services (technology neutral basis) uplink: 880-915 MHz downlink: 925-960 MHz UGA 018

TABLE 34: EXAMPLE FOR 890-942 MHZ ALLOCATION

UGA018 Frequency band 880-915 MHz Uplink and 925-960 MHz Downlink is allocated to mobile and is utilised on a technology neutrality basis.

There are some potential improvements that Uganda could consider for its future Table of Frequency Allocations. Many countries include a more detailed structure. These structures often include a typical applications column to capture the technology and frequency blocks used for that technology and a country notes column to capture ITU recommendations and government publications related to the frequency. For example, South Africa uses the data structure shown in the table below. An example of a publication that would be useful in Uganda's Table of Frequency Allocations is the latest TVWS standard in the 470-694 MHz band.

ITU Region 1 allocations and footnotes	Country allocations and Footnotes	Typical applications	Typical applications Country notes and comments (references to government gazettes)
890-942 MHz FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 Radiolocation	890-942 MHz MOBILE except aeronautical mobile 5.317A NF9 NF10 NF11	GSM-R (BTX) (921-925 MHz) IMT900 MTX (880-915 MHz) IMT900 BTX (925-960 MHz) RFID (including, passive tags and vehicle location (915.1 – 921 MHz) 915-921 MHz	Paired with 877.695-880 MHz Paired with 925-960 MHz Paired with 880-915 MHz International Mobile Telecommunication Roadmap (GG No.38213) 14 November 2014. Radio Frequency Assignment Plan (GG N. 38640) as amended 30 March 2015.

TABLE 35: SOUTH AFRICA'S SPECTRUM TABLE STRUCTURE

NF9 (IMT Frequency Bands – Terrestrial): The table below lists all possible IMT frequency bands identified by the ITU and relevant ITU Radio Regulation footnotes as well as the applicable ITU-R channel plan.

Band	Frequency range	Regulation footnotes	Channel plan	WRC resolutions	Networks operating in Uganda
450 MHz	450-470 MHz	5.286A	Recommendation ITU-R M.1036	224 (Rev. WRC- 15)	No
700 MHz	694-790 MHz	5.312A and 5.317A	Recommendation ITU-R M.1036	224 (Rev.WRC-15) and 760 (WRC-15)	No
800 MHz	790-862 MHz	5.316B and 5.317A	Recommendation ITU-R M.1036 (A3)	224 (Rev. WRC- 15) and 749 (Rev. WRC-15)	Yes
900 MHz	880-915 MHz // 925-960 MHz	5.317A	Recommendation ITU-R M.1036 (A2)	224 (Rev. WRC- 15) and 749 (Rev. WRC-15)	Yes
1500 MHz	1 427-1 518 MHz	5.341A, 5.346, and 5.346A	Recommendation ITU-R M.1036	223 (Rev. WRC- 15), 750 (Rev. WRC- 15), and 761 (WRC-15)	No
1800 MHz	1710-1785 MHz // 1805 – 1880 MHz	5.384A	Recommendation ITU-R M.1036 (B2)	223 (Rev. WRC- 15)	Yes

Table Continued ⟶

Band	Frequency range	Regulation footnotes	Channel plan	WRC resolutions	Networks operating in Uganda
1900 MHz	1900-1920MHz	5.388	Recommendation ITU-R M.1036 (B4)	212 (Rev.WRC-15)	No
2100 MHz	1920-1980 MHz // 2110-2170 MHz	5.388	Recommendation ITU-R M.1036 (B1)	212 (Rev. WRC- 07) and 223 (Rev. WRC-12)	Yes
2100 MHz (TDD)	1900-1920 MHz, 2010-2025 MHz	5.388	Recommendation ITU-R M.1036 (B1)	212 (Rev. WRC- 07) and 223 (Rev. WRC-12)	No
2300 MHz	2300-2400 MHz	5.384A	Recommendation ITU-R M.1036 (E1)	223 (Rev. WRC- 12)	No
2600 MHz	2500-2690 MHz	5.384A	Recommendation ITU-R M.1036 (C1)	223 (Rev. WRC- 12)	Yes
3500 MHz	3300-3400 MHz	5.429B	Recommendation ITU-R M.1036 and ITU-R M.2481	223 (Rev. WRC- 15), 245 (Rev. WRC-19) To be discussed WRC- 23	No
3.5 GHz	3400-3600 MHz	5.430A	Recommendation ITU-R M.1036 (F1)	NA	No

TABLE 36: CURRENT IMT ALLOCATIONS IN REGION 1

NF10 (876-880 // 921-925 MHz): This frequency band is used by GSM-R systems.
NF11 (915-921 MHz): Suppressed

Nigeria has a similar data structure and publishes its frequency allocation table online.[89] Ofcom in the UK also publishes its frequency table online.[90] While Uganda does provide a downloadable document of its table,[91] this is static until updated and uploaded (the current version is 2017). Publishing a frequency table online makes it possible to have a continuous up-to-date frequency allocation table that can easily be checked by potential local users of spectrum or international companies interested in wireless deployments. These are some of the features typically captured in the column sections:

- In the country allocation section: footnote links with aspects shared between multiple frequency blocks (the latest 2020 Uganda Table of Frequency Allocations does now include this);
- In the typical applications section: a list of the technology and frequency ranges of typical applications being used nationally; and
- In the notes section: paired frequencies, ITU recommendations and country government gazettes or publicly available publications on topics related to the frequency block.

89 - https://www.ncc.gov.ng/technical-regulation/spectrum/frequency-allocations#segment-2-30-300mhz
90 - http://static.ofcom.org.uk/static/spectrum/fat.html
91 - https://www.ucc.co.ug/wp-content/uploads/2017/09/Uganda-Table-of-Frequency-Allocation_SEPTEMBER-2017.pdf

These topics can be captured with fewer column sections. For example, 'Typical Applications' and 'Country Notes' as well as publications could be captured in the 'National Use' column. But at a high level, these three topics are valuable for ensuring that a complete, succinct level of detail is captured for each spectrum band.

8.2. DETAILED COMMENTS ON THE FREQUENCY ALLOCATION TABLE

This section focuses on the ITU frequency categories with the most activity. Categories such as Maritime Mobile, Maritime Radio Navigation, Meteorological Aids and Meteorological-Satellite have not changed much in the past few decades and are relatively static. The categories with the most activity are Broadcasting, Fixed, Fixed-Satellite and Mobile. The full set of frequencies used for IMT spectrum in Region 1 is provided in Appendix 14.6 for easy-reference purposes. Full detailed comments are provided in Section 14.5, and some key aspects are highlighted here.

8.2.1 Low Band (0 to 1 GHz)

The 432-438 MHz band had no national use listed. However, the 433.05-434.79 MHz band is used for Internet of Things (IoT) applications, such as Lora, and 433 MHz is also used for low-power applications, such as garage door openers, headphones, baby monitors and remote-control applications. We note that such information has to be sought through contact with the UCC.

The 450-470 MHz band is used for narrow band-IMT2000 technologies (CDMA). However, the current band has no cellular phone support and is still used for PMR radio systems, such as MPT-1327, TETRA, APCO 25 and DMR. The planned action in the Radio Frequency Spectrum Master Plan is to re- farm the band for the introduction of IMT and fixed wireless access (FWA) (target date for ITA is Q2 2022).

For the 470-694 MHz band, Uganda should pursue harmonising TVWS regulation with CRASA across the African continent to avoid the complexity of customising equipment for each country's unique set of TVWS rules for spectrum access. A standard for the use of TVWS (470- 694 MHz) has been published and will be subject to non-interference and on a non-protection to users basis under a secondary assignment. There is also a risk of encroachment on this band as the 600 MHz IMT band (617-652 MHz down, 663-698 MHz up) is being discussed at WRC-23 for use in Region 1. Uganda could also look at the possibility of reserving blocks of unused digital television frequencies during the first phase of TVWS rollouts to avoid delays.

Potential use for IoT in the 915-925 MHz band: The space division duplex band between the band used for 900 MHz IMT can be used for IoT application, such as LoraWAN. This band was highlighted as a potential IoT band in the Radio Frequency Master Plan. According to the UCC Radio Frequency Master Plan, the 900 MHz band (880-960 MHz) is undergoing a new channel arrangement. An ITA for the new channel arrangement will be posted in Q1 2022.

A summary of low band spectrum allocations for mobile, fixed, broadband and satellite is provided in the table below.

UHF Frequencies (MHz) VAS 20%				Notes	ITU Allocation	Used in Uganda
Start	End	Guard band	Band width			
430	440		10	Amateur and ISM (e.g. 433.05-434.79 MHz used for Lora)	IoT/SRD	Yes
450	470		20	450 MHz IMT band	Mobile	
446	446.2		0.2	446.0-446.2 is for used for private mobile Radio (PMR)	Mobile	Yes
470	694		224	Television broadcasting band and TVWS band used on a secondary use basis	Fixed shared spectrum & broadcasting	Yes
617	698		81	600 MHz IMT band (617-652 MHz down, 663-698 MHz up) WRC-23	Mobile	
694	790		96	700 MHz IMT band	Mobile	
790	862		72	800 MHz IMT band (791-811 MHz uplink, 832-852 MHz downlink)	Mobile	Yes
863	870		7	802.11ah (Europe bandwidth options 1 or 2 MHz) 20dBm max power. Lora (863- 870 MHz)	License-exempt WLAN IoT/SRD	Yes
915	925		10	0.9 GHz IoT band for technology such as LoraWan	IoT	
880	960	10	70	900 MHz IMT band (880-915 MHz uplink, 925-960 MHz downlink)	Mobile	Yes

Green = allocated; yellow = considered

TABLE 37: REGION 1 LOW BAND ITU SPECTRUM ALLOCATIONS FOR THE UHF BAND

8.2.2

Mid Band (1 GHz to 6 GHz)

The 1500 MHz IMT band (1426-1518 MHz) currently has very low mobile phone support and is not harmonised across Region 1 – this even though an economic impact study done by GMSA in 2015 showed that the economic benefits of IMT in this band could be USD 40 billion.[92] There are a number of other IMT bands Uganda can use, such as the 2100 MHz TDD band between 2010 and 2025 MHz (15 MHz of bandwidth), and the bands

92 - https://www.gsma.com/asia-pacific/resources/global-momentum-and-economic-impact-of-the-1-4-1-5-ghz-band-l-band-for-imt/

historically used for WiMAX, such as the 2300 MHz band between 2300 and 2400 MHz (100 MHz of bandwidth) and the 2600 MHz FDD band between 2500 and 2690 MHz (190 MHz of bandwidth). IMT satellite is being proposed in the 1980-2010 MHz band. This could provide IMT services to remote areas of Uganda, where the cost of building mobile cell phone towers is not feasible.
According to the UCC Radio Frequency Spectrum Master Plan, the full 2 GHz band from 1800 to 2170 MHz is being reviewed by UCC; UCC wishes to adopt band policy to facilitate the introduction of IMTs across the full band (P-LTE) to support rural and private networks. ITA for this band is expected in Q4 2023.

A summary of mid band spectrum allocations for mobile, fixed, broadband and satellite is provided in the table below.

L-Band Frequencies (MHz)				Notes	ITU Allocation	Used in Uganda
Start	End	Guard band	Band width			
1427	1518		91	1500 MHz IMT band. Current phone support for 1500 MHz band very minimal and band not harmonised across Region 1	IMT	Yes Yes
1710	1880	20	150	1800 MHz IMT band (1710-1785 MHz uplink, 1805-1880 MHz downlink)	IMT	
1900	1920		20	1900 MHz IMT band	IMT	
1920	2170	130	120	2100 MHz IMT FDD band (1920-1980 MHz uplink, 2110-2170 MHz downlink)	IMT	
2010	2025		15	2100 MHz IMT TDD band	IMT	

Green = allocated; yellow = considered

TABLE 38: REGION 1 MID BAND ITU SPECTRUM ALLOCATIONS FOR THE L-BAND

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There are many opportunities for licensed fixed wireless links between 2 GHz and 6 GHz with wide equipment support. The following bands are available: the 2025-2110 MHz band, the 2200- 2285 MHz band, the 2307-2387 MHz band, the 3400-3600 MHz band and the 3600-4200 MHz band.

The 3600-4200 MHz band needs to be coordinated with C-band satellite downlinks. This is feasible due to the fixed location of point-to-point links that can be checked for interference with nearby C-band satellite installations.[93]

93 https://www.newamerica.org/documents/2382/Clegg_Preso_Broadband_Opportunities_in_C- Band_for_New_America_061518.pdf

According to the Radio Frequency Spectrum Master Plan, the 2.3 GHz band (2300-2400 MHz) is being transformed according to the implementation of the new 2.3 GHz band policy, and an invitation for spectrum will be issued in Q2 2022. According to the plans, the 3300-3400 MHz band will continue to be monitored regionally and internationally for IMT use, with a planned ITA by Q1 2022.

Frequencies between 3600 and 5000 MHz are currently undergoing a lot of flux. The 3600-3800 MHz being used for IMT in Regions 1 and 2 will be discussed at WRC-23. The use of 3800-4200 MHz for licensed point-to-point links is under discussion in the EMEA region, but this band will need to be coordinated with C-band satellite links, or existing satellite links using the C-band in Uganda will need to be transitioned to the K-, Ku- or Ka-bands. According to the Radio Frequency Spectrum Master Plan, the 3800-4200 MHz band will continue to be monitored regionally and internationally, with a planned ITA by Q3 2024.

There is also discussion about the 4800-4990 MHz band for licensed point-to-point links in the EMEA region. The band is also being studied under WRC-23 agenda item 1.1, and, according to the Radio Frequency Spectrum Master Plan, this band will continue to be monitored for regional and international developments related to its use, with an expected ITA planned for Q4 2024.

S-Band Frequencies (MHz)				Notes	ITU Allocation	Used in Uganda
Start	End	Guard band	Band width			
2025	2110		85	2200 MHz band for FWA	Licensed PtP links	
2200	2285		85	2200 MHz band for FWA	Licensed PtP links	
2300	2400		100	2300 MHz IMT band. Was also historically used for WiMax. Used for FWA in Botswana	IMT	Yes
2307	2387		80	2300 MHz band for FWA	Licensed PtP links	
2401	2483		82	2401-2473 US (channels 1-11), 2401-2483 most of the world (channels 1-13), 2401-2495 Japan(channels1-14) – normallylimitedto 20 dBm	License-exempt WLAN	Yes
2500	2690		190	2600 MHz IMT band: IMT2600 MTX (2500- 2570 MHz), IMT2600 TDD (2570-2620 MHz), IMT2600 BTX (2620-2690 MHz). Was also historically used for WiMax	IMT	Yes
3300	3400		100	3400 MHz IMT band (band 52 TDD)	IMT	

Table Continued ⟶

S-Band Frequencies (MHz)				Notes	ITU Allocation	Used in Uganda
Start	End	Guard band	Band width			
3400	3600		200	3500 MHz IMT band (band 42 TDD) and PTP band. Was also historically used for WiMax. Used for CBRS in the US. Used for FWA in Botswana	IMT	Yes

Green = allocated; yellow = considered

TABLE 39: REGION 1 MID BAND ITU SPECTRUM ALLOCATIONS FOR THE S-BAND

The 4800-4990 MHz band is being studied under WRC-23 agenda item 1.1, and, according to the Radio Frequency Master Plan, this band will continue to be monitored for regional and international trends related to the usage of the band, with an expected ITA in Q4 2024.

In the Uganda frequency allocation table, the 5GHz WiFi bands (5150-5350 MHz, 5470-5725 MHz and 5730-5850) are incorrectly labelled as ISM bands. These bands were originally used for various applications, such as military radar systems and weather satellites, at the time WRC-03 allocated them for use by radio local area networks (RLANs) with the condition that satellite and radar systems be protected. In the US, they are labelled unlicensed national information infrastructure (U-NII) bands. The Radio Frequency Spectrum Master Plan also identifies these frequency bands as potential spectrum to support M2M/IoT applications.

The band between 5850-5925 is currently used for C-band satellite uplinks (VSAT/SNG/PTP links) (5850-6425 MHz), but there are also opportunities to use parts of this band for fixed links (5850-5925 MHz) using carrier-grade WiFi equipment if coordination is used. A summary of mid band spectrum allocations for mobile, fixed, broadband and satellite is provided in the table below.

TABLE 40: REGION 1 MID BAND ITU SPECTRUM ALLOCATIONS FOR THE C-BAND

C-Band Frequencies (MHz)				Notes	ITU Allocation	Used in Uganda
Start	End	Guard band	Band width			
3600	4200		600	C-band satellite downlink and fixed links (3600- 4200 MHz)	Licensed PtP links Satellite	Yes
3600	3800		200	3600-3800 MHz under discussion for IMT use at WRC-23	IMT	
3800	4200		400	Licensed spectrum being considered for EMEA region 1 (satellite first needs to transition to higher frequencies (12 GHz, 28 GHz and 40 GHz bands)	Licensed PtP links	
4800	4990		190	Licensed spectrum being pursued in EMEA Region 1	Licensed PtP links	

Table Continued →

C-Band Frequencies (MHz)				Notes	ITU Allocation	Used in Uganda
Start	End	Guard band	Band width			
4910	4990		80	Potential for PTP links (some WiFi equipment supports these frequencies); need to ensure doesn't interfere with radio astronomy and outside broadcast (OB) links	Licensed PtP links Broadcasting	
5150	5855	120	585	5150-5350 MHz indoor use, 5470-5600 MHz, 5650-5725 MHz, 5725-5850 MHz outdoor use 1W EIRP outdoor use	License- exempt WLAN	Yes
5850	5925		75	Currently used by fixed satellite (Earth-to-space) C- band uplink, OB broadcast, terrestrial backhaul. Supported by a wide range of carrier-grade WiFi equipment	License- exempt WLAN Licensed PtP links Broadcasting Satellite	Yes

Green = allocated; yellow = considered

8.2.3 High Band (Greater than 6 GHz)

There has been an intense amount of activity in the 6 GHz band in the past two years. The FCC in the US opened up the entire 6 GHz band from 5925 to 7125 MHz for WiFi and other license-exempt use in April 2020.[94] The European Commission approved regulations that will allow the deployment of WiFi in the lower 6 GHz band from 5925 to 6425 MHz in June 2021.[95] The African Telecommunications Union's emerging technologies task group suggested in July 2021 that the lower 6 GHz band from 5925 to 6425 MHz be made available for unlicensed use on a non-exclusive, non-interference and non- protected basis.[96] The UCC Radio Spectrum Master Plan is considering the adoption of the lower 6 GHz band to support WiFi-6. In Region 1, the upper 6 GHz band from 6425 to 7025 MHz is being considered for IMT at WRC-23. However, there are notable exceptions to the upper block of the 6 GHz band being used for IMT in Region 1. In March 2021, Saudi Arabia released the full lower and upper block of 6 GHz for WiFi,[97] and Kenya is also exploring using the entire 6 GHz block for WiFi and other license-exempt uses.[98]

There are some good spectrum opportunities for both IMT and license-exempt use in the high band region for Uganda. The 17 GHz band (17.1-17.3 GHz) and 24 GHz band (24.0-24.25 GHz) can be used to build fixed wireless links although generally these will be for short-range links as they have 100 mW EIRP power limits. The 60 GHz band (57-66 GHz), known as WiGig, is currently used by the 802.11ad standard for building outdoor point-to-point links and the 802.11ay standard for high-speed indoor cable replacement with speeds up to 7 Gbps.

According to the UCC Radio Spectrum Master Plan, the 60 GHz band is envisaged to support FWA to support 5G (NR-U) private and dedicated networks, with an ITA expected in Q4 2022.

94 - https://www.fcc.gov/document/fcc-opens-6-ghz-band-wi-fi-and-other-unlicensed-uses-0
95 - https://www.eetimes.eu/eu-boosts-6ghz-spectrum-for-wi-fi-use/
96 - https://www.icasa.org.za/uploads/files/GH_Communnication-ATU-R-Recom.pdf
97 - https://wifinowglobal.com/newsletter/saudi-arabia-releases-full-6-ghz-band-to-wi-fi-and-takes-global-lead-in-mid-band- unlicensed-spectrum/
98 - https://www.wi-fi.org/countries-enabling-wi-fi-6e

The 24500-27500 MHz band (250 MHz of bandwidth) has recently been licensed for 5G in Europe and is a potential band for high-capacity 5G cellular in urban areas.

There are several spectrum developments for satellite. Many of the new LEO satellite providers will be offering services in the Ka-band (27500-31000 MHz). In the UCC Radio Spectrum Master Plan, 17.7- 19.7 GHz in the Ku-band (space-to-Earth) and 27.5-29.5 GHz in the K-band (Earth-to-space) are being explored for operation of Earth stations in motion (ESIMs). An ITA for these bands is expected in Q4 2022.

The E-band (71-76 GHz paired with 81-86 GHz) is typically used for fixed links, and, according to the UCC Radio Frequency Spectrum Master plan, an invitation for application for spectrum will be posted via a public notice in Q1 2022.

A summary of high band spectrum allocations for mobile, fixed, broadband and satellite is provided in Table 37.

Notes	Frequencies (MHz)				Notes	ITU Allocation	Used in Uganda
	Start	End	Guard band	Band width			
C-band	5925	6425		500	C-band satellite uplink, and adopted by EU for license-exempt WiFi. African Telecommunications (ATU) Emerging Technologies Task Group recommend license-exempt access to lower 6 GHz band.	License- exempt WLAN	
						Satellite	
	6425	7025		600	Being considered for IMT in Region 1 at WRC-23; allocated for license-exempt WiFi in the US; Kenya considering for license-exempt WiFi	IMT	
						License- exempt WLAN	
X-band	7025	7125		100	Being considered for IMT in all regions at WRC-23	IMT	
Ku-band	11700	12200		500	Ku-band satellite downlink	Satellite	Yes
	14000	14500		500	Ku-band satellite uplink	Satellite	Yes
	17100	17400		300	License-exempt band	License- exempt WLAN	
	17700	21200		3500	Ka-band satellite downlink	Satellite	Yes
K-band	24000	24250		250	ISM license-exempt band for short- range P2P links or non-specific short- range devices (SRDs)	License- exempt WLAN	
						IoT/SRD	
	24500	27500		3000	5G spectrum (licensed in Europe)	IMT	

Table Continued ⟶

Notes	Frequencies (MHz)				Notes	ITU Allocation	Used in Uganda
	Start	End	Guard band	Band width			
Ka-band	27500	31000		3500	Ka-band satellite uplink	Satellite	Yes
V-band	57000	66000		9000	60 GHz license-exempt V-band (WiGig) 802.11ad, 802.11ay	License- exempt WLAN	
E-band	71000	86000	5000	10000	E-band (71-76 GHz / 81-86 GHz)	Fixed	
Green = allocated; yellow = considered							

TABLE 41: REGION 1 HIGH BAND ITU SPECTRUM ALLOCATIONS

8.2.4

Recommendations

Low bands (sub-1 GHz) support widespread coverage, including indoors and across urban, suburban and rural areas, while mid band spectrum offers a good mixture of coverage and capacity benefits. High bands provide very high-capacity links above 1 Gbps. Over the near term, new mid band spectrum in the 3.3 GHz to 4.2 GHz bands will be valuable for 4G and 5G networks that balance the need for coverage and capacity, and sub-1 GHz spectrum in new bands such as 700 MHz will provide excellent value for uncovered rural areas. TVWS in the 470 to 694 MHz UHF band will also support the needs for coverage in low density rural areas for alternative access models such as wireless ISPs (WISPs) and community networks. Providing additional spectrum for WiFi in the 6 GHz band will provide valuable capacity for already-congested WiFi networks and allow offloading from congested mobile networks to WiFi networks. Over the long term, new 5G spectrum in the bands above 7 GHz, such as the 28 GHz band, will provide the high capacity required in high density urban areas. The 60 GHz license-exempt bands can also serve as fibre replacement to create high-capacity links in areas with high population density. For very remote areas, LEO services in the Ka-band will provide high- capacity, low-latency links, and ESIM services in the Ku- and K-bands will provide remote services for land vehicles in motion.

Over the long term, new 5G spectrum in the bands above 7 GHz, such as the 28 GHz band, will provide the high capacity required in high density urban areas.

8.3. BEST PRACTICES IN EMERGING SPECTRUM MANAGEMENT

8.3.1 United States (Americas)

The US has been a first mover in many areas of spectrum access innovation. As far back as the 1930s, the US acknowledged that it was impossible to license every radio resource, and this was unnecessary anyway when there was little risk of harmful interference. In 1938, the Federal Communications Commission (FCC) created a new license-exempt rule allowing some specific types of short-range communication devices, such as baby monitors and wireless loudspeakers, to operate without a license. Until the 1980s, each individual device had to apply for license exemption, which was creating an enormous administrative backlog. In order to streamline this process, in 1989, the FCC decided to 'future proof' its rules and created broad categories of rules that were application- and device- neutral. As long as the devices met the technical constraints of these rules, they were license-exempt.

This led to a burst of innovations such as RFID, WiFi and Bluetooth in the 1990s that has spurred a multi- trillion-dollar industry; the IoT industry alone is worth USD 14 trillion.[99]

The US has continued to innovate in spectrum management in the new millennium. In 2008, the FCC voted to approve the unlicensed use of TVWS – radio frequencies allocated to a broadcasting service but not used locally. TVWS rules allowed secondary users to make use of channels that are unused by the primary broadcasting users. This is a so-called two-tier licensing model. In 2017, the FCC created new commercial rules for the 3.5 GHz Citizens Broadband Radio Service (CBRS) – a 150 MHz band from 3550 to 3700 MHz. Parts of the band were still reserved for the federal government to limit interference with Navy radar systems and aircraft communications. CBRS makes use of a three-tier licensing model to accommodate a variety of commercial uses on a shared basis with incumbent federal and non-federal users of the band in the US. The three tiers are as follows:

- The Incumbent Access tier users include authorised federal and grandfathered fixed satellite service users currently operating in the 3.5 GHz band protected from harmful interference from Priority Access and General Authorised Access users.
- The Priority Access tier consists of Priority Access Licenses (PALs) that will be assigned using competitive bidding within the 3550-3650 MHz portion of the band. Each PAL is defined as a non-renewable authorisation to use a 10 MHz channel in a single census tract for three years.
- The General Authorised Access tier is licensed-by-rule to permit open, flexible access to the band for the widest possible group of potential users. General Authorised Access users are permitted to use any portion of the 3550-3700 MHz band not assigned to a higher-tier user and may also operate opportunistically on unused Priority Access channels.

Use of the CBRS band does not require spectrum licenses, which, in turn, is expected to reduce the cost of data transmissions. This will enable carriers to deploy 5G faster and with less administrative burden using the shared airwaves instead of trying to acquire spectrum licenses at an auction or through deals.

In 2020, the FCC adopted new rules for the 6 GHz band (5.925-7.125 GHz), unleashing 1200 MHz of spectrum for unlicensed use and was the first regulator to do so. These new rules are a critical part of WiFi 6, the next generation of WiFi, and play a major role in the growth of the IoT. WiFi 6 will be over two-and-a-half times faster than the current standard and will offer better performance for consumers. Opening the full 6 GHz band for unlicensed use also increased the

99 - https://www.inc.com/andrew-thomas/this-industry-is-projected-to-be-14-trillion-by-2020-here-are-the-top-influence.html

amount of spectrum available for WiFi by nearly a factor of five. The US authorised indoor low-power operations over the full 1,200 MHz and standard-power devices in 850 MHz of the 6 GHz band. The justification for opening the entire 6 GHz band rather than half of the band, as is the case in other regions such as Europe, is to make broadband connectivity available to all Americans, especially those in rural and underserved areas. This band will be particularly valuable in building long-range point-to-point links.

8.3.2

United Kingdom (Europe)

The UK regulator Ofcom has made many bold spectrum management moves in the past two decades. In 2015, after extensive consultation and trials over several years, Ofcom published TVWS regulation enabling access to unused parts of the radio spectrum from 470 to 790 MHz.[100] Ofcom improved on the TVWS regulations used in the US and enabled the option for secondary TVWS devices to dynamically set their power based on channel and power level pairs received from a TVWS database. In 2019, Ofcom created shared access licenses[101] – a new framework for the shared use of spectrum in four new spectrum bands (shown in Table 1). Ofcom created these licenses to ensure that there is better use of underutilised radio spectrum and to make it easier for more people and businesses to use radio spectrum and support growth and innovation in the telecommunications sector – especially for future 5G networks.

