



Linking the Role of Government to Internet Diffusion in Nigeria: Is the “Giant” of Africa Awakening?

Nixon Muganda

**Department of Informatics
University of Pretoria, South Africa**

Felix Bankole

**Department of Information Systems
University of Cape Town, South Africa**

Abstract

This paper focuses on the role of government in the development of the Internet, as a representative artifact of a National Information Infrastructure (NII) of a country. We consider Nigeria, a developing country that has been attempting to enhance the role of Information and Communication Technologies (ICTs) in various sectors of her economy over the years. A longitudinal analysis of Internet diffusion, as a representative NII technology was undertaken using the Global Diffusion of the Internet (GDI) framework. As is the typical practice with studies employing the GDI framework, empirical data was gathered from a variety of documentary sources including government/regulatory bodies reports and policies, websites, newspapers and research articles. The analysis reveals that there has been a determined focus on the development of the NII infrastructure in Nigeria. What comes to the fore is the important role that government is playing in ensuring that the Internet contributes to the economic rejuvenation of the country. We pinpoint that the federal government has been ineffective in indirectly facilitating the sector in the roles of strategist, guider and integrator. It is hoped that current and future policy initiatives in the telecommunications industry will change the negative determinants of NII development.

Keywords: Nigeria, Internet Diffusion, Africa, Telecommunications Policy, GDI

INTRODUCTION

This paper focuses on the role of government in national information infrastructure development (NII), a term related to “everything that produces, contains, processes, or uses information, in whatever form, or whatever media, as well as the people who develop the information, applications and services” (Kahin 1997, p.163). NII initiatives are partly government – driven and are typically intended to promote the diffusion of Information and Communication Technology (ICT) innovations related to all spheres of social and economic activity (Castels, 1996). The ICT revolution, typically referred to as the information society, or even the knowledge society, is considered as a conglomerate of technologies for information processing and communication currently related to all domains of human activity, realized through pervasive NII initiatives by governments (Castels, 1996). Building such large scale NII initiatives requires the mobilization of resources, legislation and political will for successful realization of a knowledge-based society, yet the objectives of such NII programs are rarely realized as envisioned (Fomin, 2004). We seek to assess how the role of government impacts on the success of NII initiatives in an African context guided by the following research question:

“How does the role of government impact the trajectory of Internet development?”

The national information infrastructure (NII) notion was first coined by the Clinton administration as a political (and therefore a government) plan aimed at building a nation-wide network and information resource premised on the Internet and World Wide Web (WWW) (Branscomb & Kahin 1996; Kahin & Abbate 1995; McGarty 1992). The EU later followed with the Bangemann report for the establishment of a European information infrastructure as the basis of the information society (Bangemann Report, 1994). The concept of NII has for instance been applied as a theoretical tool for studying the nature of the evolution of communication platforms (Jansen & Nielsen, 2005). We therefore use the diffusion of the Internet and the WWW, as representative of a conglomerate of technologies that can be used as indicators of NII development. The context of our study is Nigeria, a developing country that has been attempting to enhance the role of various ICTs in various sectors of her economy over the years. Nigeria is the most populous country in Africa with a population of over 168 million. This current article is a substantial modification of an earlier paper that was published in *Proceedings of the 10th Annual Conference on World Wide Web Applications*,

3-5 September 2008, Cape Town, South Africa. We make modifications in the framework to take into account the significant role that mobile telephony is playing in Africa; changes in the analysis of Internet diffusion since 2008 are also taken into account as well as a substantial review of the literature to support our argumentation towards a discussion of the role of government in NII development.

A specific focus on NII initiatives in Nigeria is motivated by the need to contribute to the accumulation of knowledge on experiences related to the development of NII since the 1990s when democratic reforms started ‘sweeping’ across Africa. It is reported that by December of 2010, 48 African nations had held democratic elections, a probable indicator that governance in Africa is becoming more accountable, and thus the opportune -ness of assessing the role of government in various sectors in the economy. History has also shown that the democratization forces (Table 1) in Africa played a role in the liberalization of the telecommunications sector which was ‘fought’ at the negotiating table (Muiruri, 2004): On one hand, national governments in Africa were stuck with quangos that continued to be a drain on budgetary resources, yet realization of a national telecommunications infrastructure remained a ‘pipe dream’. Further, a majority of these governments hold the belief that telecommunications remains a national security issue and should be controlled by the government. On the other hand, there were civil society organizations in many parts of Africa that pressed for telecommunications sector reform in order to spur Internet development in the continent. There was also pressure from international financial institutions and development partners that insisted on sector reforms in order for African national governments to receive budgetary support. Of course due to resource constraints, many national governments in Africa acquiesced to pressure to liberalize the telecommunications sector, despite their opinion being contrary to the international donors.

Actors	Milestone	Determinants
Internal Donors; Civil Society; governments	Telecommunications Liberalization	Wider Democratization of Africa
Private Sector; Civil Society	Commercialization of the Internet	Public Resource Constraints
Quangos, Private Sector	Cellular Service Takes Root	Unresponsive Fixed Telephony

Table 1: 'Forces of Change' in NII Development in Africa

We focus on Nigeria, not due to its representativeness of Africa alone, but based on the claim that it will continue to play a significant role in Africa’s ICT sector, and as a global player. This paper recognizes that there is currently a dearth of

studies that have focused on Internet development in Africa. The specific focus of the study is to assess the role of government in Internet diffusion in Nigeria.

There are five major sections in the article. The first section presents a discussion of the various NII perspectives and the justification for assessing the role of government Internet diffusion. The second section of the paper presents the framework that has been adopted for assessing the diffusion of the Internet and the diffusion of its technologies in Nigeria; while the third sections presents empirical analysis, emphasizing the influencers of Internet diffusion; while the fourth part is on government policy initiatives for the development of the Internet and their likely impacts. The fifth section presents the conclusions structured around the role of government in infrastructure development.

LINKING THE ROLE OF NII DEVELOPMENT TO THE GOVERNMENT

Shin (2007) categorizes several roles that may be played by the government during the process of building a NII. The government can act as a *direct intervener*, by setting goals and guidelines for industry to follow (*controller*); by providing the physical infrastructure for everyone to access information (*builder*); by creating a fair business competition ground (*regulator*) and by becoming a major producer and buyer of ICT (*investor*).

The government can also act as an *indirect facilitator*, in which it becomes the main body for developing a vision for the whole country (*strategist*); creates a proper environment for innovation and growth through channeling of resources to the ICT sector (*guider*); establishes ICT as a national priority (*leader*); and articulates the objectives of various programs into a single vision (*integrator*) (Shin, 2007). The two major sub-categories (direct or indirect intervener) will be used to point out possible roles that were, and were not, adequately played by the government in positively influencing the development of a NII for Nigeria. This is done by looking at the various determinants and how the policy initiatives by the Nigerian government are likely to impact the trajectory of Internet diffusion.

We link the role of government from the various NII perspectives: that from a Physical NII perspective¹, any government is in a better position to augment NII development over already existing installed bases of other infrastructure; while from a Socio-Technical perspective², the long term evolution of a NII requires the nurturing of the various substructures of a NII, based on common platform of

¹ The physical infrastructure perspective regards IIs as an *extension of the existing physical infrastructure* such as roads, schools, power plants, transport systems, and communication systems (Webster, 1978 cited in Jansen & Nielsen, 2005).

