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THE Regulator

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Digital Mainstreaming

High-level forum maps action in four digital economy areas

United Republic of Tanzania

MINISTRY OF INFORMATION, COMMUNICATIONS AND INFORMATION TECHNOLOGY

TANZANIA COMMUNICATIONS REGULATORY AUTHORITY

ISO 9001:2015 CERTIFIED

DOT TZ DOMAIN NAMES REGISTRATION

1.0 INTRODUCTION

Domain names are used for electronic communications, specifically for e-mails and web applications. These include addresses under dot-tz country code Top Level Domain (.tz ccTLD).

Dot TZ domains have been registered on the third level since their establishment in 1995. Unique domains were preceded by characters that identified the nature of the organization owning the domain; Government entities are preceded by go.tz, Commercial organizations by co.tz, Non-profit organizations by or.tz. For example; tra.go.tz, vodacom.co.tz, and tznic.or.tz.

TCRA introduced the opening of a second level domain registration to react to the Internet market demand of the requirement of much shorter and catchy domain names. It is now possible to register a domain on the second level, such as tcra.tz, tigo.tz, or quar.tz. This will allow for much shorter and more memorable domain names.

Opening of second-level will not affect the existing third-level domains and are not by any chance replacing each other. Those registrants with existing third-level domains are given priority to register equivalent second-level domains before 1st June 2022 if required. If not, they can still use their third level domain names indefinitely and new third level domains are also registered.

2.0 ANNOUNCEMENT

The announcement is hereby given to the public that the second-level domain name registration under Dot TZ namespace is now open as follows:-

- Between 1st March and 31st May 2022 (Priority Level One), those with existing domain names, and trademarks requiring second-level domains are welcome to register their equivalent domains.

- Between 1st and 30th June 2022 (Priority Level Two); those who registered third-level domains during Priority Level One and required second-level domains are welcomed to register.

- From 1st July 2022 – Onwards (General Availability) – Registration of second-level domains is open to the general public.

3.0 REGISTRATION INFORMATION

For Second level .tz domain name registration, visit https://karibu.tz and for more information regarding the registration of .tz domain names and other related issues, kindly contact TCRA through;

Director General,
Tanzania Communications Regulatory Authority,
Mawasiliano Towers,
20 Sam Nujoma Road,
P.O. Box 474,
14414 DAR ES SALAAM.
Tel: +255 22 21 99 760 - 9 / +255 22 24 12 011 – 2 / +255 784 55 82 70 – 1 Email: dg@tcra.go.tz; cc: rajisi@tcra.go.tz

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Regulator

The Regulator is published quarterly by the Tanzania Communications Regulatory Authority (TCRA). The Authority's functions and duties include enhancing public knowledge, awareness and understanding of the regulated goods and services, and disseminating information about matters relevant to its functions.

TCRA is an independent Government agency established under the Tanzania Communications Regulatory Authority Act No. 12 of 2003 to regulate electronic and postal communications in Tanzania.

Specifically, the Authority is responsible for enhancing the welfare of Tanzanians through:

- Promoting effective competition, economic efficiency
- Protecting consumers
- Promoting the availability of regulated services
- Licensing and enforcing licence conditions of broadcasting, postal and telecommunications operators
- Establishing standards for regulated goods and services
- Regulating rates and charges (tariffs)
- Managing the radio frequency spectrum
- Monitoring the performance of the regulated sectors
- Monitoring the implementation of ICT applications.

TCRA has offices in Zanzibar and in five zones - Northern (Arusha), Lake (Mwanza), Central (Dodoma), Southern Highlands (Mbeya) and Eastern (Dar es Salaam).

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COVER PHOTOGRAPH
The internet is the main driver of the digital economy.

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Mobile money transaction value doubles in two years

The value of mobile money transactions and internet usage doubled in two years as Tanzania accelerates its strategic move to a digital economy.

Average mobile money transactions per account increased by 90.9 per cent between 2015 and 2021 and the value of transactions almost doubled – from 3,320,146 shillings per mobile account in 2015 to 6,339,606 shillings in 2021, according to the latest TCRA statistics.

Internet usage and financial inclusion are key building blocks of a digital economy.

Table 1: Trends in Mobile subscriptions, mobile money accounts, number of transactions and amounts transacted (2015 – 2021)

Year	Mobile subscriptions	Number of Mobile Money Accounts	Number of transactions	Average Transactions per account	Amount transacted in TZS	Average amount transacted per account
2015	39,665,600	17,639,349	1,458,471,661	82.7	58,565,217,000,000	3,320,146.2
2016	40,044,186	18,080,622	1,606,771,804	88.9	72,022,311,000,000	3,983,397.9
2017	39,953,860	21,889,618	2,244,983,330	102.6	102,935,578,000,000	4,702,484.0
2018	43,497,261	23,367,826	2,943,015,134	126.0	141,189,615,000,000	6,042,051.8
2019	47,685,232	25,864,318	3,217,680,240	124.4	165,471,636, 000,000	6,397,680.2
2020	51,220,233	32,268,630	3,477,059,633	107.8	201,698,605, 000,000	6,250,609.5
2021	54,044,384	35,285,767	4,029,178,046	114.2	223,697,871,000,000	6,339,606.3

Table 2: Mobile money transactions growth

Year	Mobile money accounts	Average transactions per mobile money account	Increase	Average amount transacted per mobile money account in TZS	Increase
2015	17,639,349	82.7		3,320,146.2	
2016	18,080,622	88.9	6.2	3,983,397.9	663,251.7
2017	21,889,618	102.6	13.7	4,702,484.0	719,086.1
2018	23,367,826	126.0	23.4	6,042,051.8	1,339,567.8
2019	25,864,318	124.4	-1.6	6,397,680.2	355,628.4
2020	32,268,630	107.8	-16.6	6,250,609.5	-147,070.7
2021	35,285,767	114.2	6.4	6,339,606.3	88,996.8
Cumulatively, average transactions per account increased by 38.1 per cent				Average value of transactions increased by 90.9 per cent	

Average mobile money transactions per account increased by 38.1 per cent while the average value of transactions increased by 91 per cent, implying that fewer subscribers transact large volumes.

Table 3: Internet Subscription, penetration and usage trends (2019 –2021)

Year	Subscriptions	Penetration	Increase	Internet Data Volume in MBs	Average usage per subscription in MBs	Increase
2019	25,794,560	46%	2%	219,788,614,276	8,520.7	
2020	28,470,506	49%	3%	351,644,419,110	12,351.2	3,830.5 (44.95%)
2021	29,858,759	50%	1%	557,217,157,162	18,661.8	6,310.6 (51%)
Cumulative increase from 2015 to 2019 is 4%				Increase from 2019 is 10,141.1 or 120 per cent		

Current postal challenges underline need for synergies

Statement by TCRA Director General, Dr. Jabiri Kuwe Bakari on this year's Africa Postal Day on 18 January 2022.



Dr. Jabiri Kuwe Bakari

The process of improving the postal industry calls for sustained dialogue, collaboration, confidence building and learning between and among members. Complimentarily and not competition is the way to keep such a dialogue alive.

Through harnessing synergies with players of the wide Postal sector, the development of the digital economy and ongoing ICT boom offers a unique opportunity for the development of postal services in Africa which can only be achieved through a wide engagement with stakeholders. While impressing that innovation is no longer an option, the Post must accordingly devote all its efforts by engaging with external stakeholders.

