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SOCIAL-CULTURAL ENVIRONMENT OF COMMUNICATION TECHNOLOGY DEVELOPMENT IN NIGERIA (BROADBAND DEVELOPMENT AS A CASE STUDY)

This research considers the broadband technology development in Nigeria and the environmental factors that bear on its penetration within the country. A thorough studies was conducted on the social and cultural factors that influence the individuals', organizations' and the nation's attitude toward the acceptance and usage of broadband. To affirm this, different assessment tools (organizational culture assessment instrument (OCAI) and Global Innovation Index) were used, which show that the level of the technology penetration in Nigeria widely reflects the various friendly and unfriendly socio-cultural factors that operate within the country. To increase the rate at which broadband penetrates in Nigeria, the identified factors should first be considered and treated either to maximize its posed opportunities or to minimize its unfavorable bearings. This article did not run through all the possible socio-economic factors that affect the rate of broadband technology development and penetration in Nigeria, and hence might require a further studying and identification and tackling of other factors before its development and penetration rate can be improved on. Fig. 6, tabl. 3, ref. 16.

Key words: communication, broadband adoption and penetration, communication technology, technological setup, development, telecommunications and ICT sector, internet connectivity article.

Introduction. The technology is the science of the methods and processes of production of raw materials, goods and services. Technology could be referred to as a body of knowledge of information, skills and experience which is developed for the production of goods and services. It includes scientific and technical knowledge related to products, processes and methods of production; engineering knowledge required to design, develop, implement, produce, operate, install, service, maintain, and adapt machinery; and, also, managerial knowledge required to marshal a labor force, operate plant and equipment, obtain and administer funds, and identify, establish and satisfy markets.

Technological setup is a set of technologies, specific to a certain level of production. In other words, every level of production irrespective of where and what, has a given generation of innovative technology it is characterized with. Generally, there are about six distinct palpable technological setups, and the penetration and acceptance of each of these technological setups with respect to different countries, organizations and cultures vary. One main reason for this variation is because of the

differences in the socio-cultural environments that impact on respective social systems.

Getting any new idea adopted, even when it has obvious advantages, is usually very difficult. There is wide gap various field, between what is known (available technology) and what is actually put into practice (accepted and used technology). Many innovations require a lengthy period than others, from the time when they become available to the time they are widely adopted; hence a common challenge for many individuals, organizations and nations is how to speed up the rate of penetration and acceptance of an innovation [1]. In order to tackle this challenge the social system in question and socio-cultural environment from which it operates must first be identified and analyzed with the aim of determining its current state (challenges, risks and opportunities), and then possible ways of improving it.

Thus **this article is aimed at** investigating some socio-cultural factors that influence communication technology development in Nigeria. To achieve this aim, the author used broadband penetration as a sample study. In the view of this work, a punctilious evaluation of the history of the world's communication technology development, analysis of broadband penetration world-wide and its future trend, current situation of broadband penetration in Nigeria, factors that influence broadband penetration in Nigeria, characteristics and benefits of increasing broadband penetration in Nigeria was made. Additionally, the author elucidated the various challenges that stunt the penetration of broadband in Nigeria, and in conclusion gave some recommendations as to the best possible course of actions to mitigate the challenges.

Methodology. To analyze the socio-cultural factors of broadband penetration in Nigeria, the author used two main approaches: 1) analysis of socio-cultural environment of organizations, including the attitude of individuals in the organizations; 2) analysis of socio-cultural environment on the national level. For the study of the organizational and national socio-cultural environment, the author used organizational culture assessment instrument (OCAI) and Global Innovation Index respectively, as tools for evaluation. Based on the result of the analysis, it was concluded that there are favorable, as well as, unfavorable factors that affects the penetration of broadband in Nigeria, and the extent to which this penetration rate will climb will be highly dependent on the way these factors are managed.

Main findings and discussions. *History of the world's communication technology.* Communication is a connate aspect of human living. This implies that right from creation, man has always devised a means to communicate with each other, as he is what we can call a relational being. Looking back to the evolution of human communication, we can say that the development of communication dated back to many hundreds of years ago (30 000 - 15 000 years ago), when the prevalent means of commination was the use of oral language. This later progressed to the use of cave drawings (circa 15,000 B.C.), written word (5,000 B.C.), printing press (roughly 1450), telegraph (1844), radio (1920s), television (which became more wide-spread in the 1950s), and finally to digital technology.