² The socio-technical perspective regards II as a “*shared, evolving, open, standardized, heterogeneous and a socio-technical construction*” (Hanseth, 2002, p. 7).

protocols to ensure interoperability, stability, reliability and persistence (Lyytinen & Yoo, 2002). This is a feat which can be effectively carried out if the government plays a dominant role in marshaling collaboration and resources from heterogeneous stakeholders. The Network perspective ³ of NII brings to the fore the value of NII investments and the attainment of a critical mass that ensues. Therefore, building a physical NII is not the object, rather, the object of any infrastructure is whether it is adopted or not. We therefore consider the criticality of NII use in assessing the role of government in developing a NII.

Additionally, a *relational perspective* ⁴ of a NII directs attention to the distinction between the various users and the developers; which can be characterized as the demand and supply side of an Information Infrastructure (II) respectively (see Jansen & Nielsen, 2005). The concern of the users from the demand side relate to necessary investments for the adoption of NII technologies and services, as well as their preferences and practices that influence use. The supply side of the NII designers and developers build on the *strategies, practices* and *investments* required for the successful realization of NII programs of action. NII program designers, based on their own context and history, interpret the development processes and their implications differently since NII technologies still remain an as an export to developing countries (Kumar et al, 2007), are at first, interpreted by the Western designers, and eventually also need to be interpreted and contextualized by the designers in the local context of the developing countries. What eventually is the NII for a country emerges as the interests of the various designers according to how they believe the various design choices support their own interests.

All the four NII perspectives are interrelated and mutually supportive of each other and are useful in describing and explaining the information infrastructures and their complex dynamics. The substructures of NII services and technologies from the various II perspectives underlined are continually *evolving* (Hanseth & Monteiro, 1998) and essentially historical in character, implying that changes are related to what already exists (David, 1985). The emphasis is therefore on the significance as well as the constituents and structure of their *installed bases*. The Information Systems (IS) perspective, while recognizing the various II views, is particularly inspired by a *relational perspective*, in which distinction is made between the *demand-side* of installed base, which is composed of the user preferences, practices and investments, and the *supply-side*, which is related to the

³ The network economics perspective considers II as evolving according to network effects such as increasing returns, positive feedback, network externalities, path dependency and lock-in (Jansen & Nielsen, 2005)

⁴ This perspective reveals how choices and politics embedded in such systems become articulated components (Jansen and Nielsen, 2005).

design, implementation and diffusion of technologies of relevance for the development of a NII. Integrating the IS and the role of government in developing countries teases out the importance of focusing on the *supply-side* of NII development.

RESEARCH FRAMEWORK FOR INTERNET DIFFUSION ASSESSMENT

This study adapts the Global Diffusion of the Internet (GDI) framework by Wolcott et al (2001) to investigate the diffusion of the Internet infrastructure in Nigeria. The GDI framework consists of six *dimensions*, each of which describes a somewhat intuitive and measurable feature of the presence of the Internet (a NII) and its related technologies in a country (Wolcott et al, 2001). Figure 1 captures this adapted version of the GDI dimensions and their interrelationships. The *National Information Infrastructure (NII)* provides the telecommunications base, without which there would be no Internet and other related technologies which are relevant for an NII. Between the *NII* and the *Users* (Individuals and Organizations) are a host of proxies (Internet Service Providers, National Backbone Providers; Application Service Providers; Fixed and Wireless Service Providers, etc.) – the NII Service Providers. The dimension that captures the state of the *NII* is *Connectivity Infrastructure*. The *Users* at the top level require certain technologies to use NII-based services. The dimensions that capture these aspects are *Sectoral Absorption* and *Pervasiveness*. *Pervasiveness* is a measure of the number of individual users of various NII technologies in a country relative to the total population. *Sectoral Absorption* considers the use of the NII technologies from the viewpoint of adoption at an organizational level.

Sophistication of Use recognizes that the adoption of the leading edge applications that derive from the Internet depends not only on what the users want, but also on what the Internet is able to provide. Organizational infrastructure captures the number and robustness of the organizations that provide various services such as Internet Service Providers, National Backbone Providers; Application Service Providers; Fixed and Wireless Service Providers. *Geographic Dispersion* reflects the extent to which these organizations, along with the supporting Internet infrastructure, are distributed across the entire territory of a country.

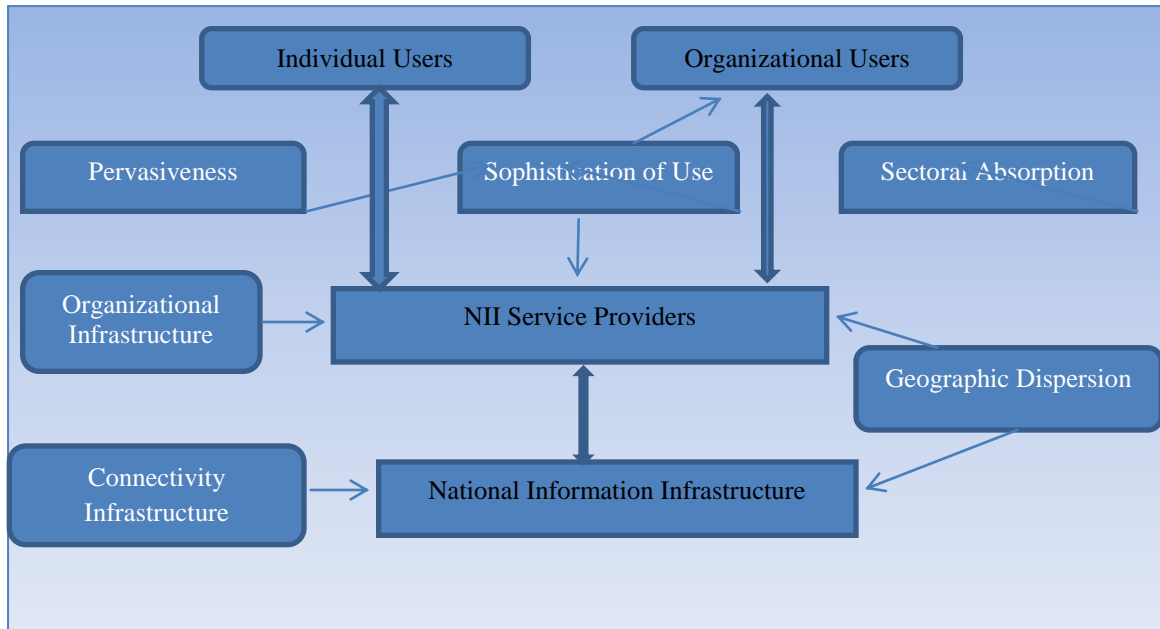


Figure 1: Constituents of the NII Technology Cluster (Adapted from Wolcott et al. 2001)

In our assessment, we make the assumption that the six dimensions (*Organizational Infrastructure; Connectivity Infrastructure; Geographic Dispersion; Sectoral Absorption and Sophistication of Use*) cover all aspects that may be of interest when measuring the use of NII-based services such as the Internet. Each dimension may be assigned one of five ordinal values ranging from zero (non-existent) to four (highly developed). These levels can be used to indicate the state of development of the NII in a particular country at a given point in time. The GDI framework has been used to analyse Internet diffusion in over 40 countries, thus it can be considered to be well documented (Wolcott et al, 2001). Therefore, we rely on this history to provide some traction for the modified version that we advocate for and employ it to assess the state of Internet diffusion in a country.