For the success of its endeavours the Postal sector, when implementing transformative programmes, should consider public-private partnerships (PPP) as a way to harness synergies with other players while considering and weighing the advantages and disadvantages of that approach. It must analyze alternatives and follow a process designed to guarantee the successful implementation, operation and conclusion of different programmes.

The analysis of the legal and regulatory framework of the respective activity is vital and must be done by considering the market environment and its capabilities. Postal operators must follow a precise roadmap, conduct an analysis, develop strategies and find the best possible solutions for their particular projects.

The current world epidemic emphasizes the need for the postal sector to work with other sector players in stimulating socio-economic development. As Postal services now use technology to improve business processes and meet the growing demands of digitally-savvy customers – to ensure they remain commercially viable into the future, it must work with other sector players.

In providing Postal services during this time when the world is battling COVID - 19 it is paramount for the subsector to work closely with other sector players in service delivery to communities. The spread of the Covid-19 pandemic and the suppression of the working environment aimed at management of the crisis has changed the way we live, operate and consume. Through harnessing synergies with other players of the wide, the Postal sector must ensure service delivery.

Partnership in service delivery during the COVID-19 crisis has led postal sector customers to move quickly and operate online. Digital communication is pushing postal services to scale up operations; as evidenced in innovations in last-mile delivery for e-commerce and technology adaptability by the sector. Digital postal services as the efficient, central communication centre and secure tool to support this transformation of working modes are important in the Postal Sector.

As a way of harnessing synergies with players of the wide Postal Sector, TCRA, in collaboration with Postal and courier operators is in the process of reconsidering guidelines by resetting mail service levels such as service standards, delivery points and frequency of deliveries to address challenges caused by the COVID-19 pandemic.

Harnessing synergies for Africa's Post

January 18 is celebrated as Africa Postal Day, ater the day in which the Arusha-based Pan African Postal Un-ion (PAPU) was founded in 1980 as a specialized agency of the then Organization for African Unity, now African Union on Postal affairs. This year's theme was: 'Harnessing synergies with players of the wider postal sector in Africa'. We present statements by the Minister for Information, Communications and Information Technology, Hon. Nape M. Nnauye, (MP) and PAPU Secretary General, Sifundo C. Moyo. TCRA DG's statement is published on page 3.



Postal sector stakeholders marching in Dodoma to mark this year's Africa Postal Day on 18 January 2022.

Postal sector opening to serve vulnerable groups

By Hon. Nape M. Nnauye (MP), Minister for Information, Communications and Information Technology

Historically, the post office has been one of the most reliable instruments for the transmission and exchange of written documents and parcels. . Postal services continue to play an important role today in the transmission of knowledge and information, contribution to education and distance learning, trade, business, research and development. It has a significant contribution to the implementation of national, regional and global strategies.

Postal and courier service providers, being global players, enable the smooth, safe and cost-efficient movement of goods and resources along the supply chain. With the advancement of Information and Communication Technologies (ICT) in recent decades, businesses have been creatively extended to be conducted over the Internet or through e-business which is fast-growing and robust and promises to be a new avenue for the creation of wealth. Postal and courier services have completely changed the processes and standard operating procedures to cope with technology.

Business and commerce depend upon and benefit from physical communication since parcels and packages can reliably and professionally be conveyed by the post office. It is worth noting that the core postal business will remain for a long time the delivery of paper-based traditional products.

Tanzania has been one of the

leading countries in Africa using information technology in postal operations, including counter automation, *"track and trace"* of international mail, electronic mail; electronic money transfer and the use of diagnostic quality of service measurement systems. It is envisaged that the full use and application of ICTs in the Post will meet the growing demand for reliable, affordable and quality services with a high level of technological added value. Hybrid mail, which combines electronic transmission and physical delivery, and other ranges of diversified internet-based online services are examples.

This theme of this year's celebration is: Harnessing synergies with players of the wider postal sector in Africa. The debate on the opening up the UPU to a wider sector of postal players was made at the 27th UPU Congress in Abidjan, Ivory Coast in August/September 2020. It was agreed that the need for opening up follows the transformation of the postal sector which has seen wide-scale liberalization, privatization and a surge in e-commerce activity. It is important to note that wider postal sector players now also include customs authorities, postal suppliers and supply chain service providers.

The major benefits for member countries of the UPU and PAPU for opening up to wider sector postal players include strengthening universal service and catalyzing e-commerce development. Vulnerable users and citizens in rural and remote areas need postal services to remain connected in an increasingly digital world. With wider sector postal player involvement, the Designated Postal Operators will then be required to interconnect with other players to complete the supply chain.

We all know that letter mail has been increasingly replaced by electronic communication, while e-commerce has led to significant growth in parcel delivery services. Collaboration and stakeholder interconnectivity is the key to upholding and adapting essential postal infrastructure on a continental scale. While in recent years' regulatory interventions have focused on letter mail services, the postal digital transformation and the growth of e-commerce, have made the delivery of parcels, packets, goods and merchandise the key focus of attention for Postal and courier operators in our countries.

Interconnected postal networks are becoming increasingly vital to ensure the quality of service, innovative services, and the global interoperability of letter and parcel delivery operations. The use of common standards and technology increases clarity and legal certainty and may lead to lower costs and fewer interoperability issues. This is the work of postal regulators and we need to strengthen and harmonize regulatory frameworks in Africa. The Government is committed to creating a conducive environment for the efficient operation of the postal sector and ensuring the number of stakeholders from the private sector and public institutions participating in cooperation frameworks facilitate the provision of postal and courier services.

Being a ministry responsible for technology development, we will strengthen ICT awareness programmes throughout the country so that postal operators and others can make optimal use of ICTs in service delivery. In this context, postal and courier services will continue to play a significant role in the Tanzanian economy and the country's information society. I believe that the physical communication network will remain a viable alternative and a reliable means of exchanging information for a long time to come.

Supportive partnerships key to growth

By Sifundo C. Moyo., PAPU Secretary General

The choice of this theme, "Harnessing synergies with players of the wider postal sector", is consistent with the ongoing worldwide discussions and consultations on the proposed opening-up of the Universal Postal Union (UPU) to players of the wider postal sector; an issue that has taken centre stage in the current global agenda.

In this age of widespread cross-border trade buoyed by global e-commerce, solitary initiatives and efforts by postal organizations are no longer desirable or beneficial. In fact, in the fast-paced world of today, the going-it-alone, solo individual approach to doing business is less efficient, counter-productive, and eventually becomes sub-optimal and unprofitable due to its lack of competitiveness.

Yet on the same score, the existence of partnership options provides avenues for added value-creation which is a decisive asset in a marketplace of ever-growing competition where ubiquitous technology solutions make it increasingly easier for new players to enter the race and compete favourably.

In this setting, it is critical for the postal industry in particular to find new ways of spurring collaborative innovations in response to the customer's needs of today and tomorrow. Empirical evidence and the existing body of literature is replete with examples of the benefits of partnerships where their pursuit is no longer an option, but a necessity, owing to their remarkable potential for finding innovative solutions to prevailing needs and challenges.

When properly executed, opening up to others holds undeniable benefits for any organization, including sharing risks and responsibilities, raising investment levels, exchanging know-how, broadening business networks, finding innovative solutions, opening up new business prospects, boosting development potential, etc.