In order to employ a comprehensive analysis of the history of technological development of communication, we will divide the development into four eras: pre-mechanical, mechanical, electromechanical and electrical.

Pre-mechanical (between 30 000 and 15 000 BC). This age marked the earliest age of communication technology, which started obviously from the use of mere oral language, symbolic language and picture drawings also known as petroglyphs which were usually carved in rock. At this time, the first alphabets (such as the Phoenician alphabet), pens and paper were developed. Due to an emergent need for permanent information storage, books and libraries were later developed. More so during this

period the first numbering system was invented, the aftermath of which was the subsequent advent of calculator (about 2700 BC).

Mechanical (1450 and 1840). This era is known as the period of a new form of communication technology innovation. Lots of new technologies such as printing press which facilitated the mass production of books, newspapers (around 1604), etc. were invented. This led to a somewhat democratization of the communities, as everyone had the possibility to read and spread information, and to question and challenge the information given by established authorities. Subsequently, mechanical telephone and optical telegraph system were created. Moreover, slide rule (an analog computer used for multiplying and dividing), and pascaline (a mechanical computer) were all invented at that time.

Electromechanical (between 1840 and 1940). This era started in 1800s, at the creation of telegraph system (which used electric signals of dots and dashes to transmit language electronically through wires). In 1835, Samuel Morse designed Morse code, and in 1876, Alexander Graham Bell created a telephone. This allowed people to discover information by themselves and also to connect almost outright across long distances, in order word, it relatively sped up communication. Radio was debuted in 1894 by Guglielmo Marconi, and twenty years after, the first television was developed. Harvard Mark 1, the first large-scale automatic digital computer was constructed circa 1940.

Electronic (1940 to present). This is the age we presently live in. This age is noted for the development of digital computing system. The first high-speed digital computer - ENIAC, which used vacuum tubes and punch cards was invented in 1945. This had the capability of being reprogrammed to solve a wide range of computing problems. At a later time, transistor, integrated circuit, and CPU, in order of precedence, were introduced to replace vacuum tubes and punch cards. Internet made its debut in 1983, however, the impact was not felt until 1990s. At this time, it was recorded that about a million end systems were connected to the Internet. Another very significant innovation during this time was the invention of the World Wide Web (WWW).

In summary, the main trend in communication technology could be said to have progressed from man-to-man real-time communication (e.g., telephone), non-real-time communication via an ICT system (e.g., email), and man-to-machine communication to enhance the operability of the machine [2].

A contemporary change in communication technology is shown in fig. 1 below.

The invention of the World Wide Web (www) in 1991 led communication to a new phase that can reasonably be regarded as an optimization phase. The effect of this innovation was so magnificent that about 80 percent of the world was predicted to have been connected to the Internet as at 2010.

Analysis of broadband penetration in the world. The latest technological advancement in communication is in "speed". This was made possible by the development of broadband technology. Broadband could be defined as a high bandwidth connection to the Internet. Broadband is easier and faster to use than the traditional telephone and modem, as information can be sent and downloaded much quicker. Broadband connections comprise both fixed and wireless services offering connectivity with download speeds greater than 256kbit/seconds. Fixed services include DSL, Cable and Fiber. Wireless connections consist of, among others, Satellite and Mobile and Data subscriptions. However, they do not extend to Wi-Fi.

As shown in fig. 2, the advancement of broadband adoption in the world has progressed from multiple new connectivity services to broadband services and lastly to user-centric broadband services.

		1990s	2000s	2010s
Types of Internet interface		GUI (graphical user interface)	TUI (touch-based user interface)	NUI (natural user interface)
Forms of networks		The Internet	Broadband & wireless networks	Near-field communication
Communicators	Person-person (realtime)	Phones, videophones (analog)	Phones, videophones (IP)	Unrestricted sharing context
	Person-person (non-realtime)	Emails, groupware	Blogs, SNS	Multimodal, re-experiencing
	Person-machine	Personal computers	Mobile phones, smartphones	Wearable, assistance
Major trend		Connectivity (flexible connection)	Mobility (connects anywhere and anytime)	Optimization (connects optimally)