Spectrum band	Authorised bandwidth	Permitted deployment
1781.7-1785 MHz	2x33 MHz	Indoor and outdoor (max 10-m height)
1876.7-1880 MHz		
2390-2400 MHz	10 MHz	Indoor and outdoor (max 10-m height)
3800-4200 MHz	10, 20, 30, 40, 60, 80 and 100 MHz	Indoor and outdoor (max 10-m height)
24.25-26.5 GHz	50, 100 and 200 MHz	Indoor only

TABLE 42: SUMMARY OF SHARED ACCESS LICENSE BANDS

The bands have the following two power category licenses:

• Low power licenses are for industrial and enterprise networks (private networks) that should support voice and data applications in and around a site. Low power licenses are limited to 24 dBm for the 1800 MHz and 2300 MHz bands. In the 3.8 to 4.2 GHz band, the power limit is 24 dBm for carriers using less than 20 MHz channel widths and 18 dBm per 5 MHz for carriers with channel width greater that 20 MHz. In the 26 GHz spectrum band, the power is limited to 23 dBm. There is no license fee for using these bands in low power mode.

• Medium power licenses are targeted towards FWA deployments in rural areas, agriculture or private networks spread over a larger area. The maximum permitted power for all bands in this power category is 42 dBm. The licensing fee is 80 GBP for a 2x3.3 MHz / 10 MHz channel and 800 GBP for a 100 MHz channel.

100 - https://www.nominet.uk/what-is-tv-white-space/
101 - https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/shared-access

In addition to shared spectrum licenses, in 2019, Ofcom created local access licenses,[102] which enable organisations and enterprises to gain access to radio spectrum previously allocated/licensed to mobile service providers but not being utilised throughout the entire country. If the spectrum is not being used in a specific geographical location, an organisation can approach Ofcom and request a local access license to make use of it. A local access license is available in any band covered by the 2011 mobile trading regulations and includes the 800, 900, 1400, 1800, 1900, 2100, 2300 and 2600 MHz bands that are widely used for mobile 2G, 3G, 4G and 5G technologies. The licenses will apply for a period of three years and cost 950 GBP.

8.3.3

New Zealand (Australasia)

New Zealand encourages innovative ideas to use spectrum more efficiently as well as the creation of new methods or opportunities for connecting the unconnected. To this end, New Zealand has created Managed Spectrum Park (MSP) licenses and allocated spectrum to the Māori Spectrum Working Group and has an open data spectrum policy.

New Zealand created MSP licenses in 2008. The licensed band consists of 40 MHz of spectrum from 2575 MHz to 2620 MHz. In this regime, the licensee agrees to share the block of spectrum by means of licensing or employing compatible equipment capable of sharing the same spectrum (this could be using techniques such as antenna polarisation, careful site selection, power control and databases). MSP licenses are allocated following an expression of interest process, which may involve a ballot if applicants can't agree to share spectrum. To ensure the spectrum is efficiently utilised, services must be implemented within two years of allocation.

Established in 2019, the Māori Spectrum Working Group advocates for Māori interests in radio spectrum and spectrum auctions in the future. A recent deal was signed that allocated a significant slice of 5G spectrum to the Māori.[103] 50 MHz of unused spectrum in the 3.5 GHz band, currently supported by smartphones, was made available to the Māori in 2020. Māori interests in radio spectrum date back to 2004, when the Māori Television Broadcasting Service was established (currently they own two DTV channels). This is similar to social purposes spectrum licenses created in Mexico for communities to deploy mobile service in the 850 MHz band.

The New Zealand regulator opted for a simple approach for licensed microwave links. They charge a flat fee of $150 per link regardless of frequency.[104] New Zealand also has a fully open data policy regarding spectrum use. All licensed spectrum users can be looked up on the regulator's website.[105] The website provides the name of the license holder, the location of sites with a grid reference, the spectrum they are using and the license type.

8.3.4

South Africa (Africa)

South Africa's current broadband policy, SA Connect – ratified in 2013 – grew out of the NDP[106] **(focused on addressing poverty and inequality) to address the lack of affordable high-speed and high-quality bandwidth for businesses, public institutions and citizens.** The plan has a vision of 80% of the population connected at 100 Mbps by 2030 and 100% of the population connected at 10 Mbps by 2030. Spectrum access is a critical component of achieving targets in the NDP plan and the SA Connect policy. Without sufficient spectrum in the lower bands, coverage targets won't be achieved, and in the mid and high bands, capacity targets won't be achieved. The national commitments to ICTs that followed

102 - https://www.mpirical.com/blog/shared-access-driving-innovation-in-the-uk-with-local-spectrum-licencing
103 - See 5G deal signed with Maori (https://www.stuff.co.nz/business/118193085/sparks-5g-roadblock-cleared-after-government-strikes- deal-with-mori)
104 - https://www.rsm.govt.nz/licensing/licences-you-must-pay-for/fixed-location-licences/fixed-link-licence/
105 - https://rrf.rsm.govt.nz/smart-web/smart/page/-smart/domain/licence/SelectLicencePage.wdk
106 - https://www.gov.za/issues/national-development-plan-2030

SA Connect in 2013 have not been met, and no significant progress has been made to reach the specific objectives. However, in spite of this, the private sector has made impressive gains. By 2012, the mobile operators had already achieved 99% mobile population coverage (although this was never independently verified). Mobile operators last received competitive spectrum 15 years ago and have re-farmed their existing spectrum in the allocated 900,1800 and 2100 MHz bands for 3G and 4G networks.

At the end of 2020, ICASA announced the auction of 406 MHz of high-demand spectrum in an invitation to apply (ITA). 80 MHz of this spectrum was reserved for a new wholesale open access network (WOAN). The aim of the WOAN is to create a wholesale open access wireless network that smaller operators can use to open up more competition in the services market. The idea of the WOAN has received mixed opinions from industry. Smaller players in the market support the creation of a WOAN to increase competition, and larger players are against it. The WOAN will be awarded in a separate bid process that was expected in 2021. Both processes were delayed by court proceedings. Larger operators who bid for and are awarded spectrum in the expected auction are required to collectively purchase 30% of the WOAN capacity as a condition for being awarded new high-demand spectrum. Open-access models have been very successful when used by fibre network operators and empower many ISPs to compete as service providers, which works well to drive down prices. It has yet to be seen if the model will work with a mobile wholesale access network.

South Africa published final TVWS **regulations in 2018,[107] becoming the first African country to publish a** TVWS **regulatory framework.** In early 2021, the first commercial TV white [108] space networks began rolling out.

South Africa also has a very robust growing WISP market. WISPs in South Africa have developed experience in rolling out low-cost connectivity via fixed wireless broadband access (typically under R500 per month for uncapped 5 Mbps internet access) to over half a million customers across South Africa mostly using license-exempt WiFi spectrum and some licensed wireless point-to-point spectrum. WISPs will also start using TVWS to cover areas where WiFi connectivity was challenging due to terrain or vegetation.

The Wireless Access Providers Association (WAPA) currently represents more than 220 organisations, including large and small players as well as supports industries such as equipment vendors and software providers. WAPA's members predominantly operate in peri-urban and rural areas, which often lack affordable or reliable access to broadband internet. As a class, WISPs serve to drive down the cost to communicate and increase broadband penetration. A model like that of WAPA may work well to help support small operators who need assistance with spectrum licensing, as an interface to the regulator for arbitration, and to represent the needs of smaller operators when policies and regulations are being formed.

South Africa also has an active community networks movement, and a number of community networks around the country provide affordable access to local free content to users. The most well-known and established is the Zenzeleni community network, established in 2012. It offers quality, high-speed internet comparable to that in the country's most developed urban centres. The internet service is truly affordable. The model aims to significantly cut costs of telecommunications, retain expenditure within communities as a form of social entrepreneurship and support the development of a rural digital ecosystem to bridge the digital divide. Zenzeleni has also created strategic partnerships with international organisations such as the Internet Society and the Association for Progress Communication, amongst others, as well as the government to forge a path for getting community networks recognised as a mechanism for positive change and connectivity in South Africa, throughout Africa and internationally.

107 - https://www.icasa.org.za/legislation-and-regulations/regulations-on-the-use-of-television-white-spaces-2018
108 - https://techcentral.co.za/tv-white-spaces-in-south-africa-is-now-ready-for-lift-off/105428/

8.3.5

8.3.5. South Korea (East Asia)

In 2013, South Korea launched the Ultra Broadband convergence Network (UBcN) project, with targets of 1 Gbs speeds on fixed lines and 10 Mbs on wireless. The policies and programmes under UBcN facilitated the rapid expansion and use of broadband. To date, about 50 million people in South Korea (or 97% of the population) use the internet,[109] and the country has the world's fastest average internet connection speed (169 Mbps for mobile connections and 171 Mbps for fixed connections).[110] South Korea has also consistently ranked first in the UN ICT Development Index since its launch. To support these targets, South Korea has developed advanced spectrum management and planning systems. It has a Central Radio Management Service (CRMS) that covers broadcasting and communication with regional branches to offer radio administration services and monitor radio spectrum compliance.[111] The South Korean Ministry of Science and ICT (MSIT) announced the establishment of a new fund specifically targeting technologies and projects that can provide data rates of 10 Gbps, with plans to reach a 50% adoption rate of the super-fast speeds by 2022.[112]

South Korea has consistently been trend setters in 5G development. In April 2019, The Republic of Korea launched the world's first business-to-consumer (B2C) smartphone-based 5G commercial services. In two years, the number of 5G subscribers surpassed 13 million, accounting for 20% of total mobile subscriptions in the country.[113] The government has also introduced various support measures, including tax credits for 5G investments, and is encouraging network sharing in suburban and rural areas to facilitate the fast rollout of the 5G network with nationwide network deployment by 2022.

South Korea has chosen 3.5 GHz spectrum as the main network for 5G, and MSIT is planning to deploy 28 GHz primarily for hotspot and B2B services. This strategy balances the coverage and capacity trade-offs of these two bands, with 3.5 GHz providing good coverage and 28 GHz providing high capacity.

Public 5G spectrum auctions took place on 18 June 2018. The government made available a total of 2680 MHz, including 280 MHz (3420 ~ 3700 MHz) in the 3.5 GHz spectrum band and 2400 MHz (26.5 ~ 28.9 GHz) in the 28 GHz band. In the case of the 3.5 GHz spectrum, the operator must install 15% of LTE base stations in three years and increase the percentage up to 30% in five years. Under these conditions, mobile carriers must install 22,500 5G base stations by the end of 2021, for a total of 45,000 by the end of 2023. These targets ensure operators don't park unused spectrum for long periods of time.

On 5 December 2019, the MSIT launched a mid- and long-term 5G spectrum strategy called the 5G+ Spectrum Plan. Some of the key ideas of the plan include the following:

- Use unlicensed spectrum for 5G using 5G NR-U (New Radio Unlicensed Band),
- Secure the world's largest 5G spectrum, and
- Accelerate innovation in spectrum management, regulations and systems.

109 - https://datareportal.com/reports/digital-2021-south-korea?rq=korea (slide 17)
110 - https://datareportal.com/reports/digital-2021-south-korea?rq=korea (slide 27)
111 - https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2018/SMWE- China/Presentations/case%20study%20in%20Korea.pdf
112 - https://www.researchandmarkets.com/reports/3763620/south-korea-fixed-broadband-market-statistics
113 - http://documents1.worldbank.org/curated/en/389891611234263109/pdf/World-Bank-Group-Korea-Office-FY20-Annual- Report.pdf

By reallocating unlicensed frequencies, the government aims to boost 5G+ strategic industries such as smart cities, autonomous cars and drones. Standalone 5G NR-U is basically a version of 5G that can be deployed into unlicensed spectrum.

South Korea has good policies to encourage competition. Mobile operators must provide mandatory wholesale services to MVNOs under the Telecommunications Business Act Enforcement Decree from 2020. In addition, the government is planning to reduce 5G wholesale prices. The government is making efforts to encourage MVNOs to provide 5G services. In addition, some frequencies have been set aside by MSIT for new operators entering the market, and blocks have been reserved in the 700 MHz, 28 GHz, 2.5 GHz and 2.3 GHz bands in case a fourth mobile carrier enters the market. In the future, MSIT plans to supply a 6 GHz band as unlicensed frequency, aiming to commercialise this in 2022.

8.4. NOTABLE ACHIEVEMENTS RELATED TO SPECTRUM ACCESS IN AFRICA

The pandemic presented a particular challenge to the release of spectrum to operators. While most spectrum auctions around the world were delayed in 2020, a number of African regulators, including Ghana, Kenya, South Africa, Zambia and Zimbabwe acted quickly to release spectrum to operators to help them cope with increased demand for capacity on their networks. Where operators had existing spectrum, this helped to expand capacity on existing networks but typically did not result in new infrastructure being built, partly due to the uncertainty related to the permanence of the spectrum making infrastructure investment risky but also due to the physical challenges of construction logistics during the pandemic.[114] Recent initiatives include the following:

- In 2020, Kenya and Nigeria announced draft regulations for TVWS use, and South Africa granted access to TVWS spectrum as part of their COVID-19 response.[115]
- WiFi-enabled 'hello hubs 'brought internet to underserved communities in Uganda in 2020.[116]
- TVWS regulation was finalised in Mozambique in early 2019. In a market of a largely lower income population with tough economic viability, schools were connected in three main cities with TVWS, and Raspberry Pi devices were used to provide access for school pupils in school IT labs.
- In 2019, Kenya's BRCK acquired Surf to become the largest public WiFi network in sub-Saharan Africa.[117]
- In 2018, a number of African countries began licensing digital dividend spectrum (700 and 800 MHz) for mobile broadband: 800 MHz is now licensed in Uganda, Nigeria, Kenya and Ghana, and 700 MHz is licensed in Kenya.[118]
- In 2014, Rwanda built a single wholesale network (SWN) – a government-initiated network that compels mobile operators and others to rely on wholesale services provided by the SWN as they serve and compete for retail customers. The SWN was implemented by Korea Telecommunication Rwanda Networks (KTRN) for 4G only in the 800 and 1800 MHz bands. The target for the network was 4G coverage for 98% of the population after five years. By 2018, 95% of the population had been covered by 4G LTE from the KTRN wholesale network.[119]

114 - https://manypossibilities.net/2021/02/africa-telecoms-infrastructure-in-2020/
115 - https://manypossibilities.net/2021/02/africa-telecoms-infrastructure-in-2020/
116 - https://www.forbes.com/sites/chrisstrub/2020/01/15/wifi-enabled-hello-hubs-bring-Internet-to-underserved-communities- in-uganda/#67df58923063
117 - https://techcrunch.com/2019/02/15/brck-acquires-isps-everylayer-and-surf-to-boost-africas-public-wi-fi/
118 - https://opentelecomdata.org/spectrum-chart/
119 - https://www.newtimes.co.rw/news/four-years-later-95-rwanda-covered-4g-Internet

Community networks in Africa provide an example of how to increase ownership in telecommunication infrastructure, reduce cost of connectivity and make use of low-cost, license-exempt technology, such as WiFi, and new emerging techniques, such as TVWS, to provide access. These have been deployed since the early 2000s and are growing steadily. Following is a list of some active community networks in Africa (a full description can be found in 'Community Connectivity: Building the Internet from Scratch'[120]):

- Uganda: Bosco
- DRC: Mesh Bukavu, Mesh Boma, Pamoja Net
- Ghana: Akwapim Community Wireless Network
- Kenya: Tunapandanet
- Namibia: Connecting Eehana
- Nigeria: Fantsuam Foundation, Ibadan WUG
- Somalia: Abaarso
- South Africa: Zenzeleni, iNethi, SoWUG, Cape Town WUG, Johannesburg WUG, Durban WUG, Home of Compassion
- Tanzania: ICT4RD, Sengerema Wireless Community Network
- Tunisia: Mesh SAYADA
- Zambia: Macha Works
- Zimbabwe: Murambinda Works

8.5. SPECTRUM AUCTIONS IN AFRICA

In the 1990s and early 2000s, mobile spectrum in Africa was allocated via administered assignment or via a beauty contest. In the administered assignment of spectrum, a regulator directly assigns a licensed operator spectrum, often with some conditions, such as target population coverage in specific areas with poor connectivity. In a beauty contest, a set of criteria are created, such as spectrum efficiency and areas that need to be covered, with a fixed set of prices, and existing or new operators apply and are evaluated against these criteria. Over the past decade, as demand for radio frequency spectrum has increased and demand for spectrum from mobile operators is outstripping supply, 'Market-based 'mechanisms for spectrum management, such as spectrum auctioning, are becoming more popular. Auctions tend to be more transparent and less vulnerable to lobbying than the beauty contest approach.

Spectrum auctions need to balance a wide range of objectives, some of which can be conflicting. Revenue generation, spectrum efficiency and promoting competition are some of the objectives, and, in theory, the operator who is prepared to pay the most for the spectrum should have the highest valuation for it. However, high reserve prices could deter participation by smaller players or even cause an auction to fail completely. Some typical measures to ensure wider competition include auctioning spectrum in small lots, spectrum set-asides for new entrants and spectrum caps to ensure that no operator is able to monopolise access to spectrum in a particular band or across bands.

Surprisingly, as of 2013, among African countries, only Nigeria had successfully conducted and concluded a spectrum auction. However, in the past six years, a number of African countries have been embracing spectrum auctions even though some have failed and ended in a negotiated settlement or ended in continued court battles. The digital dividend (the releasing of the 700 MHz and 800 MHz bands as broadcasting transitioned to digital television) appeared to be the catalyst to a slew of spectrum auctions across the continent. A summary of spectrum auctions is provided below.

120 - https://Internet-governance.fgv.br/sites/Internet-governance.fgv.br/files/publicacoes/community_connectivity_- _building_the_internet_from_scratch_0.pdf

8.5.1

8.5.1. Kenya

Kenya has not had a spectrum auction in the true sense of the word, but their story is still interesting and an example of innovation in spectrum assignment. Assignment of spectrum in the 800 MHz band in Kenya began in 2014 with a request from the Kenyan government to the largest operator, Safaricom, to build a national police communications network. Safaricom initially agreed to pay USD 56.2 million and build the requested network in exchange for access to 2x15 MHz of 800 MHz spectrum. After complaints from Airtel and Telkom Kenya, the regulator compelled Safaricom to relinquish 2x5 Mhz of spectrum so that each of the three incumbent mobile network operators would be assigned 2x10 MHz of 800 MHz spectrum each, for a total of 60 Mhz of spectrum. The three operators then agreed to each pay USD 25 million for the spectrum licenses. The cost of the national police network has now been disaggregated from the spectrum sale. The licensing process for the 700 MHz band was completed in 2017. This was not strictly an auction but rather a process that allowed two consortiums of five companies each to apply for a license. An operator was required to pay an up-front fee of USD 25 million for a spectrum license for a 10-year period. To promote more competition, the licenses were closed to the three top operators, who already had spectrum in the 800 MHz band.[121]

8.5.2

8.5.2. Nigeria

In late 2013, the Nigerian communication regulator (NCC) announced a spectrum auction for 30 MHz of 2.3 GHz spectrum. The auction attracted only two bidders and was won by a new entrant consortium called Bitflux. Bitflux paid just over the reserve price of USD 23 million for the spectrum license. Later, in 2014, the regulator launched an auction in the 2.6 GHz band. This was withdrawn and re-attempted in 2015 but again withdrawn. Finally in March of 2016, the regulator announced an auction of spectrum in the 2.6 GHz band. In total, 14 lots of 2x5 MHz spectrum (140 MHz of spectrum in total) were put up for bid. By the end of the bidding process, only one operator, MTN Nigeria, was willing to meet the reserve prices of USD 16 million per lot. MTN bid for six lots, paying a total of USD 96 million for 60 MHz of spectrum. The remaining spectrum remains unsold. The spectrum license period for this auction was 10 years.

Nigeria recently had an auction of two lots of 100 MHz spectrum in the 3.5 GHz band from 3500- 3600 MHz and 3700-3800 MHz.[122] Each 100 MHz lot had a reserve price of USD 197.4 million. The auction took place on 13 December, 2021. This auction placed a reserve price of USD 1.974 million per MHz on the spectrum and the licenses are valid for a period of 10 years. Mafab Communications Ltd and MTN Nigeria Plc, emerged as the two successful winners of the 3.5 gigahertz (GHz) spectrum auction, each paying US$273.6 to obtain a holding.[123] MTN was able to select a holding in the 3500MHz-3600MHz band, while Mafab was allocated the 3700MHz-3800MHz holding.

121 - https://manypossibilities.net/2017/04/the-failure-of-spectrum-auctions-in-africa/
122 - See 3.5 GHz for IMT Services (available at https://www.ncc.gov.ng/technical-regulation/spectrum/spectrum- auctions/upcoming-auctions/1064-3-5ghz)
123 - See MTN and Mafab bag 3.5GHz spectrum in Nigerian auction (available at https://developingtelecoms.com/telecom-business/telecom-regulation/12504-mtn-and-mafab-bag-3-5ghz-spectrum-in-nigeria-s-auction.html)

8.5.3 Mozambique

In April of 2013, the Mozambique regulator announced the auction of five lots of 2x5 MHz (a total of 50 MHz) of 800 MHz spectrum with a reserve price of USD 30 million per lot. The auction did not attract any bids and was widely perceived to have an excessively high reserve price. The auction was quietly withdrawn. Another auction was held in 2018 for the 800 MHz, 1800 MHz and 2600 MHz bands, but only the 800 MHz band attracted bids, likely due to excessively high reserve prices. Vodacom, Movitel and mCell all secured portions of the 800 MHz band, bringing in a total of USD 83.4 million from the spectrum sale.

8.5.4 South Africa

Since 2010, the South African regulator has attempted to convene a spectrum auction many times. The first two were in the 2.6 GHz and 3.5 GHz bands, and the third attempt in 2016 was in the 800 MHz, 2.6 GHz and 3.5 GHz bands. Each time the auction has been withdrawn, with another one being cancelled in February of 2017. This is mostly attributed to a lack of coherent vision from the Ministry of Communications and Digital Technologies, which has seen eight different ministers since 2009 and which has, in turn, led to disputes between the regulator and the ministry. The third attempt at auctioning this spectrum was cancelled due to the ministry's new policy at the time of removing all exclusive-use spectrum in favour of a national wholesale network.

In 2020, a new ITA for a spectrum auction was issued for 700 MHz, 800 MHz, 2.6 GHz and 3.5 GHz bands (a total of 406 MHz of spectrum). The ITA included spectrum caps of a maximum of 2×21 MHz in sub-1 GHz holdings (including existing spectrum holdings) and an overall maximum of 184 MHz (including existing spectrum holdings). The prices are high relative to the rest of Africa. For example, a 2x10 MHz 800 MHz block will cost USD 78 million. Six operators responded to the ITA (Vodacom, MTN, Telkom, Liquid Telecoms, Rain Networks and Cell C). 80 MHz of spectrum in these four high- demand spectrum bands was reserved for the Wireless Open Access Network (2x10 MHz of 700 MHz, 1x30 MHz of 2.6 GHz and 1x30 MHz of 3.5 GHz). In March 2021, the High Court issued a judgement interdicting the regulator from continuing with the ITA processes for high-demand spectrum and the licensing of the WOAN, respectively, due to a court application filed by Telkom.

Since then, the parties have reached an out-of-court settlement which resulted in an information memorandum for the purpose of consulting on the proposed ITA. Following consultation with operators, a second information memorandum was published on 16 November 2021.[124] Following consideration of written representations on this information memorandum, a final ITA was published on 10 December 2021.[125] It is expected that the auction process will begin in March 2022 and that the licensing of the WOAN will be in May 2022. The license is issued with the condition that it needs to be fully utilised within five years. Should the spectrum not be fully utilised, the regulation authority will initiate a process to either (i) share unused spectrum among operators in areas where it is needed or (ii) force an operator to surrender a portion of the spectrum or cancel the issued radio frequency spectrum license.

124 - See ICASA publishes an updated Information Memorandum for another round of consultation (available at: https://www.icasa.org.za/news/2021/icasa-publishes-the-updated-information-memorandum-for-another-round-of- consultation)
125 - See ICASA issues an invitation to apply for high demand radio frequency spectrum (available at: https://www.icasa.org.za/news/2021/icasa-issues-an-invitation-to-apply-for-high-demand-radio-frequency-spectrum)

8.5.5 Ghana

In 2015, the Ghanaian regulator announced an auction of 800 MHz spectrum, offering two lots of 2x10 MHz spectrum (a total of 40 MHz) with a reserve price of USD 67.5 million per lot. While local companies were encouraged to participate, none of the three Ghanaian companies that registered for the auction were able to meet the reserve price. The only company to meet the reserve price for a single lot was Scancom (MTN), resulting in an effective monopoly for MTN in the 800 MHz band. The regulator has announced plans to attempt to auction the remaining spectrum with the intention of using auction proceeds to fund the rollout of digital terrestrial broadcasting infrastructure. The license is valid for a period of 15 years.

8.5.6 Senegal

In 2015, the Senegalese regulator announced an ITA for LTE spectrum in the 700 MHz, 800 MHz and 1800 MHz bands – specifically, three blocks of 2x30 MHz in 800 MHz, four blocks of 2x20 MHz in 700 MHz and three blocks of 2x30 MHz spectrum in 1800 MHz. The reserve price for a 20-year license was set at approximately USD 50 million. The auction was effectively boycotted due to the high reserve price and resulted in a stand-off between the regulator and operators. This was resolved in June of 2015 when the regulator restarted the licensing process, having negotiated a deal with the former fixed-line incumbent operator Sonatel to pay USD 53 million for 2x10 MHz of spectrum in the 800 MHz band and 2x10 MHz in the 1800 MHz band. The 20-year license commits Sonatel to provide 70% population coverage within five years and 90% coverage within 10 years.

8.5.7 Tanzania

In 2018, market leader Vodacom Tanzania and a newcomer in Tanzania's fast-growing communications sector, Azam Telecom (T) Limited, were picked as the winners of the spectrum auction in the 700 MHz band. Vodacom Tanzania Plc acquired 2x10 MHz for a total price of USD 10.005 million, and Azam Telecom (T) Ltd acquired 2x10 MHz for a total price of USD 10 million. Azam struggled to deploy its network and returned the spectrum. The spectrum license is valid for a period of 20 years.[126]

8.5.8 Angola

The Angolan Institute of Communications (INACOM) held its first open spectrum auction in August 2017 for the 800 MHz spectrum. Until this point, mobile spectrum licenses had been allocated behind closed doors to the two existing telcos, Unitel and Movicel. The spectrum was awarded to Angola Telecom, which launched 4G LTE services on 800 MHz later in 2018.

8.5.9 Botswana

Botswana has not had spectrum auctions, and this is arguably one of the countries where spectrum demand is too low to warrant an auction. In January 2021, the population size was 2.37 million. A recent ITA was released by the Botswana Communications Regulatory Authority (BOCRA) in July 2021 for IMT licenses in the 450 MHz, 800 MHz, 2.1 GHz, 2.6 GHz and 3.5 GHz spectrum bands. This is effectively a beauty contest and will be evaluated on spectrum, functional and economic efficiency and comes with coverage and capacity obligations of 30 Mbps in the 800 MHz and 3.5 GHz bands and 20 Mbps in the 2.1 GHz and 2.6 GHz bands. The license period for these IMT bands is 15 years. The price for these bands is very low compared to other African countries. For example, a national use 2x10 MHz 800 MHz package is approximately $77k, and a national use 50 MHz TDD 3.5 GHz package is approximately $51k. To put this in perspective, a 2x10 MHz 800 MHz block in the current South Africa ITA will cost USD 78 million.

126 - See GSMA advocacy for Tanzania spectrum auction (https://www.gsma.com/subsaharanafrica/gsma-advocacy-for- tanzania-spectrum-auction)

8.5.10

Lessons Learned and Recommendations

There are many lessons to be learned from the failed spectrum auctions in Africa, and one could argue that only Mozambique has had some level of success auctioning the 800 MHz spectrum. Highlighting a country that has had a successful auction also provides some valuable insights. One such country is Costa Rica.[127] Costa Rican mobile operators have historically benefited from timely and fair access to sufficient spectrum at affordable prices compared to other developing countries in the region. In 2017, the national regulator Superintendencia de Telecomunicaciones (SUTEL) auctioned 70 MHz of spectrum in the 1800 and 2100 MHz bands (ICE, the state-owned operator, has 550 MHz of total spectrum due to historical reasons and so was excluded from the auction). Following unsold spectrum in 2011, the regulator decided to re-auction the unsold concession in 2017 at a much lower reserve price (USD 70 million in 2011 versus USD 43 million in 2017). Movistar and Claro were able to secure the spectrum in 2017 (40 and 30 MHz, respectively) for USD 43 million, which, in $/MHz/population terms, was over 55% cheaper than the average for developing countries in Latin America.