The possible determinants used to explain the various levels of the six dimensions representing Internet diffusion in a country are derived from the generic ones that form part of the GDI framework and are modified to be relevant to NII in general (Table 2).

Qualities of the NII technology itself	
1. Perceived value of a NII	Value the NII provides to a country.
2. Ease of use of the NII-Based Applications	Looks at literacy and availability of local-language content
3. Cost of Internet and Mobile Telephony access	Entails looking at Internet costs (dial-up, ISP, etc.) and mobile phone usage costs relative to income levels
Inter-relationships within the NII technology cluster	
4. Access to constituent technologies	Looks at the balance between all the technologies that must be present for various levels of use
5. Demand for capacity, multiplicity of Service Providers, services provided	How demand at various levels of the cluster is driving the connectivity infrastructure development
External/surrounding forces	
6. Geography	How physical geography influences NII development
7. Adequacy and fluidity of resources	A broad category considering financial, informational, human, technological or capital, and material resources and the ease with which they can flow from where they are to where they are needed
8. Ability to execute	The ability to develop a sound strategy and a suitable design given opportunities and constraints, and the ability to manage plans through to completion
9. Culture of entrepreneurship	How entrepreneurship is rewarded
10. Regulatory/legal framework	Specific laws and regulations influencing Internet diffusion
11. Forces for change	Include competitive environment, presence of demanding domestic customers, rate of creation of new organisations, presence of champions
12. Enablers of change	Conditions that allow a community to accept and incorporate change, including institutional, historical, cultural, and educational factors

Table 2: Determinants of NII Diffusion (adapted from Wolcott et al., 2001)

The choice of the Global Diffusion of the Internet (GDI) framework as the explanatory lens for mapping Internet diffusion and its determinants was based on its robustness in making country level assessments of the Internet as a NII cluster of technologies (Wolcott et al, 2001).

RESEARCH METHODOLOGY

The philosophical assumption underpinning this study is interpretivist, and it adopts a qualitative research approach with the overarching theme of explaining the nature of government intervention in NII development in Nigeria. The GDI framework advocates a qualitative approach since it recognizes that development of telecommunications infrastructure is a multifaceted phenomenon that takes place in a variety of ways over time (Wolcott et al, 2001). The qualitative approach does not constrain the analysis to any predetermined variables, but rather allows the researcher to examine the "rich organizational and political processes whereby a given set of information technology is "instantiated" (Lee, 1999). Furthermore, it has long been recognized that interpretive methods, along with surveys and possibly field experiments and case studies, are most appropriate for studying information systems phenomena at the level of a society (Galliers and Land, 1987). Thus we find in the IS literature itself strong justification for taking a qualitative approach in determining the value of the dimensions.

Based on recommendations from the classic GDI framework, this study relied on the following recommended sources of empirical data (Wolcott et al, 2001, Brown et al., 2007):

- Collecting any available data from other studies, press reports, net-based collections methods, government reports and policy documents, etc.
- Collecting primary data from the Internet/WWW itself. For example, surfing web pages of ISPs, government websites, etc.

The design of the GDI framework allows for the analysis, discussion and the interpretation of the results, which are depicted as a Kiviat diagram. The next section therefore presents the analysis and a discussion of the results.

ANALYSIS AND DISCUSSION OF RESULTS

The starting point is to provide a summary of NII technology diffusion on a Kiviat diagram as well as a summary of the possible determinants responsible for the dimension levels. This is then followed by a discussion on how these determinants have influenced the magnitude of the GDI dimensions.

Figure 2 summarizes the analysis of Internet diffusion in Nigeria up to July 2012, and is discussed in more detail below. Table 2 provides a summary of the determinants that are considered as proximate causes of Internet diffusion status depicted in Figure 2. The analysis and discussions that follow refer to Figure 2 and Table 2 and are structured around the six dimensions in the following order: pervasiveness; geography; sectoral absorption; connectivity infrastructure; organizational infrastructure and sophistication of use.

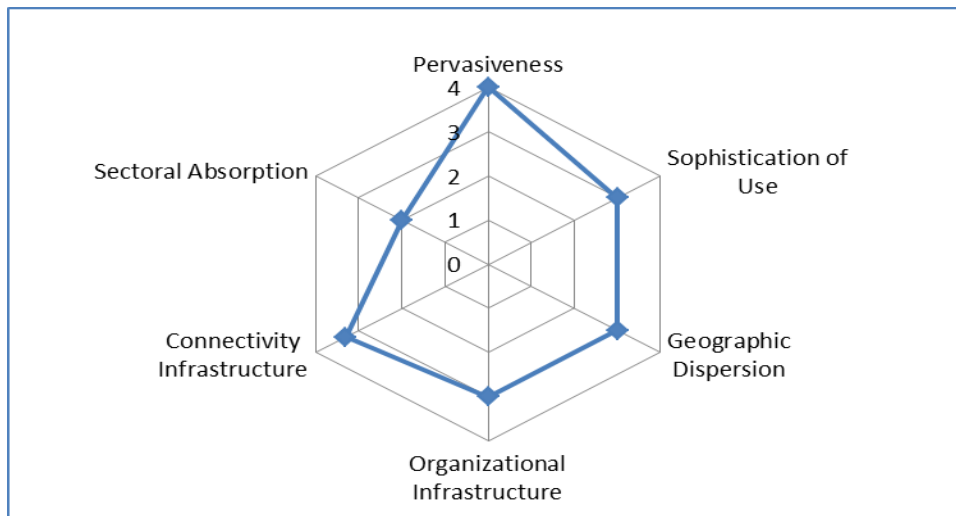


Figure 2: Nigeria: Internet Diffusion (2012)

The analysis and discussion that follow are structured around the six dimensions in the following order: pervasiveness; geography; sectoral absorption; connectivity infrastructure; organizational infrastructure and sophistication of use. The discussion points out how the various determinants impact on the dimensions of the modified GDI framework, by relying on the Internet as a representative artifact for the constituent technologies that comprise the NII of a country. Thus, a study of Internet diffusion in a country provides an adequate snapshot for the status of the NII.