Fig. 1. Current trend in communication technology [2]
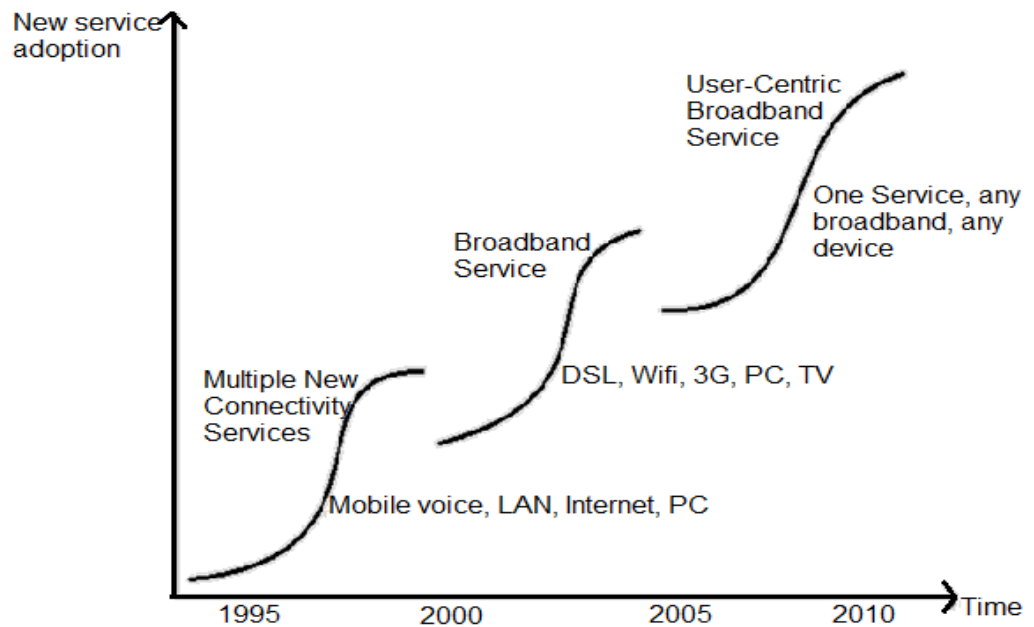

Fig. 2. Technological setup of broadband communications

With regards to technologies, fixed broadband subscriptions continue to grow via cable and fiber optic platforms, and in terms of end-users, cable and satellite communications continue to grow annually at 1.8% and 1.5%, respectively.

Up till 2013, the top ten countries in the world noted for fixed broadband penetration are all located in Europe, with the exception of the Rep. of Korea, in 6th place. In 2014, there were four economies where fixed broadband penetration

exceeded 40%. According to International Telecommunications Union, the total fixed broadband subscription in 2014 accounted 27% in developed world, and 6% in developing world, total mobile broadband subscription was 84% in developed world, and 21% in developing world.

Global ranking of broadband penetration (2013) [10] is represented in table 1 below.

<div align="right">Table 1</div>

Fixed (wired) and Mobile-Broadband Subscriptions per 100 inhabitants, 2013

Country	Fixed broadband penetration	Rank	Country	Rank	Mobile broadband penetration
Monaco	44.7	1	Singapore	1	135.1
Switzerland	43.0	2	Finland	2	123.5
Denmark	40.2	3	Japan	3	120.5
Netherland	40.1	4	Australia	4	110.5
France	38.8	5	Bahrain	5	109.7
Korea (Rep.)	38.0	6	Sweden	6	108.7
Norway	36.4	7	Denmark	7	107.3
United Kingdom	35.7	8	Korea (Rep)	8	105.3
Iceland	35.1	9	Hong Kong, China	9	95.4
Germany	34.6	10	United States	10	92.8
Andorra	34.6	11	United Arab Emirates	11	89.0
Country	Fixed broadband penetration	Rank	Country	Rank	Mobile broadband penetration
Belgium	34.4	12	United Kingdom	12	87.2
Luxembourg	33.5	13	Norway	13	85.7
Canada	33.3	14	New Zealand	14	81.3
Malta	32.8	15	Luxembourg	15	80.5
Sweden	32.6	16	Estonia	16	77.4
San Marino	32.5	17	Qatar	17	76.8
Liechtenstein	32.5	18	Iceland	18	74.3
Finland	30.9	19	Botswana	19	74.1
Hong Kong, China	30.8	20	Coastal Rica	20	72.1

From the table above, we can conclude that developing countries are lagging in the adoption of broadband. For instance, Nigeria was ranked 179 with a fixed penetration of 0%, Ghana – 145 with 0.3% fixed penetration, Kenya 154 with 0.1% fixed penetration, etc. The reason for this lag might be attributed to relative non-readiness of most developing countries to adopt the technology. However, compared to the mobile penetration the rate is significantly different. For most African countries the rate had an upward slope. Nigeria, for example, was ranked 93 with a fixed penetration of 10.1%, Ghana – 52 with 39.9% fixed penetration, Kenya 115 with 3.0% fixed penetration, etc.