While spectrum auctions are theoretically the most efficient way to assign spectrum, their success or failure is highly dependent on the detail of their design and the context of the relevant market. The experiences of African countries suggests that reserve prices are often set too high, with the objective of maximising revenue rather than ensuring participation and competition. By contrast, non-competitive assignments may be more effective at ensuring all available spectrum is assigned and shared among operators. However, beauty contests lack transparency, and where spectrum has been assigned by non-competitive means, it is also possible that an important national resource has been undervalued. The GSMA released a report[128] with key elements for successful spectrum auctions, and following are the key positions:

- The top priority for spectrum auctions should be to support affordable, high-quality mobile services;

The experiences of African countries suggests that reserve prices are often set too high, with the objective of maximising revenue rather than ensuring participation and competition.

127 - See Spectrum Pricing in Developing Countries: Evidence to Support Better and More Affordable Mobile Services (https://data.gsmaintelligence.com/api-web/v2/research-file-download- old?file=5a8f746015d3c1f72e5c8257e4a9829a&download)
128 - See https://www.gsma.com/spectrum/resources/spectrum-auctions/

• Auctions are a tried-and-tested award mechanism but can and do fail when poorly designed;
• Auctions should not be the only award process as they are not always suitable;
• Auctions designed to maximise state revenues risk serious harm to consumers;
• Assign a sufficiently large amount of spectrum and publish roadmaps to support high-quality mobile services;
• Spectrum caps and set-asides distort the level playing field;
• License obligations and conditions should be designed to minimise the cost of covering non-profitable
areas and avoid distorting the award of spectrum;
• The chosen auction design should not create additional risk and uncertainty for bidders;
• Poorly chosen lot sizes or inflexible packages of spectrum lots risk inefficient outcomes;
• Policymakers should work in partnership with stakeholders to enable timely, fair and effective awards.

In addition to these guidelines, the approach used for assigning spectrum should factor in Uganda's 'Framework for Spectrum Assignment to Telecommunications Services in Uganda'[129] with the following considerations:

• The allocation, allotment and/or industry purpose/use of the respective spectrum
• Does the use of the respective spectrum necessitate exclusive use, or can it be shared? • The status of the use of the respective band
• The amount of spectrum available versus the demand
• The market structure

These guidelines provide valuable insights for allocating spectrum. Shared spectrum access is explored in the following section, and this together with the intended use, the intended market structure and the potential spectrum demand will dictate the approach required for licensing spectrum. If a spectrum auction approach is followed, there are situations where spectrum caps could be used judiciously to ensure more competition in the market. In addition, license obligations are critical to ensure universal access but need to be balanced carefully with the profitability of the spectrum for the bidder.

8.6. ASSESSING THE IMPACT OF ALTERNATIVE BROADBAND ACCESS MODELS

Most of the world's population is accessing the internet on a mobile or fixed wireless connection that makes use of radio spectrum. Smarter spectrum policy and regulation can radically change the cost economics of deploying wireless networks – expanding access to underserved and previously unserved communities, increasing competition and reducing costs for consumers. To support deployments, regulators need to make new spectrum available on an exclusive-use basis for new 4G and 5G mobile networks and satellite networks or on a license-exempt basis for WISPs, community networks or governments deploying next-generation WiFi and last-mile FWA. Spectrum needs to be made available across a range of low band, mid band and high band frequencies to support fixed and mobile terrestrial- and satellite-based communications. This diversity is key to addressing connectivity gaps and improving affordability.

While it is clear that more licensed and unlicensed spectrum is needed to support next- generation wireless applications, it is becoming increasingly difficult for regulators to move incumbent users from their existing assignments and clear that

129 - Framework for Spectrum Assignment to Telecommunications Services in Uganda, 2019 (https://www.ucc.co.ug/wp-content/uploads/2017/09/Framework-for-spectru-assignment-in-Uganda-20191.pdf)

spectrum for new uses and users. Fortunately, the emergence of various types of spectrum-sharing technologies enables regulators to allow wireless network operators access to new spectrum bands without displacing incumbent government users and commercial licensees. These spectrum-sharing regimes are made possible by the emergence of spectrum-sensing capabilities and cloud-based spectrum-sharing databases that can dynamically assign unused frequencies while protecting incumbent users from harmful interference. The best examples of spectrum-sharing technology are TVWS in the UHF band, 3.5-3.65 GHz CBRS in the US and 6 GHz WiFi.

In addition, regulators should consider licensing for space-based satellite communications as well as experimental high altitude platform stations (HAPSs). These technologies promise higher throughput and lower latency connectivity than is available from traditional geostationary satellite constellations. They are suitable in remote locations where terrestrial connectivity cannot be cost effectively deployed, providing direct connectivity to consumers and IoT devices as well as backhaul connectivity to last-mile mobile and fixed wireless networks. There are now numerous non-geostationary orbit satellite constellations, including OneWeb, SpaceX, Kuiper, Telesat and others. HAPS providers, such as HAPSMobile, have conducted their first test flights. These providers 'connectivity solutions are in varying stages of development, but each of the companies is committed to deploying global offerings, with a focus on helping to close the global broadband gap.

Spectrum access can now be placed into four categories that move from a rigid to a more flexible regulatory approach, as shown in Figure 17. The categories are as follows:

- A static licensing regime: Spectrum is licensed to national or regional users, such as cellular operators or broadcasters, on an exclusive basis.
- License shared access: A primary license holder, such as a satellite operator, shares spectrum with a secondary licensed holder, such as an operator building point-to-point links.
- License-exempt shared access: A primary license holder, such as a broadcaster, shares unused spectrum with a secondary user, such as a wireless access provider, on a license-exempt basis. This may be a model used for TVWS.
- A spectrum commons: Where all users of the spectrum obey rules such as maximum power levels and 'listen before talk' to avoid interfering with each other. Bluetooth and WiFi are common examples.

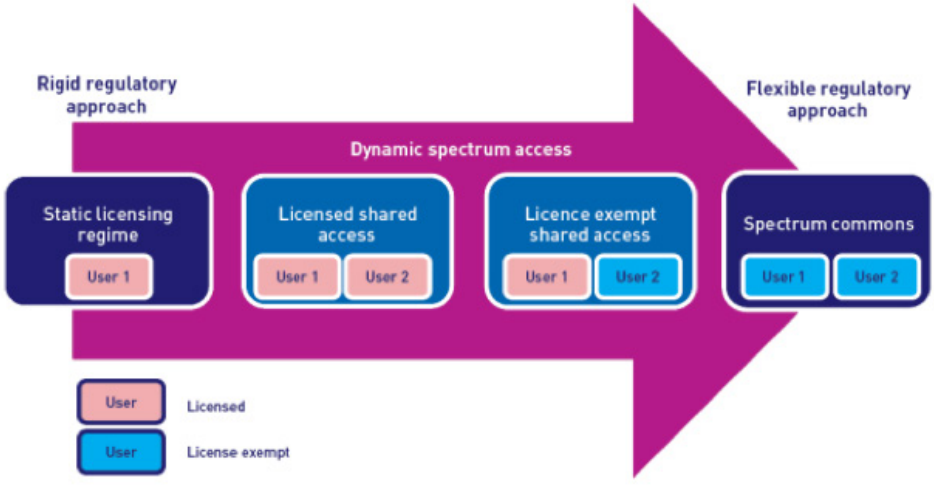


FIGURE 17: SPECTRUM ACCESS APPROACHES

The right spectrum access model will depend on the intersecting needs of efficient spectrum usage, generating spectrum revenue that requires guarantees of non-interference for incumbents that pay spectrum fees, increasing competition in the market, increasing coverage or capacity in poorly serviced areas and selecting the right ownership model (will the network be a privately or publicly owned network or a hybrid of both). A healthy spectrum ecosystem will have a good mix of access approaches. For example, users should be able to widely access mobile networks using a static licensing regime but at the same time have access to lower-cost broadband fixed access options via fibre, fixed wireless using licensed-shared access or a spectrum commons model at home or at public WiFi hotspots using a spectrum commons model.

The important message is that not all spectrum bands or spectrum access models are created equal or equally suitable for different environments and users' needs and it is important not to overemphasise the value of one specific block of spectrum or technology over another.

This section specifically looks at spectrum access that can support alternatives to mobile cellular access that is generally well studied and understood. Alternative access includes solutions from community and cooperative networks, WISPs and government programmes that create low-cost public WiFi access. These access modalities often depend on license-exempt spectrum and new techniques, such as dynamic spectrum access with lower spectrum and network licensing costs.

8.6.1 Dynamic Spectrum Access

Some useful studies were done by the Boston Consulting Group in 2016 to look at the economic case for bringing broadband to the rural US.[130] They compared LTE, TVWS and satellite technology and concluded that a mix of technologies in different bands deployed across the country would require capital expenditure of USD 8 billion to USD 12 billion less than any individual technology alone (Figure 18). They also established a match between population density and the most suitable technology (Figure 19). It was clear that TVWS provided the most cost-effective solution for approximately 80% of the rural US and in general was the cost-effective technology of choice for population densities between two and 100 residents per square mile (5 and 500 residents per km2). Satellite was more effective at very low population densities of one resident per square mile (2.6 km2).

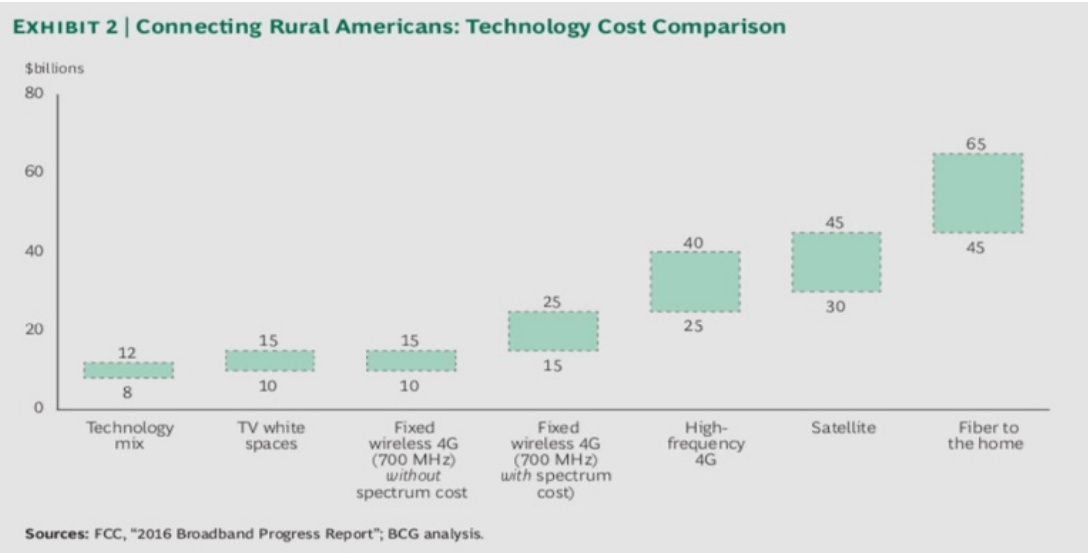


FIGURE 18: COST COMPARISON OF TECHNOLOGIES

130 - https://www.bcg.com/publications/2018/economic-case-bringing-broadband-rural-united-states.aspx

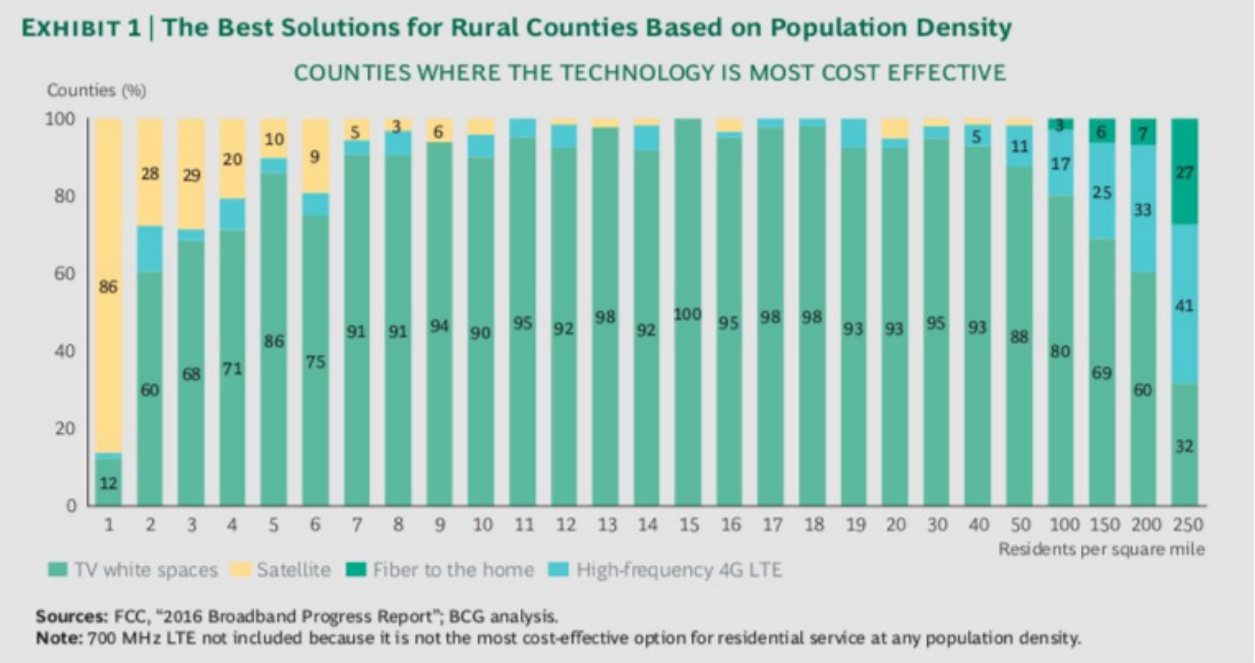


FIGURE 19: MATCHING POPULATION DENSITY TO THE MOST COST-EFFECTIVE TECHNOLOGY

Uganda has a high percentage of its population living in rural areas (approximately 74.8%). This makes the country well suited to technologies that work well at lower population densities. In total, 58.6% of the land mass has a population density between five and 500 residents per km2, where technologies that work with spectrum under 1 GHz, such as cellular or TVWS technologies, could be considered, and 49.88% of the population live in these areas.

It is useful to categorise areas into five zones with different population densities matched to technologies that work with spectrum under 1 GHz, such as cellular or TVWS, cellular and WiFi technologies that work with spectrum above 1 GHz and satellite technology. For broadband FWA, it is highly likely that roof-mounted WiFi radios could replace many above-1 GHz indoor cellular modems at a much lower cost. The results of this categorisation are shown in the table below.

Category	Population density (people/ km2)	Technology likely to be most suitable	% of area covered	Population covered
A	> 500	Areas suited mostly to > 1 GHz cellular / WiFi	8.7%	50.10%
B	100 to 500	Areas suited to a mix of < 1 GHz TVWS / cellular technology and > 1GHz cellular / WiFi	32.9%	43.92%
C	18 to 100	Areas suited mostly to < 1GHz TVWS / cellular technology	19.5%	5.59%
D	5 to 18	Areas suited to a mix of < 1GHz TVWS / cellular technology and satellite	6.2%	0.37%
E	0 to 5	Mostly suitable for satellite	32.7%	0.01%

TABLE 43: MATCHING TECHNOLOGY TO POPULATION DENSITY IN UGANDA

This categorisation shows the following:

- 50% of the population living in 8.7% of the land mass are suited to > 1 GHz cellular or WiFi with a population density that is > 500 ppl/km2. These areas are shown in red in Figure 15 and are high population density urban areas.
- 44% of the population living in 32.9% of the land mass are suited to a mix of < 1 GHz TVWS or cellular technology and > 1 GHz cellular or WiFi with a population density between 100 and 500 ppl/km2. These areas are shown in orange in Figure 14 and are typically located in higher density rural areas near the outskirts of towns and cities.
- 5.6% of the population living in 19.5% of the land mass are in a < 1 GHz TVWS or cellular technology sweet spot with a population density between 18 and 100 ppl/km2. These areas are shown in yellow in Figure 20 and are in medium density rural areas, small rural towns and on the distant outskirts of major towns and cities.
- 0.37% of the population living in 6.2% of the land mass are suited to a mix of < 1 GHz TVWS or cellular technology and satellite with a population density between 5 and 18 ppl/km2. These areas are shown in green in Figure 20 and are mostly located in low population density rural areas.
- 0.01% of the population living in 32.7% of the land mass are suited to satellite technology with a population density < 5 ppl/km2. These are very remote areas shown in grey in Figure 20.

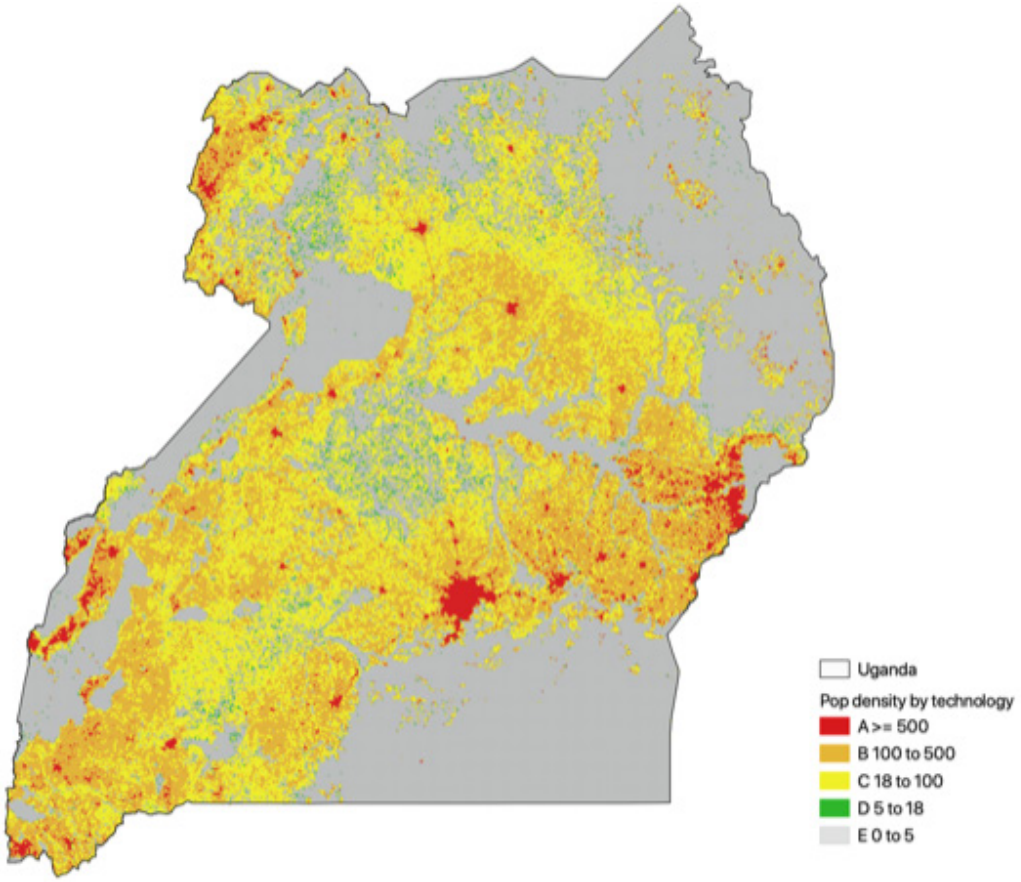


FIGURE 20: MATCHING POPULATION DENSITY TO TECHNOLOGY ZONE A[131]

131 - >500 people / km2, Zone B: 100 to 500 people / km2, Zone C: 18 to 100 people / km2, Zone D: 5 to 18 people / km2, Zone E: 0 to 5 people / km2

8.6.2 Current TVWS Regulation

Uganda published a finalised Standard for TVWS in November 2019, allowing the usage of some of the TV spectrum for communications by white space devices (WSDs). The standard allows access to spectrum from 470 MHz to 694 MHz. The standard requires a geolocation spectrum database to control the availability of channels to WSDs requiring access to spectrum. To date, a geolocation database provider has not been appointed, and there are no operating TVWS networks in Uganda. Uganda shut off analogue television broadcast signals in 2015 and transitioned to digital television.

South Africa is the only country in Africa that has commercially operating TVWS networks making use of a geolocation spectrum database. There are some notable differences between South Africa and Uganda's TVWS regulatory frameworks. South Africa provides different power levels for urban and rural regions, and the operational parameters provided by the geolocation database in South Africa are six, including the geographic area in which the parameters are valid compared to the simpler set of four parameters used in Uganda.

There has been very slow uptake of TVWS across the region, and the differences in TVWS regulatory frameworks for different African countries may delay deployments as each database supplier and manufacturer will need to customise their systems to these different standards – including customisation for Uganda.

Recommendations: The following is suggested to accelerate the uptake of TVWS in Uganda:

- Work with the Communications Regulators 'Association of Southern Africa (CRASA) to create a harmonised TVWS standard across the region to avoid customisation for each African country, and
- For the first phase of deployment of TVWS, reserve a portion of nationally unused TV spectrum for TVWS that can be used by TVWS equipment on a license-exempt basis.

8.6.3 License-Exempt Spectrum

License-exempt spectrum is critical for providing broadband FWA or wireless hotspots for WISPs, community networks and other smaller players as licensed spectrum mostly requires large upfront capital costs to purchase spectrum licenses. There are a few exceptions where WISPs use licensed spectrum to build more reliable point-to-point links. All license-exempt spectrum currently available in Uganda is > 1 GHz, and the technology requires line-of-site links. This can be a problem in areas with lots of dense vegetation or in hilly areas – this problem can be overcome with repeaters or using the TVWS technology discussed in the previous section.

8.7. CURRENT STANDARDS

Most of the license-exempt spectrum uses WiFi technology. Some of the manufactures allow you to switch to a proprietary protocol, such as Ubiquity's Airmax protocol, which is generally not compatible with other equipment running standard WiFi protocols. These propriety protocols generally improve the capacity and performance with many simultaneous users but still have to obey the general rules of license-exempt bands, such as 'listen before talk', 'detect and avoid' and maximum power spectral density. A new generational WiFi naming convention was started in 2018 by the WiFi Alliance. The goal is to allow consumers to easily recognise the type of WiFi capability found in their devices and network connections, much as the cellular market makes use of 3G, 4G and 5G.

The current WiFi generations and standards are as shown in the table below.

TABLE 44: ORIGINAL AND NEW NAMES FOR WIFI TECHNOLOGIES

New naming convention	Original naming convention (using IEEE in the prefix)
WiFi 4	802.11a, 802.11b, 802.11g, 802.11n
WiFi 5	802.11h, 802.11i, 802.11-2007, 802.11-2012, 802.11ac
WiFi 6	802.11ad, 802.11af, 802.11-2016, 802.11ah, 802.11ai, 802.11aj, 802.11aq, 802.11ax, 802.11ay.

8.7.1 Band 2.4 GHz (2400-2483.5 MHz)

This is the genesis band for building license-exempt fixed wireless links. Original fixed wireless links using IEEE 802.11b and 802.11g radios were using this band from the early 2000s. There was very little spectral interference from other devices using this band in the early to mid-2000s, but as more devices started using the 2.4 GHz band, and more fixed wireless links were set up, interference for broadband fixed wireless access (BFWA) started becoming a problem. New IEEE 802.11 standards that used the 5 GHz band were being launched from the mid-2000s onwards, and many WISPs started migrating their equipment into the 5 GHz bands. This band is still the most common frequency for access to end-user devices (laptops, mobile phones and tablets) from hot spots as many legacy devices are still in circulation, and some new devices still only support single-band 2.4 GHz WiFi access. For BFWA, there are still a few links using 2.4 GHz in small towns or rural areas, where there is little interference. In urban areas, 2.4 GHz is mostly unusable for outdoor links due to interference.

8.7.2 Band 5 GHz (5150-5855 MHz)

Although 802.11a equipment was available in the 5 GHz band from the early 2000s, it was only with the launch of 802.11n that 5 GHz band started being for BFWA applications from the late 2000s. The 5 GHz band provides 380 MHz of outdoor spectrum and 200 MHz of indoor spectrum compared to only 83 MHz of spectrum in the 2.4 GHz band. The band also allows much wider channels widths (up to 160 MHz) and hence much higher capacity links compared to the 2.4 GHz band, with maximum allowed channel widths of 20 MHz. In the 5.250-5.350 GHz band, devices must employ dynamic frequency selection (DFS) and transmit power control (TPC) capabilities. This is to avoid interference with weather radar and military applications and may result in this portion of the band not always being available. This 5 GHz band is now the de-facto band of choice for BFWA as well as other outdoor applications, such as IP cameras. For point-to-point links, very high-gain antennas, up to 30 dBi with narrow 5-degree beams and line-of-sight ranges up to 50 km, are possible in this band.

8.7.3 Band 6 GHz (5925-7125 MHz)

The FCC in the US opened up the entire 6 GHz band from 5925 to 7125 MHz for WiFi and other license-exempt use in April, 2020.[132] The European Commission approved regulations that will allow the deployment of WiFi in the lower 6 GHz band from 5925

132 - https://www.fcc.gov/document/fcc-opens-6-ghz-band-wi-fi-and-other-unlicensed-uses-0

to 6425 MHz in June 2021.[133] The African Telecommunications Union's emerging technologies task group suggested in July 2021 that the lower 6 GHz band from 5925 to 6425 MHz be made available for unlicensed use on a non-exclusive, non- interference and non-protected basis.[134] In Region 1, the upper 6 GHz band from 6425 to 7025 MHz is being considered for IMT at WRC-23. However, there are notable exceptions to the upper block of the 6 GHz band being used for IMT in Region 1. In March 2021, Saudi Arabia released the full lower and upper blocks of 6 GHz for WiFi.[135]

Unlicensed devices will share this band with licensed services that mostly use this band for terrestrial point-to-point microwave links. The devices will make use of an automated frequency coordination (AFS) system to avoid interference with primary users, but this will only be required for outdoor devices. AFS is in its essence a database lookup scheme that will allow 6 GHz WiFi devices to use AFC-protected bands in the event that a primary user is not found in the particular area. Fortunately, 6 GHz primary users are fixed and change rarely. This more than doubles the amount of spectrum available for WiFi, and the IEEE has decided that the band will exclusively be used by WiFi 6 generation protocols, such as IEEE 802.11ax and IEEE 802.11ad. WiFi performance will increase by an order of magnitude in the 6 GHz band due to the availability of much wider channel widths, improved interference management and legacy WiFi not being allowed in the new 6 GHz band. IEEE 802.11ax-based devices are already available commercially.

The current use of the band is for fixed point-to-point links (5925-7110 MHz) and fixed satellite links Earth-to-space (5925-7075 MHz) and space-to-Earth (6700-7075 MHz). The band will provide a massive increase in capacity for BFWA due to an additional 500 MHz to 1.2 GHz of spectrum. The AFS database can be used to protect primary satellite users, PTP licensed users, and license- exempt users that could access any remaining spectrum in a specific area.

