On Issues and Challenges of Rural Telecommunications Access in Nigeria

Y. A. Adediran
Department of Electrical & Electronics Engineering, University of Ilorin, Ilorin, Nigeria
adediran.ya@unilorin.edu.ng

J. F. Opadiji
Department of Computer Engineering, University of Ilorin, Ilorin, Nigeria
jopadiji@unilorin.edu.ng

N. Faruk
Department of Telecommunication Science, University of Ilorin, Ilorin, Nigeria
faruk.n@unilorin.edu.ng

O.W. Bello
Department of Information & Communication Science, University of Ilorin, Ilorin, Nigeria
laibello@unilorin.edu.ng

ABSTRACT

Rural telecommunication access has to do with provision of telecommunication infrastructure in rural communities for the purpose of connectivity within communities and with the rest of the world. There has been growing interest in how to provide universal telecommunication access in developing countries. The trend in digital divide between the rural and urban areas for developing countries reveals a growing gap. Efforts are being made by developed nations to close the gap; hence, there is the need for reversal of this trend by developing nations in their pursuit of sustainable development. The rural communities in Africa, particularly in Nigeria, are strongly faced with many challenges which include extreme poverty, lack of social services and infrastructures, low level of education and health status, as well as unequal access to income opportunities. Despite the fact that telecommunications services in Nigeria could be traced back to 1851, the aforementioned factors, coupled with the difficult physical terrain in some cases, have made them lack behind the urban areas with regard to provision of telecommunications access. In this paper, issues and challenges of providing telecommunications access in the rural areas are provided. The work looks in-depth into the socio-cultural, literacy, security, infrastructure, regulatory and financial sustainability issues. Furthermore, the paper proffers some technological options/solutions to meeting the telecommunications needs of the rural communities in Nigeria within a very short, but reasonable, time.

INTRODUCTION

Telecommunications literally means 'the sharing of information over a distance'. It basically has to do with the conveyance of messages, by electrical means, well beyond the limits of hearing distances. Its theory evolved from mathematical theories and empirical formulas derived from experiments on electricity and magnetism in the 19th century. These led to the invention of telegraphy, telephony, wireless communications, copper conductors and manual exchanges, all forming parts of a communication network. From the 20th century till date, efforts have always been geared towards the development of appropriate improved technologies for achieving optimum quality of service and adequate quantity of facilities and services in order to meet the realities and needs of the age (Ige, 2002). Telecommunication services in Nigeria could be traced back to the colonial era when the colonial masters had to establish communication services with their home government in London. Since then, Nigeria has witnessed positive transformation in the telecommunications sector, though with little or nothing to contribute to the hardware development.

Nigeria's telecommunication sector is found to be one of the fastest growing sectors and this is due to government's liberalization policy of the sector in 2000 (Sadiq et al, 2011). In addition, telecommunication sector has benefited from significant investment in Nigeria over the past fifteen years. This sector had a greater impact on the country's growth over the past fifteen years when compared with other sectors (Sadiq, Oyelade & Ukchukwu, 2011; Pyramid Research, 2011). For example, the percentage share of gross domestic products (GDP) from telecommunications sector in Nigeria rose from 0.06 % in 1999 to 3.5% in 2011 (Nwana, 2014) and about 12.50% in the third quarter of 2013 (National Bureau of Statistics, 2014). However, efforts have been concentrated in the urban communities, thus leaving the rural ones to grapple with low access to telecommunication services.

Rural telecommunication access has to do with provision of telecommunication infrastructure, and universal service in rural communities for the purpose of connectivity within the communities and with the rest of the world. There is a global interest in how to provide universal telecommunication access in developing countries, particularly in the rural areas. Providing telecommunication infrastructure in rural areas is halted by many challenges, some of which

are related to technological issues. However, the focus on the technological aspect essentially concentrates towards advancing the technology. Although it is paramount, we may not however neglect other factors that could have tremendous effects on service provision. Such factors include maintenance of quality of service delivery, service distribution, infrastructure penetration, rural-urban shift and lack of supporting infrastructure such as roads and power grid, all needed to be reviewed. The impact of these factors may however vary from country to country and from region to region. Therefore, the focus of this paper is to provide extensive review on the issues and challenges of providing telecommunication access in Nigeria, also proffers solutions to meeting the services within a very short, but reasonable, time.