In the near future, global broadband penetration as indicated in NTT data, will experience a substantial increase (see fig. 3).
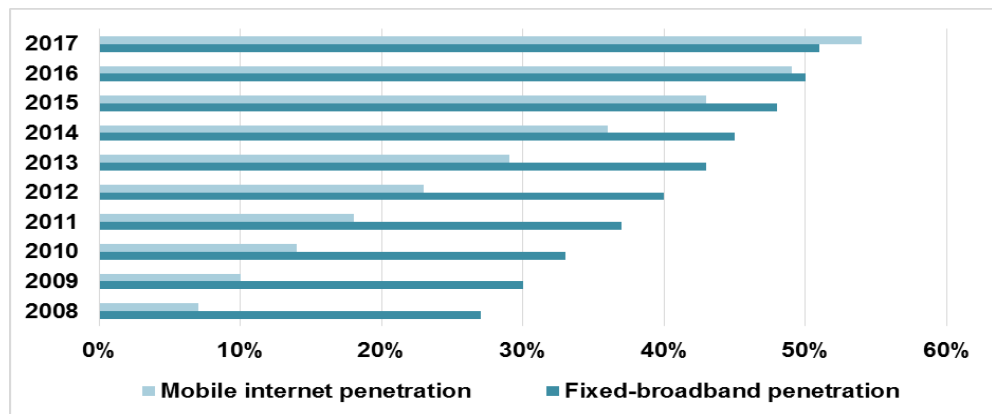
Fig. 3. Worldwide fixed broadband and mobile internet penetration from 2008 to 2017

The figure above suggests that broadband penetration will increase from 50% to 51% (fixed broadband) in 2016 and 49% to 54% (mobile broadband) in 2017. This increase will bring about an improvement in not only communication but also in economy and standard of living at large.

Current situation of broadband penetration in Nigeria. Since the introduction of internet in Nigeria in 1996, both the government and some private investors have made a notable effort on a constant improvement of the network. The figure of telephone subscription has progressed from 113,195,951 in 2012 to 127,606,629 and 139,143,610 in 2013 and 2014 respectively. As at September 2015, the figure further increased to 150,660,631. On the other hand, internet penetration has experienced an upward slope (though not until 2001) from 0.1% in 2001 to 30.94% in 2012, 64.23% in 2013 and 76.32% in 2014. Notwithstanding these improvements, the level of performance of internet connectivity in the country is still inadequate, especially when compared with that of other countries, including some developing countries as Kenya, Ghana, etc. the reasons for this situation are especially because of poor infrastructure supply - domestic backbone networks, and poor management of the available ones.

A model of tele-density and Internet Penetration rate in Nigeria is represented in fig. 4.

The realization of the sluggishness of internet connection and the urgent need for its improvement made the country seek the adoption of broadband infrastructure. Research proves that the internet usage at large and the broadband penetration rate in Nigeria is below average (less than some other African countries: Kenya, Ghana and South Africa). It was estimated that the factual rate of broadband penetration in the Nigeria is approximately 10%.

As evident in fig. 5, we can see that contrary to the rate of broadband penetration in the most world's-developed countries, the rate of broadband adoption in Nigeria is relatively low; its advancement has progressed from multiple new connectivity services to broadband services. Thus, Nigeria still needs to improve its broadband services.

Currently, the prime Broadband backbone infrastructure in Nigeria comprises Glo 1 fiber optic Cables, WACS, NigcomSat-1R and Mainone. Nigeria presently uses optical fiber as the primary backbone infrastructure. However, this infrastructure, though present in all the states including the federal capital territory, is not interconnected with each other and is only concentrated in state capitals and a few urban centers. For instance, only a handful out of about 774 local governments