8.7.4 Band 17 GHz (17.1-17.3 GHz)

This spectrum is often used for wireless access systems (WAS) and radio local access networks (RLANs). The maximum power allowed is 100 mW (20 dBm) EIRP. The band is shared with spectrum used for satellite communication for Earth exploration and space research. The band is not mentioned as having any specific allocation in Uganda but could be made available for license-exempt point-to-point links for BFWA. There is some equipment available in this band, such as SIAE ALFO plus 17 GHz Link, 100 Mbps (upgradeable to 500 Mbps).[136]

8.7.5 Band 24 GHz (24.0-24.25 GHz)

This is classified as an ISM (industrial, scientific, medical) license-exempt band. The band is shared with spectrum used for amateur satellite communication and amateur radio, and the maximum allowed power is 100 mW EIRP. The band is not mentioned as having any specific allocation in Uganda but could be used for license-exempt point-to-point links for BFWA. There is equipment available that can create high-capacity point-to-point links, such as Ubiquiti AirFiber 24 AF-24/AF-24HD (1.5 Gbps to 2 Gbps).[137]

8.7.6 V-Band 60 GHz (57-66 GHz)

60 GHz WiFi, also known as WiGig, refers to a collective set of wireless network protocols in the 60 GHz band. The band covers the frequencies from 57 to 71 GHz. This includes the current IEEE 802.11ad standard and upcoming IEEE 802.11ay standard. The

133 - https://www.eetimes.eu/eu-boosts-6ghz-spectrum-for-wi-fi-use/
134 - https://www.icasa.org.za/uploads/files/GH_Communnication-ATU-R-Recom.pdf
135 - https://wifinowglobal.com/newsletter/saudi-arabia-releases-full-6-ghz-band-to-wi-fi-and-takes-global-lead-in-mid-band-unlicensed-spectrum/
136 - https://www.miro.co.za/product/siae-17ghz-100mb-fd-link-2-x-terminal-equipment-including-poe-connector-grounding-kit- no-antenna/
137 - https://www.miro.co.za/product/ubiquiti-airfiber-24ghz-1-4gbps-gps-sync-point-to-point-radio-poe-incl/

standard is typically designed for indoor wireless LAN cable replacement applications to deliver multi-gigabit speeds up to 7 Gbps (802.11ad). Indoor devices will typically be tri-band and operate in the 2.4 GHz, 5 GHz and 60 GHz bands. The IEEE 802.11ay will allow transmission rates of 20-40 Gbps with ranges of up to 300–500 metres. Region 1 allow frequencies from 57.24 GHz to 65.88 GHz. The 802.11ad standard can be used for outdoor point- to-point links up to 2 km, but this band can be affected by rain. There is some high-capacity equipment available that can offer up to 1 Gbps links, such as Siklu EtherHaul 600TL[138] and IgniteNet.[139] The band is not mentioned as having any specific allocation in Uganda but could be very beneficial for short-range, license-exempt high-capacity links.

8.8. ECONOMIC ARGUMENTS

Building an economic argument for license-exempt spectrum for the future of the internet has been well studied by Thanki[140]. Although this was done for WiFi, it is equally true for new license-exempt shared access technologies such as CBRS, TVWS and 6 GHz WiFi. In 2012, Thanki estimated the global economic value of WiFi to be between USD 52 and 99 billion per annum based on the yearly benefit gained from using WiFi. With the release of 6 GHz WiFi in 2020, this global economic value will increase significantly. Thanki also pointed out at the time in 2012 that 69% of the total internet traffic was being carried on WiFi on smartphones and tablets, and in the absence of WiFi, 150,000 to 450,000 new cellular base stations would need to be built to cope with smartphone traffic. This saved mobile operators an investment of between USD 30 and 93 billion per year. In South Africa, the amount of traffic offloaded to WiFi was 49% in 2020. Worldwide, the amount of internet traffic carried by WiFi was 79% in 2020.

License-exempt spectrum being used for WiFi and license-exempt shared access schemes such as TVWS **and 6 GHz WiFi will help WISPs continue to grow their market share and will play an important part in the mix of access solutions in Uganda.** WiFi operators in Uganda, such as CSquared, which have city-wide wholesale last-mile WiFi FWA solutions, and Zoom Wireless, which launched WiFi internet services for business and residential customers in 2014 in parts of northern Uganda at approximately 50% of the rates of its competitors with no usage caps, are examples of operators that could use additional license-exempt spectrum.

A more recent study[141] of 6 GHz in Brazil showed that unlicensed access in the 6GHz band could add USD 165.5 billion to Brazil's economy. The study, titled 'Assessing the economic value of unlicensed use in the 6 GHz band in Brazil', was published by the Dynamic Spectrum Alliance[142] and T elecom Advisory Services LLC and conducted by leading scholars of economics and telecommunications policy. The study looked at the impact on service quality, coverage and affordability as well as the impact on different applications and use cases. The methodology relied upon in this study identified the different sources of economic value, estimated them independently and then aggregated them within a single value. Its findings revealed a significant early economic impact following the allocation of 1,200 MHz in the 6 GHz band for unlicensed use. The cumulative economic value between 2020 and 2030 associated with enabling license-exempt access to the 1200 MHz in the 6 GHz band amounts to USD 112.14 billion in GDP contribution, USD 30.03 billion in producer surplus to Brazilian enterprises and USD 21.19 billion in consumer surplus to the Brazilian population. The total contribution amounts to USD 163.5 billion to the Brazilian economy over the next 10 years.

138 - https://www.miro.co.za/product-category/pc_ma-carrier-wireless/pc_mtg5na-60-ghz-v-band/pc_ndyzna-siklu-v-band/
139 - https://www.miro.co.za/product/ignitenet-metrolinq-60ghz-radio-1gbps/
140 - https://www.microsoft.com/en-us/research/uploads/prod/2016/02/spectrum-economic-significance-of-license-exempt-spectrum-report_thanki.pdf
141 - http://dynamicspectrumalliance.org/wp-content/uploads/2020/11/1-DSA-Valor-Economico-Uso-Nao-Licencia-do-6-GHz- Brasil-1.pdf
142 - http://dynamicspectrumalliance.org/

8.9. COMMUNITY NETWORKS |

While they remain small in size and geography, there are now a growing number of community networks or social-purpose operators that show promise for connecting communities where traditional operators do not cost-effectively provide coverage or affordable access. Community networks operate on the following core principles:

- Collective ownership: network infrastructure managed as a common resource;
- Social management: network infrastructure is operated by community members;
- Open design: the network implementation and management details are public;
- Open participation: anyone can extend the network if they follow the network principles; and
- The promotion and development of local content in local languages.

Community networks[143] can be operationalised, wholly or partly, through individuals and local stakeholders, NGOs, private sector entities or public administrations. They are mostly structured as a cooperative, where any surplus is reinvested in the network or pays dividends to cooperative members. Some markets, such as that of the United States, have a deep history of community networks going back to the early days of electrification and telephony. In the United States, these network operators – still numbering close to 1,000 – grew up in rural agricultural communities and adopted a cooperative business model leveraging existing farmers 'cooperatives. The US National Telecommunications Cooperative Association still has 850 independent, community-based telecommunications company members leading innovation in rural and small-town America.

While community networks are well known in some markets, such as the United States, one of the main barriers to the adoption of an enabling regulatory framework for community networks or social-purpose operators is that few people know they exist. This applies not only to the rural communities that are most likely to benefit but also to policymakers, regulators and development organisations. Lack of awareness is compounded by the view that access markets can be sufficiently well served only by a handful of large-scale national mobile and fixed network operators competing to provide services of sufficient coverage and quality and at an affordable price. The experience of the United States has shown the opposite to be the case – some of these rural markets can only be served by non-profit community-based network operators.

There is an increasing body of evidence, as shown in the 43-country Community Networks report by GisWatch (APC and IDRC, 2018), that support for expanding the telecommunications operator ecosystem to include community networks and embedding this in national broadband plans could help provide affordable access to more vulnerable communities. Two successful recent cases of community networks – one providing fixed connectivity and the other providing mobile connectivity – are highlighted below.

Spain's Guifi.net, which received the European Broadband Award for the best innovative model of financing, business and investment in 2015, supports thousands of individual participants and 26 local for-profit and non-profit operators sharing infrastructure in common with a fibre and wireless backbone and multihoming internet links with WiFi and fibre to the home (FTTH) fixed broadband connectivity. The nodes of the network are contributed by individuals, companies and administrations that freely connect to an open network of telecommunications and extend the network wherever the infrastructure and content might not otherwise be accessible. Guifi.net allows for a wide set of different business models to exist around an infrastructure commons, and this flexibility has been the secret of its success. As of June 2021, Guifi.net had 36,881 active nodes and 70,135 km of wireless links.[144]

Community Cellular Networks in Oaxaca, Mexico, nominated for a World Summit on the Information Society (WSIS) award in 2019, is an example of a community-based mobile network. In 2013, because of the joint efforts between Rhizomatica, REDES A.C. and those in charge of a community radio station in a small village called Talea de Castro in the state of Oaxaca, it was possible to create an indigenous mobile telecommunications network completely operated, owned and managed by the community itself. The community decides who is responsible for managing the network, how it will operate and even how much service costs. Currently, the service is licensed through a cooperative called Telecomunicaciones Indígenas Comunitarias A.C. (TIC A.C.), comprised of 14 operating communities which cover 63 localities. TIC A.C. also has an operational team that accompanies individuals and communities seeking to build, manage and operate their own communication networks.

143 - See APC and IDRC (2018).
144 - https://guifi.net/en

As of July 2020, Community Cellular Networks has provided daily service to more than 3,500 people despite some of the harshest conditions for building communications networks in Mexico. In 2021, Community Cellular Networks, which has been allocated 10 MHz in the 850 MHz band, won a court case that exempts it from paying spectrum fees. In addition, the government regulations provide low-cost satellite capacity to local operators, such as those that are part of TIC A.C. Rhizomatica now functions as a local and international organisation to support communities that want to build and maintain self-governed and self-owned telecommunication infrastructure. They are involved in policy and regulatory advocacy, open-source technology development for GSM networks and capacity building.

In Kenya, the Communications Authority of Kenya (CA) formulated a Licensing and Shared Spectrum Framework for Community Networks in November 2021. The license application fee is Ksh1000 ($8.90), with an annual renewal fee of KSh5000 ($44.40). The license is valid for 10 years. The community network will be limited to a sub-county. This is considered affordable compared to the lowest fee in the network facilities provider license, where an initial license fee is Sh200,000 ($1777.80).

There are opportunities for UCC[145] to support new or existing community-based operators with funding from universal service funds and by creating additional licensed and license- exempt spectrum. Local government can also leverage funding used to connect local government anchor facilities to also provide affordable backhaul for community-based operators. Additional license- exempt spectrum opportunities have been discussed in this section, and social-purpose IMT spectrum licenses could also be created – following the Mexican model. An example of a community-based non- profit organisation in Uganda is Battery Operated System for Community Outreach (BOSCO), which supports 48 ICT and development centres with over 60,000 beneficiaries in the Northern and West Nile regions in Uganda.[146] This organisation could make use of additional spectrum and funding to provide connectivity to surrounding communities.

In Kenya, the Communications Authority of Kenya (CA) formulated a Licensing and Shared Spectrum Framework for Community Networks in November 2021. The license application fee is Ksh1000 ($8.90), with an annual renewal fee of KSh5000 ($44.40).

145 - Uganda has a category for communal networks in its licensing scheme, available to non-profits. https://www.ucc.co.ug/wp-content/uploads/2020/05/COMMUNAL-ACCESS-PROVIDER-LICENSE-25-05-2020.pdf

146 - https://www.apc.org/en/users/bosco-uganda

Community-based operators currently need to apply for a Communal Access Provider license to operate. This license involves a $2500 application fee, a $3000 annual fee and 2% of annual revenue with many coverage and QoS requirements. This would preclude most community-based operators from starting a small-scale community network in an under-serviced area of Uganda. Kenya have solved this problem and recently adopted a community network licensing framework with affordable license fees[147] A sub- county community license application fee is Ksh1000 ($8.85), and the annual renewal fee is Ksh5000 ($44.20). The license is valid for 10 years. Subsidies from universal service funds can also be used to support community network operators to provide required infrastructure, such as backhaul or towers.

Should Uganda follow a Kenyan community network licensing model or license waivers, employ subsidies from universal service funds and provide sufficient license-exempt or shared spectrum for community network operators, their probability of success will be greatly improved.

8.10. LOW EARTH ORBIT PLATFORMS AND HIGH-ALTITUDE PLATFORM SYSTEMS

Connecting very remote areas with population densities less than 100 people per km2 is often best suited to satellite technology as terrestrial connectivity is not cost effective. These areas make up 25.7% of the land mass of Uganda and 5.96% of the population. Traditionally, geo-stationary satellite technology, such as VSAT, was used in very remote areas, but there are many new emerging higher-capacity and lower-latency space-based technologies that the Ugandan regulator can look at for these regions for direct connectivity to consumers and IoT devices as well as backhaul connectivity to last-mile mobile and fixed wireless networks.

LEO satellite systems that have launched or are in the process of being launched include OneWeb, SpaceX, Kuiper and Telesat. High-altitude platform systems (HAPS) providers, such as HAPSMobile, have conducted their first test flights. There are already allocated ITU frequency assignments in the Ku and Ka bands for these space-based platforms that will need to be ratified should UCC license one of these platforms for operation in Uganda.

The ITU is also discussing the co-use of IMT bands used for both terrestrial cellular technology and space-based cellular (see Resolution 212 from WRC-19).[148] In this resolution, it is agreed that the co-coverage and co-frequency deployment of the terrestrial and satellite components of IMT could be feasible if deployed as an integrated network supported by a system providing the management of frequency utilisation by both components. Hence it would be possible for a cellular operator in Uganda to make use of a space-based platform offering IMT services to reach more remote regions if they coordinate their frequency use and coverage with the space-based platform.

Low-income users in remote regions will likely not be able to afford purchasing LEO or HAPS units for home or business connectivity. It is more likely that these systems will be used for backhaul to a fixed wireless network, such as a community network or small WISP operating in a rural region which can aggregate demand from users.

147 - https://www.apc.org/en/news/kenya-adopts-community-networks-licensing-framework
148 - https://www.itu.int/dms_pub/itu-r/oth/0C/0A/R0C0A00000F0068PDFE.pdf

8.11. RECOMMENDATIONS

Following are some recommended actions to support alternative broadband access and spectrum models in Uganda that can increase the level broadband consumer choices:

- Releasing additional license-exempt spectrum in the 6 GHz, 17 GHz, 24 GHz and 60 GHz bands will provide opportunities to build high-capacity fixed wireless links in poorly connected regions for traditional operators and community network operators.
- Creating a social-purpose IMT spectrum license to support community-operated cellular networks, such as allocating only 5 MHz in any of the 800 MHz, 2600 Hz or 3500 MHz bands, could allow a community-based operator to deploy low-cost small cell technologies in poorly connected rural villages.
- License LEO technology to provide backhaul for small wireless operators and community networks in poorly serviced regions.
- Explore HAPS technology to provide IMT services in remote regions.

The overall aim of the recommendations below is to ensure that Uganda's spectrum is used to provide affordable access for its citizens and enable a competitive marketplace in the telecommunications sector.

Problem	Recommendations
Improving the frequency allocation table	Provide an online version of the frequency allocation table that is constantly kept up to date. Add a typical application section that lists technologies and frequency ranges as well as a notes section that lists paired frequencies and any other important notes. Provide links to published documents related to spectrum band where appropriate. See Section 8.2 for comments on the frequency allocation table and Section 14.5 for detailed comments on the frequency allocation table.
Allocating a healthy spectrum mix	Over the near term, new mid band spectrum in the 3.3 GHz to 4.2 GHz range will be valuable for 4G and 5G networks that balance the need for coverage and capacity, and sub-1 GHz spectrum in new bands, such as 700 MHz, will provide excellent value for uncovered rural areas. TVWS in the 470 to 694 MHz UHF band will also support the needs for coverage in low-density rural areas for alternative access models, such as WISPs and community networks. Providing additional spectrum for WiFi in the 6 GHz band will provide valuable capacity for already- congested WiFi networks and allow offloading from congested mobile networks to WiFi networks. Over the long term, new 5G spectrum in the bands above 7 GHz, such as the 28 GHz band, will provide the high capacity required in high-density urban areas. The 60 GHz license- exempt bands can also serve as fibre replacement to create high-capacity links in areas with high population density.

Problem	Recommendations
Guiding principles for licensing spectrum	Based on lessons learned from auctions in African countries and around the world and Uganda's 'Framework for Spectrum Assignment to Telecommunications Services in Uganda', the following guiding principles are made: • First, check the industry purpose/use of the spectrum and the requirement for exclusive or shared access. Check the amount of spectrum required vs demand and the market structure envisaged. • In the case where demand for the spectrum is high, and there is clear need for exclusive access to the spectrum, follow the spectrum auction principles outlined below; otherwise, explore other models such as shared spectrum, license-exempt spectrum or a beauty contest. a. The top priority for spectrum auctions should be to support affordable, high-quality mobile services; b. Auctions designed to maximise state revenues risk serious harm to consumers; c. Spectrum caps and set-asides can distort the level playing field or could ensure more competition in the market – they need to be designed well; d. License obligations and conditions should be carefully designed to incentivise expansion in poorly serviced areas while at the same time minimising the cost of covering poorly serviced areas; e. Poorly chosen lot sizes or inflexible packages of spectrum lots risk inefficient outcomes.
Adding additional alternative access options in Uganda to improve choices for consumers	Release additional license-exempt spectrum in the 6 GHz, 17 GHz, 24 GHz and 60 GHz bands to provide opportunities to build high-capacity fixed wireless links in poorly connected regions for traditional operators and community network operators. This should be coupled with subsidies from universal service funds for infrastructure such as backhaul and towers and affordable license fees for community network operators (use Kenya's community network licensing model as a reference) or license waivers. Create a social purpose IMT spectrum license to support community-operated cellular networks; for example, allocating only 5 MHz in any of the 800 MHz, 2600 Hz or 3500 MHz bands could allow a community-based operator to deploy low-cost small cell technologies in poorly connected rural villages. License LEO technology to provide backhaul for small wireless operators and community networks in poorly serviced regions. Explore HAPS technology to provide IMT services in remote regions.

TABLE 45: SUMMARY RECOMMENDATIONS

09

BROADBAND BLUEPRINT

The Broadband Blueprint is a set of action points that needs to be implemented to extend broadband access and use to all Ugandans. It briefly outlines the methodology, the tools for the project and the recommendations of the study. Each chapter gives substantial detail on each component of the Blueprint and should be referred to for more information. The broadband value chain is the conceptual model that links the components together. The main outputs of the Blueprint are in the connectivity and ecosystem segments (Figure 7).

The UBP provides users with a single window to assess the current status of broadband access. A range of data was collected from different stakeholders, particularly from UCC and NITA. Even though collecting accurate and timely data was very difficult, the benefit of the portal is that it can relatively easily be updated. As a result, a new and updated assessment of the current status of broadband access can quickly be produced. This is a much-needed step forward for Uganda because updated data analytics has been a perpetual challenge.

The PESTEL model highlights the challenges facing the sector. Taxation is one issue highlighted by the PESTEL analysis. The policy focus on the ICT sector is not reflected in Uganda's tax regime, which discriminates against the ICT sector through a wide range of excise duties. The result is that the current tax regime directly sabotages any broadband policy. There are other challenges – notably, no RoW regulatory regime, the enforcement of a facilities sharing regime among all sectors and changes to the spectrum planning and licensing regimes, all covered in Chapter 7.

The tools to fix the broadband ecosystem in Uganda are currently available. For the ecosystem, Chapters 3, 6 and 7 describe the steps that need to be taken. The most important steps are highlighted in Table 40. However, expanding mobile broadband coverage is new to MoICT&NG. The primary tool to expand coverage is the UBP, and this report should be read in conjunction with the UBP. Section 9.1 uses data from the UBP to identify areas that need broadband infrastructure. The UBP is a dynamic model because outputs will be automatically updated as new data are collected.

9.1. BROADBAND DEMAND

The econometric analysis of the various ICT surveys and panel data sets did not yield suitable affect sizes to estimate unmet broadband demand. Instead, a geospatial approach was used. The calculations were based on average monthly expenditure and the share of communication expenditure from the UNHS of 2019/20. The average monthly per capita expenditure in Uganda was UGX 73,988 in 2020, and the average communication expenditure share was 3.5%. This means that Ugandans spend on average UGX 2,590 per month on communications. While this figure seems low, keep in mind that per capita includes everyone, not just mobile phone users.

Ugandans spend on average UGX 2,590 per month on communications.

	Monthly per capita expenditure UGX	Com. share %	Monthly per capita com. expenditure UGX	Broadband expenditure share (30%)	People not covered by 4G	Monthly unmet demand for broadband UGX million	USD million
Uganda	73,988	3.5%	2,590	777	12,861,440	7,899	2.1
Central	102,427	4.6%	4,712	1,413	2,046,079	2,892	0.8
Eastern	56,287	2.8%	1,576	473	2,346,703	1,110	0.3
Northern	51,135	2.2%	1,125	337	3,931,702	1,327	0.4
Western	69,951	2.7%	1,889	567	4,536,957	2,571	0.7
Sources	UNHS, 2020			Calculation	GIS estimates	Calculation FX 1USD=UGX 3700	

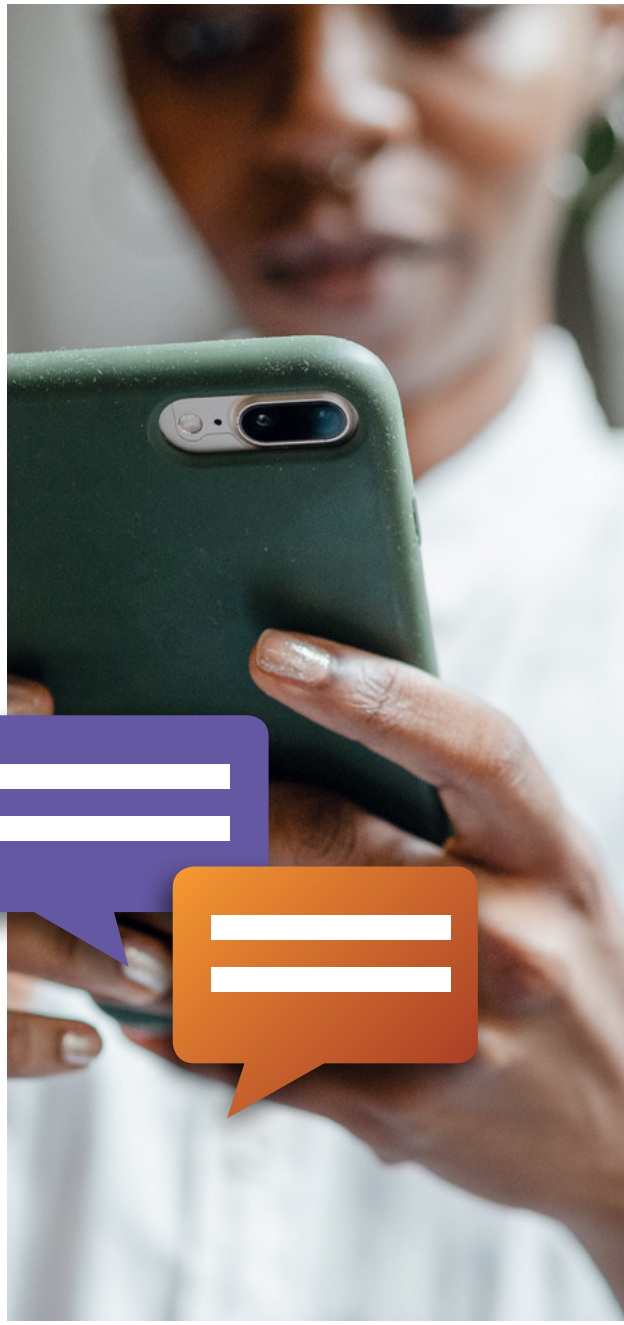
TABLE 46: BROADBAND DEMAND

Uganda's average communication expenditure needs to be allocated to data and non-data expenditure. Uganda is still a 2G mobile country; that is, people mostly use voice and SMS. This report assumes that 30% of the communication expenditure is used for data. This is a conservative estimate given the MTN and Airtel revenue breakdown. MTN's data revenue was 34% of its voice and SMS revenue in the financial year ending in December 2020 (Table 47). Airtel's share of data revenue as a percent of service revenues was 36.4% for the 2020 financial year (Table 48). Based on these inputs, the average broadband expenditure per capita per month is UGX 777 for Uganda.

The UNHS 2019/20 also provides a regional breakdown of per capita expenditure. The highest average broadband expenditure is the central region, with UGX 1,413; the second highest in the Western region, with UGX 567. For the Eastern region, the average expenditure for broadband is UGX 473, and for the Northern region it is UGX 337 per month.

MTN Uganda (ZAR million)	2019	2020
Outgoing voice	3,306	3,901
Incoming voice	336	399
Data	1,035	1,505
Digital	19	24
Fintech	1,662	2,111
SMS	126	160
Devices	61	53
Wholesale	72	62
Other	83	105
Total Revenue	6,700	8,320
Data+ SMS + Voice Revenues	3,768	4,460
Data revenue as share of SMS and voice revenue	27%	34%
Source: MTN investor relations		

TABLE 47: REVENUES OF MTN UGANDA



The data share estimate of 30% is conservative and likely to increase over the next 10 years. While the data share of service revenues is still very low for MTN and Airtel Uganda, this is likely to change, following the trend of other African countries, such as Ghana, Kenya and South Africa as well as global trend towards an all-data business model.

Airtel Uganda (UGX million)	2019	2020
Airtime	579,988	648,864
VAS and Data	418,516	562,521
Mobile money	194,895	261,974
Interconnection	68,516	66,702
Roaming	9,615	3,872
Service revenues	1,271,530	1,543,933
Sales of products	5,208	7,709
Total revenue	1,276,738	1,551,642
Data revenue as % of airtime revenues	72.2%	86.7%
Data revenue as % of service revenues	32.9%	36.4%
Source: Airtel investor relations		

TABLE 48: REVENUES OF AIRTEL UGANDA

9.2. BROADBAND QUALITY OF SERVICE (QOS)

As more services are offered online, the quality of broadband is increasingly important. Better QoS means a better experience and translates into greater time spent online. Download speeds measured by cable.co.uk show that download speeds in Uganda are reasonable.[149] At an average of 5.16 Mbps, Uganda ranked 14th in Africa in 2020 (see also Table 22). The cable.co.uk data show that some of Uganda's broadband speed targets are out of date, especially the National Broadband Policy and the National Strategy on the Fourth Industrial Revolution. Alternatively, other targets, such as the 30 Mbps urban download speed in the ICT Sector Strategic Investment Plan, have not been achieved.

At an average of 5.16 Mbps, Uganda ranked 14th in Africa in 2020

149 - QoS data are collected by the UCC, but the data were not made available to the consultants for this study.

Policy or license	Bandwidth (Mpbs)
National broadband policy	4
ICT Sector Strategic Investment Plan 2014/15–2019/20	
Rural	5
Urban	30
National Strategy on Fourth Industrial Revolution	
100% geographic coverage	4
80% geographic coverage	8
New licenses for national telecommunications operator	
90% geographic coverage	8

TABLE 49: BROADBAND QOS POLICY TARGETS IN UGANDA

There is a wide range of broadband QoS targets internationally. For example, South Africa's target is 80% of the population connected at 100 Mbps by 2030 and 100% of the population connected at 10 Mbps by 2030. At the other end of the scale, South Korea has the world's fastest average internet connection speed of 169 Mbps for mobile connections. Botswana ties spectrum allocation to coverage and download speed obligations. On 800 MHz and 3.5 GHz bands, there is an obligation to provide 30 Mbps and 20 Mbps in the 2.1 GHz and 2.6 GHz bands.

Choosing a single national QoS target could increase the cost of covering non-profitable areas. Instead, the recommendation from Chapter 8 is to support alternative broadband access and spectrum models in Uganda that can increase the level of broadband consumer choices. This means adopting a range of spectrum options, including releasing license-exempt spectrum, releasing social-purpose spectrum and also placing obligations on operators for certain download speeds based on the application or sectors. For example, higher QoS obligations could be required for educational institutions or for business-specific applications. QoS obligations could be excluded for license-exempt operators or social-purpose spectrum allocations in order to reduce the cost as much as possible.

Intervention	Chapter	Horizon
Design QoS requirements based on application/ sector/purpose that take into account the additional costs of higher QoS requirements for non- profitable areas	8	2 years

TABLE 50: QOS INTERVENTION

9.3. EXPANDING BROADBAND COVERAGE

All of the screenshots in this section are from the UBP, and this section should be read in conjunction with the UBP. Interventions can be assessed at the regional, sub-regional, district and sub-county level. As each intervention is implemented, the portal can be updated to show the latest information available from that intervention.

In the connectivity segment, there are two major interventions to expand broadband coverage: subsidising fibre rollout and RAN sites. These two components require a significant amount of money, and so they are spelled out in more detail in the sections below.