Determinant	Sources	Sample References
Forces of Change (" <i>change</i> ")	Transition to civilian rule from military rule in 1999 has continued to be a factor in democratization of the Nigerian society	Akinsola et al, 2005
	Continued commitment of state and the federal government of Nigeria to telecommunications reforms. For instance the establishment of the first communications satellite in Africa by NigSatCom	www.nigeriabusiness.com; Ndukwe, 2007.
	The GSM revolution began in August 2001 and changed the face of Information and Communications Technology in Nigeria. There is also the contribution of Private Telephone Operators (PTOs) and other landmarks such as the licensing of Globacom as Nigeria's second national operator (SNO) as well as the licensing of	Awe, 2011

	22 fixed wireless operators.	
Regulatory/Legal Framework <i>("regulations")</i>	Putting in place structural and institutional structures for telecommunications reforms	www.ncc.gov.ng
	Establishment of the most stable regulatory regime in Africa	Ndukwe, 2005
Ability to Execute (AE) <i>("execution")</i>	Inability to enforce consumer rights protection and disputed licensing obligations that leads to a long process	Amaefule, 2008
	Inability to execute major infrastructure projects, such as the loss of the Nigerian space satellite to a solar flare NigComSaT-1 after its launch in 2003.	Abubakar, 2008
	Nigeria's failure to implement the rural telephony project is threatening the success of the complementary development plan of the International Telecommunications Union (ITU).	Gegere, 2011
Culture of Entrepreneurship (CE) <i>("entrepreneurship")</i>	159 ISPs remain operation, with over 400 businesses being registered in the last year.	NCC, 2011; Dalhat, 2007
Adequacy and Fluidity of Resources <i>("resources")</i>	Increased capital inflows into the sector by private companies and government. Increased foreign direct investments since change to civilian rule	Dalhat, 2007; Ndukwe, 2005
	Major investments flows from the Federal Government of Nigeria, such as the investments in NigeriaSat-2 and NigeriaSat-X, the most powerful optical Earth observation satellites ever built by Britain	NCC, 2011
Cost of Internet Access (CIA) <i>("costs")</i>	A diverse network service infrastructure reliant on GSM technology, CDMA, fixed and satellite communications systems which has let to low costs, but which are still high compared to other regions in Africa	Iboma, 2008
	Cost of doing business in the country and one of the major challenges they face is the erratic power supply	[Esiedeza, O; 2011]
Perceived Value of the	Early realization by the first civilian government that the Internet can be valuable as an enabler of economic	Dalhat, 2007; Ndukwe, 2007

Internet (PVI) ("value")	development	
	Individuals and business have realized the value of the Internet and are using it for e-mail, research, building web pages and e-commerce	NCC, 2011
	Individuals are also engaging in blogging, chatting, and entertainment (pornography) online	Various Nigerian-based web sites
Ease of Use of Internet (EUI) ("Ease of Use")	Low Computer and adult literacy levels coupled with inadequate local content	UN, 2008
	Digital Content language is predominantly English; Sites now emerging which use local languages	World Wide Web sites
Access to Constituent Technologies ("Constituent Technologies")	Low PC and electricity penetration; high levels of poverty make these constituent technologies less of a priority for households	UN, 2008; Ndukwe, 2007; Akinsola et al, 2005.
	Computers for All Initiative (CANI). a homegrown intervention to bridge the digital divide in Nigeria It is a Nigerian model of Government Assisted PC Purchase Program (GAPP). Many countries worldwide have implemented GAPPs- usually through incentives driven models- to boost their PC penetration, productivity levels and economies	[www.onlinenigeria.com, 2011]
Demand for Capacity; Multiplicity of ISPs and Services ("demand")	Introduction of mobile telecom in Nigeria for which growth has been very massive from 266, 461 in 2001 lines when it was first introduced to 74, 511, 614 in January 2010 and teledensity currently stands at 54% creating room for more growth	[Freedom House, 2011]
	Increased Competition based on Differentiation, even as costs keep on going down	Ofose, 2011
Enablers of Change ("Enablers")	The launching of Main One and Glo 1 submarine cables	[wwwmainonecable.com 2011]
	Establishment of the National Information Technology Agency and the National Information Technology Development Fund (NITDEF)	[Achimugu, Oluwagbemi, Oluwaranti, 2010]

Table 3: Possible Determinants of Internet Diffusion in Nigeria

Pervasiveness of the Internet in Nigeria

Nigeria's population accesses the Internet through various modes such as through cyber cafes, at work, academic institutions and at home. A much more recent phenomenon is access to the Internet through mobile phones. At an assumed natural rate of 2.5%, the population of Nigeria is estimated to be 167,912,561 by October 2011 (NPC, 2011). Internet World Statistics (IWS) estimates the number of Internet subscribers in Nigeria to be 45 million by December 2011 from an estimated 8 million users in 2008 (IWS, 2011). This forecast assumes that there will be increases occasioned by the introduction of a number of initiatives by the government and other stakeholder since the start of the year. In addition, private sector initiatives such as increasing adoption of Mobile Internet may also be used to account for the forecast. Thus, the proportion of the total population to the number of Internet subscribers by end of 2011 is 27%. This puts Nigeria at level four of pervasiveness of the Internet (Table 4), i.e. that the Internet infrastructure is now a common feature in Nigerian society.

Determinants of Internet Pervasiveness

This pervasiveness may partly be attributable to the introduction of Internet access via mobile-phone service occasioned by the increase in mobile-phone usage and data services since 2004, private sector and government investment in technology, and increased competition between FWA providers (Freedom House, 2011). The growth in mobile phone usage may have spurred *demand* for Internet services. Regulatory reforms (*regulations*) that have been undertaken since 1992 with the establishment of the Nigeria Communications Commission (NCC) under the stewardship of Ernest Ndukwe (CEO of NCC), regarded as a visionary responsible for the transformation of the telecommunications infrastructure (Punch, 2008), continue to play a role in enhancing the pervasiveness of the Internet. The NCC's success in liberalization efforts since the year 2000 under Ndukwe can therefore be attributed to his leadership (*enablers*). Subsequent adoption of the National Policy on Information Technology may also currently be providing the necessary "fresh" impetus as a blue-print for synergizing government strategies for developing a NII.

Level 0	Non-existent. The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country. There may be some Internet users in the country; however, they obtain a connection via an international telephone call to a foreign ISP.
Level 1	Embryonic. The ratio of Internet users per capita is on the order of magnitude less than one in a thousand (less than 0.1%).
Level 2	Nascent. The ratio of Internet users per capita is on the order of magnitude of at least one in a thousand (0.1% or greater).
Level 3	Established. The ratio of Internet users per capita is on the order of magnitude of at least one in a hundred (1% or greater).
Level 4	Common. The ratio of Internet users per capita is on the order of magnitude of at least one in ten (10% or greater).

Table 4: Pervasiveness of the Internet in 2012

Early efforts at the democratization of the Nigerian society from military rule which culminated in the handover of power to a civilian government may also have been pivotal as an impetus for change (“*change*”). However, given the incidence of high poverty levels at 61% of the population according to 2010 statistics (Brock, 2012), the cost of the Internet is still out of reach for many citizens (*costs*). Further, increased competition continue, based on service differentiation, are beginning to play a role by ensuring that operators maintain loyal customers (*demand*).

Geographic Dispersion of the Internet

Geographic dispersion measures the physical dispersion of the Internet within a country. The dimension looks at the number of Internet points of presence (POPs) in the first-tier political subdivisions (Wolcott et al, 2001). An Internet point of presence is taken to mean the physical presence of an ISP or a public data network operator (PDNO) in the first-tier political unit (Wolcott et al, 2001). The PDNO re-sells bandwidth to the ISPs or directly to large organizations. However, we adapt the view on geographic dispersion to also take into account the component of Internet dispersion ascribed to mobile phone operators, who are effectively providing Internet services on the mobile platform. Internet geographic dispersion is partly linked to the influence of the mobile operators who continue to roll out Internet services in order to capture a data market that up to now has not had the same high growth as the voice market. Data services have become competitive as mobile operators aim to sustain their operations and increase sales following a levelling off of voice revenue (Mobile Monday, 2011). In addition, the traditional ISPs are now heavily investing in the data market and are expanding services even to remote rural areas in a bid to wrestle the market from mobile operators. Thus, the rapid diffusion of digital mobile phone systems with embedded Wireless Application Protocol (WAP) implies that the conceptualization of Internet

geographic dispersion needs to at least take into account the additional Internet capacity that has been leveraged at very low cost by households and businesses in developing countries (Rajkumar & Wheeler, 2011).