RURAL AND NIGERIA RURAL COMMUNITIES

It is a daunting task to define what is 'rural' because its definition depends on so many criteria which vary from country to country and from time to time. For example, what may be considered rural in developed countries like USA and UK may not resemble what is rural in developing countries like Nigeria. In the USA, rural is any territory that is not urban. For national level analysis in Canada, there are at least six alternative definitions of the word 'rural', the classification depending upon the issue being addressed. The question is whether 'rural' is a geographical concept (a location with boundaries on a map) or whether it is a social representation (a community of interest, a culture and way of life). Within the geographical context, for example, 'rural' may be a function of labour market context or settlement context (de Plessus, Beshiri & Bollman, 2001).

IFAD (2011) considers rural people to constitute about 72% of the people living in extreme poverty, that is, on less than US$1.25 per day. However, absolute levels are generally low in developed countries while rural poverty is virtually non-existent in EU and northern Europe (Adisa, 2012). This implies that most of the developing countries have most of the rural population in the world.

In Nigeria, a rural area is classified based on population criterion and as defined by the national statistical office, National Bureau of Statistics. The 1963 census regarded an area inhabited by less than 5,000 people as rural. However, the 2006 census put the threshold at 20,000 people. These indicate that the rural-urban thresholds vary from time to time and from nation to nation. Some criteria used to differentiate between 'rural' and 'urban' include: Size, Population Density, Population Composition, Closeness to Nature, Occupation, Culture, Social Interaction, Social Stratification, Social Mobility, Social Control, and Levels and Standard of Living.

3.0 RURAL DEVELOPMENT AND SUSTAINABILITY

The United States Department of Agriculture (USDA) defines rural development as improvement in the overall rural community conditions, including economic and other quality of life considerations such as environment, health, infrastructure and housing (Adisa, 2012). Rural America tends to be poorer than urban America, a situation that is similar all over the world. However, rural America has a strong tradition of self-starting, risk taking and cooperation. Thus, rural America can be said to be sustainable because a sustainable community is more environmentally sound, economically prosperous and socially equitable. This cannot be said of rural communities in developing countries, such as Nigeria.

Rural development can be said to be sustainable if there is a process of constant change and transformation of the rural areas, encompassing a wide scope of processes and programmes such as (Adisa, 2012): Enhancement of governance at all levels, Development of production process (agriculture and non-agricultural industry, mining, etc.), Development of institutions and their capacities in key areas, and Development of rural infrastructure (roads, electricity, telecoms, housing, water, etc.).

CHALLENGES OF RURAL TELECOMMUNICATIONS ACCESS IN NIGERIA

Provision of telecommunications access to the rural communities in Nigeria has, at various times, suffered setbacks due to corruption and monstrous creations of the past governments in Nigeria. The paths to achieving universal access have led to resounding failures and wasted resources. For example, the Rural Telephony Project (RTP), a loan initiative of a consortium of Chinese investors, gulped a whooping N5 billion before it could no longer fly (Sesan and Omo-Ettu, 2007). However, there are so many issues and challenges bedeveling service provision to rural communities' aside the aforementioned corruption.

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SOCIO-CULTURAL AND ECONOMIC CHALLENGES

The socioeconomic impact of rural telecommunication access has been extensively researched through commissioned studies by various international organizations, such studies cutting across different parts of the world (OECD, 2004; DFID, 2005; Kawasumi, 2014). Some studies have also been carried out with respect to rural telecommunication access in Nigeria. In a study conducted by Pyramid Research (2010), the impact of mobile communications on social and economic activities in Nigeria was extensively discussed. The research details how mobile phones have redefined the way people interact. The effects of these interactions on Nigeria's macroeconomic indices were also mentioned. Opata (2013) made a case for the use of rural telecommunication access in engineering sustainable growth of the Nigerian economy. Nwammuo *et al* (2013) sought to answer the question of the main beneficiaries of the growing Information and Communication Technology (ICT) business in Nigeria and also studied the level of diffusion and utilization of ICT among Nigerian rural women. The economic profile of a rural community allows one to describe the feasibility of implementing a rural telecommunication access scheme in such a community. This economic outlook determines the level of returns on investment and economic sustainability for a rural telecommunication access scheme by providing information for cost and revenue modelling (Nayan et al, 2012). In Nigeria, despite a high economic growth rate of an average of about 7% annually (DFID, 2012), more than two-thirds of the population live below the poverty level, earning less than US$1 a day. With half of Nigeria's population living in the rural areas (World Bank, 2014b), it is evident that the larger percentage of the low income earners in the country is in the rural communities. This poses a major challenge to the deployment of rural telecommunication infrastructure in Nigeria because of the purchasing power of rural dwellers.