Intervention	Action item	Chapter/section	Horizon
RAN sites	10-year investment plan to rollout fibre and RAN sites	9.3	10 years
Fibre			
Spectrum	Design alternative spectrum models to encourage innovation (see e.g. the New Zealand case study)	8.6	Short term: 1–2 years
	Support community networks through tools such as license- exempt spectrum, especially in the 17 GHz, 24 Ghz and 60 GHz bands	8.8 & 8.9	Immediate
	Create a social-purpose IMT spectrum license to support community-operated cellular networks in the 800 MHz, 2600 MHz or 3500 MHz bands	8.11	Short term: 1–2 years
	License LEO technology to provide backhaul for small wireless operators	8.10	Short term: 1–2 years
	Pilot HAPS technology to see if it is a feasible option to provide IMT services in remote regions	8.10	Short term: 1–2 years

TABLE 51: BROADBAND BLUEPRINT: EXPANDING MOBILE BROADBAND COVERAGE

9.3.1

Expanding Mobile Broadband Coverage

A grid approach was used to identify positions for new RAN sites systematically. In order to identify locations for new RAN sites, a 12 x 12-km grid was placed over Uganda. For each 12 x 12-km square, the number of people that are not covered by 4G signal were selected. The centre of these squares are marked as proposed RAN sites. This would safeguard that at least 10,000 people would be covered by 4G signal who were previously not covered. The best position of the RAN site is likely to differ from the one identified by this process when taking elevation, electricity, connectivity and fibre into account. The best location of a RAN site can be discussed with MNOs, and MNOs can propose those during tender processes. The yellow circles outlined in red show the locations of each proposed RAN site.

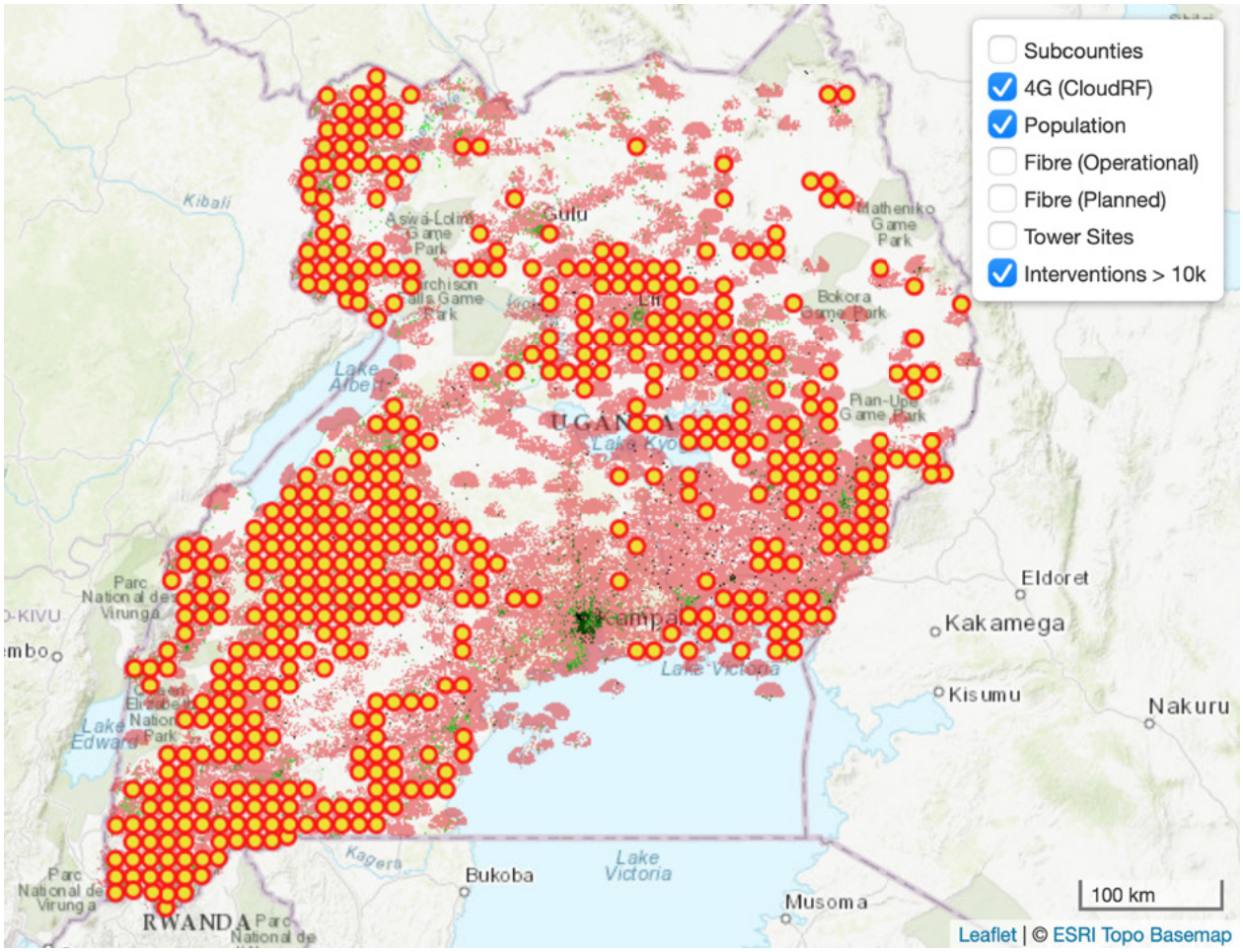


FIGURE 21: NEW PROPOSED RAN SITES [150]

Cost estimates for a new RAN site are based on the tower rental business model. The assumption is that the active equipment costs USD 50,000, with an economic life of five years. The estimates further assumes a tower rent, including electricity, of USD 2,500 per month and an operating expenditure (OPEX) of USD 500 per month.

150 - https://d2srqv2tsfke29.cloudfront.net/9a07beb5cb7be1a7e828f1228baf23ab.html

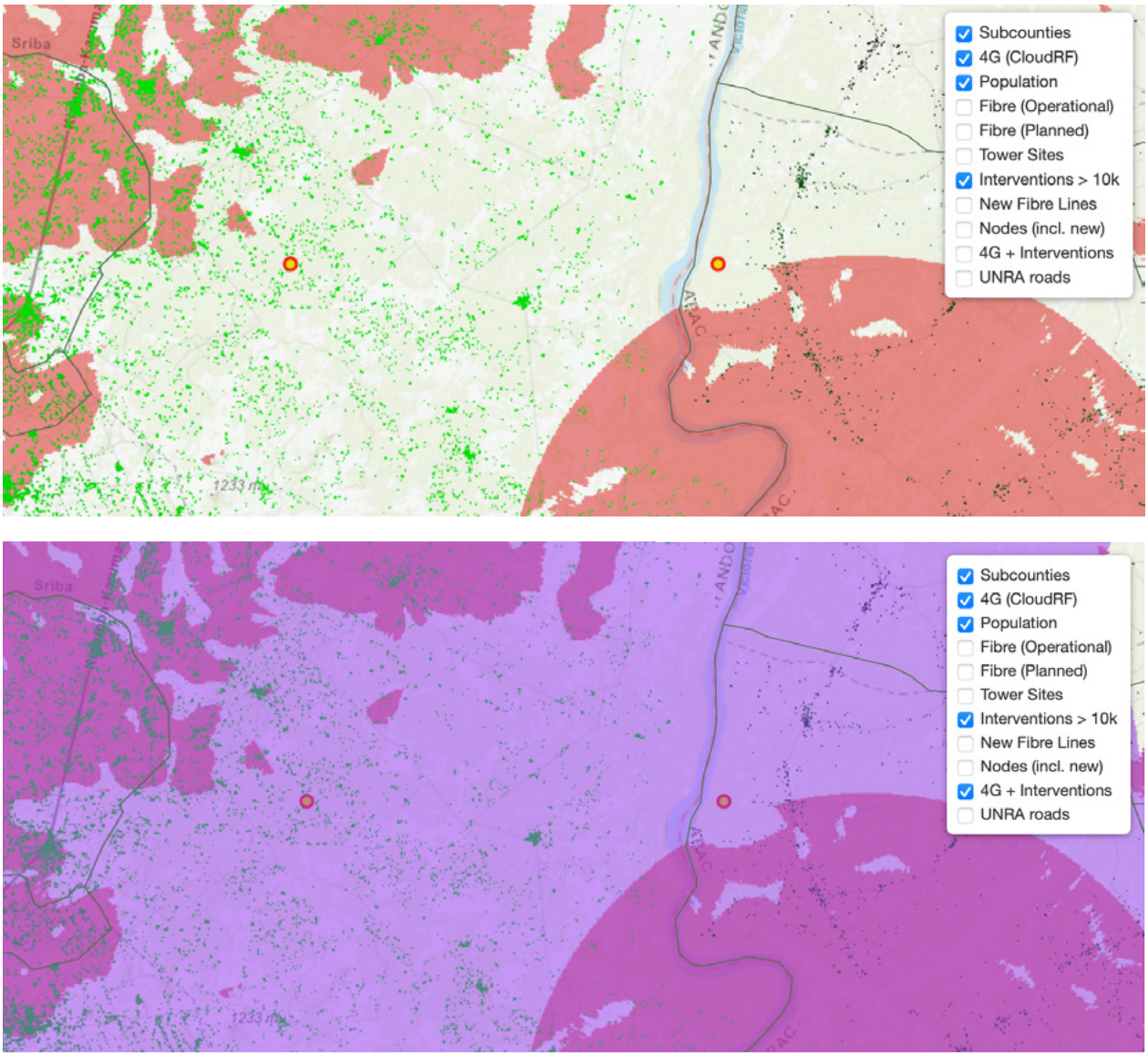


FIGURE 22: EXAMPLE OF A NEW RAN SITE

In terms of environmental considerations, tender specifications for new RAN sites can be a requirement to use renewable energy. This could impact on the subsidy requirement.

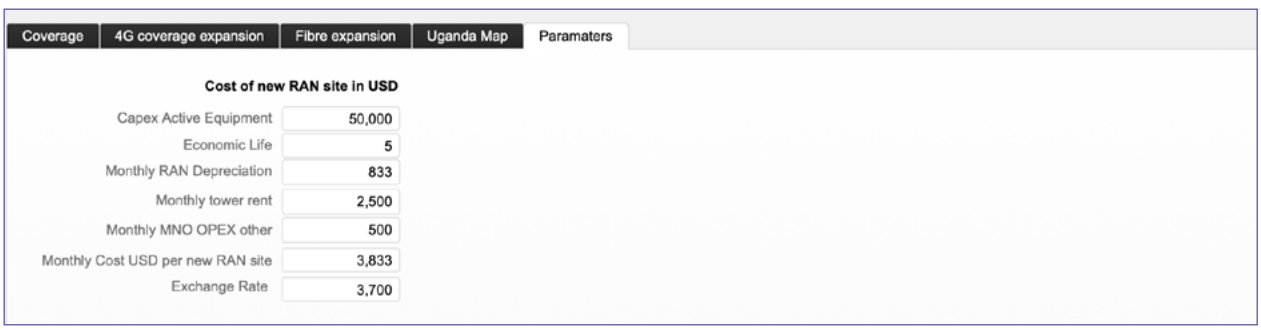


FIGURE 23: COST PARAMETERS FOR NEW RAN SITES

Currently, 12.86 million Ugandans live in areas without 4G coverage. The interventions will provide coverage for nine million. The population covered by 4G signal would increase from 72% to 92% through the intervention. The central region would increase coverage to 92%, the eastern region by 95%, the northern by 84% and the western region by 94%. The northern region is not as well covered after the intervention compared to the others because its population density is lower. The new RAN site locations were selected because they would cover at least 10,000 inhabitants. Figure 22 provides an example of how the new RAN sites would close 4G coverage gaps. The green dots mark population, and the purple is the additional 4G coverage from the new RAN sites.

		Current		Intervention		
		4G population coverage	People not covered by 4G	New RAN sites	People covered by intervention	4G population coverage
Uganda		**72%**	**12,861,440**	**503**	**8,996,013**	**92%**
Regions	**Central**	84%	2,046,079	73	1,085,940	92%
	Eastern	80%	2,346,703	95	1,728,472	95%
	Northern	58%	3,931,702	138	2,390,849	84%
	Western	61%	4,536,957	197	3,790,752	94%
	Buganda North	76%	1,175,882	41	4,431,095	92%
Sub-Regions	**Buganda South**	86%	870,143	32	5,805,345	96%
	Acholi	61%	774,064	16	1,528,023	77%
	Ankole	61%	1,412,949	63	3,557,107	97%
	Bukedi	87%	334,243	14	2,479,221	99%
	Bunyoro	60%	1,156,321	48	2,766,737	96%
	Busoga	85%	702,903	24	4,528,563	97%
	Elgon	81%	446,511	18	2,325,312	100%
	Kampala	100%	53		1,849,606	100%
	Karamoja	40%	762,891	19	1,063,061	83%
	Kigezi	59%	677,592	29	1,641,845	99%
	Lango	59%	1,111,976	50	2,622,200	97%
	Teso	65%	863,045	39	2,356,938	97%
	Tooro	63%	1,290,095	57	3,432,256	99%
	West Nile	63%	1,282,770	53	3,339,123	96%

TABLE 52: 4G ROLLOUT AND IMPACT

Only two sub-regions will have less than 90% 4G population coverage, Acholi with 77% and Karamoja with 83%. Karamoja will have twice the coverage after the intervention, an increase from 40% to 83% 4G population coverage. Coverage in Acholi will have increased from 61% to 77%. Table 51 is a static representation of the impact of the interventions. As the portal is updated, Table 51 will automatically reflect any new data, making the portal a dynamic tool for assessing the sector.

9.3.2 Expanding Fibre Routes to Connect All District Capitals

A NITA-U target is to connect all district capitals to fibre. Figure 24 shows operational fibre in blue and the proposed new fibre lines in purple. Each proposed fibre line follows the existing road network, so the estimated distance is as accurate as possible. Extending fibre access is necessary because high bandwidth applications, especially video, require fibre backhaul to operate effectively. Microwave links can be used, especially in rural areas, but as demand grows, they will be increasingly congested and thus not a long-term solution to high-density population areas. Fibre is also generally more reliable than microwave in inclement weather. Access to fibre backhaul is commonly used as a metric to measure progress towards a digital economy. Section 4.2.2 analyses the current status in terms of access to fibre and shows that Uganda lags behind Kenya significantly. In order for Uganda to realise its objective of becoming a regional node connecting East Africa, it needs to expand its fibre network.

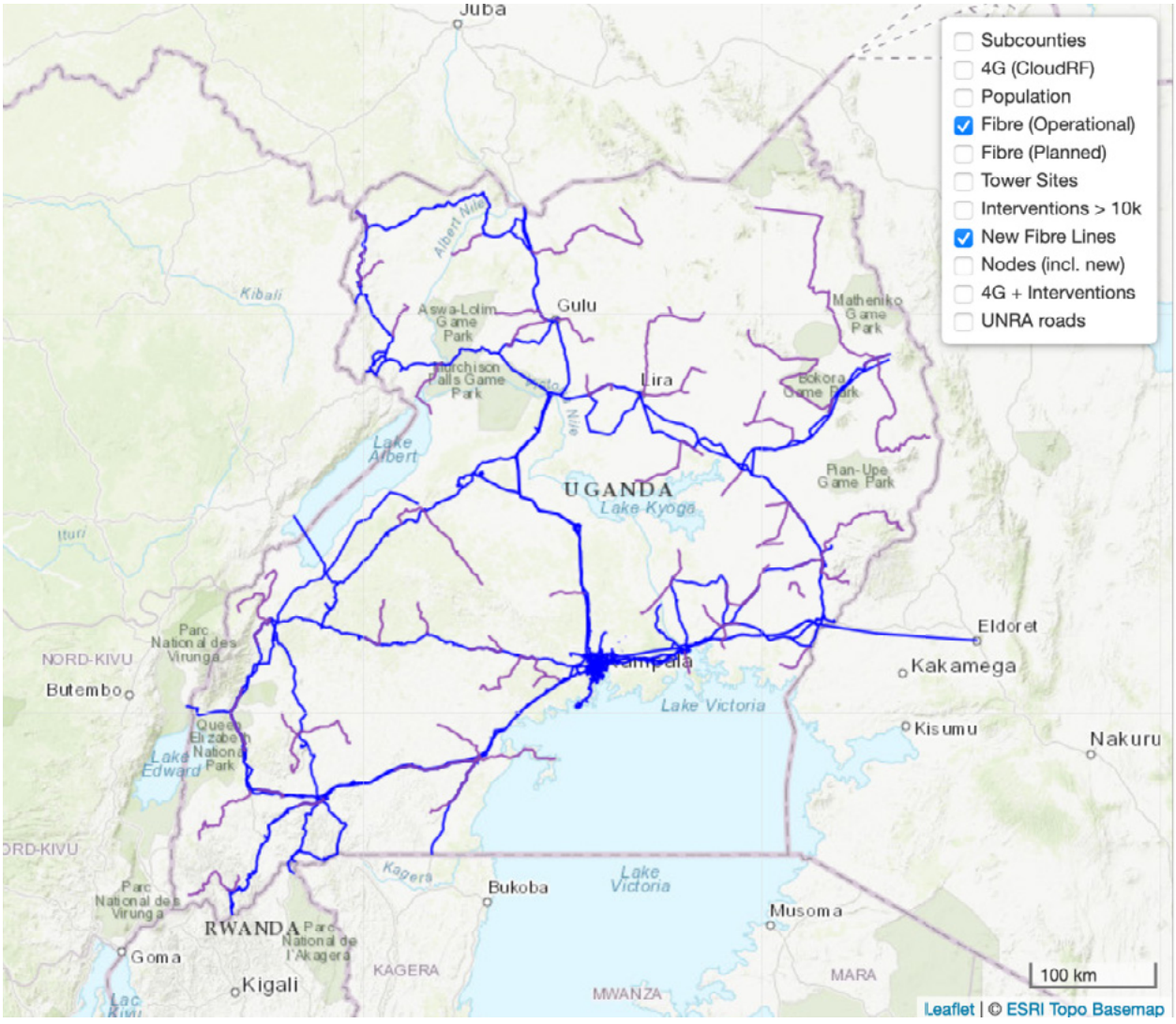


FIGURE 24: EXISTING AND PLANNED FIBRE [151]

151 https://d2srqv2tsfke29.cloudfront.net/9a07beb5cb7be1a7e828f1228baf23ab.html

Extending fibre access to district capitals also means adding new fibre nodes. These exchange points are places were businesses, government institutions and consumers can connect to the fibre network and get substantially faster, and often cheaper, access to the internet. The green dots in the figures below show where people live. Where there are more than 10,000 people in a 12-km radius of a fibre line, a node has been established.

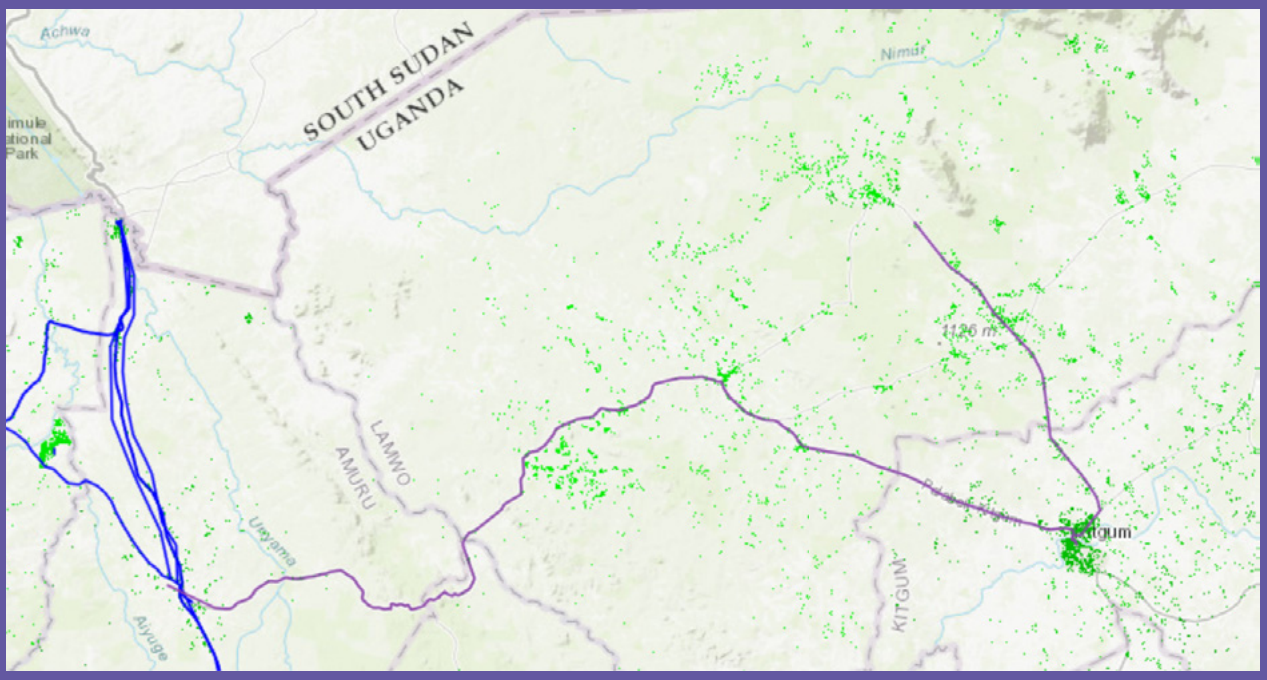


FIGURE 25: EXAMPLE OF FIBRE TO DISTRICT CAPITALS FOLLOWING THE ROAD NETWORK

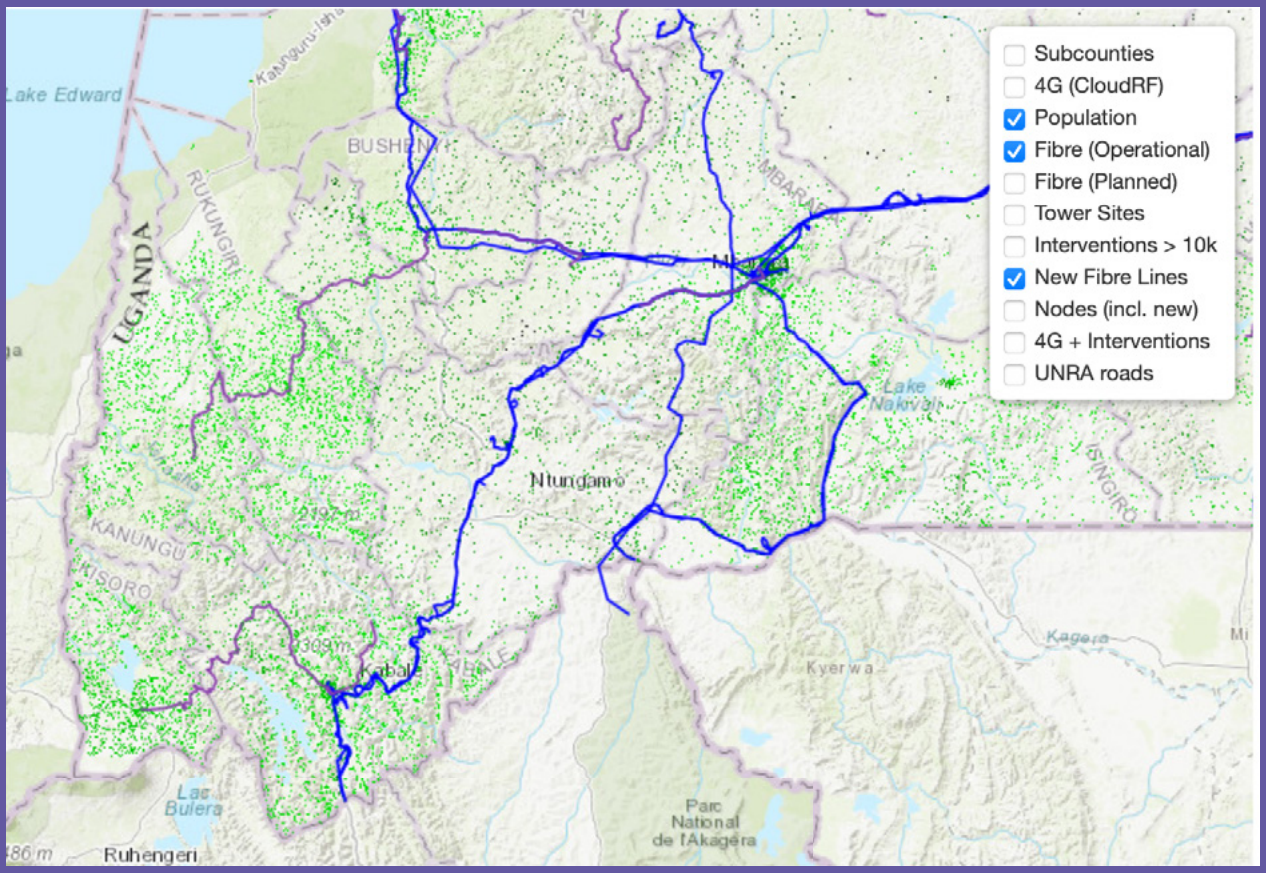


FIGURE 26: SECOND EXAMPLE OF FIBRE CONNECTING TO DISTRICT CAPITALS

The interventions add an additional 3,104 km of fibre, representing an increase of over 16% to the total amount of fibre available in Uganda. Table 52 also compares the current situation in terms of access to fibre to the situation after the interventions. In the western region, for example, the population within 10 km of a fibre node goes from 19% to 45%. All Ugandans would be within 50 km of a fibre node.

Start Point Latitude	Longitude	End Point District	Latitude	Longitude	Fiber link in km	Road access fee UGX per km per year	Road access fee USD per km per year	Road access fee USD year for route	Fibre cost meter	Fibre cost USD
0.6053	33.4709	Mayuge District Head-Qtrs	0.4487	33.4862	21.8	100,000	27	589	8.50	185,215
0.4369	33.2029	Buvuma District Head-Qtrs	0.2732	33.2390	18.6	100,000	27	501	8.50	157,675
0.9501	33.1118	Kayunga District Head-Qtrs	0.7171	32.8951	41.9	100,000	27	1,132	8.50	356,150
0.9508	33.1114	Buyende District Head-Qtrs	1.1571	33.1637	29.2	100,000	27	790	8.50	248,540

FIGURE 27: COST OF RURAL FIBRE ROLLOUT

The cost of the fibre rollout to district capitals consists of a fee for road access per km per year and the cost of fibre installation and civil works per metre. The cost of road access is $26 per km per year. The fee in Uganda shilling is 100,000 per km whether underground or on a pole.[152] The cost for the fibre and the civil works is estimated to be $8.50 per metre. The total cost of the route includes civil works, the fibre cable and one year of road access. Road access fees for subsequent years will be captured by OPEX.

		Current				After Intervention			
		Fibre km	Population within distance to a fibre node			New fibre km	Population within distance to a fibre node		
			10km	25km	50km		10km	25km	50km
Uganda		**19,707**	**29%**	**67%**	**93%**	**3,242**	**56%**	**94%**	**100%**
	Central	7,527	47%	74%	94%	511	63%	96%	100%
	Eastern	2,979	23%	67%	97%	769	65%	97%	100%
Regions	Northern	3,984	24%	59%	81%	1,367	51%	93%	100%
	Western	5,217	19%	64%	98%	596	45%	90%	100%
	Buganda North	2,155	25%	70%	97%	238	42%	93%	100%
Sub-Regions	Buganda South	2,942	48%	70%	91%	273	69%	97%	100%
	Acholi	1,215	19%	34%	58%	350	47%	84%	100%
	Ankole	1,998	23%	80%	99%	263	48%	95%	100%
	Bukedi	573	28%	67%	100%	92	77%	100%	100%
	Bunyoro	1,560	21%	62%	100%	77	32%	84%	100%
	Busoga	1,284	25%	71%	98%	160	50%	95%	100%
	Elgon	238	19%	60%	89%	293	90%	100%	100%

Table Continued ⟶

152 - Statutory Instruments 2017 No. 44. The Uganda National Roads Authority.