We see the continuing impact of the 124 registered ISPs spread over at least 20 out of 36 states in Nigeria, playing a role in enhancing geographic dispersion (NCC, 2011). Fixed Wireless Access (FWA), another avenue for improving the geographic dispersion of the Internet, is also available in at least 27 of the 36 states and a further 577 licenses have been issued for cybercafé business in different states, while there are probably thousands more cybercafés providing access in different geographical regions in Nigeria (NCC, 2012). Of course, we still recognize that over 30% of the Internet providers are still coalesced around the two major urban centers of Lagos and Abuja, even as mobile telephony data options continue to put a dent on this skew-ness. Nigeria is therefore at level 3 (Table 5), that is, the Internet POPs are located in at least 50% of the first tier political subdivisions of the country, which in the Nigerian case are states; and industry estimates are that mobile network coverage is more than 75%.

Level 0	Non-existent. The Internet does not exist in a viable form in such a country. No computers with international IP connections are located within the country and mobile service providers are not providing Internet services.
Level 1	Single location. The Internet points-of-presence (POPs) are confined to one major population center and the mobile network coverage is confined to a single political subdivision of the country
Level 2	Moderately dispersed. Internet points-of-presence are located in multiple first-tier political subdivisions of the country and mobile network coverage covers about 50% of the country.
Level 3	Highly dispersed. Internet points-of-presence are located in at least 50% of the first-tier political subdivisions of the country; mobile network coverage is at least 75% of the country.
Level 4	Nationwide. Internet points-of-presence are located in essentially all first-tier political subdivisions of the country. Rural access is publicly and commonly available and mobile network coverage is nationwide.

Table 5: Geographic Dispersion of the Internet in 2012

Determinants of Geographic Dispersion

Telecommunications infrastructure growth has been phenomenal over the last ten years. Notable influencers of geographic dispersion arise from continuous commitment to sector reform by the Federal and State governments of Nigeria which has resulted in a stable regulatory regime (*regulations*) as well as a worldwide trend in foreign direct investment flows (*resources*) into high market

growth areas, especially in the development of broadband services and infrastructure deployment (Ndukwe, 2009) The latter are likely to impact the geographic dispersion of Internet-based services. Further, the successful funding of telecommunications infrastructure and ICT projects in Nigeria have partly been attributed to *consolidation* in the banking sector (which has increased funding options for the telecommunications and ICT sectors in Nigeria (*resources*). According to the former Chief Executive of NCC, Ernest Ndukwe, telecommunications investment in Nigeria since 2001 had exceeded USD18 billion by 2010, further reinforcing the view that the business environment post-military rule (*change*) continues to play a role in influencing positive FDI inflows (*resources*).

The attainment of level 3 for Internet Geographic Dispersion is intricately linked to the continued commitment to sector reforms by the federal government of Nigeria through the Nigeria Communications Commission (*change and regulations*) and the improving image of Nigeria as an attractive investment destination (*enablers*), which has resulted in increased foreign direct investment (*resources*) since re-establishing democratic rule in 1999 (Ndukwe, 2008). The starting point for the stable regulatory regime was linked to an initial review of the National Telecommunications Policy (NTP) in 1999, which led to the enactment of the Nigerian Communications Act (NCA), 2003. This was viewed as a catalyst (*enabler*) to what has been deemed as an ICT infrastructure revolution in Nigeria, based on an approach to provide better licensing services, public – private-partnerships, Universal Service Provision Fund (USPF) initiatives and multinational and multilateral support initiatives (Amuwa, 2010). The return to civilian rule with the resultant improvement in the business climate appears to be influencing the emergence of key business and institutional *enablers*, which continue to play a role in shaping the vibrancy of the telecommunications sector in Nigeria. Further, as the most populous country, the attractiveness of Nigerian market for entrepreneurs’ promises growth opportunities that continue to attract not only local investors (*enablers*), but also foreign investors. However, while there is the perception that the Internet is highly dispersed (partly attributable to the mobile network coverage), we highlight the fact that supply of electricity remains unreliable (*constituent technologies*), which may further impact on how the Internet is actually used in Nigeria.

Broadband Internet Sectoral Adoption

Internet Sectoral Absorption assesses the extent of Internet diffusion in the academic, commercial, health and public sectors (Wolcott et al, 2001). It is used to assess the proportion of all organizations in each sector that has leased lines. The GDI framework uses IP connectivity as the base measure of the dimension as described in Table 6. Nigeria has in the recent past recorded the fastest

telecommunications sector growth in Africa with an average of 535% annual growth rate in 2007 (Dalhat, 2007). This growth has led to increased spending on IT of at least 15% per annum in the economy, resulting in the creation of thousands of jobs in the economy (Dalhat, 2007). This resurgence in the telecommunications sector has also led to an increased use of the Internet by individuals and businesses alike as shown in the growth trends in Table 6.

Year	Number of Users
2001	115,000
2002	420,000
2003	750,000
2004	1769,000
2007	5000,000
2008	8000,000
2009	10,200,000
2011	44,000,000
2012	45,000,000

Table 6: Internet User Growth (Source: NCC & IWC)

To capture sectoral absorption in this section, the estimate is based on a general trend in Internet use as a critical government initiative to diversify the Nigerian economy. This has resulted in capital inflows, not only from the government, but also from the private sector. The federal government's continuous funding of the sector is therefore influencing the trajectory of Internet absorption through various initiatives such as establishment of the Universal Service Provision Fund in 2003 to encourage equitable investments in the sector given that about 70% of Nigeria's population live in the rural areas (Dada, 2011); initiation of a number of broadband backbone infrastructure projects, some of which are complete and may see Internet penetration increasing by 35% in the next two years (Oluocha, 2011); establishment of the Universities Bandwidth Consortium for bulk purchases of bandwidth by public universities (Dada, 2011); development of a National Roadmap for IT outsourcing, Mobile Internet Units (MIUs), development of a Public Service Information Network (PSNET), establishment of IT parks and through the Computer for All Nigerians Initiative (CANI) (Dalhat, 2007). We expect that these initiatives will continue to impact different sectors, even though only about 10% of rural households and 40% of urban households in Nigeria have access to electricity, a critical component required for Internet access.

Based on this background information, the following estimates may be made due to lack of information on sectoral absorption of the Internet in the specific sectors.

The academic sector may be regarded as having minimal Internet absorption due to the fact that with a 50% rural-based population (CIA Fact book, 2012) and with low electricity penetration, not more than 10% of the institutions have broadband access, which the current Minister for Communications Technology attributes to the high cost of broadband (Adepetun, 2012). In the academic sector, there is low computer penetration in most rural and poor urban-based schools, thus the schools do not have even dial-up connectivity; a possible indicator that the priorities of the schools are geared towards other concerns (AllAfrica, 2012). According to the National Bureau of Statistics of Nigeria, the poverty incidence in 2010 was about 61% of people living on a dollar per day and this poses a great constraint on the ability of parents to contribute towards connectivity of academic institutions (Onuba, 2012). Broadband Internet access for the health sector may also be accorded a similar estimate as the academic sector, given that the general population depends on public health facilities constrained by funding levels influenced by government priorities. On the other hand, the commercial and public institutions can be afforded a medium level rating given that most of these institutions have electricity and are able to get funding from the private and public sector as well (Oketola, 2012). The recorded growth of the Internet has mostly taken place in these sectors.