headquarters already on the route of the primary optical fiber backbone are connected.
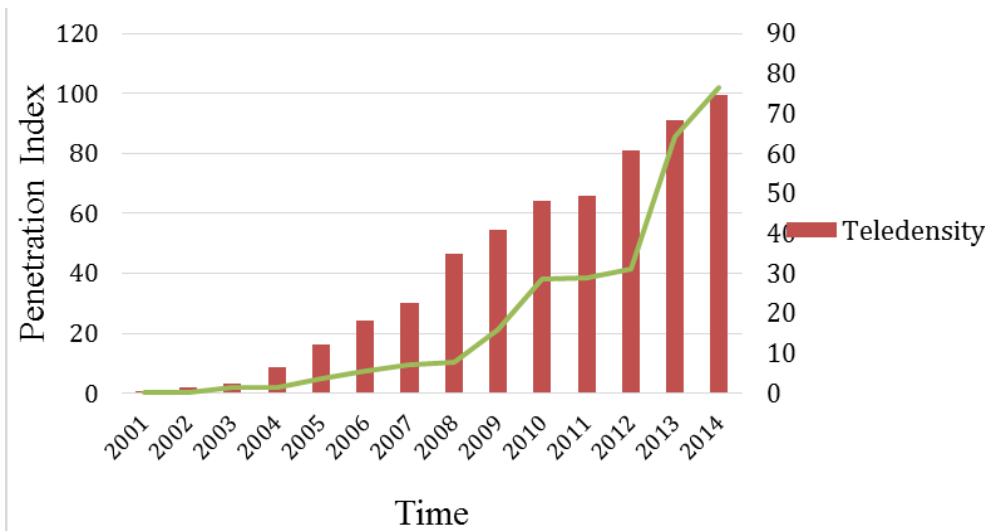

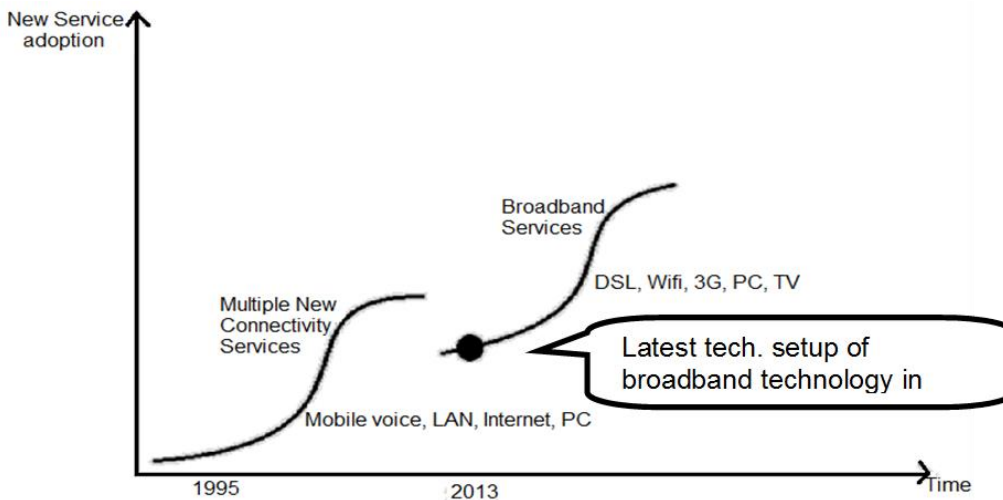Fig. 4. Tele-density and Internet Penetration rate in Nigeria

Fig. 5. Technological setup of broadband communications in Nigeria

Wireless technology is the principal delivery medium for broadband access in Nigeria [5]. The development of mobile networks (2.5G (GPRS), EDGE, UMTS, HSPA, HSPA+, HSUPA, HSDPA and CDMA EV-DO technologies, as well as, the introduction of smartphones and other mobile devices) has not only contributed to the current growth of internet subscription in Nigeria, but has also been the main reason for broadband adoption in the country. It is expected that in the near future the rate of broadband penetration in Nigeria will escalate to about 30%. However, this growth will mainly be as a result of further development of mobile networks, including 4G and or LTE network.

Factors that influence broadband penetration in Nigeria. It is true that broadband penetration in Nigeria has been forecast to have an upward trend in the future, notwithstanding this increase can only become reality on the basis of certain factors. The main socio-economic factors that determine the growth rate of broadband penetration in Nigeria are as follows:

Organizational factors: By dint of using the organizational culture assessment instrument (OCAI) [15], we can define the organizational culture in Nigeria as been dominated by "hierarchy" and "market" culture (see fig. 6). This simply implies that organizations in Nigeria, including telecoms have a formalized and structural working environment that is driven by efficiency, competition and customer satisfaction.