Additionally, partnerships aid in streamlining business processes, productivity enhancement, opening up new markets, and the creation of new products and services. Ultimately, working together in a meaningful and fruitful partnership is a sensible route towards achieving sustainability, significant transformation and valuable outcomes. A strategic partnership renders win-win outcomes which yield dividends for all stakeholders.

Postal operators have the opportunity to expand their business reach and grow in their target markets, customers benefit from the value addition and subsequent service propositions offered by the Operator whilst employees find greater and better opportunities for development through new perspectives and expertise. As PAPU, we already have the resolve to enter into myriad relationships with Training institutions such as the African Advanced Level Telecommunications Institute (AFRALTI), Airline Industry Organizations such as the African Airlines Association (AFRAA), the African Civil Aviation Commission (AFCAC), just to mention a few.

I would therefore strongly encourage all postal industry players across Africa to explore mutually supportive and rewarding partnerships to achieve stronger growth and contribute to the advancement of our common agenda for a harmonized transformation of our continent's postal sector. However, our postal players must be ready and prepared for mutual engagements to avoid being regarded as lessor parties that are susceptible to exploitation and manipulation. It has been observed that whereas partnerships are a viable solution, utmost care must be exercised to choose the "best fit, right" partner.

This entails ensuring that the partnership is rooted in shared values and common goals after fully understanding the other party's core values, objectives and expertise. Clarifying their motivations to find areas of harmony is an absolute necessity

The Postal industry across Africa is currently seized with the digital transformation agenda that seeks to grow the postal sector and reposition it, with abundant clarity, as a key driver of inclusive socio-economic development in our countries. This transformation agenda provides scope for collaborations with technology and solution vendors for the development of new digital products and services

The Postal sector must utilize synergies with these partners to reclaim lost market share and consolidate its grip on the world of e-services; e-commerce, e-government, e-money (digital) and pursue the achievement of total compatibility to the e-post environment of its operations and service offerings. Currently, PAPU is actively participating in the study on the digitalization of postal services, with a special focus on the improvement of e-commerce.

The study is spearheaded by the African Union Commission (AUC) and the Universal Postal Union (UPU) but funded by the French Government. Our ultimate goal is to have as many of our Member States embrace the recommendations therefrom, which will, in earnest, be concluded and availed to us early this year.

Furthermore, our intonation is to boost the intra-African trade and expand export flows per the African Continental Free Trade Area (AfCTA) guidelines. As I conclude, it is my fervent hope that the dawn of the year 2022 will be used as an opportunity to take stock of how far we have come and to set new targets whose ultimate goal will be to consolidate and cement the important role of the post in our communities

Tanzania's inclusive digital transformation strategies

By Lokila Mosso

Riding on the wave of technological growth in Tanzania's communication sector, the Government has launched a phased awareness programme on the digital economy for high-level policymakers.

For four days, from 8 to 11 March 2022, some of the ministers, permanent secretaries and heads of regulatory institutions converged in Zanzibar for the first phase of training on the importance of the digital economy. Resources persons included international experts in ICT, economics and multi-sector regulation.

The programme is coordinated by the Tanzania Communications Regulatory Authority. It is designed to enable participants to develop "inclusive" digital transformation policies, legal and regulatory frameworks and strategies and become agents of change in Tanzania's digital journey.

The other objectives are to enable policymakers to identify key digital economy concepts, trends, opportunities and challenges faced and learn about various enabling digital economy policy approaches.

These include digital infrastructure, digital products, skills and innovation and understanding the key elements and the process of developing an enabling regulatory environment for the digital sector and its linkages in all other sectors of the economy.

The Digital Economy refers to an economy that is based on digital computing technologies; the interconnectedness of people, organizations, and machines that results from the Internet, mobile technology.

The Digital Economy is backed by the spread of Information and Communication Technologies (ICT) networks across all business sectors to enhance productivity. Digital transformation of the economy is altering conventional notions about how businesses are structured, how consumers obtain goods and services, and how states need to adapt to new regulatory challenges.

The success of the digital economy is determined by the availability of supporting infrastructure, terminal devices, digital skills and a well-planned strategy on digital transformation. Electronic communication services are increasingly becoming important for everyone.



TCRA Board member Eng. Dr. Mzee Suleiman Mndewa (front right) and other seminar participants following a presentation.

Planning and building inclusive digital transformation strategies will empower top executive policymakers who have a stake in the communications sector in becoming successful agents of change in development through improving their national digital transformation journeys in all sectors of the economy; key issues being inclusiveness.

Digital Technologies have the power and potential to disrupt and transform all sectors of the economy.

A communique issued at the end of the Zanzibar seminar identified some of the key building blocks for the digital economy in Tanzania. These are summarized below.

1. Political will is critical in the realization of successful Digital Economies. Cross-sectoral coordination is a key imperative for a successful Digital Economy.

2. Building a successful Digital Economy rests on five pillars. These are:

   (a) An enabling Environment: regulatory, policy and investments;

   (b) Basic Infrastructure: roads, ports, airports, electricity and water;

   (c) Digital Infrastructure: mobile networks, fixed networks like fibre, Internet,

   (d) Enabling technologies: OTTs, IoTs, 5G, Digital currencies, etc.

   (e) Human Capital Development/Skills: Digital literacy, Media literacy, curricula, entrepreneurship, etc.

3. Each sector needs to review its current policies, laws and regulatory systems with intentions of making them Digital Economy-compliant.

4. All basic infrastructure (such as railways, gas, water pipes, electricity pylons, arterial roads) should be designed and built with consideration of the Digital Economy.

5. A strategy is required to establish a relevant ICT skills development programme in the curricula from primary schools through to universities. This would include the following elements:

   (a) Every school/college to have an ICT laboratory.

   (b) Establishing special ICT schools from secondary and beyond.

   (c) Making ICT a "compulsory subsidiary" subject for Advanced Secondary Schools and an Optional course at O-Level Secondary Schools.

5. Special broadcasting channels for education should be established and used to teach science and ICT among others. (editor's note: TCRA introduced a new licence category for such channels in February 2022)



Seminar participants in a souvenir photograph.

Enabling Environment for the Digital Economy

Excerpts from the presentation by Prof H Sama Nwana at the Digital Economy Seminar, Zanzibar, March 2022.

Tanzania now recognises the "Digital Economy" as more than just "ICT/Telecoms".

The Digital Economy requires Three Pillar Platforms, namely; the Connectivity Platform (ICT Sector) e.g. fixed and mobile broadband, voice, SMS and USSD; the ID Platform -passport, national ID drivers licence and mobile number

and the payment platform (finance/Central Bank) credit cards, bank accounts, mobile money. Tanzania is meandering towards a good payments platform with TIPS, an interoperable digital payment platform operated by the Bank of Tanzania.

There are five Pillars of the Digital Economy: [1] Enabling Environment [2] Basic Infrastructure [3] Digital Infrastructure [4] Enabling Technologies and [5] Human Capital Development.

The evolving Digital Economy is more encompassing than just a single sector/regulator (Ministry of ICIT + TCRA). It needs true multi-sector leadership – centrally coordinated preferably.

Sectors need to work together – and truly together – within a Digital Economy.

Tanzania would need a living and actionable Digital Economy Blueprint.