Sector	Minimal (1 point)	Medium (2 points)	Majority (3 points)
Academic	0%-10% have leased line Internet connectivity	10%-90% have leased line Internet connectivity	90% have leased line Internet connectivity
Commercial	0%-10% have Internet servers	10%-90% have Internet servers	90% have Internet servers
Health	0%-10% have leased line Internet connectivity	10%-90% have leased line Internet connectivity	90% have leased line Internet connectivity
Public	0%-10% have Internet servers	10%-90% have Internet servers	90% have Internet servers

Table 7: Sectoral Absorption of the Internet in 2012

Determinants of Sectoral Absorption

The perceived value of the Internet (*value*) and the culture of entrepreneurship (*entrepreneurship*) evident in the large number of companies that have been setup within the telecommunication sectors as well as the continued investment inflows (*resources*) are the likely causes of this state of affairs to date. Recognition of the value of the Internet can be seen in the numerous initiatives that the federal government is involved in which has resulted in the highest adoption rate in sub-Saharan Africa (Dalhat, 2007). However, there are still numerous constraints that are negatively affecting sectoral absorption especially in the academic and the health sectors which are dispersed in many areas where there is no electricity

(*constituent technologies*). The challenge of providing an affordable and extensive electricity supply still remain a dream for the Nigerian government which is limiting usage of the Internet due to limited access to constituent technologies (*constituent technologies*). A summary of sectoral absorption is given in Table 8.

Sectoral Point Total	Sectoral Absorption	Dimension Rating
0	Level 0	Non-existent
1-3	Level 1	Rare
4-6	Level 2	Moderate
7-9	Level 3	Common
10-12	Level 4	Widely Used

Table 8: Sectoral Absorption of the Internet in 2012

Connectivity Infrastructure

Connectivity Infrastructure refers to the extent and robustness of the physical structure of the network and is measured by the aggregate bandwidth of the domestic and international backbones, the number and type of inter-connection exchanges, and the type and sophistication of local access methods being used (Wolcott et al., 2001). Based on the analysis below, Nigeria can be placed at level 3 with regard to domestic backbone, international links and Internet exchanges; while access methods can be placed at level 4 as indicated by the shaded portion of Table 9. An analysis of connectivity infrastructure recognizes connectivity as a concept that has changed dramatically due to actions partly attributable to Nigerian Communications Commission (NCC, 2012). There are at least 23 license categories that support connectivity infrastructure to enable Internet diffusion, and the categorization by Wolcott et al (2001) simply provides a snapshot of the status of the connectivity infrastructure by looking at the *national aggregate bandwidth*. We assess national aggregate bandwidth by analysing international links, domestic backbone, and access methods.

Level		Domestic Backbone	International Links	Internet Exchanges	Access Methods
Level 0	Non-existent	None	None	None	None
Level 1	Thin	<=2 Mbps	<=128 Mbps	None	Modem
Level 2	Expanded	2 Mbps-200 Mbps	128 Kbps- 45 Mbps	1	Modem 64 Kbps leased line

Level 3	Broad	200 Mbps- 100 Gbps	45 Mbps-10 Gbps	More than 1; bilateral or open	Modem 64 Kbps leased line
Level 4	Extensive	100 Gbps	10 Gbps	Many; both bilateral and open	<90% modem or 64 Kbps leased line

Table 9: Connectivity Infrastructure of the Internet as of 2012

International Links

International connectivity is provided by three international gateway providers; two (NITEL and Globalcom) have been operational since 2002, while one (Prest Cable) has been operational from 2007 (NCC, 2012). The three international gateway operators provide a switching system that routes international traffic between international networks and the domestic network. There are also twenty three operators under the license of International Data Access (IDA), whose scope of services include interconnectivity capacity to all the operators in the Nigerian telecommunication industry. The twenty three operators under the IDA license provide physical connectivity to the ISPs who do not have the capacity for having their own international connectivity. There are also two Internet exchange points (Internet Exchange Nigeria Limited and Interstellar Communications Limited) providing bilateral and open services. In addition, the NCC has a license category with eighteen licenses for provision of colocation services (NCC, 2012). We consider this as an additional service that enhances international connectivity since the colocation services can be hosted outside the country and therefore providing external capacity.

Data on actual aggregate bandwidth of Nigeria is difficult to get, however, gleaned information from recent initiatives give an indication as to the possible level of national demand. For instance, Connectivity Scorecard (2011) reports that less than 0.1 percent of households in Nigeria have broadband service, giving an indication of how constraining bandwidth is in Nigeria. Further, according to a study conducted by the International Data Corporation, only 0.1 percent of households in Nigeria have Internet access compared to 2.2 percent in Kenya (Obura, 2012). This low household Internet connectivity is linked to the high cost of Internet access in Nigeria (Adepetun, 2012). The expectation is that the introduction of new submarine cables (SAT-3 and Main One, which were launched on 1 July 2010, GLO-1 in October 2010, WACS from 2011, and ACE from 2012) are likely to dramatically improve international bandwidth for Nigeria (Connectivity Scorecard, 2011). In addition, the national long-distance operators

are building a fiber-optic backbone around the country which will extend international connectivity beyond Lagos and Abuja.

Data on actual aggregate bandwidth of Nigeria is difficult to get, however information gleaned from various media sources (Uzo, 2011) cite optimistically that that over 11.2 terabits of bandwidth would be available to the Nigerian market by 2011(). However, this bandwidth is not differentiated from national bandwidth (in the form of national fibre optic backbone). Based on these optimistic estimates, tempered with concerns that broadband access to Nigerian households is still one of the lowest at 0.1 percent, we may place international bandwidth availability at level 3, since international links are broadly available and hence it is possible for individuals and institutions to have access within the range of 45 megabits per second to 10 gigabytes per second, despite high Internet costs. This places Nigeria at level 3 for international links and Internet exchanges.

Domestic Backbone

There are several categories of operators that can be considered as backbone operators in Nigeria (NCC, 2011). The traditional classification mainly takes into account the role that was played by the Telcos which were the sole national operators. In Nigeria, there are currently two national operators, operating under the National Carrier License (NITEL and Globalcom), and an indication of a completely liberalized telecommunications market. There are also a number of operators operating under a diversified set of license categories. For instance, there are sixteen operators under the Universal Access Service License, where mobile service providers mobile Internet as one of their service offerings. The inclusion of these under the domestic backbone category highlights the role that mobile Internet plays in Africa, given the limited coverage of fixed line connectivity traditionally offered by the national operators. There are eleven fixed wireless access (FWA) service providers operating in at least four states, who are critical in extending fixed telephony access and nine long distance operators (NCC, 2011). There are also a total of nine metropolitan (fiber) cable network operators whose initiatives continue to enhance the backbone (domestic) infrastructure for Nigeria. However, because a number of these initiatives are incomplete and the cost of access is still prohibitive, we estimate that this component of the connectivity infrastructure can be placed at level 3, indicating that the national Internet infrastructure is broad (Wolcott et al., 2001).