		Current				After Intervention			
		Fibre km	Population within distance to a fibre node			New fibre km	Population within distance to a fibre node		
			10km	25km	50km		10km	25km	50km
Sub-Regions	Kampala	2,430	100%	100%	100%		100%	100%	100%
	Karamoja	148	15%	22%	37%	624	67%	94%	100%
	Kigezi	334	10%	38%	92%	121	60%	98%	100%
	Lango	811	22%	66%	96%	261	50%	98%	100%
	Teso	884	17%	67%	98%	224	56%	97%	100%
	Tooro	1,326	18%	62%	100%	135	44%	87%	100%
	West Nile	1,810	32%	81%	100%	133	50%	94%	100%

TABLE 53: IMPACT OF PROPOSED FIBRE INTERVENTIONS

9.3.3

10-Year Investment Plan

There is a two part strategy behind the 10-year investment plan to expand broadband coverage and quality. The first part of the strategy is to invest in fibre first. Fibre is a future-proof technology because high-quality backhaul is a necessary prerequisite for broadband. New technologies such as 5G (and soon 6G) demand significant bandwidth that alternatives cannot supply. Fibre investment has also been constrained by a lack of funds and high costs. Indications are that the cost per metre of fibre in Uganda is more than double the cost of fibre in Namibia. By putting investment into fibre, the objective is to increase the pool of available funds and to improve the economies of scale of laying down fibre and so reduce the cost to a comparable level with best practice countries in Africa. The second part of the strategy is to delay RAN site rollout because there are many RAN sites that are commercially viable. The private sector is far more nimble and flexible than the public sector in terms of mobilising funds, and in the time it would take to subsidise RAN sites, many of these areas might already be covered. By funding RAN sites only in year 6 of the investment plan, many (and hopefully most) commercially viable RAN sites would be covered. Also, funding RAN sites at a later stage means that several of the recommendations of this report can be implemented: the data can be shared publicly, especially with MNOs, and public consultations with the private sector can occur where the regulator is putting data into the public domain for discussion. The regulator can point out where they believe RAN sites are commercially viable, and these locations can be investigated; if necessary, pilots can be run to test the model's assumptions. All of these new data can be fed back into the model to create more accurate data projections for the future. This approach means that it is probable that the required subsidy would be lower than projected because fewer RAN sites need to be subsidised, and this money can be used to test out alternative infrastructure funding models. Table 53 shows how the money would be split per year. The money is evenly split for the first five years based on available funding. This approach could easily change depending on the funding available.

	RAN Sites	National Fibre	Total USD
Year 1		5,277,123	5,277,123
Year 2		5,277,123	5,277,123
Year 3		5,277,123	5,277,123
Year 4		5,277,123	5,277,123
Year 5		5,277,123	5,277,123
Year 6	8,103,943		8,103,943
Year 7	8,103,943		8,103,943
Year 8	8,103,943		8,103,943
Year 9	8,103,943		8,103,943
Year 10	8,103,943		8,103,943

TABLE 54: 10-YEAR INVESTMENT PLAN

9.3.4

Economic Impact of the 10-Year Investment Plan

The impact of the fibre investment is difficult to assess since there are no affect sizes for GDP growth and job creation or for the impact of better QoS. However, for broadband penetration, the economic growth can be projected.

	4G population coverage	Mobile broadband SIM per 100 inhabitants
Current	72%	32.4%
Through intervention	92%	41.5%
Difference	20%	9.0%
Increase	28%	28%
Sources	GIS	ITU, Dec, 2020

TABLE 55: EXPECTED INCREASE IN BROADBAND PENETRATION

Increasing 4G population coverage from 72% to 92% is a percentage increase of 28%. Applying this increase to the current mobile broadband penetration of 32.4% leads to a 9% higher penetration, of 41.5%.

	GDP 2019 USD million	Additional GDP USD million	Tax to GDP ratio %	Additional tax USD million
Mobile coverage intervention	34,387	761	11.7%	89.4
Sources	WDI, 2020	Calculation based on ITU, 2020	Most recent available WDI, 2021	Calculation

TABLE 56: EFFECT OF A 9% INCREASE IN MOBILE BROADBAND PENETRATION

The additional tax revenues from a single year pay for both RAN site and fibre intervention. Applying the effect size of the ITU (2020) study for a 9% higher broadband penetration to the 2019 GDP and tax-to-GDP ratio yields an additional GDP of USD 761 million and additional tax revenue of USD 89.4 million. This is considerably higher than the USD 70 million needed for the investment.

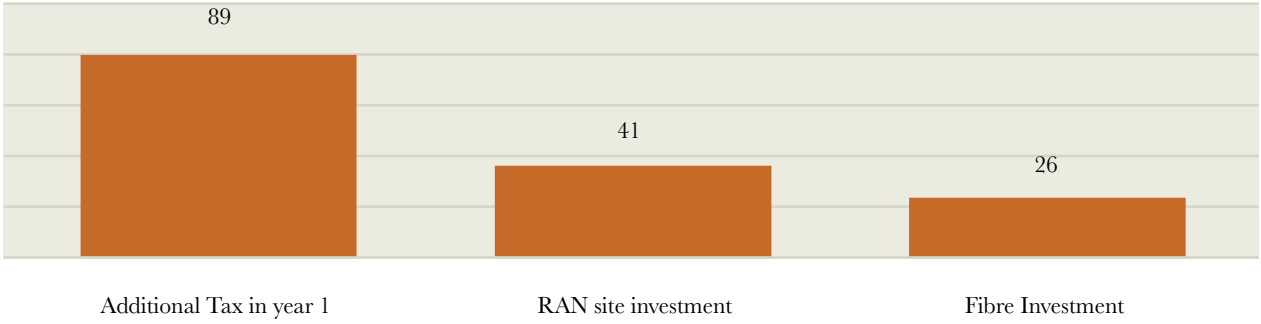


FIGURE 28: COMPARING EXPECTED TAX REVENUES TO COST OF INVESTMENT (USD MILLION)

The investment plan addresses the last and middle miles of the value chain connectivity segment. The study calculates what is needed and how much it will cost. RAN sites and fibre routes can be tendered individually based on the reverse auction principle. The proposed investment will pay for itself after one year through increased tax revenues. Instead of an equal distribution across years, as in Table 53, the rollout is driven by the availability of funds in the RCDF.

9.4. POLICY, REGULATORY AND INSTITUTIONAL RECOMMENDATIONS

Most Ugandans access the internet on a mobile or fixed wireless connection using spectrum. Smarter spectrum policy and regulation can radically change the cost economics of deploying wireless networks – expanding access to underserved and previously unserved communities, increasing competition and reducing costs for consumers. Spectrum needs to be made available across a range of low band, mid band and high band frequencies to support fixed and mobile terrestrial- and satellite- based communications. This diversity is key to addressing connectivity gaps and improving affordability. The Blueprint lists five action items on spectrum that can be implemented either immediately or within a short time period of one to two years. There is no investment needed to implement these action items. What is required is the regulatory and political will to implement.

The broadband ecosystem is an enabling component. As shown in Figure 7, it is the component that crosses all other components of the value chain. Not only is monetary investment necessary, but also the legal and policy framework and economic expertise are needed. The analysis in Chapter 3 and section 5.4 shows the negative impact of a dysfunctional ecosystem. When taxation policy expressly sabotages broadband policy, there is little point to a broadband policy. When targets cannot be set because there are so many competing policy documents, there is little point in setting targets in the first place. Table 57 sets out the Blueprint for the broadband ecosystem with the aim of fixing the existing ecosystem and replacing it with a dynamic and flexible system that supports innovation and recognises the value of investment in the sector.

Competition is the lever to expand affordable access to broadband. Up until now, broadband access has depended entirely upon MNOs and, to a small extent, ISPs. New spectrum models are emerging in other markets, such as New Zealand and South Africa, that show there are alternatives models, and the sector doesn't have to be dominated by only two operators. However, effective competition is only possible with transparency and certainty. Both of these aspects are missing from the current landscape in Uganda. At present, it is difficult for new entrants to assess what spectrum is available. Updating the frequency table would address this issue. New entrants are also unable to get purchase in the market by sharing facilities because facilities sharing regulations are not being effectively implemented. Other regulations that have been passed, such as competition, are not enforced. The regulator acts as a bottleneck rather than a proponent of open data and transparency. Simple initiatives, such as open data regulations, could have an outsized impact by establishing the current status of broadband in Uganda and the resources available to new entrants as well as kick-starting consultations with the private sector by ensuring that all stakeholders have access to up-to-date and accurate information.

New entrants are also unable to get purchase in the market by sharing facilities because facilities sharing regulations are not being effectively implemented.

Intervention	Action item	Chapter/ Section	Horizon
Broadband policies	Rationalisation of broadband policies to establish a single, clear policy source to which operational policies and strategies are parented	5.4	Short term: 1–2 years
	Support initiatives to ensure consistency in policy outcomes, e.g. that broadband policies are not contradicted by tax policies	5.4	Medium term: 3–5 years
	Develop a cross-sector RoW policy and promulgate any necessary amendments to the communications and land laws	7.1.4	Immediate
	Adopt the Radio Spectrum Management Policy of 2019 (as guidelines)	7.1.5	Immediate
	Develop a revised open data policy	5.4	Immediate
Legal and regulatory	Review licensing guidelines (for services and spectrum) to include sandbox provisions that encourage more innovation in the sector and provisions setting out services that may be provided without a license	7.1.1	Short term: 1–2 years
	Enforce the competition regulations and finalise the competition and consumer protection law	7.1.2	Immediate
	Begin consultations on feasible RoW regulations	7.1.4	Short term: 1–2 years
	Finalise the facilities sharing guidelines and begin consultations on cross-sector facilities sharing	7.1.3	Immediate
	Update the frequency table	8	Immediate
	Develop open data regulations targeting UCC and infrastructure providers	5.4 & 7.6	Immediate
	Enforce consumer protection regulations, and finalise the competition and consumer protection law	7.1.7	Immediate
	Repeal sector-specific taxation	3.1 & 3.2	Medium term: 3–5 years
	Review laws and regulations related to content	7.8	Medium term: 3–5 years
	Develop Critical Infrastructure Act to facilitate the protection of critical infrastructure across the board	7.10	Short term: 1–2 years
Institutional arrangements	If development of the digital economy is a goal, line ministries need to receive adequate funding to fulfil their mandates	6.1	Medium term: 3–5 years
	Clear targets for government departments to minimise inter- governmental conflict and stone-walling (e.g. getting data from UCC)	6.1	Short term: 1–2 years
	Develop internal skills within ministries and government departments	6.2	10 years
	Consultation with the private sector	6.3	Immediate

TABLE 57: BROADBAND BLUEPRINT: IMPROVING THE BROADBAND ECOSYSTEM

10

CONCLUSIONS

Based on the analysis and recommendations provided in the different chapters in this report, it is evident that transitioning from the current state of broadband access in Uganda to what is desirable to achieve the DUV aspirations will require coordinated and collaborative action across government. This includes the policy environment, where focus and consistency is needed especially in reducing the costs of rollout and access; the institutional arrangements to ensure clear roles in a collaborative rather than combative setting; the legal and regulatory environment to ensure a regionally competitive investment climate, ease of infrastructure rollout, collaboration, fair competition and consumer protection; and approaches to spectrum management that create opportunities for large, small and community players to enable access. With direct international connections to five countries, Uganda is positioned to become an internet hub for its landlocked neighbours, providing connectivity and data centre services. This opportunity is, however, time sensitive as Kenya and Rwanda are rapidly improving their ICT infrastructures and investment climates.

The UBP was developed as an analytical tool that has the major benefits of both visualisation and permitting the continuous update of data to provide 'present time' snaps of coverage, gaps and options as well as identifying and estimating costs for locations where subsidy is required. For the first time, users across the government can visually assess the location of ICT infrastructure. As different government departments work through the portal, there will be an incentive to update data. The structure of the portal means that the analytical framework can be easily updated, and new inputs can be quickly uploaded. Dissolving departmental data silos that are currently a major impediment is an important step towards a coordinated all-of-government approach to the ICT sector.

The broadband value chain shows that the main challenge facing Uganda is in the connectivity segment. Used international bandwidth is low. Only 29% of the population is within 10 km of a fibre node compared to 41% in Kenya. Uganda suffers from high data prices: As a percentage of GNI per capita per month, Uganda is ranked 27th in Africa for a 300-MB basket. At a high level, the solutions to these connectivity challenges are to reduce obstacles to data usage, such as high prices; remove obstacles to fibre rollout, such as RoW access; lower the cost of operating a network in Uganda by creating an innovative and flexible spectrum management system; and transforming the ICT taxation regime by lowering excise duties and removing sector-specific taxation.

The Broadband Infrastructure Blueprint is a set of actions, along with timelines, that Uganda needs to take to realise the DUV aspirations, with the greatest focus being on getting the ecosystem right. Table 56 summarises what needs to be done in order to address the gaps and remove the barriers in the ecosystem to promote a fast rollout of and access to broadband.

The nature of the spatial distribution of population combined with the economic state is such that, for the 10-year projections of the Blueprint, many communities and areas will be commercially unviable. This means that as part of the Blueprint, Uganda needs to provide for subsidies to achieve targeted coverage if the SDGs by-line of 'Leaving no one behind' is to be achieved.

A total of investment of USD 70 million over the next 10 years is required to ensure that at least 90% of the population has access to either fixed or mobile broadband. There is a two-part strategy behind the 10-year investment plan to expand broadband coverage and quality.

The first part of the strategy is to invest USD 29 million in fibre first. New technologies such as 5G (and soon 6G) demand significant bandwidth that alternatives cannot supply. This is the estimated amount required to connect all district capitals to fibre. This investment will increase the backhaul capacity for RAN sites and incentivise 4G upgrades. The interventions add an additional 3,242 km of fibre, representing an increase of over 16% to the total amount of fibre available in Uganda. People living within a 10-km radius to a fibre node would be increased from 29% to 56% and those living within 25 km from 67% to 94%. Starting with fibre rollout creates a springboard for service providers to reach all areas that are commercially viable using either FTTX or RAN sites. Many potential locations for new RAN sites are commercially viable. By funding RAN sites only in year 6 of the investment plan, many (and hopefully most) commercially viable RAN sites would already be covered.

The second part of the strategy is to subsidise the expansion of the RAN site rollout after the connection of all district capitals to fibre. The estimated subsidy required to increase the 4G population coverage from the current 72% to 92% is about USD 41 million. Uganda's UAS fund, administered by the RCDF, will be responsible for this intervention. In total, 503 new RAN sites would be subsidised, bringing 4G coverage to 9 million more Ugandans.

It is evident that Uganda has all the underpinning requirements for an inclusive, fully digitalised economy, provided there is consistent and coordinated political will and leadership to deal with the remaining barriers and gaps highlighted in this report. None of the gaps or challenges identified is insurmountable.

> **The estimated subsidy required to increase the 4G population coverage from the current 72% to 92% is about USD 41 million.**

11. REFERENCES

BoU 2020a. Bank of Uganda, FINANCIAL STABILITY REPORT June 2020 | Issue No. 12. https://www.bou.or .ug/bou/bouwebsite/bouwebsitecontent/FinancialStability/financial_stability/Rpts/All /Financial-Stability-Report-June-2020.pdf.

BoU 2020b. ANNUAL SUPERVISION REPORT, December 2020 | Issue No. 1, https://bou.or .ug/bou/bouwebsite/bouwebsitecontent/Supervision/Annual_Supervision_Report/asr/An nual-Supervision-Report-2020.pdf.

BoU (2020c) STATISTICAL ABSTRACT, https://www.bou.or .ug/bou/bouwebsite/bouwebsitecontent/publications/Statistical_Abstract/2020/20 20-Bank-of-Uganda-Statistical-Abstract.pdf

BoU 2019. Bank of Uganda, FINANCIAL STABILITY REPORT June 2020 | Issue No. 11, https://www.bou.or .ug/bou/bouwebsite/bouwebsitecontent/FinancialStability/financial_stability/Rpts/All /Financial-Stability-Report-June-2019-final-2.pdf.

BoU 2018. Bank of Uganda, FINANCIAL STABILITY REPORT June 2020 | Issue No. 10, https://www.bou.or .ug/bou/bouwebsite/bouwebsitecontent/FinancialStability/financial_stability/Rpts/All /Financial_Stability_Report_June-2018_final.pdf.

Czernich N., Falck, O, Kretschmer, T. and & Woessmann L., (2009). "Broadband Infrastructure and Economic Growth," CESifo Working Paper Series 2861, CESifo, https://ideas.repec.org/p/ces/ceswps/_2861.html.

Edquist, H., Goodridge, P., Haskel, Li, X., and Lindquist, E. (2018). "How Important Are Mobile Broadband Networks for the Global Economic Development." Information Economics and Policy, Volume 45, December 2018, Pages 16-29, https://www.sciencedirect.com/science/article/pii/S0167624517301695.

GSMA. (2016a). Digitalisation and mobile sector taxation in Europe: The experience in Hungary, https://www.gsma.com/mobilefordevelopment/wp- content/uploads/2016/03/GSMA_Digitalisation_and_mobile_sector_taxation_experience_in_Hungary.p df.

GSMA. (2016b).The Internet Value Chain, May 2016, https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2016_Report_TheInternetValueChain.pdf.

GSMA. (2018).The Data Value Chain, June 2018, https://www.gsma.com/publicpolicy/wp-content/uploads/2018/06/GSMA_Data_Value_Chain_June_2018.pdf.

GSMA (2021). Spectrum Pricing, GSMA Public Policy Position, May 2021, https://www.gsma.com/spectrum/wp-content/uploads/2021/05/Spectrum-Pricing-Positions.pdf.

ITU (2013). Taxing telecommunication/ ICT services: an overvIew, https://www.itu.int/en/ITU-D/Regulatory-Market/Documents/Publications/T axation2%20E-BAT3.pdf.

ITU (2020). How broadband, digitisation and ICT Regulation impact the global economy, https://www.itu.int/en/ITU- D/Conferences/GSR/2020/Documents/ITU_Global_Econometric_Modeling_GSR-DiscussionPaper .pdf.

11. REFERENCES

ITU (2016). Guidelines for the review of spectrum pricing methodologies and the preparation of spectrum fee schedules, ISBN 978-92-61-19661-5, https://www.itu.int/en/ITU-D/Spectrum-Broadcasting/Documents/Publications/Guidelines_SpectrumFees_Final_E.pdf.

Koutroumpis, P, (2018). The economic impact of broadband: evidence from OECD countries, April 2018, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/113299/economic-broadband-oecd- countries.pdf.

Qiang, Christine Zhen-Wei, Carlo Rossotto, and Kaoru Kimura. (2009). "Economic Impacts of Broadband." In Information and Communications for Development. Washington D.C.: World Bank. OECD (2011). Economic Impact of Internet/Broadband Technologies, 2011, DSTI/ICCP/IE(2011) i/Rev1.

Scott, Colin (2012). "Does Broadband Internet Access Actually Spur Economic Growth?" http://www.eecs.berkeley.edu/~rcs/classes/ictd.pdf.

Stork, C. (2020). Chapter 7. Regulatory responses to evolving technologies, Digital Regulation Handbook, International Telecommunication Union and The World Bank, 2020, ISBN: 978-92-61- 31651-8, https://www.itu.int/en/myitu/Publications/2020/08/31/09/09/Digital-Regulation-Handbook.

ALA (2000): Information Literacy Competency Standards for Higher Education, ALA, 2000, : http://www.ala.org/acrl/ilcomstan. html.

Baro, E. E. (2011). "A survey of information literacy education in library schools in Africa". Library Review, March.

Bawden, D. (2001), "Information and digital literacies: a review of concepts", Journal of Documentation, Vol. 57 No. 2, pp. 218-59.

Benchmarking baskets, ACORN-REDECOM Conference 2010 Brasilia, D.F.

Bertot, J. C. (2003). The multiple dimensions of the digital divide: more than the technology 'haves' and 'have nots. Government Information Quarterly, 20(2), 185–191.

Breivik. P. S., & Senn, J. A. (1998). Information literacy: Educating children for the 21st century. (2nd ed.). Washington, DC: National Education Association.

Britz, J. J. (2004). To know or not to know: a moral reflection on information poverty. Journal of information science, 30(3), 192-204.

Britz, J. J. (2008). Making the global information society good: A social justice perspective on the ethical dimensions of the global information society. Journal of the Association for Information Science and Technology, 59(7), 1171-1183.

Carlson, U. (2010): Children and Youth in the Digital Media Culture, Nordic Horizon, Edited by Ulla Carlson, published by the International Clearinghouse on Children, Youth and Media, 2010.

Eisenberg, M., Lowe, C., & Spitzer, K. (2004). Information Literacy: Essential Skills for the Information Age. 2nd. edition. Libraries Unlimited.

11. REFERENCES

Esselaar, S., Song, S. and Stork, C. (2017). Universal Basic Internet as a Freemium Business Model to Connect the Next Billion, in DigiWorld Economic Journal, No. 108, 4th quarter 2017.

Gebremichael, M. D. and Jackson, J. W. (2006). "Briding the gap in Sub-Saharan Africa: A holistic look at information poverty and the region's digital divide". Government Information Quarterly 23: 268.

Fuchs, C. and Horak, E. (2008). "Africa and the Digital Divide". Telematics and Informatics 25: 105.

Hargittai, E (1999). Weaving the western web: explaining differences in Internet connectivity among OECD countries. Telecommunications Policy, 23(10-11):701–718, 1999.

Hargittai, E (2002). Second-level digital divide: Differences in people's online skills. First Monday, 7(4), April 2002.

Hargittai, E (2005). Survey Measures of Web-Oriented Digital Literacy. Social Science Computer Review, 23(3):371–379, 2005.

Horton, F. W. (2008): Understanding Information Literacy: A Primer, UNESCO, https://unesdoc.unesco.org/ark:/48223/pf0000157020.

ITU (2011). Measuring the information society. Retrieved March 25, 2014, from http://www.itu.int/en/ITU- D/Statistics/Documents/publications/mis2012/MIS2012_without_Annex_4.pdf

JISC (2020), Building digital capabilities: The six elements defined, https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF.

Khan. S, Chair. C, & Deen-Swarray, S. (2015). Taking the Microscope to ICT Gender Gaps in Sub- Saharan Africa. Communications Policy Research South Conference, Zanzibar , August 2016, https://researchictafrica.net/publications/Conference_Publications/2016_Chair_Deen- Swarray_Khand_T aking_a_microscope_to_ICT_gender_gaps_in_Africa_CPRsouth_Best_Paper .pdf.

Lwanga, S.and Lemeshow, S. (1991): Sample Size Determination in Health Studies – A Practical Manual, World Health Organisation, Geneva.

Milek, A., Stork, C. and Gillwald, A. (2011). Engendering communication: a perspective on ICT access and usage in Africa, Emerald Group Publishing Limited, Vol. 13 Issue: 3, pp.125 - 141, ISSN: 1463- 6697.

de Lanerolle, I., Gillwald, A., Stork, C., and Calandro, E. (2014). Let Them Eat Movies: (How) Will Next- Generation Broadband DiffuseThroughAfrica?, in Broadband as a Video Platform, edited O'Neill, J., Noam, E. , Gerbarg, D., Springer, ISBN 978-3-319-03617-5.

Polo, L. and Martin, P. (2013). "Children's digital literacy practices in unequal South African settings". Tilburg University: Tilburg Papers in Culture Studies #60.

Rea, L. and Parker, R. (1997): Designing and Conducting Survey Research – A Comprehensive Guide, Jossey-Bass Publishers, San Francisco.

11. REFERENCES

Rong Wang (undated)., Internet Use and the Building of Social Capital for Development: A Network Perspective, University of Southern California

Schmidt P. and Stork, C. (2008). Towards evidence-based ICT policy and regulation: e-Skills, Volume 1, Policy Paper 3, ISSN 2073-0845.

Sen (1992). Inequality Re-examined, Oxford: Clarendon Press

Stork, C. & Calandro, E. (2014). Internet gone mobile in Namibia, in ICT Pathways to Poverty Reduction, ISBN-13: 978-1853398155, http://www.amazon.com/Pathways-Poverty-Reduction-Edith- Ofwona/dp/1853398152.

Stork, C., Calandro, E. & Gamage, R. (2014). "The future of broadband in Africa", info, Vol. 16 Iss: 1, pp.76 - 93, https://www.emeraldinsight.com/doi/pdfplus/10.1108/info-10-2013-0055.

Stork, C., Esselaar, S. and Chair, C. (2016). OTT - threat or opportunity for African Telcos?, printed at first African ITS conference 10-11 March 2016, http://www.africa-its.org.

Stork, C., Esselaar, S. and Chair, C. (2017). OTT - threat or opportunity for African Telcos?, Telecommunications Policy, Volume 41 (2017), http://www.sciencedirect.com/science/article/pii/S0308596117302069.

Stork, C., Kapugama, N., & Samarajiva, R. (2018). Economic impacts of mobile telecom in rural areas in low- and lower-middle-income countries: Findings of a systematic review. Information Technologies & International Development (Special Section), 14, 191–208, http://itidjournal.org/index.php/itid/article/view/1485/596.

Thanki, R. (2012). The Economic Significance of Licence- Exempt Spectrum to the Future of the Internet, https://www.microsoft.com/en-us/research/uploads/prod/2016/02/spectrum-economic-significance- of-license-exempt-spectrum-report_thanki.pdf

Tuominen et al. (2005). Information Literacy as a Sociotechnical Practice. The University of Chicago Press.

UBOS (2020). The Uganda National Household Survey - UNHS 2019/2020, https://www.ubos.org/wp- content/uploads/publications/09_2021Uganda-National-Survey-Report-2019-2020.pdf.

UCC (2021). Market performance report 2021, https://www.ucc.co.ug/wp- content/uploads/2021/09/2Q21-MARKET-PERFOMANCE-REPORT-compressed.pdf.

UNESCO (2008): Towards Information Literacy Indicators, UNESCO Paris, Conceptual framework paper prepared by Ralph Catts and Jesus Lau.

UNHS (2020). Uganda National Household Survey 2019/2020. https://www.ubos.org/wp- content/uploads/publications/09_2021Uganda-National-Survey-Report-2019-2020.pdf.

UNSD (2005): Designing Household Surveys Samples: Practical Guidelines, United Nations, New York.