Proposed Tanzanian Digital Economy Steps from 2022 to 2025 and Beyond.

1. Strengthen offline ICT and telecoms policy and regulation (Ministry of Information, Communications and Information Technology and TCRA0
2. Drive and implement digital economy pillar platforms plus the five pillars of the digital economy (President's Office Coordinating across many sectors) – including postcodes, fibre, FWA, etc.
3. Drive content, broadcasting and media policy, regulation and implementation
4. Drive online policy, regulation and implementation (mitigate harms)
5. Minimize big tech (FANGAM) dominance and big tech harms
6. Drive the following:
   - (i) Cybercrime and cybersecurity policy, regulation and implementation.
   - (ii) Artificial intelligence, machine learning policy and regulation.
   - (iii) Online privacy and data protection policy and regulation.
   - (iv) Electronic commerce policy laws, policy and regulation.
   - (v) Over the top (OTT) policy, regulation and implementation.
   - (vi) Digital economy education and capacity building across government, citizens and consumers (e.g. fake news, misinformation, deep fakes, etc.).

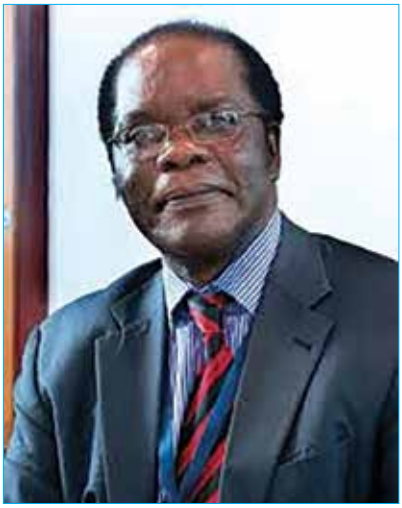
Higher broadband growth spurs economic growth and job creation. There is a connection between broadband penetration and GDP growth.



A digital library in a Tanzanian university. Digital economy steps from 2022 to 2025 and beyond should include digital economy education and capacity building across government, citizens and consumers.

ICT sector Development, the Digital Economy

This paper by Prof; John S. Nkoma of the College of ICT (CoICT), University of Dar es Salaam, Chairman of the Universal Communications Services Access Fund (UCSAF) Board and Former Director-General of TCRA was presented to the recent high-level policy makers' seminar on the digital economy in Zanzibar early March 2022. He discusses the development of the ICT Sector, Digital Transformation journey and the future of the Digital Economy in Tanzania. It has been formatted for the Regulator.



Prof; John S. Nkoma

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The ICT Sector

The Information and Communication Technology (ICT) sector has grown very fast over the past few years mainly because of convergence of telecommunications, broadcasting and computers, digitization of services and applications, and excellent policy, legal and regulatory framework.

The unprecedented growth of the ICT sector in recent years could partly be attributed to the interplay of stakeholders. The ICT sector stakeholders include the Government, Operators, Consumers and the sector Regulator.

Digital Transformation Journey

Digital transformation is a process, a journey, not an event. As such, some requirements must be met. The ICT sector itself must adopt digital technologies, as articulated in the ICT policy, ICT sector legislation and regulations. The important question, however, is to what extent have the other sectors adopted ICTs in their policies?

Examples of such policies include those on energy, water, transport, finance, tax, education, health, agriculture, industries, the environment, tourism and the judiciary.

Definition of the Digital Economy

There are several definitions of the "Digital Economy". The Organization for Economic Cooperation and Development (OECD) defined it as "an economy that incorporates all economic activity reliant on, or significantly enhanced by the use of digital inputs, including digital technologies, digital infrastructure, digital services and data" [1]. It refers to all producers and consumers, including the government, that are utilizing these digital inputs in their economic activities.

Sector Policy

A policy is a deliberate and systematic set of statements made based on principles to guide decisions to achieve rational outcomes. A policy is a statement of intent and is implemented as a procedure or protocol. Policies are generally developed by Ministries in consultation with experts drawn from diverse stakeholders. Policies should be designed to have positive intended consequences, but may also have unintended consequences such as cybercrime, fake news, social media disinformation [2].

The National Information and Communications Technology Policy of 2016

The current ICT/Telecommunications policy of Tanzania is the National Information and Communications Technology Policy of 2016 (NICTP 2016) [3] having reviewed the earlier 2003 versions.

Sector Legislations: Primary Legislations

There are three sector legislations in the communications sector, each of which has its regulations – the Electronic and Postal Communications Act (EPOCA) of 2010 [4], the Universal Communications Service Access Act, 2006 [5] and the Tanzania Communications Regulatory Authority (TCRA) Act of 2003 [6].

The Electronic and Postal Communications Act (EPOCA) of 2010

The Tanzania ICT/ Telecommunications sector is governed by the sector legislation known as the Electronic and Postal Communications Act (EPOCA) of 2010 [4].

The Universal Communications Service Access Act, 2006

To ensure communication services reach rural and urban under-served areas, Tanzania has established the Universal Communications Service Access Fund (UCSAF) through the Universal Communications Service Access Act, 2006 [5].

Development of the ICT Sector: Infrastructure, Services and Applications

One of the most powerful tools of a Regulator is the granting of a license. A license is an authorization or official permission by a regulatory body to a service provider to own something and provide services to consumers. The services are provided by the licensee as per license conditions.

The ICT/Telecommunications regulator in Tanzania, TCRA, operates the Converged Licensing Framework (CLF) introduced in 2005 [7], which has four licenses- Network Facility License, Network Services License, Application Services and Content Service License. These are technology-neutral and service neutral [7]. Technology neutrality is important as it enables service providers to use the same spectrum as technology evolves through 2G, 3G, 4G, 5G and future generations. Spectrum is a scarce resource that needs to be managed efficiently by the Regulator [8]

Infrastructure

The digital transformation journey requires that there must be the necessary ICT Infrastructure. Below we describe three important infrastructure: the National ICT Broadband Backbone (NICTBB) as an ICT/telecommunications infrastructure, digital broadcasting infrastructure and postcodes as a postal infrastructure.

ICT/Telecommunications Infrastructure

One important ICT/ Telecommunications Infrastructure is the National ICT Broadband Backbone (NICTBB) which started operations in 2009. The NICTBB is an important facility that will contribute to the digital economy through the provision of internet bandwidth.

It can be noted that the NICTBB has been designed to connect with all our neighbouring countries: Kenya, Uganda, Rwanda, Burundi, Zambia, Malawi and Mozambique, and plans are in progress to link with DRC. It is also connected, in Dar es Salaam, to EASSy submarine fibre-optic cable [9] and SEACOM fibre-optic cable [10].

Broadcasting Infrastructure

Tanzania was the first country in Africa to successfully migrate from analogue to digital broadcasting, starting in 2012. Digital Broadcasting Infrastructure is illustrated in Figure 3, showing the three standards DVBS, DVBT and DVBC for satellite, terrestrial and cable television respectively.

(***Editor's note:*** DVBT is the abbreviation of Digital Video Broadcasting Terrestrial, DVBC is Digital Video Broadcasting cable; and DVBS is Digital Video Broadcasting Satellite. Tanzania has adopted the DVBT2 standard).

As an example of a planned digital transformation, we can give an example of the Analogue to Digital Broadcasting. TCRA engaged the public through public consultation documents in 2005, 2006 and 2007. In 2009 an International tender for licensing of MUX operators was floated by TCRA, and three MUX operators were licensed in 2010.