Fig. 6. Dominant organizational culture in Nigeria

Relatively to broadband penetration, we can say that the possibility of growth is high, as telecommunications companies always strive to satisfy the pressing needs of customers (for high-speed of connection, cost reduction, etc.), as well as, to improve efficiency and remain competitive even in the world market. Defining the prevailing organizational culture in Nigeria on the basis of leader type, value drivers, theory of effectiveness, and quality improvement strategy, we will have the following:

Leader Type: Hard drivers, rivals, producers, Coordinators, monitors, organizers;

Value Drivers: market share, goal achievement, profitability, efficiency, timeliness, consistency, and uniformity;

Theory of Effectiveness: aggressively competing and customer focus are effective;

Quality Improvement Strategy: improving productivity and competiveness, creating external partnerships, process control, measurement, systematic problem solving, and quality tools.

National factors: National socio-economic factors which include how the government accept, support and react to innovation at large are other crucial factors that would determine the extent of broadband penetration in Nigeria. According to the Global Innovation Index, as shown in table 2, the level of openness of Nigeria to innovation is highly below average. The reasons for this could be attributed to the

severe political issues in the country, inadequacy of necessary infrastructure, poor creativity culture of workforce, lack of human capital and research, etc.

Table 2

National factors that influence broadband penetration in Nigeria

Indicators	Score (1 – 100)	Rank	Facts of existence
Institution	53.3	91	political unrest, crime and theft, ineffective government bureaucracy, restrictive and unfavorable labor regulations (e.g. taxation policy)
Human capital and research	24.1	115	low public expenditure on quality research institutions, inadequacy educated workforce
Infrastructure	28.2	61	Inadequate supply of infrastructure, paucity of backbone network
Market sophistication	28.0	112	unguaranteed investor protection, poor strength of legal rights for credit (inadequate access to investment financing), intensity of local competition
Business sophistication	22.4	116	-
Scientific output	15.7	106	Inadequate protection of intellectual property, marked Firm-level technology absorption, low level of broadband Internet subscriptions, inadequacy of Internet bandwidth
Creative outputs	23.6	102	poor creativity culture of workforce, low level of R&D performed and financed by business, as well as university/industry collaboration

From the table above, we can see some huge threats to the penetration of broadband technology in Nigeria. The severity of these threats might imply that the rate of broadband penetration will experience a sluggish move, thus might not reach 30% by 2018 as predicted.

Characteristics and benefits of increasing broadband penetration in Nigeria. Beside the socio-economic factors that influence the level of broadband penetration in Nigeria, broadband has some inherent features that favors its penetration in the country. Some of these attributes include its relative advantage, compatibility, complexity, triability and observability.

Relative advantage: high-speed internet connection, highly cost effective, consistency, and reliability.

Compatibility: improved communication system has long been awaited in Nigeria. Broadband conforms to the values and needs of the populace at large.

Complexity: very easy to use, does not require the development of new and complicated skills and understanding to be able to use.

Triability: the government and some prime economic sectors could text the worthiness of the novation by delivering significant services via the net.

Observability: for every 10% increase in broadband penetration, GDP increases by 1.38%; Government and the populace at large would be able to easily connect to the world, thus improve their living standards.

In addition to these, the penetration of broadband in Nigeria presents huge advantages to the individuals, organizations and the nation as a whole. Some of these

benefits include high-Speed of connection, cost-effective, consistency and reliability, better quality & consumer satisfaction, improve in economic development & living standard of the populace. For the purpose of this work, these benefits will be analyzed under the various key sectors of the country's economy: education, commerce, public safety, government, economic and health care.

The benefits of increasing the penetration of broadband in Nigeria is shown in table 3 below.

Table 3

Advantages of broadband penetration in Nigeria

№	Key sectors	Benefits
1	Education	Enhances access to distance learning programs; enhances access to a wide array of professional development opportunities for educators and learners
2	Commerce	enhance e-Commerce & m-Commerce activities in the country
3	Agriculture	Fosters the operation and monitoring of farmer's equipment remotely & the weather condition, eliminating the need for regular farm visits by technicians; improve the famer's knowledge about better farming management practices
4	Public safety	enables new ways of achieving public safety – including new ways of calling for help and receiving emergency response swiftly; provides a more capable and efficient emergency system by providing more voice channels for the service, including voice over IP, VOIP
5	Government	move government processes online, increase the speed of service delivery, improve transparency, reduce arbitrariness and impropriety, and promote cooperation across departments at different levels of government
6	Economic	Leads to increase in GDP growth (World Bank report suggests that a 10% increase in broadband penetration yields an additional 1.38% increase in GDP growth for middle income countries); contributes to job creation and economic growth by improving productivity and accelerating innovation
7	Health care	Speed up advancement (e.g. tele-therapy, telemedicine, advanced diagnostics, etc.); facilitates electronic exchange of information such as data, images and video

From the above analysis, we can thus conclude that the characteristics and benefits of broadband technology has the capability of intensifying the rate of its adoption within the country.