12. APPENDIX

12.1.List of ISPs in Uganda

S/N	OPERATOR	LICENSE CATEGORY	AREA OF COVERAGE
1	MTN Uganda Limited	National Telecom Operator	National
2	Airtel Uganda Limited	National Telecom Operator	National
3	Tangerine T/a Lyca Mobile	National Telecom Operator	National
4	Ubuntu Towers	National Public Infrastructure Provider	National
5	Insite Uganda Ltd	National Public Infrastructure Operator	National
6	Group Vivendi Africa	(1) Regional Public Infrastructure Provider	Central region
		(2) Regional Public Service Provider	Central region
7	Liquid Telecom	(1) National Public Service Provider	National
		(2) Regional Public Infrastructure Provider	Central & Western regions
8	TruIT Uganda Limited	National Public Service Provider	National
9	Blue Crane Communications Ltd	National Public Service Provider	National
10	Bandwidth and Cloud Services Group Limited	(1) National Public Service Provider	National
		(2) Regional Public Service Provider	Central and Eastern Region
11	United Wireless	National Public Service Provider	National
12	Internet Solutions Uganda Limited	National Public Service Provider	National
13	Smile Communications Uganda Limited	(1) National Public Infrastructure Provider	National
		(2) Regional Public Service Provider	Central Region
14	Hamilton	National Public Service Provider	National
15	C-Squared	Regional Public Infrastructure Provider	Central Region
16	East Africa Broadband Services	Regional Public Service Provider	Central Region
17	Oyo Broadband Services	Regional Public Service Provider	Western Region
18	Cloud Core Services	National Public Service Provider	National
19	Echotel Proprietary Uganda Limited	(1) National Public Service Provider	National
		(2) Regional Public Infrastructure Provider	Central Region
20	Roke Telecom	(1) National Public Service Provider	National
		(2) Regional Public Infrastructure Provider Central and Eastern	Central and Eastern Region

12. APPENDIX

S/N	OPERATOR	LICENSE CATEGORY	AREA OF COVERAGE
21	Fezatel Limited	Regional Public Service Provider	Central and Eastern Region
22	Kampala Siti Cable	Regional Public Service Provider	Central Region
23	Kageddo Ventures Limited	Vending and Installation	National
24	American Tower Corporation (ATC)	National Public Infrastructure Provider	National
25	Uganda Electricity Transmission Company Limited	National Public Infrastructure Provider	National
26	Datanet.com	Regional Public Service Provider	Central
27	Sombha Solutions Store Limited	(1) National Public Service Provider	National
		(2) Regional Public Infrastructure Provider	Central Region
28	Seacom Uganda Limited	(1) National Public Service Provider	National
		(2) Regional Public Infrastructure Provider	Central and Eastern
29	Uganda Telecom	National Telecom Operator	National (Under Administration)
30	BT Solutions	Regional Public Service Provider	Central Region
31	Simbanet/Wananchi	(1) National Public Service Provider r	National
		(2) Regional Public Infrastructure Provide	
32	Sky Dot Com	(2) Regional Public Infrastructure Provider	Central Region
33	Gilat Telecom	National Public Service Provider	National
Source: https://www.ucc.co.ug/list-of-telecom-providers/			

12.2.Cost for UXIP services

Description	Non-Recurring Cost (NRC) US$	Monthly Recurring Cost (MRC) US$
Peering port 10 Mbps	200	Free
Peering port 100 Mbps	200	75
Peering port 1 Gbps	200	500
Peering port 10 Gbps	200	1000
Virtual Local Area Network (VLAN)	100	Free
Physical Private Network Interconnect (PNI)	100	150

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Description	Non-Recurring Cost (NRC) US$	Monthly Recurring Cost (MRC) US$
Additional Rack Unit (RU)	100	250
Additional Peering IP Address	100	20
Source: Uganda Internet Exchange Point(www.uixp.co.ug), 2021		

12.3.List of RAN Site Interventions

Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Bukomero Town Council	0.7020	32.0220	12,845	None, is profitable
Kapeke	0.9180	31.8060	22,333	None, is profitable
Muwanga	0.7020	31.9140	16,184	None, is profitable
Lwamata Town Council	0.8100	31.9140	13,982	None, is profitable
Nkandwa	0.8100	31.8060	18,214	None, is profitable
Kikyusa	0.9180	32.7780	10,794	None, is profitable
Buwunga	-0.3780	31.8060	12,190	None, is profitable
Kyanamukaaka	-0.4860	31.8060	10,558	None, is profitable
Kyesiiga	-0.5940	31.6980	14,892	None, is profitable
Butoloogo	0.7020	31.5900	14,034	None, is profitable
Butoloogo	0.8100	31.4820	14,151	None, is profitable
Butoloogo	0.8100	31.5900	23,445	None, is profitable
Kitenga	0.4860	31.4820	15,693	None, is profitable
Madudu	0.5940	31.4820	12,394	None, is profitable
Kasambya	0.3780	31.1580	15,628	None, is profitable
Kibalinga	0.4860	31.2660	12,176	None, is profitable
Kibalinga	0.5940	31.2660	23,645	None, is profitable
Kigando	0.3780	31.3740	10,419	None, is profitable
Nabingoola	0.4860	31.1580	11,074	None, is profitable
Kasambya Town Council	0.3780	31.2660	13,908	None, is profitable
Western Division	0.5940	31.3740	12,773	None, is profitable
Western Division	0.4860	31.3740	15,631	None, is profitable

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Nabbaale	0.5940	32.7780	11,969	None, is profitable
Kalongo	1.2420	32.7780	10,754	None, is profitable
Kibanda	-0.9180	31.2660	13,580	None, is profitable
Kifamba	-0.8100	31.3740	10,647	None, is profitable
Ddwaniro	-0.5940	31.3740	21,599	None, is profitable
Kacheera	-0.5940	31.1580	14,520	None, is profitable
Kiziba	-0.8100	31.2660	16,406	None, is profitable
Kyalulangira	-0.7020	31.2660	21,106	None, is profitable
Lwamaggwa	-0.4860	31.2660	20,087	None, is profitable
Lwamaggwa	-0.5940	31.2660	22,274	None, is profitable
Lwanda	-0.7020	31.4820	17,343	None, is profitable
Rakai Town Council	-0.7020	31.3740	12,524	None, is profitable
Lwemiyaga	0.1620	31.1580	13,341	None, is profitable
Lwemiyaga	0.1620	31.0500	16,407	None, is profitable
Mateete	-0.1620	31.4820	16,022	None, is profitable
Mijwala	-0.1620	31.3740	12,197	None, is profitable
Kitimbwa	0.8100	32.8860	10,325	None, is profitable
Namayumba	0.4860	32.2380	12,463	None, is profitable
Kinuuka	-0.2700	31.1580	13,187	None, is profitable
Lyantonde	-0.4860	31.1580	19,010	None, is profitable
Mpumudde	-0.2700	31.2660	10,541	None, is profitable
Lyakajjula	-0.1620	31.2660	11,041	None, is profitable
Kalangaalo	0.5940	31.9140	10,251	None, is profitable
Ssekanyonyi	0.4860	32.1300	11,963	None, is profitable
Najja	0.2700	33.1020	13,782	None, is profitable
Ssi-Bukunja	0.1620	32.9940	10,563	None, is profitable
Ssi-Bukunja	0.1620	32.8860	10,838	None, is profitable
Nyenga Division	0.3780	33.2100	21,839	None, is profitable
Bigasa	-0.0540	31.6980	18,424	None, is profitable
Kitanda	-0.1620	31.5900	18,958	None, is profitable
Busamuzi	0.2700	33.3180	22,627	None, is profitable

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Buvuma Town Council	0.1620	33.2100	10,191	None, is profitable
Kabulasoke	0.1620	31.8060	11,412	None, is profitable
Kyegonza	0.2700	31.8060	10,552	None, is profitable
Lwabenge	-0.0540	31.8060	11,281	None, is profitable
Bananywa	1.2420	31.3740	21,297	None, is profitable
Butemba	1.0260	31.5900	12,817	None, is profitable
Gayaza	0.9180	31.4820	12,272	None, is profitable
Mulagi	0.9180	31.6980	13,254	None, is profitable
Nsambya	1.1340	31.4820	18,823	None, is profitable
Ntwetwe	0.9180	31.5900	13,725	None, is profitable
Malongo	-0.3780	31.2660	16,205	None, is profitable
Ndagwe	-0.4860	31.3740	22,994	None, is profitable
Kabira	-0.7020	31.6980	11,953	None, is profitable
Kabira	-0.7020	31.5900	18,959	None, is profitable
Kirumba	-0.4860	31.5900	12,335	None, is profitable
Kalwana	0.5940	31.5900	21,780	None, is profitable
Kitumbi	0.5940	31.6980	15,416	None, is profitable
Kitumbi	0.7020	31.6980	16,439	None, is profitable
Myanzi	0.4860	31.9140	10,275	None, is profitable
Nalutuntu	0.4860	31.8060	10,408	None, is profitable
Budhaya	0.3780	33.7500	31,470	None, is profitable
Busedde	0.5940	33.3180	34,785	None, is profitable
Mukongoro	1.3500	33.7500	31,038	None, is profitable
Nyero	1.4580	33.8580	35,881	None, is profitable
Masaba	1.1340	34.3980	44,308	None, is profitable
Khabutoola	0.9180	34.2900	31,758	None, is profitable
Namutumba	0.8100	33.7500	32,368	None, is profitable
Bulaago	1.2420	34.3980	38,830	None, is profitable
Banda	0.1620	33.8580	36,691	None, is profitable
Mukura	1.5660	33.8580	33,482	None, is profitable
Kateta	1.4580	33.5340	34,683	None, is profitable

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Bupoto	0.9183	34.3976	35,060	None, is profitable
Lobule	3.4020	31.0500	44,682	None, is profitable
Butama Mitunda Town Council	0.5980	29.9955	35,887	None, is profitable
Buhara	-1.3423	30.0740	27,657	None, is profitable
Kyarumba	0.1620	29.9700	39,344	None, is profitable
Kitswamba	0.3780	30.1860	34,883	None, is profitable
Lake Katwe	0.0540	29.9700	35,251	None, is profitable
Nyamarunda	0.9180	30.9420	28,836	None, is profitable
Kabasekende	0.8100	30.9420	25,397	None, is profitable
Muramba	-1.3401	29.6470	33,081	None, is profitable
Bwongyera	-0.8100	30.0780	28,875	None, is profitable
Ruhaama	-1.0171	30.4002	29,546	None, is profitable
Rugarama	-1.0260	30.0780	28,913	None, is profitable
Bugangari	-0.7020	29.8620	36,908	None, is profitable
Biguli	0.3780	30.8340	32,038	None, is profitable
Kayonza	-0.9226	29.6507	35,135	None, is profitable
Butunduzi Town Council	0.4860	30.8340	39,055	None, is profitable
Katooke	0.7020	30.7260	35,772	None, is profitable
Kisojo	0.4860	30.7260	29,789	None, is profitable
Nyabuharwa	0.5940	30.5100	26,974	None, is profitable
Nyankwanzi	0.8100	30.7260	29,726	None, is profitable
Kashumba	-0.9180	30.9420	27,786	None, is profitable
Kashumba	-0.8100	30.9420	34,219	None, is profitable
Kabuyanda	-0.9180	30.6180	26,697	None, is profitable
Nyakitunda	-0.8100	30.7260	39,632	None, is profitable
Nyakitunda	-0.9180	30.7260	48,811	None, is profitable
Bitsya	-0.2700	30.5100	25,724	None, is profitable
Hapuuyo	0.5940	31.0500	27,198	None, is profitable
Hapuuyo	0.5940	31.1580	35,704	None, is profitable
Kakabara	0.4860	30.9420	28,611	None, is profitable

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Mpara	0.3780	30.9420	27,631	None, is profitable
Bwikara	0.9180	30.7260	27,973	None, is profitable
Kagadi Town Council	0.9180	30.8340	40,816	None, is profitable
Kyenzige	1.0260	30.8340	27,653	None, is profitable
Mpeefu	1.0260	30.7260	31,743	None, is profitable
Kasambya	0.9180	31.2660	27,306	None, is profitable
Mpasaana	1.0260	31.3740	30,076	None, is profitable
Nyamweru	-1.1340	29.9700	25,380	None, is profitable
Kabwoya	1.2420	31.1580	29,033	None, is profitable
Rugando	-0.7020	30.5100	27,521	None, is profitable
Rwamucucu	-1.1340	30.0780	25,007	230
Bufunjo	0.7020	30.8340	24,743	2,658
Kanyabwanga	-0.5940	29.9700	24,308	6,658
Nyamirama	-0.7020	29.7540	24,282	6,894
Burere	-0.3780	30.2940	24,024	9,262
Nyarushanje	-0.9180	29.9700	24,017	9,326
Mwizi	-0.8100	30.6180	23,703	12,211
Nyakishana	-0.3780	30.4020	23,580	13,343
Kibiito Town Council	0.4860	30.1860	23,364	15,329
Mukongoro	1.3500	33.8580	27,899	16,092
Kasodo	1.1340	33.6420	27,835	16,587
Kabamba	1.0260	31.0500	23,044	18,269
Loregae	1.8900	34.5060	38,271	20,549
Kazo	0.0540	30.7260	22,786	20,640
Kisiita Town Council	1.1340	31.3740	22,712	21,314
Bukalasi	1.0260	34.3980	27,164	21,730
Bunyafa	1.1340	34.2900	26,823	24,343
Kaharo	-1.2420	30.0780	22,303	25,076
Murora	-1.3238	29.7563	22,272	25,358
Kakomongole	1.8900	34.6140	37,349	25,598
Mbarara North Division	-0.7020	30.6180	22,213	25,905

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Alito	2.4300	32.7780	36,993	27,546
Maliba	0.3780	30.0780	21,937	28,438
Nyakishenyi	-0.9180	29.8620	21,925	28,552
Kyegegwa Town Council	0.4860	31.0500	21,910	28,686
Kisinga	0.0540	29.8620	21,857	29,170
Rubuguri Town Council	-1.1340	29.6460	21,703	30,590
Mabende	0.9180	30.5100	21,658	31,000
Kyere	1.4580	33.6420	25,939	31,120
Nabiswa	1.0260	33.8580	25,908	31,358
Bufundi	-1.2420	29.8620	21,607	31,471
Bwijanga	1.4580	31.5900	21,444	32,972
Asamuk	1.9980	33.6420	25,672	33,165
Mbaare	-0.9180	31.0500	21,393	33,438
Bufundi	-1.3372	29.8783	21,163	35,549
Bugoye	0.2700	30.0780	21,040	36,682
Mutara	-0.7020	30.0780	20,742	39,415
Kasimbi	0.9180	31.0500	20,696	39,843
Ruborogota	-1.0180	30.6174	20,600	40,725
Kiryandongo	1.8900	32.1300	20,595	40,773
Bwera	0.0529	29.7660	20,544	41,236
Kamuganguzi	-1.3500	29.9700	20,390	42,657
Kwosir	1.3500	34.6140	24,420	42,769
Kigorobya	1.5660	31.2660	20,293	43,542
Kasitu	0.8100	30.1860	20,239	44,045
Kyaterekera	0.9180	30.6180	20,185	44,534
Katooke	0.7020	30.6180	20,164	44,730
Kyembogo	0.8100	30.6180	20,124	45,096
Buswale	0.3780	33.8580	23,995	46,028
Bisheshe Division	-0.0540	30.5100	19,896	47,196
Ruyonza	0.2700	31.0500	19,754	48,495
Nyabbani	0.0540	30.4020	19,563	50,249

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Sop-Sop	0.8100	34.0740	23,357	50,915
Kamwezi	-1.2343	30.1808	19,311	52,568
Bufunjo	0.8100	30.8340	19,298	52,689
Bumasheti	1.0260	34.2900	23,059	53,206
Arivu	2.8620	30.9422	32,102	54,311
Kashambya	-1.0260	29.9700	19,085	54,648
Rengen	3.0780	33.9660	31,779	56,081
Nkondo	1.2420	32.9940	22,637	56,436
Bihanga	-0.2700	30.4020	18,818	57,098
Birembo	0.9180	31.1580	18,814	57,138
Mpara	0.3780	31.0500	18,794	57,318
Kabwoya	1.3500	30.9420	18,794	57,319
Masinya	0.3792	34.0599	22,386	58,365
Buhimba	1.2420	31.2660	18,678	58,388
Nkooko	0.9180	31.3740	18,525	59,786
Kakabara	0.5940	30.9420	18,348	61,417
Nyarubuye	-1.2421	29.6483	18,279	62,047
Kiziranfumbi	1.3500	31.1580	18,225	62,543
Chema	1.3500	34.3980	21,663	63,902
Buyanga	0.7020	33.6420	21,581	64,533
Nyamarwa	0.7020	31.1580	17,894	65,588
Rubaare	-0.9180	30.1860	17,868	65,828
Kigambo	0.7020	30.9420	17,856	65,941
Kyarusozi	0.8100	30.5100	17,734	67,057
Ntotoro	0.8098	30.0781	17,706	67,310
Bukiro	-0.4860	30.5100	17,573	68,537
Rubaya	-1.4324	29.9583	17,534	68,894
Labori	1.4580	33.2100	21,011	68,907
Bugamba	-0.8100	30.5100	17,484	69,353
West Division	2.9700	34.0740	29,302	69,636
Kigarama	-0.4860	30.4020	17,403	70,096

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Kanaba	-1.2420	29.7540	17,370	70,403
Bukabooli	0.3780	33.6420	20,815	70,406
Buyanja	-0.8100	29.9700	17,172	72,223
Ruborogota	-1.0191	30.5120	17,111	72,778
Kerwa	3.7259	31.2659	28,690	72,987
Rubanda Town Council	-1.1340	29.8620	17,060	73,254
Panyangara	2.9700	34.1820	28,493	74,065
Bwizi	0.3780	30.7260	16,971	74,072
Rugarama	-0.7020	30.2940	16,910	74,632
Busiriba	0.3780	30.5100	16,844	75,232
Butiru	0.8112	34.2890	20,016	76,534
Busiu	0.9180	34.1820	19,965	76,927
Kyabigambire	1.4580	31.4820	16,575	77,709
Kyangwali	1.1340	30.7260	16,533	78,091
Tara	3.2940	31.0500	27,716	78,318
Ruteete	0.4860	30.2940	16,439	78,954
Nkungu	0.1620	30.8340	16,365	79,638
Muko	-1.1340	29.7540	16,362	79,662
Kyangwali	1.1340	30.8340	16,249	80,700
Endiizi	-0.8100	31.1580	16,208	81,081
Nyaravur	2.4300	31.1580	26,889	82,843
Kyangwali	1.2420	30.8340	15,991	83,076
Awei	2.2140	33.2100	26,830	83,162
Ngarama	-0.9180	30.8340	15,962	83,335
Bukiro	-0.3780	30.5100	15,943	83,510
Ngai	2.5380	32.4540	26,747	83,618
Otwal	2.5380	32.6700	26,642	84,192
Rutenga	-1.0260	29.8620	15,806	84,773
Ngoma	-1.1264	30.2838	15,798	84,842
Nabukalu	0.7020	33.7500	18,911	85,008
Kigorobya	1.6740	31.3740	15,744	85,340

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Kabwoya	1.2420	31.0500	15,642	86,275
Arapai	1.8900	33.6420	18,523	87,981
Kicuzi	-0.1620	30.2940	15,273	89,668
Nyamarwa	0.7020	31.2660	15,267	89,720
Keihangara	-0.1620	30.6180	15,254	89,848
Buyende	1.2420	33.2100	18,229	90,234
Benet	1.3500	34.5060	18,209	90,386
Mpungwe	0.4860	33.5340	18,175	90,652
Nkooko	1.0260	31.4820	15,122	91,057
Kitaihuka	1.0260	31.2660	15,087	91,382
Buhimba	1.3500	31.2660	15,033	91,873
Mutunda	1.9980	32.2380	15,001	92,169
Buhanika	1.3500	31.4820	14,997	92,208
Buremba	0.1620	30.7260	14,992	92,250
Tubur	1.9980	33.5340	17,956	92,331
Engari	-0.0540	30.6180	14,969	92,460
Kei	3.6180	31.1580	24,912	93,663
Rugarama	-0.9180	30.0780	14,760	94,385
Buyanga	0.4860	33.9660	17,651	94,668
Rukoni East	-0.9180	30.5100	14,702	94,916
Nyakagyeme	-0.8100	29.8620	14,546	96,353
Kyamuhunga	-0.4860	30.0780	14,383	97,845
Ogur	2.4300	32.9940	24,126	97,963
Buhimba	1.3500	31.3740	14,354	98,116
Amwoma	1.9980	33.1020	24,078	98,223
Bwanswa	0.8100	31.3740	14,140	100,078
Malongo	0.2700	33.4260	16,941	100,107
Kayonza	-1.0260	29.7540	14,115	100,308
Kisojo	0.3780	30.6180	14,110	100,358
Bugondo	1.5660	33.3180	16,851	100,797
Panyimur Town Council	2.2240	31.2729	23,591	100,893

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Bulesa	0.4860	33.8580	16,710	101,881
Kathile	3.6180	34.0740	23,339	102,268
Bileafe	3.0780	31.0500	23,264	102,683
Bwamiramira	0.8100	31.0500	13,852	102,721
Buhunga	-0.7020	29.9700	13,841	102,826
Northern Division	-1.2420	29.9700	13,824	102,985
Kikagate	-0.9928	30.7133	13,756	103,604
Logiri	2.7540	30.9420	23,066	103,764
Karita	1.4580	34.7220	23,016	104,037
Akaa	2.4409	30.8423	22,991	104,174
Kadungulu	1.5660	33.2100	16,371	104,480
Kyamuhunga	-0.4860	29.9700	13,648	104,599
Kanyum	1.3500	33.9660	16,355	104,603
Kateta	1.3500	33.5340	16,302	105,009
Katenga	-0.5940	30.0780	13,594	105,100
Gweri	1.7820	33.7500	16,279	105,187
Bundibugyo Town Council	0.7020	30.0780	13,580	105,220
Amugu	2.1060	33.3180	22,752	105,483
Kakindo	1.1340	31.1580	13,544	105,559
Ruyonza	0.2700	30.9420	13,530	105,680
Opwateta	1.2420	33.8580	16,200	105,794
Kyaterekera	1.0260	30.6180	13,508	105,883
Agweng	2.5380	32.8860	22,672	105,922
Nsinze	0.8100	33.6420	16,139	106,260
Kabonero	0.4860	30.0780	13,443	106,481
Kashare	-0.3780	30.6180	13,437	106,538
Kirima	-0.9180	29.7540	13,427	106,632
Oluvu	3.1813	30.8538	22,504	106,839
Akalo	2.1060	32.8860	22,489	106,924
Nalweyo	1.1340	31.2660	13,391	106,963
Kalapata	3.6180	34.1820	22,360	107,628

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Ndeija	-0.8100	30.4020	13,315	107,658
Bihanga	0.2700	30.6180	13,286	107,924
Katanda	-0.2700	30.1860	13,279	107,989
Mugusu	0.5940	30.1860	13,235	108,396
Ngoma	-1.1340	30.1860	13,222	108,518
Kyabugimbi	-0.4860	30.2940	13,164	109,047
Leju Town Council	3.1860	31.0500	21,879	110,262
Nkoma	0.2700	30.7260	12,902	111,451
Masha	-0.7020	30.7260	12,873	111,723
Bumwoni	0.8281	34.3794	15,392	111,983
Kihuura	0.5940	30.8340	12,843	111,999
Matale	0.8100	31.1580	12,821	112,197
Ludara	3.5100	31.0500	21,523	112,208
Acaba	2.3220	32.5620	21,470	112,501
Inomo	2.1060	32.7780	21,467	112,516
Bugaya	1.1340	33.2100	15,311	112,611
Parombo	2.3262	31.1569	21,393	112,920
Bugaaki	0.7020	30.5100	12,724	113,087
Kidongole	1.2420	33.9660	15,238	113,168
Kichwamba	-0.2700	30.0780	12,702	113,290
Busakira	0.3780	33.5340	15,108	114,166
Odek	2.6460	32.6700	21,139	114,309
Nyakatonzi	-0.0540	29.8620	12,556	114,630
Moruita	1.8900	34.7220	21,012	115,003
Akeriau	1.9980	33.4260	14,965	115,261
Engaju	-0.2700	30.2940	12,468	115,441
Kabwoya	1.1340	30.9420	12,379	116,263
Ihunga	-0.8100	30.1860	12,311	116,884
Kitoba	1.5660	31.3740	12,307	116,922
Bukwo	1.2547	34.7205	14,747	116,932
Kabambiro	0.1620	30.5100	12,288	117,094

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Kasenda	0.3780	30.2940	12,257	117,379
Abia	2.4300	33.1020	20,545	117,560
Kamwenge	0.1620	30.4020	12,189	118,003
Kicheche	-0.1620	30.4020	12,158	118,291
Loro	2.2140	32.5620	20,388	118,418
Himutu	0.9180	34.0740	14,529	118,607
Barr	2.2140	33.1020	20,270	119,065
Vurra	2.9700	30.9420	20,229	119,291
Oleba	3.2936	30.9425	20,192	119,491
Lodonga	3.4020	31.1580	20,121	119,883
Omugo	3.1860	31.1580	20,088	120,062
Ndeija	-0.7020	30.4020	11,902	120,647
Mahyoro	0.0540	30.2940	11,726	122,257
Kei	3.5100	31.1580	19,685	122,268
Nyakyera	-0.9180	30.4020	11,623	123,209
Kigaraale	0.4860	30.6180	11,583	123,571
Rweikiniro	-1.0260	30.2940	11,575	123,643
Inomo	2.1060	32.6700	19,392	123,869
Atik Division	1.9980	32.5620	19,301	124,371
Akoromit	1.9980	33.7500	13,776	124,377
Alwa	1.8900	33.2100	13,719	124,815
Abok	2.5380	32.5620	19,126	125,328
Got-Apwoyo	2.4300	31.4820	19,034	125,830
Magamaga	2.6460	33.7500	18,995	126,044
Bunambutye	1.4580	34.3980	13,539	126,196
Mabaale	1.0260	30.9420	11,175	127,319
Mahyoro	-0.0540	30.2940	11,173	127,345
Rugaaga	-0.8100	31.0500	11,143	127,614
Harugongo	0.7020	30.2940	11,133	127,711
Agali	2.1060	33.1020	18,667	127,838
Zombo Town Council	2.5380	30.9420	18,665	127,847

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Kigumba	1.8900	31.9140	11,086	128,138
Palam	1.8900	34.0740	13,256	128,366
Ikumbya	1.0260	33.3180	13,254	128,377
Toroma	1.6740	33.9660	13,172	129,006
Purongo	2.5380	31.8060	18,441	129,078
Kwera	1.8900	32.9940	18,436	129,102
Goli Goli	1.1340	33.8580	13,113	129,463
Ntungamo	-0.9180	30.2940	10,907	129,789
Bubango	0.7020	31.0500	10,899	129,860
Kihuura	0.5940	30.7260	10,894	129,901
Okwang	2.5380	33.1020	18,252	130,109
Bwanswa	0.8100	31.2660	10,832	130,475
Burunga	0.0540	30.9420	10,798	130,786
Kazo Town Council	-0.0540	30.7260	10,782	130,934
Kyabakara	-0.1620	30.1860	10,722	131,483
Buhemba	0.2700	33.7500	12,831	131,623
Kicwamba	0.7020	30.1860	10,560	132,974
Ochero	1.5660	32.9940	12,643	133,067
Labori	1.4580	33.3180	12,576	133,576
Southern Division	3.3969	30.9606	17,535	134,034
Bukiise	1.2420	34.2900	12,473	134,366
Endiizi Town Council	-0.9180	31.1580	10,287	135,480
Kameruka	1.1340	33.9660	12,322	135,526
Namalu	1.7820	34.6140	17,248	135,607
Buhanda	-0.0540	30.4020	10,244	135,877
Kakanju	-0.4860	30.1860	10,232	135,984
Kapir	1.5660	33.7500	12,237	136,178
Kamet	1.3500	34.7220	12,177	136,635
Kabingo	-0.7020	30.8340	10,114	137,075
Olio	1.5660	33.5340	12,099	137,232
Budongo	1.5660	31.4820	10,093	137,262

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Buremba	0.1620	30.6180	10,070	137,476
Aber	2.1060	32.3460	16,821	137,944
Kuluba	3.6087	30.9600	16,789	138,118
Buwunga	0.4860	33.6420	11,963	138,276
Aliba	3.1860	31.4820	16,694	138,639
Ayivu Division	3.0753	30.8394	16,643	138,914
Sigulu Island	0.1620	33.7500	11,875	138,956
Awei	2.1060	33.2100	16,623	139,027
Imanyiro	0.4860	33.4260	11,660	140,597
Alango	2.4300	33.2100	16,269	140,964
Chawente	1.8900	32.6700	16,155	141,585
Uleppi	2.7540	31.0500	16,129	141,727
Koch-Goma	2.6460	32.0220	16,019	142,331
Magoro	1.6740	34.0740	11,434	142,334
Kaptererwo	1.2628	34.7991	11,383	142,721
Bukedea	1.3500	34.0740	11,336	143,085
Omodoi	1.7820	33.9660	11,325	143,168
Kachumbala	1.2420	34.0740	11,291	143,432
Kijomoro	3.1860	30.9420	15,709	144,027
Willa	2.1060	33.6420	11,144	144,560
Lorengedwat	2.4300	34.6140	15,532	144,996
Magamaga	2.7540	33.7500	15,421	145,606
Odek	2.6460	32.7780	15,343	146,029
Aleka	2.5380	32.7780	15,335	146,075
Lapono	2.9700	33.4260	15,249	146,547
Apapai	1.8900	33.4260	10,809	147,126
Akisim	1.2420	33.7500	10,803	147,168
Ongino	1.5660	34.0740	10,787	147,292
Zeu	2.5380	30.8340	15,098	147,373
Lungulu	2.7540	31.9140	15,063	147,561
Kapelebyong	2.3220	33.8580	10,734	147,703

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Masaba	0.3780	33.9660	10,725	147,771
Minakulu	2.4300	32.3460	15,004	147,888
Koch-Goma	2.5380	32.0220	14,898	148,465
Bukatube	0.3780	33.3180	10,631	148,494
Romogi	3.5100	31.3740	14,850	148,727
Mukuju	0.8100	34.1820	10,586	148,832
Banda	0.2700	33.8580	10,568	148,971
Erussi	2.3400	31.0830	14,790	149,055
Busabi	0.7020	33.8580	10,546	149,145
Pingire	1.4580	33.4260	10,507	149,438
Asuret	1.6740	33.5340	10,488	149,583
Agulu Division	1.8900	32.5620	14,580	150,209
Nebbi	2.5380	31.0500	14,506	150,610
Lopeei	2.5380	34.3980	14,503	150,627
Morungatuny	2.1060	33.5340	10,313	150,931
Anyara	1.9980	33.3180	10,233	151,541
Naweyo	1.0260	34.0740	10,204	151,767
Lii	2.5380	32.2380	14,280	151,850
Olio	1.5660	33.4260	10,178	151,966
Panyango	2.5380	31.3740	14,207	152,245
Malongo	0.1620	33.5340	10,141	152,247
Katine	1.8900	33.5340	10,034	153,066
Athuma	2.4345	30.9386	14,036	153,184
Anaka Payira	2.5380	31.9140	13,980	153,489
Rengen	3.0780	34.0740	13,902	153,917
Abim Town Council	2.6460	33.6420	13,694	155,054
Kululu	3.4020	31.2660	13,649	155,303
Midigo	3.6180	31.2660	13,528	155,963
Kucwiny	2.5380	31.2660	13,314	157,136
Okwalongwen	1.9980	33.2100	13,281	157,313
Bala	2.2140	32.7780	13,249	157,492