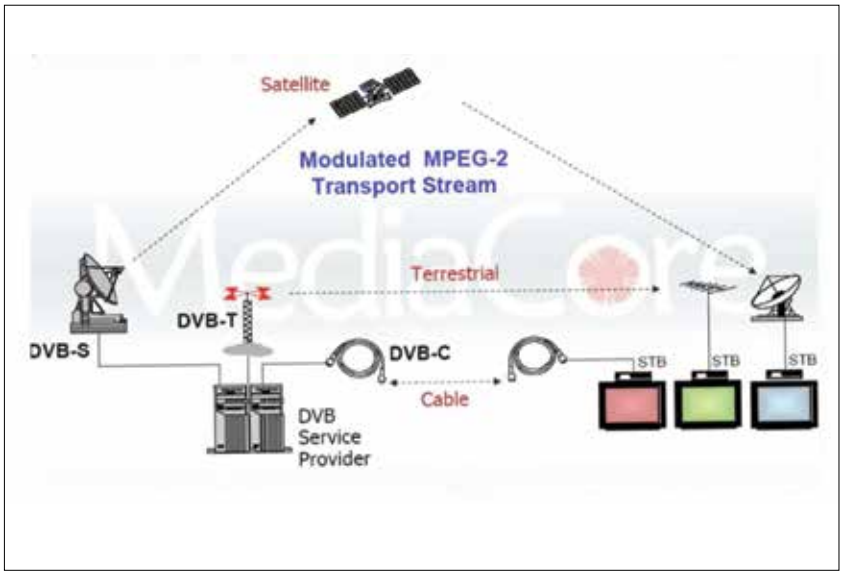


Figure 1: Broadcasting Infrastructure standards: DVBS, DVBT, DVBC



The postcode system facilitates the physical delivery of parcels and items bought through e-commerce platforms.

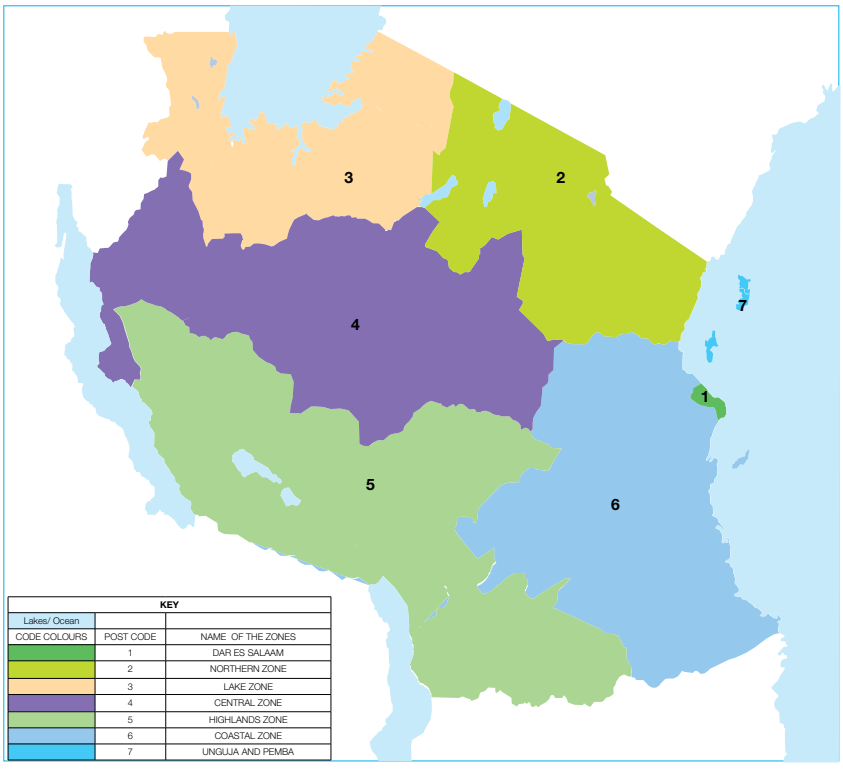


Figure 2: Postcodes zones in Tanzania

Postcode	Explanation
XXXXX	5 digits (Numeric)
X....	1st digit = Zone =1 to 7
XX..	1 and 2 (1st two digits) = Region
XXX..	1 and 2 and 3 (1st 3 digits = District)
XXXXX	All 5 digits = Ward

There was a simulcast period when both analogue and digital broadcasting were taking place. A phased Analogue Switch Off was started with the switching off in Dar es Salaam on 31st December 2012 so that the region entered full Digital Terrestrial Television (DTT), followed by other regions, analogue switch-off and entering to full DTT: 31st January 2013 (Dodoma and Tanga), 28th February 2013 (Mwanza), 31st March 2013 (Arusha and Moshi), 30th April 2013 (Mbeya). Digital broadcasting rollout was continued to other parts of Tanzania.

Postal Infrastructure

The postal infrastructure, through the use of postcodes, is an important facility that will contribute to the digital economy, especially in e-commerce. Postcodes are codes used to identify locations.

They may be numeric (numbers only) or alphanumeric (combination of numbers and letters).



The postcode system facilitates the physical delivery of parcels and items bought through e-commerce platforms

Tanzania has adopted a numeric postcode system based on 5 digits. The country is divided into seven zones, where the mainland has six postcode zones and Zanzibar is one zone, as illustrated in the map below. As an example, the postcode of Mawasiliano Towers, TCRA Headquarters is 14414.

Approximately ten years ago, TCRA did extensive research on postcodes which culminated in the publishing of the postcodes in the Government Gazette Notice No: 220 of 22nd June 2012 [11]. Ten years later, in February 2022, the Government ordered a special operation to implement the postcodes so that the physical addresses of all citizens are ready for the 2022 census.

A lot of things to learn here in the development process. One thing, technical people can conceive a brilliant idea, but we only see implementation when such ideas are comprehended by politicians.

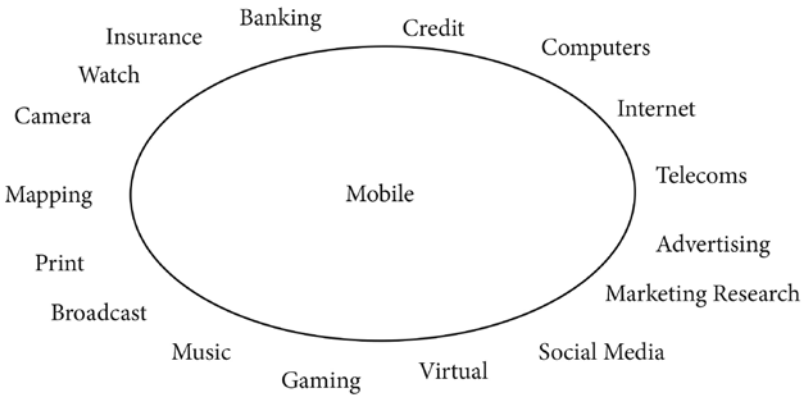


Figure 3: Mobile applications

Table 1: Mobile Subscriptions, Fixed Subscriptions and Penetration (2011 – 2021) [13]