POPULATION DISTRIBUTION AND RURAL-URBAN MIGRATION

In 2008, the world's urban population equaled the rural population for the first time. This milestone represented a demographic change and more importantly social, cultural and economic transformation. This change is more significant considering that, two hundred years ago, the world's population was overwhelmingly rural, with less than three per cent living in cities (UN-HABITAT, 2006). Urban growth began to accelerate in the 1950s when the urban population accounted for 29% of the world's population (United Nations, 2008b). Since then, humanity has witnessed the fastest urban growth ever experienced. This urban transition will undergo further progress during the twenty-first century, with largely rural regions, mainly in Asia and Africa, becoming predominantly urban. Fig 1 shows Africa rural and urban population from 1950-2050. In Nigeria, urban population growth rate has steadily increased in the last six decades, causing a massive tilt in population distribution from less than a quarter of the population living in towns and cities in the 'pre-crude oil' era to close to 55% living in urban centres in 2013 (Abass, 2012; World bank, 2014). Migration from rural to urban areas has played a key role in the rapid growth of cities and, together with the reclassification of rural localities into urban centers; it continues to be an important component of city growth. These transformations have been a major aspect, if not a driver, of economic development. On the average, urban residents have better access to telecommunication services such as the Internet, telephone, television and radio network, mobile communication services, etc.

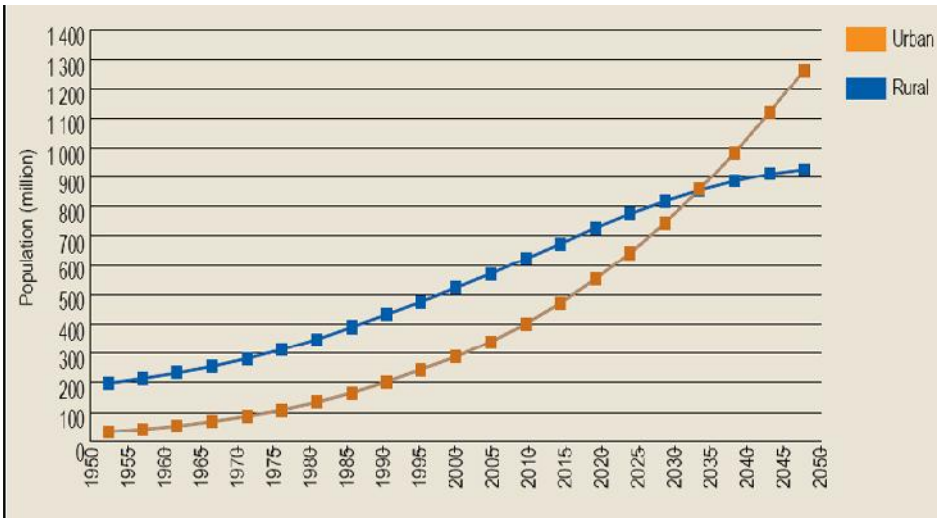

Fig 1. Africa Rural and Urban population 1950-2050. (HSRC, 2015)

The impact of the growing trend in migration from rural communities to urban centres on the feasibility of rural telecommunication access is evident in the effect that the trend has on the economy of the rural communities as well as the socio-cultural structure. With the migration of potential workforce from the rural communities, economic activities are on the decrease and the income gaps between these communities and urban centers are widening. This has the effect of posing economic sustainability challenges to rural telecommunication access. Also, most of the people migrating from rural communities in Nigeria are youths who are more likely to embrace changes in ways of life brought by telecommunication technology. With the ageing population in the rural communities, only limited services can be deployed based on the need of the population, thereby introducing a problem of resource redundancy if a wide range of telecommunication services are deployed in these communities.

LITERACY AND TELECOMMUNICATION TECHNOLOGY AWARENESS

The gap between the information-rich developed countries and Africa, with respect to information availability, continues to increase every day, and Nigeria is not an exception to this negative statistic. Though Africa has 13% of the world population, the country has only 2% of world telephone lines and 1% of Internet connectivity measured in terms of number of Internet hosts and Internet users (Ogunsola, 2005). Telecommunication technology awareness in Nigeria has grown rapidly over the years though awareness in rural communities is still at snail speed.