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Pakele	3.2940	31.9140	13,220	157,648
Amach	2.1060	32.9940	13,101	158,302
Agikdak	1.6740	32.8860	13,007	158,818
Omoro	2.2140	33.4260	13,006	158,820
Got-Apwoyo	2.5380	31.4820	12,950	159,125
Omoro	2.3220	33.4260	12,912	159,332
Chegere	2.1060	32.5620	12,819	159,842
Offaka	2.6460	31.0500	12,754	160,201
Muntu	1.5660	32.8860	12,681	160,598
Ayivu Division	2.9842	30.8559	12,665	160,684
Aduku	1.9980	32.6700	12,606	161,008
Adeknino	1.7820	32.9940	12,407	162,097
Omoro	2.2140	33.3180	12,383	162,228
Omiya Pacwa	3.1860	33.4260	12,364	162,334
Panyimur Town Council	2.3220	31.3740	12,327	162,539
Awach	2.6460	33.5340	12,300	162,683
Odupi	3.1860	31.2660	12,270	162,850
Atyak	2.6460	30.9420	12,246	162,979
Kululu	3.4020	31.3740	12,227	163,083
Ibuje	1.8900	32.3460	12,142	163,550
Rhino Camp	2.9700	31.2660	12,055	164,024
Odupi	3.2940	31.1580	11,956	164,569
Nebbi	2.4320	31.0518	11,912	164,808
Apo	3.5100	31.2660	11,911	164,815
Olilim	2.4300	33.4260	11,892	164,915
Rigbo	3.1860	31.3740	11,758	165,649
Pabo	2.9700	32.1300	11,552	166,776
Agweng	2.5380	32.9940	11,517	166,969
Chawente	1.7820	32.5620	11,507	167,023
Adok	1.9980	32.8860	11,491	167,113
Okwerodot	2.4300	32.8860	11,396	167,632

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Sub_County	Latitude	Longitude	People covered by intervention	5 Year Max Subsidy USD
Ofua	3.2940	31.8060	11,154	168,958
Koro	2.7540	32.3460	11,069	169,422
Kochi	3.6152	31.4794	11,064	169,448
Tapac	2.3186	34.9066	10,997	169,813
Akura	2.3220	33.1020	10,863	170,548
Ibuje	1.8900	32.4540	10,840	170,673
Nabilatuk	2.1060	34.6140	10,838	170,688
Nebbi	2.5380	31.1580	10,809	170,842
Kango	2.6426	30.8402	10,750	171,166
Kamdini	2.3220	32.3460	10,747	171,186
Kotomol	2.6460	33.3180	10,715	171,359
Ibuje	1.9980	32.3460	10,536	172,337
Kucwiny	2.6460	31.2660	10,522	172,416
Rigbo	3.0780	31.3740	10,509	172,487
Barr	2.2140	32.9940	10,476	172,665
Iceme	2.4300	32.6700	10,217	174,086
Pandwong Division	3.2940	32.8860	10,131	174,555

12.4.List of Fibre Route Interventions

Start Node		End Point	Length km	Cost USD
Latitude	Longitude	District name		
2.05403	33.69777	Amuria District Head-Qtrs	9.84	83,640
2.11579	34.22438	Napak District Head-Qtrs	12.71	108,035
0.95236	34.27463	Bududa District Head-Qtrs	14.13	120,105
0.60533	33.47086	Bugweri District Head-Qtrs	15.64	132,940
1.91653	33.17665	Kaberamaido District Head-Qtrs	16.25	138,125
-0.54353	30.14005	Mitooma District Head-Qtrs	17.41	147,985
2.23265	32.53677	Oyam District Head-Qtrs	17.90	152,150

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Start Node		End Point	Length km	Cost USD
Latitude	Longitude	District name		
1.49242	33.92156	Ngora District Head-Qtrs	18.54	157,590
0.43687	33.20295	Buvuma District Head-Qtrs	18.55	157,675
1.18996	33.75003	Butebo District Head-Qtrs	18.58	157,930
0.78168	33.61395	Namutumba District Head-Qtrs	19.27	163,795
0.17643	31.89328	Kalungu District Head-Qtrs	20.09	170,765
-1.25087	29.98211	Rukiga District Head-Qtrs	20.74	176,290
0.60533	33.47086	Mayuge District Head-Qtrs	21.79	185,215
1.91650	33.17588	Kalaki District Head-Qtrs	22.85	194,225
-0.17585	31.63207	Ssembabule District Head-Qtrs	22.96	195,160
2.23463	32.53503	Kole District Head-Qtrs	23.69	201,365
0.81861	34.05315	Butaleja District Head-Qtrs	24.81	210,885
-0.05233	30.75767	Kiruhura District Head-Qtrs	25.16	213,860
1.70850	33.61315	Serere District Head-Qtrs	26.05	221,425
1.08071	34.16743	Manafwa District Head-Qtrs	26.27	223,295
1.08000	34.16907	Budaka District Head-Qtrs	26.88	228,480
0.60533	33.47086	Luuka District Head-Qtrs	28.45	241,825
0.95078	33.11139	Buyende District Head-Qtrs	29.24	248,540
0.84147	32.49696	Nakaseke District Head-Qtrs	29.29	248,965
-0.30891	31.75877	Bukomansimbi District Head-Qtrs	29.43	250,155
2.80819	33.10801	Agago District Head-Qtrs	31.08	264,180
0.78168	33.61395	Kaliro District Head-Qtrs	31.31	266,135
-1.25087	29.98211	Rubanda District Head-Qtrs	31.48	267,580
3.02416	30.89858	Terego District Head-Qtrs	31.64	268,940
0.55478	31.38554	Kakumiro District Head-Qtrs	31.72	269,620
-0.12031	30.50174	Kitagwenda District Head-Qtrs	32.85	279,225
2.27286	33.17863	Otuke District Head-Qtrs	33.13	281,605
-0.13137	30.49916	Kazo District Head-Qtrs	33.69	286,365
2.64862	31.14620	Madi-Okollo District Head-Qtrs	34.48	293,080

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Start Node		End Point	Length km	Cost USD
Latitude	Longitude	District name		
3.37252	31.77197	Obongi District Head-Qtrs	35.10	298,350
1.14338	31.60358	Kiboga District Head-Qtrs	35.26	299,710
0.47195	34.08843	Namayingo District Head-Qtrs	35.99	305,915
1.44064	31.33890	Kikuube District Head-Qtrs	36.20	307,700
-0.53154	31.62320	Rakai District Head-Qtrs	36.40	309,400
-0.61468	30.04836	Rukungiri District Head-Qtrs	36.48	310,080
2.25642	32.90614	Alebtong District Head-Qtrs	38.54	327,590
3.29461	32.88325	Lamwo District Head-Qtrs	38.80	329,800
2.83821	32.17414	Amuru District Head-Qtrs	39.00	331,500
0.40452	32.04643	Gomba District Head-Qtrs	39.26	333,710
1.84976	34.72134	Amudat District Head-Qtrs	39.44	335,240
1.08071	34.16743	Namisindwa District Head-Qtrs	41.78	355,130
0.95008	33.11184	Kayunga District Head-Qtrs	41.90	356,150
1.77475	33.16574	Amolatar District Head-Qtrs	42.07	357,595
0.78168	33.61395	Kibuku District Head-Qtrs	42.33	359,805
0.45367	31.67508	Kassanda District Head-Qtrs	43.90	373,150
-0.78494	29.92638	Kanungu District Head-Qtrs	45.55	387,175
2.05237	34.57337	Nakapiripirit District Head-Qtrs	45.71	388,535
0.78862	30.22772	Bundibugyo District Head-Qtrs	45.77	389,045
2.77742	32.27073	Omoro District Head-Qtrs	46.13	392,105
3.51224	34.13466	Karenga District Head-Qtrs	48.78	414,630
1.49242	33.92156	Pallisa District Head-Qtrs	49.48	420,580
1.44221	31.34369	Kyankwanzi District Head-Qtrs	49.67	422,195
0.40418	32.04395	Butambala District Head-Qtrs	52.94	449,990
-1.14819	29.85355	Kisoro District Head-Qtrs	53.15	451,775
-0.15257	30.47802	Buhweju District Head-Qtrs	54.06	459,510
0.53711	30.94699	Kibaale District Head-Qtrs	54.88	466,480
2.84673	32.16078	Nwoya District Head-Qtrs	58.28	495,380

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Start Node		End Point	Length km	Cost USD
Latitude	Longitude	District name		
2.47116	31.48272	Buliisa District Head-Qtrs	60.41	513,485
1.91946	33.95247	Kapelebyong District Head-Qtrs	72.42	615,570
0.66813	30.28084	Ntoroko District Head-Qtrs	74.01	629,085
-0.32423	31.75516	Kalangala District Head-Qtrs	74.29	631,465
2.53349	34.64605	Nabilatuk District Head-Qtrs	77.29	656,965
2.25642	32.90614	Pader District Head-Qtrs	87.62	744,770
3.26109	32.11008	Kitgum District Head-Qtrs	110.23	936,955
1.08071	34.16743	Bukwo District Head-Qtrs	140.49	1,194,165
2.16000	34.23746	Abim District Head-Qtrs	153.99	1,308,915
2.43245	34.48082	Kaabong District Head-Qtrs	178.69	1,518,865
		Total	3,104	26,385,615

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12.5.Detailed comments on Frequency Allocation Table

Frequency	Comments
410 – 450 MHz	432 – 438: 433.05 – 434.79 MHz used for IoT applications such Lora, 433 MHz used for low power applications such as garage door openers, headphones, baby phones and remote controls.
	450 – 460: See general note on 450 – 470 MHz
450 – 470 MHz	**General Note** %Part of IMT 450 MHz: Band 31 (FDD) 450 NMT (Up) 452.5 – 457.5, (Down) 462.5 – 467.5, Band 72 (FDD) 450 PMR (Up) 451 – 456, (Down) 461 – 466 (3) Band 73 (FDD) PMR (APT) (Up) 450 – 455, (Down) 460 – 465, %PMR radio systems also used this band based on such standards as MPT-1327, TETRA, APCO 25, and DMR. PMR systems need to migrate to other bands. See WRC resolution 224 (Rev. WRC-15), ITU channel plan Recommendation ITURM.1036 on the topic. Currently no phones support this band.
470 – 890 MHz	470 – 694: Regulation for use of this band for "TV White Spaces" has been published and will be subject to non-interference and on a non-protection to users under a secondary allocation. 600 MHz IMT band (617 - 652 MHz down, 663.- 698 MHz up) is being discussed at WRC-23 for use in region 1. (https://www.gsma.com/spectrum/wp-content/uploads/2019/10/600-MHz-for-mobile-broadband.pdf)
	862 – 890: 863 – 868.6 MHz is a license-exempt band for (i) Wireless Audio systems and Wireless microphones (863 –865 MHz), (ii) CT2 cordless phones (864.1 – 868.1 MHz), (iii) FWA (864.1 – 868.1 MHz) such as 802.11ah and Lora, (iv) RFID (865 – 868 MHz)
890 – 1300 MHz	890 – 942: Take note of 224 (Rev. WRC-15) and 749 (Rev. WRC-15) and Recommendation ITU-R M.1036 (A2) (Revision 6 of ITU-R M.1036 (2019) recommends the following frequency arrangement for A2: Mobile station transmitter: 880-915 MHz, Base station transmitter: 925-960 MHz with duplex separation of 45 MHz)
	942 – 960: Take note of 224 (Rev. WRC-15) and 749 (Rev. WRC-15) and Recommendation ITU-R M.1036 (A2)
1300-1400 MHz	1350 – 1400: WRC-15 (Agenda Item A1.1) was to identify additional frequency bands for International Mobile Telecommunications (IMT). 1350-1400 MHz (1400 MHz band) and 1427-1518 MHz (1500 MHz band) are two candidate bands that are receiving growing global support as IMT service bands. These bands are referred to as 1.4/1.5 GHz.
1427 – 1518 MHz	**General Note** %An economic impact study was done on the 1500 band. (https://www.gsma.com/asia-pacific/resources/global-momentum-and-economic-impact-of-the-1-4-1-5-ghz-band-l-band-for-imt/) WRC-15 (Agenda Item A1.1) was to identify additional frequency bands for International Mobile Telecommunications (IMT). 1350-1400 MHz (1400 MHz band) and 1427-1518 MHz (1500 MHz band) are two candidate bands that are receiving growing global support as IMT service bands. These bands are referred to as 1.4/1.5 GHz. %The frequency range 1427-1518 MHz is already used for commercial IMT services in Japan. In other countries the frequency ranges are mainly used for fixed links and radar, and in some countries, programme making, and special events (PMSE) and aeronautical telemetry services use part of the band (particularly in China, Russia, and the US). However, some or all the bands are often lightly used by existing services - for example, in Europe the block 1452-1492 MHz was allocated for digital audio broadcasting (terrestrial and satellite) but was not used and so has been harmonized for IMT services

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Frequency	Comments
	%Current phone support for 1500 MHz band very minimal (total phones on GSM Arena 10012): LTE band 21 (FDD) 13 phones, LTE band 11 (FDD) 13 phones, LTE band 32 (SDL) 166 phones
1710 – 2170 MHz	1710 – 1930: Typical applications: Fixed Wireless Access TDD (1900 – 1920 MHz), IMT 1900 TDD (1900 – 1920 MHz), cordless phones (1880 – 1900 MHz), IMT 2100 FDD uplink (1920 – 1980 MHz)
	1980 – 2010: Typical applications: Fixed links (1980 – 2010 MHz), Notes: IMT-satellite being proposed (1980 – 2010 MHz)
	2010 – 2025: IMT TDD applications recommendations ITU-R M.1036
	2025 – 2110: Typical applications: Fixed links (2025 – 2110 MHz), Notes: Paired with 2200 – 2285 MHz, Check radio frequency channel arrangements in ITU-R F.1098
2170 – 2520 MHz	2170 – 2200: Typical applications: Fixed links and IMT (satellite) (2170-2200), Notes: IMT (satellite) being proposed (2170-2200 MHz) paired with 1980 – 2010 MHz
	2200 – 2290: Typical applications: Fixed links (2200 – 2285 MHz) paired with 2025 - 2110 MHz, BFWA (2285 – 2300 MHz), Notes: Check radio frequency channel arrangements in ITU-R F.1098
	2290 – 2300: Typical applications: Fixed links, BFWA (2285 – 2300) – but requires coordination
	2300 – 2450: Typical applications: FWA (PTP/PTMP) (2307-2387), ISM applications (2400 – 2483.5), RFID (2400 – 2483.5) WLAN (2400 – 2483.5), Notes: See Recommendation ITU-R M.1036
	2450 – 2483.5: Typical applications: FWA (PTP/PTMP) (2307-2387), ISM applications (2400 – 2483.5), RFID (2400 – 2483.5) WLAN (2400 – 2483.5)
	2483.5 – 2500: Typical applications: Fixed links PTP/PTMP, Notes: The band 2483.5-2500 MHz is identified for satellite component of IMT; Res.225 applies. Common international SRD band; see ITU-R Rec. SM.1896
	2500 – 2520: Typical applications: IMT2600 MTX (2500 – 2570 MHz), Notes: Paired with 2620 – 2690 MHz, Recommendation ITU-R M.1036
2520 – 2700 MHz	2520 – 2655: Typical applications: IMT2600 MTX (2500 – 2570 MHz), IMT2600 TDD (2570 – 2620 MHz), IMT2600 BTX (2620 – 2690 MHz); Notes: MTX (2500 – 2570 MHz) paired with 2620 – 2690 MHz, BTX (2620 – 2690 MHz) paired with 2500 – 2570 MHz), Recommendation ITU-R M.1036, the band 2 500-2 690 MHz is also used for BFWA in some SADC countries, Recommendation ITU-R M.1036
	2655 – 2670: Typical applications: IMT2600 BTX (2620 – 2690 MHz), Notes Recommendation ITU-R M.1036
	2670 – 2690: Typical applications: IMT2600 BTX (2620 – 2690 MHz), Notes Recommendation ITU-R M.1036
2700 – 4800 MHz	3300 – 3400: Typical applications: IMT TDD (3300 – 3400) – band 52, Notes: IMT Res. 223 (Rev.WRC-15), some sharing and compatibility studies underway at ITU to be discussed at WRC-23 and there might be a need to migrate radar out of this band.
	3400 – 3600: Typical applications: IMT3500 TDD (3400 – 3600) – band 42, Notes: This band was also historically used for WiMax. Identified for IMT at WRC-15. Used for CBRS in the US, Recommendation ITU-R M.1036. Used for BFWA in some SADC countries

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Frequency	Comments
	3600 – 4200: Typical applications: Fixed links 4GHz (3600 – 4200) and C-band downlink (3625 – 4200 MHz), Notes: The sub-band 3 600-3 800 MHz could be used for BFWA where frequency sharing with fixed satellite is feasible using coordination – this will be discussed at WRC-23. Channel arrangement for PTP links is based on ITU-R Recommendation F.635 Annex 1.
4800 – 5570 MHz	4800 – 4990: Typical applications: Fixed links (4.8 GHz) (4400 –5000 MHz), Outside Broadcast Links, Radio astronomy on 4825 – 4835 MHz and 4950 – 4990 MHz, Note: Licensed spectrum for fixed links being pursued across EMEA Region 1
	4990 – 5000: Typical applications: Fixed links (4.8 GHz) (4400 –5000 MHz), Note: Some WiFi equipment supports these licensed bands for PTP links.
	5150 – 5250: Typical applications: WAS / RLAN (5150 – 5350 MHz) (indoor use only) – note this is not an ISM band as shown in Uganda frequency table
	5250 – 5255: Typical applications: WAS / RLAN (5150 – 5350 MHz) (indoor use only) – note this is not an ISM band as shown in Uganda frequency table
	5255 – 5350: Typical applications: WAS / RLAN (5150 – 5350 MHz) (indoor use only) – note this is not an ISM band as shown in Uganda frequency table
	5470 - 5570: Typical applications: WAS / RLAN (5470 – 5725 MHz) (outdoor use) - note this is not an ISM band as shown in Uganda frequency table
5570 – 7250 MHz	5479 – 5650: Typical applications: WAS / RLAN (5470 – 5725 MHz) (outdoor use), Location Radar, Ground based meteorological radars (5600 – 5650 MHz), Note: WiFi employs DFS to detect weather radar and co-exist. Note this is not an ISM band as shown in Uganda frequency table
	5650 – 5725: Typical applications: WAS / RLAN (5470 – 5725 MHz). Note this is not an ISM band as shown in Uganda frequency table
	5725 – 5830: Typical applications: ISM applications (5725 – 5875 MHz), WAS / RLAN (5730 – 5850 MHz, SRD applications, Notes: This is a common international SRD band; see ITU-R Rec. SM.1896. Used for Transport information and control systems Recommendation; see ITU-R M.1453
	5830 – 5850: Typical applications: ISM applications (5725 – 5875 MHz), WAS / RLAN (5730 – 5850 MHz,
	5850 – 5925: Typical applications: C-band uplink (VSAT/SNG/PTP links) (5850 – 6425 MHz), ISM applications (5725 – 5875 MHz), Fixed links (5850 – 5925 MHz), Notes: Currently used by fixed satellite (earth to space) C-band uplink, OB broadcast, terrestrial backhaul. Supported by a wide range of carrier-grade WiFi equipment.
	5925 – 6700: Typical applications: Fixed links - Lower 6 GHz (5925- 6425 MHz) and Upper 6 GHz (6425-7110 MHz), C-band uplink (VSAT/SNG/PTP links) (5850 – 6425 MHz), Notes: Lower 6 GHz (5925- 6425 MHz) adopted by EU for license-exempt WiFi. African Telecommunications (ATU) Emerging Technologies Task Group license-exempt access to the lower 6 GHz band in July 2021, 6425-7025 considered for IMT in region 1 at WRC-23, Channelling plan for Lower 6 GHz band in accordance with ITU-R Rec. F.383. Channelling plan for Upper 6 GHz band in accordance with ITU-R Rec. F.384.
	6700 – 7075: Typical applications: Fixed links - Upper 6 GHz (6425-7110 MHz), Notes: 6425-7025 considered for IMT in region 1 at WRC-23, Channelling plan for Upper 6 GHz band in accordance with ITU-R Rec. F.384.
	7075 – 7145: Typical applications: Fixed links - Upper 6 GHz (6425-7110 MHz), Notes: Channelling plan for Upper 6 GHz band in accordance with ITU-R Rec. F.384.

Frequency	Comments
	7145 – 7190: Typical applications: Fixed links - Lower 7 GHz (7110- 7425 MHz), Notes: Channelling plan for L7 band in accordance with ITU-R Rec. F.385 Annex 3.
	7190 – 7235: Typical applications: Fixed links - Lower 7 GHz (7110- 7425 MHz), Notes: Channelling plan for L7 band in accordance with ITU-R Rec. F.385 Annex 3.
	7235 – 7250: Typical applications: Fixed links - Lower 7 GHz (7110- 7425 MHz), Notes: Channelling plan for L7 band in accordance with ITU-R Rec. F.385 Annex 3.
7250 – 8500 MHz	7250 – 7300: Typical applications: Fixed links - Lower 7 GHz (7110- 7425 MHz), Notes: Channelling plan for L7 band in accordance with ITU-R Rec. F.385 Annex 3.
	7300 – 7375: Typical applications: Fixed links - Lower 7 GHz (7110- 7425 MHz), Notes: Channelling plan for L7 band in accordance with ITU-R Rec. F.385 Annex 3.
	7375 – 7450: Typical applications: Fixed links - Lower 7 GHz (7110- 7425 MHz), Notes: Channelling plan for L7 band in accordance with ITU-R Rec. F.385 Annex 3.

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12.6.COMMUNITY NETWORKS: GLOBAL, REGIONAL, AND NATIONAL RECOGNITION

This appendix provides global, regional and national-level references that support the use of community networks in broadband policy and regulation.

12.6.1.Global Recognition

ITU-D: Telecommunications for rural and remote areas - The World Telecommunication Development Conference (Dubai, 2014) Recommendation 19 includes the following (ITU, 2018, 648):

- *"10. that it is important to consider small and non-profit community operators, through appropriate regulatory measures that allow them to access basic infrastructure on fair terms, in order to provide broadband connectivity to users in rural and remote areas, taking advantage of technological advances;*

- *11. that it is also important that administrations, in their radio-spectrum planning and licensing activities, consider mechanisms to facilitate the deployment of broadband services in rural and remote areas by small and non-profit community operators;"*

UN ECOSOC Resolution 2019/24 Numeral 54 includes "Community Networks" as an emerging topic (ECOSOC, 2019). The Report[153] of the United Nations Secretary General's High Level Panel on Digital
Co-operation states that: "Governments have an important role to play in creating a policy framework to enable private sector enterprise, innovation, and cooperative, bottom-up networks" (page 12). And concludes in its recommendation that: **"Second, investments should be made in both human capacity and physical infrastructure. Creating the foundation of universal, affordable access to electricity and the Internet will often require innovative approaches, such as community groups operating rural networks, or incentives such as public sector support." (page 29)**

The Annual Deliverable 2019–2020 from ITU-D Study Groups Question 5/1: Telecommunications/ICTs for Rural and Remote Areas states (ITU, 2020e): **"the following recommendations can be made for now: Ease regulatory requirements for community network operators."**
The ITU Smart Villages Blueprint[154] document produced in 2020 mentions community networks on several occasions.

12.6.2.Regional Recognition

In Africa, the Specialized Technical Committee on Communications and Information Technologies (STC- CICT) of the African Union included in its 2019 Sharm El Sheikh Declaration (STC-CICT, 2019) the following text directing the African Union Commission to:

"PROMOTE the formulation of strategy and pilot projects for Unlocking Access to Basic Infrastructure and Services for Rural and Remote Areas including Indigenous Community Networks, and develop guidelines on legislation on deployment of technologies and ICT applications, to accelerate infrastructure role [sic] out in collaboration with [African Telecommunications Union] and other regional institutions;"

The Broadband Commission's "Connecting Africa through Broadband: A strategy for doubling connectivity by 2021 and reaching universal access by 2030" (Broadband Commission for Sustainable Development, 2019) recognizes the role of community networks in three of the seven objectives of its action plan. Of particular interest is Objective 5:

153 - https://www.un.org/en/pdfs/DigitalCooperation-report-for%20web.pdf
154 - https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-SMART_VILLAGE.NIGER-2020-PDF-E.pdf

"Provide direct funding support for extending affordable broadband access to commercially challenging rural and remote areas, to women, and low-income users and the recommendations under Objective 1, "Ensure that the commercial broadband ICT market is open and structurally prepared for competitive private investment":

Adopt open wholesale and retail telecommunications market entry policies, especially competitive and unified licensing regimes, and liberal, dynamic spectrum policies. Such policies should also accommodate community and non-profit focused network operators who offer services in underserved areas."

In the Americas, the Inter-American Telecommunication Commission tracks the implementation of resolution ITU D-19 regarding small not-for-profit and community operators through resolution 268- PCC1. The report,[155] presented in 2018, shows the development of inclusive regulation for small and community operators in each of the countries (see page 29).

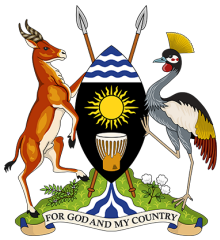
In the Asia Pacific region, community networks are a relatively new topic. Still, they were discussed in 2019 at the Third Session of the Asia-Pacific Information Superhighway Steering Committee and WSIS Regional Review and included in its deliberations.[156]

12.6.3.National Recognition

Some countries such as Kenya and South Africa include in their policy documents references to community networks, small operators, and co-operatives as a vehicle for digital inclusion.[157] Kenya highlights the need to provide for an enabling policy and regulatory framework for community-based operators in their National Broadband Strategy. South Africa not only mentions them in their National Broadband Plan and includes them as part of the Telecommunications Value Chain in their SMME Strategy, but the development and promotion of "SMMEs and cooperatives" is part of the objectives of the Electronic Communications Act, the main act of the telecommunications sector in the country. In the particular case of community networks, specific support for their development was articulated in the Budget Speech 2018 from the Department of Telecommunications and Postal Services. Unsurprisingly, South Africa is the country with the most local operators in Africa.

In the Americas during the last few years, Brazil has implemented a strong policy and regulatory strategy for facilitating the participation of small operators in serving rural and remote areas, including a recent note on how to regulate community networks.[158] In Mexico, community and indigenous operators are specifically recognized in the Telecommunications Act, and it specifies that spectrum planning activities should always take into consideration the specific needs of these operators. Mexico's new Social Coverage Program specifically refers to them as important allies in addressing unconnected areas.[159]

155 - See https://www.citel.oas.org/en/SiteAssets/PCCI/Final-Reports/CCPI-2018-33-4714_i.pdf
156 - See https://www.unescap.org/sites/default/files/Summary percent20Report percent20- percent20Third percent20AP-IS percent20SC_0.pdf.
157 - See Kenya's National Broadband Strategy 2018 (https://ca.go.ke/wp-content/uploads/2018/02/National-Broadband-Strategy.pdf); South Africa Connect: South Africa's Broadband Policy (https://www.ellipsis.co.za/wp- content/uploads/2013/10/NBP-2013.pdf); Draft Information and Communication Technology Small, Medium, and Micro- Enterprise Support Strategy (https://www.dtps.gov.za/images/phocagallery/Popular_Topic_Pictures/40756_31- 3_TeleComPostServ.pdf); Electronic Communications Act 36//2005 (https://www.dtps.gov.za/index.php?option=com_phocadownload&view=category&download=34:electronic- communications-act-2005&id=2:legislation&Itemid=142&start=20); Deputy Minister Stella Ndabeni-Abrahams: Telecommunications and Postal Services Dept Budget Vote 2018/19 (https://africanewswire.za.com/deputy-minister-stella-ndabeni-abrahams-telecommunications-and-postal-services-dept-budget-vote-2018-19/).
158 - See https://inseit.net/news/86/
159 - See https://www.gob.mx/sct/acciones-y-programas/programa-de-cobertura-social.



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