Challenges of broadband penetration in Nigeria. As already mentioned, broadband penetration rate at present is about 10%. This percentage is relatively low, especially when compared to tele-density and internet subscription rate.it is no secret that one of the main reasons for the low penetration of broadband in Nigeria is the unresolved problems facing not only telecoms industry but the entire nation. The main challenges that hamper the fast penetration of broadband in Nigeria include the following:

- High cost of obtaining right of way (ROW). This is one of the major reasons for low level of broadband penetration in Nigeria. Operators have often complained that the cost (in terms of time and money) of procuring right of way (for fiber) and sites (for base stations) is very high. For instance, it could take about 50% - 70% of the total cost of installing fiber in different states within the country to obtain ROW, and about

two years to get an approval for its deployment. All these immensely contribute to the delay in the growth of broadband penetration in the country.

- Paucity and insecurity of infrastructure. Considering the current situation in Nigeria, it would be justifiable to say that bombing and vandalism, theft, outright damage, and so on of telecommunications infrastructure has become a norm in the country. Over 70 cuts on fiber network on a monthly basis have been reported by the operators and these according to them have led to an increase in operation cost, as billions of naira are spent on a regular basis to repair the network cuts [4]

- Multiple and illegal regulation and taxation at Federal, State, and Local Government levels. The tax rate levied on telecoms companies is relatively high compared to other companies outside telecoms sector. Moreover, there are lots of illegal taxation going on in the country which greatly disfavor telecoms and ICT sectors. In most cases, telecoms sectors are faced with the situation of having to pay unnecessarily excessive taxes and payments to public and even private authorities, who might threaten and in most cases sabotage infrastructures if they fail to make the payments.

Inadequacy of investment, and low level of access to funding. This is another big reason for the low level of broadband adoption in Nigeria. There is a huge discriminatory gap between large-sized and small and medium-sized telecoms companies. Large-sized companies have greater opportunities to access funding than the small and medium-sized, thus limiting the possibility of fast demand and adoption of broadband. Also operators as often as not tend to invest only in the areas where they feel could yield substantial financial return. This attitude, however, has been of the main reasons why the rate of broadband adoption in the country is still low, as the operators concentrate only on few urban areas, leaving the rural areas undeveloped.

Conclusions and recommendations. The important of increasing broadband penetration in Nigeria cannot be overemphasized, especially because of the fact that its benefits touch virtually every aspect of the country's economy. At present, the rate of broadband penetration is almost insignificant compared to the tele-density and the rate of internet subscription in the country. However, it is forecast that by 2018, the penetration rate will increase to 30%.

Considering the characteristics of broadband, the benefits of increasing its adoption, and the social-cultural factors that might influence the adoption of broadband in Nigeria, we can say that this prediction can become reality. Notwithstanding this can only be if and only if both the public and private sector could put heads together and tackle the prevailing challenges that are facing the telecoms sector.

One of the best ways to grow broadband penetration in the country is by stimulating demand for broadband access, promoting the deployment of applications that are relevant to Nigerian users and will add values to their lives, and providing universal access to broadband services to the same extent as other communication services [5]. Operators should endeavor to extend their investment to the rural and remote areas rather than just investing in the few major cities of the federation.

The federal government should collaborate with the private sectors to invest in infrastructure, especially the national backbone infrastructure that has the capacity for allocating broadband throughout the nation. The government should review the issues of multiple and illegal regulation and taxation at all the tiers of government by establishing and ensuring the implementation of laws that protect the right of telecoms and ICT operators against these illegitimate acts. Also a serious step should be taken towards reducing both the cost and time of procuring right of way.

Without an adequate and easy access to funding by not just large-sized companies, but also the small and medium-sized ones, the predicted increase in

broadband penetration will probably become a mere speculation. For this not to be the case, both the public and private sector must devise new ways of addressing the funding limitations, increasing the viability of broadband for local and foreign investors.

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