Nigeria's telecommunication sector has grown rapidly over the years, even though awareness in rural communities is still very low. However, there is a wide gap between telecommunication subscription and penetration. For example, Figures 2-5 show more increase in subscription in developing countries than in the developed countries but in reality, the penetration is very low due to the fact that most subscriptions are concentrated in the urban areas

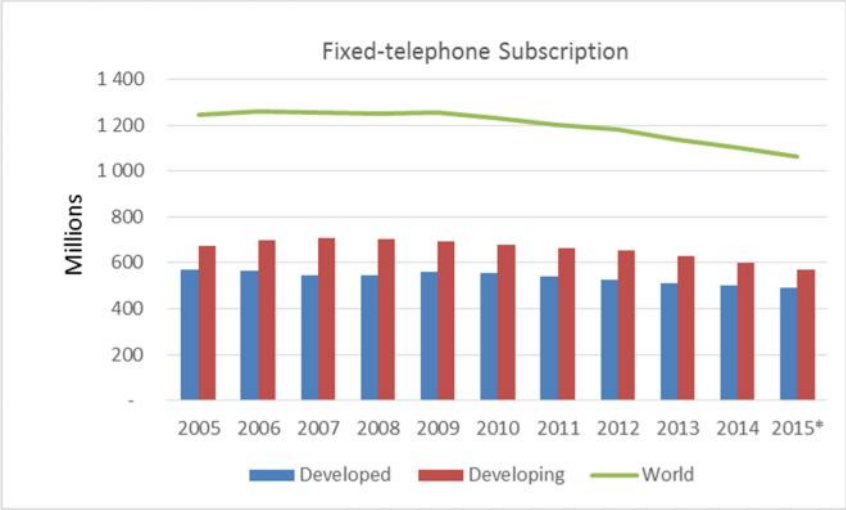

Fig 2. Fixed-telephone (*Data source:* ITU World Telecommunication/ICT Indicators database)

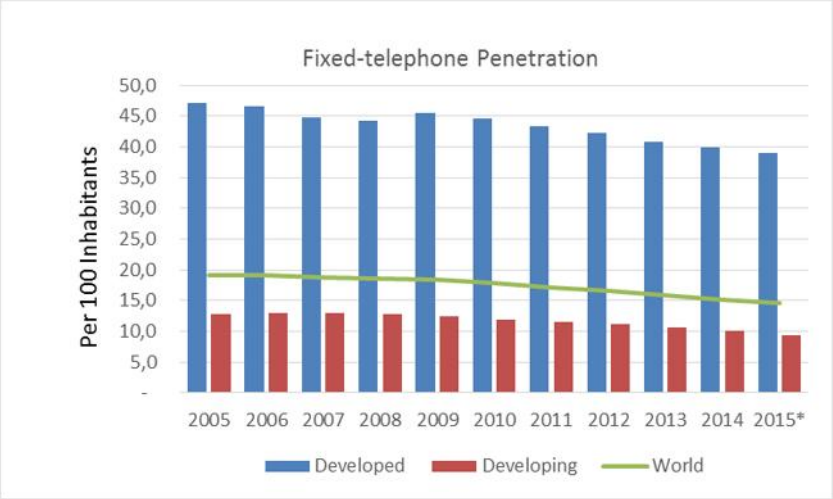

Fig 3. Fixed-telephone Penetration (*Data source*: ITU World Telecommunication/ICT Indicators database)

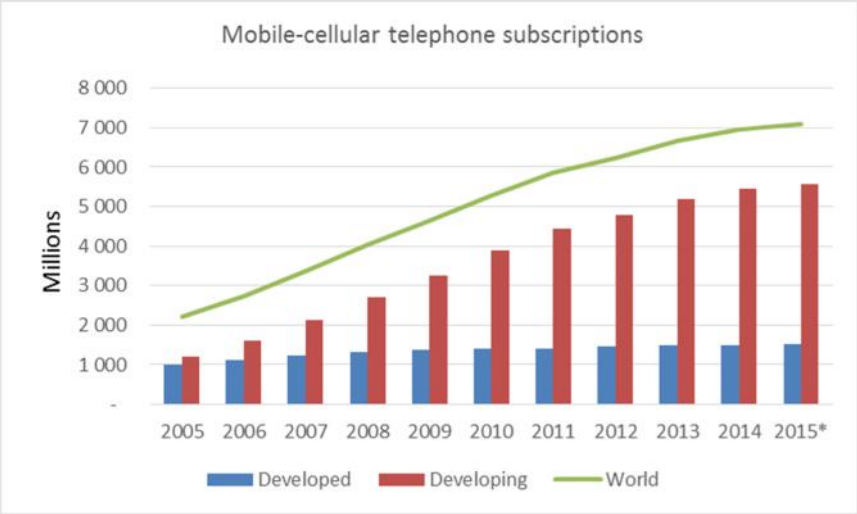

Fig 4. Mobile-Cellular telephone Subscription (*Data source*: ITU World Telecommunication/ICT Indicators database)