Access Methods

Access methods rely on connections which are possible through dial-up and leased lines fixed line services, satellite, mobile services as well as Code Division Multiple Access (CDMA) technology (NCC, 2012). However, a large majority of connections are still through dial-up modems, but many users are increasingly

using fixed wireless (such CDMA) and satellite connections. This warrants placing Nigeria at level 4 for this component. A summary of all the components of the connectivity infrastructure dimension are shown in Table 10.

Connectivity Option	2012
Domestic Backbone	Level 3
International Links	Level 3
Internet Exchanges	Level 3
Access Methods	Level 4
Overall	Level 3.3

Table 10: Connectivity Infrastructure 2012

Determinants of Connectivity Infrastructure

Possible influencers of connectivity infrastructure dimension stems from a general desire by the Federal Government of Nigeria to diversify its sources of revenue from the traditional oil revenue sources on which the former military dictatorships relied. The continued efforts aimed at liberalizing the sector is therefore strongly linked to economic growth and development objectives characterized by initiatives such as the Community Universal Service Provision Fund, the Wire Nigeria Initiative and the State Accelerated Initiative (Ndukwe, 2007). The perceived value (*value*) of the Internet in enabling economic growth by the civilian government since 1999 appears to be the overriding determinant for continuous liberalization of the telecommunications sector which has resulted in the connectivity infrastructure dimension level above. Nigeria is not at the highest level possible (Level 4 for all dimensions). This may partly be attributed to low penetration levels of various constituent technologies, e.g. electricity and computers (*constituent technologies*), high costs (*cost*) of Internet access despite a versatile and broad-based connectivity infrastructure, which translates directly to low demand by individual users (*demand*). For instance the United Nations reports that the personal computers per 100 users in Nigeria is 0.91, which is low compared to other countries such as Kenya at 1.44 (UN, 2012). The argument is that low penetration levels of these access technologies dampen individual demand, thus less need by private sector players to invest in the telecommunications sector, particularly in rural areas where electricity penetration is also low. Thus the negative demand forces for this dimension are primarily those of *constituent technologies*, *cost* and *demand*.

Organizational Infrastructure for Regulation and Competitiveness

The Organisational Infrastructure dimension provides a measure of the competitiveness of the market for Internet and telecommunications services by linking the status of the market to the role of regulatory agencies and other stakeholders (Wolcott et al, 2001). Table 11 provides an overview of the *Organisational Infrastructure* dimension and the characteristics of the different levels. Nigeria can be placed at level 3 in 2012 based on the discussions that follow structured around the competitiveness of the market, the robustness of the ISP market and barriers to entry.

Level 0	<i>None.</i> The Internet is not present in this country.
Level 1	Single. A single ISP and Mobile Operator have the monopoly in the Internet service provision market. The ISP and the Mobile Operator is generally owned or significantly controlled by the government.
Level 2	<i>Controlled.</i> There are a few ISPs and Mobile Data Operators and the market is closely controlled through high barriers to entry. All ISPs connect to the international Internet through a monopoly telecommunications service provider. The provision of domestic infrastructure is also a monopoly.
Level 3	<i>Competitive.</i> The Internet market is competitive. There are many ISPs and low barriers to market entry. The provision of international links is a monopoly, but the provision of domestic infrastructure is open to competition or vice versa.
Level 4	<i>Robust.</i> There is a rich service provision infrastructure. There are many ISPs and low barriers to market entry. International links and domestic infrastructure are open to competition. There are collaborative organizations and arrangements such as public exchanges, industry associations, and emergency response teams.

Table 11: Organizational Infrastructure of the Internet in 2012

The development of a competitive market sector can be traced to a realization of the inadequate provision of internal and external communication services by the Department of Posts of Telecommunications Department (Akinsola et al, 2005). This resulted in its split into two entities: the Nigeria Postal Services (NIPOST) and Nigerian Telecommunications Limited (NITEL). NIPOST was set up to provide postal services, while NITEL was setup to rationalize investments in telecommunication development and to provide accessible, efficient and affordable services (Arzika, 2000). As at 2001, the Federal Government of Nigeria made efforts to provide Internet services with Lagos as the main point of presence through Nitel as a government owned monopoly (Akinsola, 2005). The early years of Internet development through the government monopoly was characterized by slow infrastructure development, non-competitive equipment procurement and sub-optimal quality of service delivery (Ndukwe, 2008).

The government's regulatory body that has been instrumental in creating the competitiveness conditions is the Nigerian Communications Commission (NCC). NCC was setup up in 1992 but only commenced telecommunications sector

reform post the military rule era. The NCC initiated the reform effort from the year 2000 and interpreted this role to largely encompass promoting market liberalization, licensing of competitive operators, attracting investment, protecting new entrants from dominant operators and promoting speedy and equitable dispute settlement (www.ncc.gov.ng).

NCC efforts to liberalize the sector has resulted in a number of achievements especially the increase in private sector involvement in the telecommunications industry. For instance, the Second National Carrier was licensed in 2002 and has been operational; regional and national licenses were issued in 2002 for fixed wireless operators and successful auctions for 2G Digital Mobile licences in 2001; strengthening of the NCC as well as the release of a National Telecom Policy in 2000 (Ndukwe, 2005). To date, a total of 136 ISPs have been licensed and have been operational since 2003 and NCC has also developed a unified licencing scheme that allows a host of other service providers to compete in the telecommunications sector (NCC, 2012). A number of strong organizational bodies have also been formed to represent various stakeholder interests. For instance the Nigeria Internet Group (NIG) has been setup to handle issues focusing on Internet governance in Nigeria. The Internet Service Providers Association (ISPAN), which is an ISP lobby group and the Internet Society (ISOC) are also linked to Internet governance issues. The status of the telecommunications market in Nigeria implies that Organizational Infrastructure should be at level 4 (*Robust*). However, this state is dampened by the fact that despite Nigeria having a robust telecommunications sector, there is a lack of collaborative organizations for public exchanges and emergency incidence response teams to combat cyber-crime. This is expected to take quite some time since by April 2011, the parliament of Nigeria failed to pass laws that were expected to outlaw many forms of Internet misuse, including spamming, online ID theft, and buying goods online using stolen credit card details (Leyden, 2011). Therefore, it is inconceivable that the institutional framework for emergency incidence response for creating an enabling environment for Internet use can be in place before the right regulatory environment. Given the nature of cyber –crime, the telecommunications sector in Nigeria needs to engage collaboratively in order to curb the vice (Longe & Chiemeké, 2008). The failure to collaborate and pass enabling laws, despite the existence of enforcement institutions such as Economic and Financial Crimes Commission (EFCC) of Nigeria, implies that the organizational infrastructure that can encourage ethical use of the Internet is still nascent in Nigeria. Therefore, we place the Organizational Infrastructure at level 3 (*Competitive*) taking into account widespread incidences of cyber-crime from Nigeria. However, on a positive note, NCC has entrenched the need for regulation for telecommunications development and part of the increase in landline

infrastructure from 400000 in 2001 to 90 million in 2012 is ascribed to a stable regulatory (*regulations*) regime (Juwah, 2012).