Year	Mobile	Fixed	Total	Tele-density or penetration
2011	25,666,455	161,063	25,827,518	59%
2012	27,219,283	176,367	27,365,650	61%
2013	27,442,295	164,999	27,607,822	61%
2014	31,862,656	151,274	32,013,930	67%
2015	39,665,600	142,819	39,808,419	79%
2016	40,044,186	129,597	40,173,783	80%
2017	39,953,860	127,094	10,080,954	78%
2018	43,497,261	124,238	43,621,341	81%
2019	47,685,232	76,288	49,219,341	88%
2020	51,220,233	71,469	51,292,702	89%
2021	54,044,384	71,834	54,116,218	91%
Source: TCRA Statistics, https://www.tcra.go.tz				

Table 2: Internet Subscriptions (2011 – 2021)		
Year	Internet subscriptions	Penetration
2011	5,311,218	12%
2012	7,520,878	17%
2013	9,312,272	21%
2014	14,217,311	29%
2015	17,263,523	34%
2016	19,862,525	40%
2017	22,995,109	45%
2018	23,142,960	43%
2019	25,794,560	46%
2020	28,470,506	49%
2021	29,858,759	50%
Source: TCRA Statistics, https://www.tcra.go.tz		

Table 3: Voice traffic, SMS traffic and Internet data (2015 – 2021).			
	Voice	SMS	Internet Data
Year	Voice traffic (Minutes)	(SMS Units)	Volume (MB)
2015	43,602,387,357	49,931,762,655	374,574
2016	51,023,633,898	49,881,001,629	428,465
2017	56,053,981,867	78,278,877,567	632,446
2018	62,226,915,881	93,992,846,880	810,867,988
2019	67,383,030,453	105,437,973,380	219,788,614,276
2020	81,645,794,093	133,043,756,400	351,644,419,110
2021	94,868,568,505	137,058,741,780	557,217,157,162
Source: TCRA Statistics, https://www.tcra.go.tz			

Table 4: Mobile Money (Mobile Money Accounts, Number of Transactions and amounts transacted			
Year	Number of Mobile Money Accounts	Number of transactions	Amount transacted TZS ($x10^6$)
2015	17,639,349	1,458,471,661	58,565,217
2016	18,080,622	1,606,771,804	72,022,311
2017	21,889,618	2,244,983,330	102,935,578
2018	23,367,826	2,943,015,134	141,189,615
2019	25,864,318	3,217,680,240	165,471,636
2020	32,268,630	3,477,059,633	201,698,605
2021	35,285,767	4,029,178,046	223,697,871
Source: TCRA Statistics, https://www.tcra.go.tz			

This project is important in the digital economy, especially e-commerce, e-services delivery, taxation data and others. One can get a postcode of any place in Tanzania on a mobile phone, using either USSD, *152 * 00# and following the menu, or on the website www.tanzaniapostcode.com [12].

Services and Applications

In recent years, the ICT/Telecommunications industry has witnessed rapid development, mainly because of developments in information and communication technologies, leading to mobile communication systems have become ubiquitous as evidenced by digital lifestyles through mobile phones, digital financial services, digital music, digital television, online newspapers, digital medical equipment, e-applications (e-commerce, e-learning, e-health, e-government) and the internet. Some applications are illustrated in Figure 1. The digitalized world has a political, social, economic and environmental impact

The Digital Economy: Present and Future

As we move into the digital economy, it is very important to collect statistics and perform the necessary analysis and interpretation. In this regard, the communications Regulator, TCRA, has set up a reliable infrastructure for getting statistics from its licensed operators periodically. In this section, we shall discuss mobile, fixed, internet subscriptions, voice, SMS, data, mobile money accounts, transactions over the years, from which one gets an excellent understanding of the growth of the sector in the digital economy.

Digital economy: The present Mobile Subscriptions and Fixed Subscriptions

Over the past 20 years, Tanzania, like other countries globally, has experienced unprecedented growth of mobile subscriptions, and a decrease in fixed subscriptions, thus making mobile the more dominant means of communication. About half of the mobile subscriptions are also registered for mobile money accounts as can be seen in Tables 1 and 2.

Each mobile operator offers mobile money services, making Tanzania one of the most competitive markets with M-pesa (of Vodacom, shortcode *150 * 00#), tigopesa (of Tigo, MIC, shortcode *150 * 01#), Airtel money (of Airtel, shortcode *150 * 60#), Ezypesa (of Zantel, shortcode *150*02#),



14. Winner of a cybersecurity innovations competition organized by TCRA as part of marking the World Safer Internet Day on 8 February 2022 receives her award from the Authority's Director of. Licensing and Enforcement, Mr. John Daffa. Right is he Director of ICT and Applications Services, Ms. Connie Francis.

Table 5: Other sectors and adoption of ICTs		
S/N	Policy	Possible area where ICT can make impact
1	Energy Policy	Monitoring and reducing energy leakages Energy infrastructure monitoring and maintenance
2	Water Policy	Monitoring and reducing water leakages Water infrastructure monitoring and maintenance Water quality monitoring Promoting water conservation
3	Transport Policy	Transport infrastructure monitoring and maintenance Improving transport schedules by linking with data from the mobile sector Digital payments for tickets (e-tickets)
4	Finance Policy	Mobile banking and financial inclusion Digital currencies Digital payments towards cashless society
5	Tax Policy	Increasing tax base by linking with mobile subscribers Taxation in the digital economy
6	Education Policy	Online teaching, e-Learning Curriculum to inculcate digital knowledge from primary to tertiary level, emphasis on STEM subjects
7	Health Policy	Health monitoring by ICT devices Medical equipment monitoring and maintenance Expanding the use of telemedicine, e-Health
8	Agriculture Policy	Monitoring crop requirements and improve productivity Monitoring and improving crop storage e-Agriculture
9	Industrial Policy	Industrial infrastructure monitoring and maintenance Robotic applications
10	Environmental Policy	Monitoring environmental parameters Monitoring climate change
11	Tourism Policy	Data analysis of numbers of tourists Use of social media in promoting tourism e-Tourism
12	Judicial sector Policy	Digitization of the judicial processes e-Law

Halopesa (of Halotel, shortcode *150*88#), T-pesa (of TTCL, shortcode *150*71#), noting that the shortcodes or USSDs are prepared by the Regulator, TCRA, through their numbering plan [14].

All mobile subscribers are registered, with an identity card from the National Identification Authority (NIDA.) IDs are important as one of the three digital economy platforms; namely Connectivity platform, Payment platform and Identity (ID) Platform [2].

Voice, SMS and Internet Data

Mobile applications began with voice, followed by SMS and over the past few years data has been increasingly important because of the internet. The number of internet subscriptions and penetration or teledensity, over eleven years, from 2011 to 2021 is shown in Table 2. With the availability of the internet on the mobile phone, more subscribers can get online, and use OTT (Over the Top) applications such as Google, Facebook, Twitter, WhatsApp, Instagram, TikTok and Amazon.

In Table 3, a trend of voice, SMS and internet data consumption is shown over seven years, 2015 to 2022. It can be noted all three services are growing, but the rate of growth of data is the highest. Technically voice traffic consumption is measured in minutes, SMS consumption in SMS unit, where 1 unit is 140 bytes or 160 characters, while the unit of data is in MB or higher units such as GB, TB. PB, EB etc.