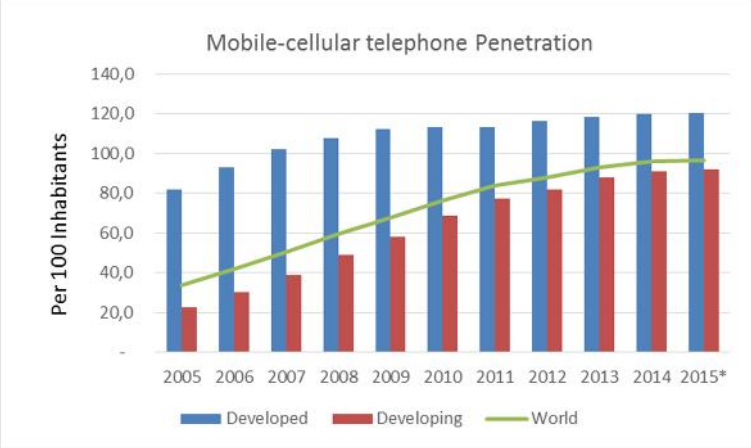

Fig 5. Mobile-Cellular telephone penetration (Data source*: ITU World Telecommunication/ICT Indicators database).*

In rural communities of Nigeria, telecommunication systems are available only on a very limited scale, and this raises doubts about the ability of these communities to participate in the current ICT-induced global knowledge economy. The wide gap in the availability and use of telecommunication technology between urban and rural communities, and the influences telecommunication exert on social integration, raise questions about the inclusion of rural communities in the globalization process. They also raise questions about the feasibility and desirability of efforts to implement rural telecommunication networks, and whether these communities can utilize telecommunication services in accordance with the socio-cultural requirements of their society (Walshan, 2001). Rural communities in Nigeria, like in other developing countries, are faced with problems of poor general and computer literacy and lack of awareness of other telecommunication services beyond telephony. Technological gaps and uneven diffusion in technology are not new. Older innovations, such as telephony and electricity, are still far from being evenly diffused in these communities.

SECURITY AND SOCIO-POLITICAL CHALLENGES

Nigeria in recent times has witnessed an unprecedented level of insecurity. This has made national security threat to be a major issue for the government and has prompted huge allocation of the national budget to security. In order to ameliorate the incidence of crime, the Federal Government has embarked on criminalization of terrorism by passing the Anti-Terrorism Act in 2011, installing computer-based Closed Circuit Television (CCTV) cameras in some parts of the country, enhancing surveillance as well as investigating crime-related offences, heightening of physical security measures around the country aimed at deterring or disrupting potential attacks, strengthening of security agencies through the provision of security facilities, and developing and broadcasting security tips in the mass media (Azazi, 2011). Despite these efforts, the level of insecurity in the country is still high. In addition, Nigeria has consistently ranked low in the Global Peace Index (GPI, 2012), signifying a worsened state of insecurity in the country. With the incessant cases of terrorism in the northern part of the country, many businesses operating in that region, including the telecommunication industry, have been adversely affected.

Rural communities are not left out of the insecurity challenges facing the country. Insecurity affects telecommunication access very severely and the business owners and operators have little or no direct control over the situation. In Nigeria, the problems range from theft of equipment to organized armed robbery, vandalizing of installation, kidnapping and demand for ransom, assassination, repeated invasion and blockading of installations and telecommunication infrastructure, etc. Insecurity discourages investment as it makes investment unattractive to telecommunication service providers. This inevitably translates to a weakened rate of development and advancement. Investors are discouraged because it increases the cost of doing business either through direct loss of goods and properties or the cost of taking precautions against business risks and uncertainty. These costs could have a negative impact on business development and progress. The Nigeria insecurity situation, in a number of cases, has halted business operations during the periods of violence and has also caused outright closure of many telecommunication facilities in a bid to protect lives of personnel and business properties, especially in the areas or zones where incidences of insecurity are rife and are a daily occurrence. In the case of Nigeria, there is also evidence of some businessmen and telecommunication companies having to relocate their telecommunication sites particularly from the North in recent time, to other more peaceful parts of the country (Nwagboso 2012).

Telecommunication firms usually rely on availability and regular supply of resources for smooth running of their operations. Security problems can cut off supply of such resources. Production activities can be disrupted when a firm is unable to access material resources needed for operation due to insecurity.

Insecurity also limits market availability. In addition to the fact that areas prone to insecurity will not be attractive to telecommunication service providers, there will be restrictions on mobility. Besides, migration of people from these areas to other parts of the country or outside as a result of insecurity will affect the customer base operations in the environment where insecurity exists. Some rural communities in Nigeria are currently experiencing this situation. Migration of people could also lead to a dearth of skilled labour. Insecurity promotes fear, thereby limiting peoples' ability to work effectively.