Mobile money

Mobile money has evolved from simple traditional payments such as domestic transfers and airtime top-ups to more complex applications such as utility payments (electricity, water and TV subscriptions) and interoperability with banks. Tanzania became the first country in the world with full interoperability in 2016. By and large, mobile financial services have contributed to financial inclusion by bridging the gap between the banked and unbanked.

However, taxation costs should be kept low to allow and encourage people to use digital transactions to achieve financial inclusion. It has to be noted that in Table 4, although the amount transacted is huge, it should be realized there is a lot of double, triple, multiple counting, as money is moved from one point to another. An important indicator should be the amount deposited by mobile operators in the central bank.

ICT Emerging issues

As technology develops very fast, there are several emerging have to be alert to, for example, the impact of OTT services, Cybersecurity, Big Data, Spectrum challenge, Internet of things (IoT), Smart Cities and Smart villages, 5G and future Generations, 3D Printing and Artificial intelligence.

Economics of the Internet: The Internet Value Chain

Although the internet has greatly contributed to national and global economies, a study of the economics of the internet is quite complex, as pointed out in a paper by A. T. Kearney, [15] commissioned by GSMA, in 2016. He pointed out that the internet value chain (IVC) comprises five segments: content rights, online services, enabling technology/services, connectivity, and the user interface (devices and applications).

As ICT infrastructure gets more developed, more e-applications such as e-commerce, e-learning, e-health, e-government, e-agriculture will be experienced in both urban and rural areas and contribute to the digital economy.

Incorporation of ICTs in other sectors

As was pointed out earlier, the ICT sector itself must adopt digital technologies, as articulated in the ICT policy and ICT sector legislation and regulations. However, as we move to the digital economy, the adoption of ICTs in other sectors is no longer optional. Below, in Table 5, we suggest possible areas where ICT can make an impact in other sectors.

4.2.3 Cryptocurrencies as Digital currencies

Cryptocurrencies are digital currencies, money or money-like assets created using computers that enables secure trading and ownership, and are primarily stored or exchanged on digital computer systems over the internet. Some of the largest cryptocurrencies include Bitcoin, Ethereum, Tether, Binance, Cardano, Solana, Terra etc. Blockchain is a technology that facilitates the management of cryptocurrencies. There is a need for the central bank to study the impact of digital currencies on the economy.

Discussion and Concluding Remarks

In this paper, we have discussed the development of the ICT sector, the digital transformation journey and the future of the Digital Economy. It has been observed that the ICT sector has grown very fast, but we wish to emphasize that this has not happened by accident, but can be attributed to what has been discussed earlier, where we outlined the policy, legal and regulatory framework of the ICT sector, comprising a systematic development of the ICT policy (NICTP 2016), the ICT sector legislations (TCRA Act 2003, EPOCA 2010 and UCSAF Act 2006) and associated secondary legislation or regulations, and the Converged Licensing Framework

(CLF) of 2005.

One of the important recommendations of this paper is that as we move to the digital economy, the adoption of ICTs in other sectors is no longer optional, but a requirement. Regulation will play an important part in the digital economy and will face considerable challenges. [16].

In the development of the ICT sector, we have seen an innovative step where TCRA introduced the Converged Licensing Framework (CLF) in 2005, with the four licenses: Network Facility License, Network Services License, Application Services and the Content Service License which transformed the ICT sector into a very competitive sector with the resulting ICT infrastructure, services and applications. It is important to note that recently, the Tanzania Government has established The Ministry of Information, Communication and Information Technology.

This Ministry has recently come out with important initiatives such as The Tanzania National Broadband Strategy (TNBS) 2021-2026 [17] and the Digital Tanzania Project, a World Bank-funded project [18], amongst others.

In this concluding section, we wish to make the following recommendations for Tanzania to move into the future of the digital economy.

There is a need to create a change team of inspired individuals dedicated to achieving the desired digitization transformation through a well-articulated vision and steps for the given sector.

- Each sector needs to develop policies, legislations and regulations which adopt ICTs as a catalyst to achieve positive outcomes for the digital economy.
- Each sector needs to develop digital infrastructure, capacity (skilled humans and devices) for data capturing and analysis.
- Need for a Public-Private Partnership to set the agenda for digitization in a given sector.
- Need to involve academia in Research and Development of emerging issues such as OTT, AI, Big data, IVC and Blockchain.
- Involve the public through presentations on radio, TV and social media to enlighten them on steps taken by the sector to achieve digitization.
- It is important to learn from best practices from other sectors which have successfully digitized their processes and systems.

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Mainstreaming Digital solutions

Digital solutions High-Level Digital Economy Policy Makers Meeting opened by Ambassador Hussein A Kattanga, the Chief Secretary of the United Republic of Tanzania concludes in Zanzibar with recommendations on accelerating the emerging Digital Economy in Tanzania.

Why the Digital Economy meeting was convened

Rapid digitalization is affecting all sectors of the economy in Tanzania (as in other countries) – including the way Tanzanians access Government services, how they pay for services, how they work, study, innovate, shop, socialize and receive services. This is the Digital Economy rapidly emerging in Tanzania which encompasses the ICT/Telecoms sector, all digital services, e-Business, e-Commerce, e-Agriculture, e-Education, e-Health, e-Transport, e-Tourism, e-Manufacturing, e- Financial services, e-Taxation, etc.

A Digital Economy Vision, Mission and Strategy for Tanzania would enhance productivity across all sectors of the economy using the Internet and other digital platforms.

For this important latter reason, a cross-cutting and very senior meeting of Ministers, Chief Secretary for the Revolutionary Government of Zanzibar, Principal/Permanent Secretaries, Regulators, Academics, the Controller and Auditor General, the Internal Auditor General, the Treasury Registrar, the Governor of the Central Bank and Heads of Public Institutions met in Zanzibar, 8th to 11th March 2022 to both understand and start mapping out the Tanzanian Digital Economy journey.

The 4-day meeting facilitated and convened by the Tanzania Communications Regulatory Authority (TCRA) was opened by the Chief Secretary of the United Republic of Tanzania, Amb. Hussein A Kattanga. The meeting was closed by the Chief Secretary for the Revolutionary Government of Zanzibar Eng. Zena Said.

The meeting achieved all of its key objectives - primarily and firstly, that of achieving a shared understanding of what the Digital Economy for Tanzania would be and, secondly, a shared understanding of the typical Digital Economy journeys, best practices and learnings from other similar middle-to-high income economies including Nigeria, Kenya, Nepal, South Africa and Malaysia. Such knowledge sharing is critical for the evolving new Digital Economy sector which literally would cover most sectors of the Tanzania economy. It is for this core reason that the meeting hosted senior representatives of the Government of the United Republic of Tanzania and the Revolutionary Government of Zanzibar.

What was covered and Lessons Learnt

Over the four days, the meeting covered all aspects of the Digital Economy foundations. On the first day, the relevant ICT/Telecoms scorecard statistics to the evolving Digital Economy were covered in much detail. This was followed by a recount of the successful establishment of the new converged ICT/Telecoms, postal and broadcasting sector in Tanzania starting in 2003 via well-articulated policies, laws, regulations and their enforcement. The session also introduced the converged licensing framework introduced in 2005 that revolutionized the ICT/Telecoms sector in Tanzania. Then all the basic foundation elements of Digital Economies were covered including the role of emerging new technologies such as Blockchains, Artificial Intelligence, Big Data, Internet of Things (IoT) across many sectors, Over the Top services (OTTs) including all the apps on smartphones, 5G, Digital Currencies, Cybersecurity, Online Regulations and more.

On Day 2, some of these foundation areas were looked at in more detail such as Cryptocurrencies, Distributed Ledger Technologies (DLTs), blockchains, OTT services and the Internet Value Chain. New ways of funding the Digital Economy converged sector were discussed along with the role of Taxes in the Digital Economy and ICT/Telecoms sectors.

On Day 3, the participants engaged in breakout sessions to tackle in a cross-sectorial manner the key pillars identified for the Digital Economy sector in Tanzania. These breakout sessions yielded key recommendations. Day 3 also covered detailed sessions on Mobile Monies/ Mobile Financial services and their migration into the Digital Economy, as well as a detailed session on Cybersecurity progress in Tanzania. These are not exhaustive and sessions allowed for good networking amongst participants who would not meet up regularly. This would be a key feature of the new Digital Economy journey.

Some Key Lessons Learned Included:

1. Political will is critical in the realization of successful Digital Economies in countries studied.

2. Cross-sectoral coordination is a key imperative for a successful Digital Economy.

3. Building a successful Digital Economy rests on five pillars namely:

   (i) Enabling Environment: regulatory, policy and investments;

   (ii) Basic Infrastructure: roads, ports, airports, electricity and water;

   (iii) Digital Infrastructure: mobile networks, fixed networks like fibre, Internet, etc;

   (iv) Enabling technologies: OTTs, IoTs, 5G, Digital currencies, etc.

   (v) Human Capital Development/Skills: Digital literacy, Media literacy, curricula, entrepreneurship, etc.

4. There are three key digital platforms in the Digital Economy:

   (i) Broadband Connectivity - platform covering mobile, fixed, satellite and Internet.

   (ii) Identity Platform – a comprehensive digital identification registry for every Tanzanian.

   (iii) Payments Platform – the replication of offline cash payments online.

   Early evolutions of these platforms in Tanzania were discussed and contrasted with equivalents in other countries like India, Brazil and Nigeria.

5. Many digital economy concepts are cross-cutting across all sectors, e.g. OTTs, Cybersecurity, Artificial Intelligence, Big Data and more. These issues appear across all sectors.

6. The Internet platform is the undisputed platform of the Digital Economy. Since it is so dominant, it brings with it the Internet Value Chain (IVC). The IVC is, in turn, encroaching on the value chains of all other sectors.

7. The Digital Economy is also challenging fiat monies leading to the emergence and issuance of digital currency equivalents, including Central Bank Digital Currencies (CBDCs). All currencies are based on public trust.

Recommendations from the Meeting

Executive Summary – Three important and key recommendations emerged.

1. Digital Transformation is a journey. Much has been achieved already and other important works are ongoing. Therefore, the meeting agreed that it would be important for a Digital Economy Diagnostic Report to be carried out to fully ascertain where Tanzania truly is now in its journey.

2. Post the Diagnostic Report, the meeting recommended that a Digital Economy Framework for Tanzania should be progressed.

3. The digital economy journey should take a 'whole government" approach and therefore it is recommended that it is coordinated centrally.

The following are more detailed recommendations for the five Digital Economy pillars noted earlier.

Enabling Environment Pillar

The key recommendations for this pillar include:

1. Each sector needs to review its current policies, laws and regulatory systems with intentions of making them Digital Economy-compliant. Both core and substantive legislation need to be reviewed to consider new economic developments.

2. The Enabling Environment must also promote Innovation;

3. Relevant policies and regulations to appreciate how start-ups companies work. This includes investment from outside the country, investment from the private sector, taxing, merger and acquisition of startup companies, etc. Also, incentives to the private sector that want to support Research and Innovation.

4. Availability of funds to support proven ideas, de-risking those start-ups to enable them to have proven products, thus attracting private investment.

5. Local Government Authorities (LGAs) be encouraged to use the 10% funds allocated for youth, women and people with disabilities to also support youths with proven ideas.

6. Whilst embarking on this Digital Economy journey, it is important to ensure redundancy, resilience and minimizing single points of failure.

7. It is important to have digital economy champions across the various sectors/ institutions

8. Short, medium and long-term targets should be clearly outlined so that the benefits of the digital economy can be realized as early as possible.

Basic Infrastructure Pillar

1. All basic infrastructure (such as railways, gas, water pipes, electricity pylons, arterial roads) should be designed and built with consideration of the Digital Economy.
2. Implement a pay-once and gig-once policy to expedite [fixed] network rollout and investment.
3. Rights of Way (RoW) to basic infrastructure should be provided in an equitable and cost-efficient manner.
4. Ensure the provision of affordable electrical power and receiving devices.

Digital Infrastructure Pillar

1. A review of the fiber market structure is recommended.
2. There is a need to revisit the NICTBB management and institute for an open access policy
3. A strategy should be implemented to bridge the 3G to 4G or higher technologies coverage gaps in broadband access and connectivity.
4. There is a need to empower citizens digitally through easily accessible communications infrastructure and affordable end-user devices to enable them effectively participate in the Digital Economy.
5. The Payment systems that support internal and external transactions from both the public and private sectors should be coordinated towards a Digital Economy-ready payments platform for Tanzania. Furthermore, speeding up the installation and use of Public Key Infrastructure (PKI) is recommended.
6. There is a need to have a unique personal identification number from birth to death instead of current practice where multiple numbers/ identifications are used.
7. Comprehensively implement the National Addressing System to facilitate e-commerce, particularly digital goods and digital services.

Enabling Technologies Pillar

Enabling technologies to foster the growth of the Digital Economy by providing new ways where sectors can grow. These technologies not only provide further efficiency gains but bigger productivity gains. These enabling technologies further develop new industries. At the policy level, there is a need to address the development and deployment of enabling technologies as follows:

1. In the short term, cybersecurity capabilities should be developed to protect critical infrastructure in Digital Economy. With massive data generation in the digital economy, there is a need to foster the use of cloud computing and big data analytics using machine learning and Artificial Intelligence
2. In the medium term, there is a need to develop capabilities in blockchain technologies, IoT and 3D printing. These technologies may help in ensuring data integrity using blockchains, tracking and sensor networks for industries that require those and 3D printing for rapid prototyping and on-demand manufacturing.
3. In the long term, biotechnology, robotics and energy storage provide new opportunities for the development of the Digital Economy. Capabilities should be developed in biotechnology, robotics and other technologies which can revolutionize manufacturing industries and other related sectors.

Human Capital Development Pillar

1. A strategy is required to establish a relevant ICT skills development programme in the curriculums from primary schools to Universities. This would include the following elements:
    a. Every school/college has an ICT laboratory.
    b. Establishing special ICT schools from secondary and beyond.
    c. Making ICT a "Compulsory Subsidiary" subject for Advanced Secondary Schools and an Optional course at O-Level Secondary Schools
2. There is a need to develop our human capital and build skills that can drive and participate in the Digital Economy and cope with the rapidly changing technologies. This should include a requirement to have basic digital literacy and skills roll-out strategy, especially in rural areas, to ensure proper digital inclusion so that no social group is left behind.
3. Develop a special strategy to strengthen ICT competencies based on professional certifications.
4. Establish special broadcasting channels for education that will be used to teach science and ICT among others.
5. There is a need to embark on continuous research to enhance skills development.