INFRASTRUCTURE DEPLOYMENT COST

Infrastructure has, for decades, been one of the bedevilling factors of universal access and services provision to rural areas in the developing countries. Rural infrastructure is of great importance in network and services provision. The high cost of deployment of network infrastructure has been the main problem that leads to high prices in the tariff

since the network operators would have to recover their investment. The term 'infrastructure' has many features and the concept of 'telecommunication infrastructure' is also a multi-dimensional concept. For example, electronic infrastructure may include the base transceiver station, microwave radio units, routers, switches, radio antennas, signal processing and transmission. However, things like the tower, BTS site, shelter for the electronic devices, power/generating system, air-conditioning systems for cooling, etc. are all non-electronic infrastructures. Now, the choice of using appropriate telecommunications infrastructure that will provide telecommunication access in the rural areas will however depend on many factors as discussed hereunder.

Despite the crucial role that transportation plays in the socio-economic development of every society, it was found that most of the developing countries, particularly in Africa are characterized by inadequate transport systems even in the urban and suburban areas according to Hilling (1996). However, Akinola (2007) pointed out that the condition of rural areas of Nigeria is worse and pathetic as they are highly deprived of infrastructural facilities when compared to the urban areas. Research efforts have shown that only about five percent (5%) of rural roads in Nigeria could be said to be in good condition (Adesanya, 1997); this is a terrible situation as the poor nature of the road makes it virtually impossible for mobility and movement of goods. Road transport situation in rural areas of Kwara State, Nigeria was examined in Usman (2014); it was found that the overall road network connectivity and level of road accessibility are poor in the area.

Access to electricity has always been one of the major challenges in developing countries. According to the report of International Energy Agency (IEA, 2010) in 2008, about 1.4 billion people in the world lacked access to electricity of which more than 587 million inhabitants were from Africa. Also, over 60% of people in Africa live in rural areas and this would affect telecommunication service provision. The lack of access to power grid poses a significant barrier to achieving the millennium development goals (MDGs) in which access to ICT is among the targeted objectives (Akpan and Isihak, 2012). However, the situation was not different in Nigeria where about 53% lacked access to electricity in 2008 according to the World Health Organization (WHO/UNDP, 2009). It is noted that wireless cellular mobile communication is a major option for universal services in Africa. However, the base stations used in cellular system consumed a lot of energy.

Some measures that could be taken to mitigate these problems include:

- Collocation and base station infrastructure sharing: In this method, mobile network operators can become partners in order to lower their increasing investments as well as increased revenue intake. Infrastructure sharing could be active (i.e. electronic based) or passive (i.e. non electronic based). Active infrastructure sharing includes: microwave radio equipment, switches, antennas, transceivers for signal processing and transmission, while the passive infrastructure sharing includes the tower, shelter, air-conditioning equipment, diesel electric generator, battery, electrical supply, technical premises and easements & pylons that account for nearly 60 percent of network rollout costs (Djamal-Eddine, 2011). Although this approach has the potential of reducing costs of investments which may vary in each country, regulatory and competitive climate may however have significant impact on the degree of sharing the infrastructure. In Nigeria, the Nigerian Communications Commission (NCC) has provided detailed guidelines on collocation and infrastructure sharing (NCC, 2016).
- Small cells deployments: the use of energy efficient smaller cells, such as micro, pico and femto cells has the advantage of helping in the reduction of energy consumption of the base station (Bhushan, *et al, 2*014). The relatively low power needs of the small cells are attributed to the fact that they have a smaller target coverage area (less radio transmit power) and can frequently be in powered-down (sleep mode) state. While network densification was conventionally proposed for urban deployment so as to achieve capacity, this approach could still be leveraged in rural areas where a cyber café model of small call can be deployed to provide universal access. A typical power consumption of macro base station range from 1000W-5000W depending on the load and climatic condition (Deruyck, 2011). The micro, pico and femto consume respectively, 100 – 300W, 9 – 15W and 6 – 14W respectively (Auer, G et al, 2011; Deruyck, 2012). The deployment of small cells could be sustainably powered with renewable energy sources.
- Software defined radio based access Networks: software defined radio (SDR) technologies allow new concepts such as OpenBTS (Open Base Transceiver Station) to be deployed. OpenBTS is a software-based GSM access point, which allows standard GSM-compatible mobile phones to be used as Session Initiation protocol (SIP) endpoints in Voice over IP (VOIP) networks (OpenBTS, 2016). OpenBTS is an open-source software that was developed and is maintained by Range Networks (Range Network, 2016). This software allows the base station, base station controller, mobile switching center and all other network

elements of the GSM network to be run as software based. This new development allows the deployment of cost effective and energy efficient radio access networks.

FINANCIAL SUSTAINABILITY OF RURAL TELECOMMUNICATION ACCESS SCHEMES

Financial sustainability is perhaps one of the major inhibitors to the growth of rural telecommunication access in Nigeria. This challenge stems from the need to provide a steady flow of financial resource for maintenance of telecommunication infrastructure and personnel. This is in addition to ensuring a promising rate of return on investment. Depending on the network access scheme that is deployed in a particular rural community, it is necessary to ensure that the market for the telecommunication services provided is robust enough to keep the network afloat.
The huge initial investment involved in the provision of telecommunication services in Nigeria, due to some of the aforementioned challenges and the currently bleak economic profiles of rural communities in Nigeria make it very difficult to craft sustainable economic models that will ensure return on investments that will be attractive to service providers.

There are other economic deterrents to the provision of rural telecommunication access in Nigeria. Some of the deterrents that are likely to affect the interest of telecommunication service providers include multiple taxation and access to capital. It has become a common practice for state and local governments in Nigeria to require companies in their territory to pay some form of taxes, in addition to that which is being paid to the federal government. This multiple taxation regime is a challenge to the provision of rural telecommunication access in Nigeria when overhead cost of providing such services is not commensurate with financial benefits derived from the communities.

. NCC'S REGULATORY CHALLENGES

NCC witnessed a flurry of activities in the telecommunications industry in its initial four years of existence. Today it has come a long way from a government agency with minimal significance to a responsible regulatory body recognised nationally and internationally. Nonetheless, the organisation has been faced with some regulatory challenges. For example, the approval to deregulate the telecommunications sector translated to licensing several operators in order to rapidly meet demand. This led to a highly fragmented market that became difficult to regulate and complex to understand, thus tasking the ability of NCC.

TECHNOLOGY OPTIONS FOR RURAL TELECOMMUNICATION ACCESS

The first target of World Summit on the Information Society (WSIS) is to connect all villages with ICTs and establish community access points. This target is quite different from the conventional *teledensity* which measures the telephones per 100 inhabitants, as it incorporates digital inclusion in the wider perspective, since community access is the main priority and not measuring per capital access. By community access we mean local availability of telecommunication infrastructure and services for rural populace. However, the basic challenges facing Africa range from electricity, access road networks, network connectivity and affordable internet access provision, infrastructure resources, land and sea fibres, satellite to the challenge of domestic connectivity, national and regional internet exchange points (IXP) solutions.

In order to extend ICT access to the rural and remote communities in Africa, there is the need to consider available options. It is however important to note that geographical location of the villages and local terrain of the environment are major issues to be considered when deploying ICT equipments to provide access to the Internet in remote communities. Other factors such as government policies, sources of funding, sustainability of the deployed infrastructures and demography of the villages are also important as they could have tremendous effects on the whole system. Each option has its own unique approach to serving the rural communities and has its own advantages and shortcomings. Some options are deployed in Nigeria and other neighbouring African countries while some are still in the developmental stages. This section outlines some of the existing, new and affordable technological options available today that can be deployed for rural telecommunications access in Nigeria and the like.

DIGITAL SUBSCRIBER LINE (DSL) TECHNOLOGY

This is a technology using existing telecommunication networks (wireline) to accomplish high-speed broadband delivery of voice, data and video (Adediran, 2005). This requires the use of copper cables laid underground or overhead. It therefore uses copper twisted pair to provide high bandwidth transmission. One of the main advantages of DSL systems is that it is a connection-oriented service and can provide broadband access at a cheaper rate when

compared to other high speed broadband services. However, there could be recurrent cost for moving of telecommunication infrastructure from the urban centres to the rural areas. Security could also be a major challenge as theft and vandalism are common and inherent practice in developing countries.

GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM) TECHNOLOGY

GSM technologies such as the 2G, 2.5G and CDMA have been promising globally over the decades and still remain the most widely deployed cellular technology, although CDMA has very low penetration in Nigeria. GSM offers a range of services which include prepaid/postpaid calling, voice mail, short message services (SMS), call waiting and call bearing. A major benefit of deploying GSM in the rural areas is that it can provide considerable data service at a wider range up to 10 km since most of the rural communities are demanding for high data rates and therefore, voice services will suffice.

CDMA 450

Due to the favourable propagation characteristics of CDMA450, it is used to provide cellular service particularly in the rural areas with very high coverage distance. Clusters of villages could be connected via CDMA 450 backbone network. CDMA 450 offers some great advantage and makes it suitable for rural deployment. For example, it could provide coverage and capacity for rural areas at a greater distance and less base stations are required to cover much geographical areas. One of the fears of the network operators is return of investment. CDMA is expected to provide less capital and operational expenditure when compared with other access technologies such as the HSPDA, WCDMA and GSM.

SATELLITE TECHNOLOGIES

Satellite technologies, such as VSAT, could be used to provide data services up to about 15 Mbps and VoIP (Wikipedia, 2014). VSAT technology has been deployed for a variety of applications and in different areas; it has proved to be an efficient and easiest way of providing internet access, for example for banks in remote areas of Brazil, Nigeria, Ghana and many developing economies. This scenario could be expanded to rural communities. Some of the advantages of deploying satellite technologies include: access to remote areas, coverage of large geographical areas and insensitivity to topology. However initial cost of investments, weather and atmospheric effects could also be some bottlenecks for this type of technology deployment.

WIRELESS LAN TECHNOLOGIES (WIFI HOTSPOTS)

Wireless LAN (WLAN) technology was designed to provide high speed wireless connection in a local area. This type of technology has been deployed widely in individual homes and businesses; and, it can be found in many public establishments, shops, buildings and buses in urban cities in the developed countries. Most of the government agencies, universities in Nigeria and internet cafes today utilize the WiFi technology for internet service. WLAN could be deployed in rural areas as it provides a relatively cheap alternative internet access and no spectrum licensing is required. WLAN technologies lacks the range and power needed to make it ideal for serving the rural community. However, coverage could be achieved by having repeater stations; but this may add to the cost. Interference may not necessarily be an issue since few access points are required for rural deployments.

WIRELESS MAN (WMAN) TECHNOLOGIES

Wireless metropolitan area network (WMAN) technology is based on broadband wireless access (Kuran and Tugcu, 2007). There are two major standards for WMAN technology, namely, IEEE 802.16 (WiMAX) and IEEE 802.20 (Mobile Fi). However, IEEE 802.16 Wimax is the global most acceptable standard which aims to provide broadband internet service in urban, suburban and rural areas. WimaX technology could be used to provide coverage up to 50 km covering hotspots villages that are close. It could also serve as a backhaul for underlying WLAN access points deployed in the rural areas. Initial cost of deploying WIMAX could be challenging.

TELEVISION WHITE SPACE (TVWS) TECHNOLOGY

TV white space technologies have been proved to be efficient for providing broadband internet service to under-served or “rural” communities. Within a small community, 2.4 GHz unlicensed WLAN can be used to provide wireless internet coverage, while the TVWS would provide cost effective backhaul connectivity to other rural areas WLANs and the rest of the world. Although TVWS technologies have not been deployed widely for commercial purpose, several organizations such as the Microsoft, Google, SpectraLink wireless, UhuruOne, WaveTek, COSTECH, TENET etc, have however led the TV white space pilot projects across the world (Opawoye *et al.* 2015). TVWS will provide flexible backbone solution at a cheaper rate and high coverage to rural villages (Adediran *et al.,* 2014). Due to its

favourable propagation characteristics, atmospheric effects are not considered as transmission bottleneck in the TVWS bands and therefore, this technology is expected to mitigate problems bedevilling satellite, WImax and WLAN deployment in the rural areas where line-of-sight is not possible.

CONCLUSION

Telecommunication sector is found to be one of the fastest growing sectors in emerging economies. There is global interest by the Government and policy makers on how to provide universal telecommunication service in the rural areas. However, providing the telecommunication infrastructure in rural areas is halted by many challenges, which may be as the result of poor infrastructure and access to basic amenities like road and electricity. Despite these, there is rapid growth in mobile and internet penetration; there are also clear interdependencies between telecommunications services and economic development, and between the penetration and urban-urban shifts. Sharing of mobile infrastructure would be an alternative that would lower the cost of network deployment, especially in rural areas. This will cut down the cost of building and maintaining the infrastructure. Government and policy makers would have to strive to build sustainable business models that support the investment in infrastructure; regional infrastructure companies should be encouraged. Also Government should create support mechanisms to support private sector investment in off-grid electrification programmes. Other immediate interventions for the regulators may include: Extending nation-wide coverage and penetration of telephone services evenly; More active enforcement activity; Improving weak infrastructural base; Encouraging more investment through import duty concession/waiver, bank loans, etc.; Local telecommunications hardware manufacturing industry; Cooperation among government agencies and, Paucity of industry information for policy planning and regulatory rule-making.

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