Determinants of Organizational Infrastructure

The mobile phone market and the fixed wireless (CDMA) market have significantly impacted on the organizational dimension, with the licensing of various players. Latest reports indicate that fixed wireless/wired CDMA connections accounted for 6 million users; CDMA 3.2 million users, while GSM connections accounting for close to 80 million users (Badaru, 2008). This installed capacity gives two indicators as to the likely influencers of this dimension. The first is that as a result of a high critical mass of potential users requiring Internet services, a requisite number of organizational (ISPs and consumer interest groups) bodies are needed to represent their interests (*demand*). The second critical determinant arises from the continued democratization and diversification of the Nigerian society arising from the commitment of the government to transform the country into a knowledge-based society post military rule (Akinsola et al, 2005). Thus the change to civilian rule has been an enabling factor in creating the right institutional environment for the development of the Internet in the country (*change*). This has also impacted on the fluidity of resources (*resources*). With the improving business climate, there have generally been increases in FDI inflows as well as funds availability through various funding mechanisms.

However, further positive development of this dimension has been stifled by the inability of the Nigerian parliament to pass a set of laws that can help in effectively dealing with cyber-crime (*execution*). This has hampered the establishment of collaborative institutions that are critical in improving the ethical climate for Internet use. In addition, regulations for consumer protection have been flouted by operators without any compensation to the consumers (Amaefule, 2008), which may point to NCC's inability to execute some of its regulatory mandate (*execution*). These scenarios may be indicators of a regulator that lacks regulatory 'teeth' to implement their regulations and therefore an inability to execute part of their mandate; as well as Nigerian government relying on archaic laws based that are ineffective in combating cyber -crime.

Sophistication of Use

The Sophistication of Use dimension evaluates the level of innovation associated with the Internet (a NII) (Wolcott et al., 2001). Table 12 provides an overview of the dimension with the highlighted portion indicating the current (2012) level based on the analysis that follows. The analysis on sophistication of use shall focus on individual as well as business use of the Internet. A study conducted by NCC (2005) showed that typically organizations use the Internet for e-mail

(59%), while others use the Internet for research (23%) and e-commerce (13%). In arguing for placing Nigeria at level 3, we focus on the use of the Internet by certain segments of users that qualify as transformative uses of the Internet. For instance, an indicator that some form of e-commerce is taking root can be linked to the proliferation of online shopping sites (such as www.234world.com) that also have integrated e-payment systems (Tech Trends, 2011). Engaging in online transactions is also becoming increasingly common place, as smartphones replace cybercafés as an access point (EIU, 2010). Further, 61% of Nigerians now rely on the digital media for research and as a source of news and entertainment; while over one million Nigerians engage with the some form of social media daily (Fergusson, 2010). There are indications that online gaming, multi Media entertainment, pre-purchasing activities, planning and organizing events, personnel administration and using the Internet for education and research is on the increase (Tele Times, 2011). Some of the resulting applications such as the development of Internet-based e-payment applications (e.g. NetNaira.com) are potentially able to change e-commerce processes that currently face constraints like low credit card penetration. Further, business processes such as advertising can significantly be impacted by the burgeoning interest in social networking within the Nigerian society. Thus, Nigeria warrants being at level 3. As some of these Internet-based innovations take root, they are expected to impact business processes and practices.

Level 0	None. The Internet is not used, except by a very small fraction of the population that logs into foreign services.
Level 1	Minimal. The user community struggles to employ the Internet in conventional, mainstream applications.
Level 2	Conventional. The user community changes established practices somewhat in response to or in order to accommodate the technology, but few established processes are changed dramatically. The Internet is used as a substitute or straightforward enhancement for an existing process (e.g. e-mail vs. post). This is the first level at which we can say that the Internet has taken hold in a country.
Level 3	Transforming. The use of the Internet by certain segments of users results in new applications, or significant changes in existing processes and practices, although these innovations may not necessarily stretch the boundaries of the technology's capabilities.
Level 4	Innovating. Segments of the user community are discriminating and highly demanding. These segments regularly apply, or seek to apply, the Internet in innovative ways that push the capabilities of the technology. They play a significant role by having a mutually beneficial and synergistic relationship with developers.

Table 12: Sophistication of Use as of 2012

Determinants of Sophistication of Use

Possible determinants of the increasing sophistication of Internet use in Nigeria can directly be linked to the pervasiveness and affordability of smartphones (*constituent technologies; cost*) which has become a complimentary tool for accessing Internet everywhere, but which unfortunately is resulting in the closure of cybercafés. Further, Nigeria, as the fastest growing telecommunications markets, implies that there is strong demand (*demand*) for Internet services (Connectivity Scorecard, 2011), despite the prevalence of Internet fraud acting as an impediment to B2C e-commerce (dampening the enthusiasm for online transactions) (Ayo, Adewoye & Oni, 2011).

ROLE OF GOVERNMENT IN THE DEVELOPMENT OF INTERNET INFRASTRUCTURE

In this section, an attempt shall be made to unearth the possible role that has been played by the government in influencing the trajectory of the Internet as a representative technology of NII. The analysis shall infer possible strategies that have been employed by the government from the determinants that have been explored in the previous section. A summary of the values of the six dimensions is shown in Table 13. A minus indicates that the determinant negatively influenced the dimension, while a positive sign indicates a positive influence.

Dimension	Level	Diffusion Determinants
Pervasiveness	Level 4: Common	<i>Demand (+); Enablers (+); Regulations (+); costs (-)</i>
Geographic Dispersion	Level 3: Highly Dispersed	<i>Change (+); Regulations (+); Resources (+); Constituent Technologies (-); Enablers (+)</i>
Sectoral Absorption	Level 2: Moderate	<i>Value (+); Entrepreneurship (+); Resources (+); Constituent Technologies (-)</i>
Connectivity Infrastructure	Level 3.3: Broad	<i>Value (+); Constituent Technologies (-); Demand (-); Cost (-)</i>
Organisational Infrastructure	Level 3: Competitive	<i>Change (+); Demand (+); Execution (-)</i>
Sophistication of Use	Level 3: Transforming	<i>Constituent Technologies(+); Demand (+); Change (-)</i>

Table 13: Summary of Nigeria's Internet Dimensions for 2012

In assessing the role of the Federal Government of Nigeria, the intention is not to assign blame or undervalue the achievements of the government, but rather the aim is to pinpoint the neglected aspects of the Nigerian NII strategy to produce suggestions for better development. The insights can be considered as ideas for policy drafters for the enhancement of NII implementation. Thus in this section,

we employ a variant of Cordeiro and Al-Hawamdeh's (2001), Lanvin (2003), Stiglitz, Orszag, and Orszag (2000) and King et al (1994) categorizations of government roles in development of an NII that was adapted by Shin (See Shin, 2007). Shin (2007) combines the various roles of government from these authors to evolve two possible strategic roles that the government can play: that of *intervener* (controller, builder, regulator, and investor) and *facilitator* (integrator, strategist, guider, and leader). A summary of these roles and the possible determinants that can provide insights into the possible underlying strategies are captured in Table 14.

Government Strategy	Sample Initiatives	Dimension(s)
Strategist	Development of the National Policy for IT	Pervasiveness (-); Geographic Dispersion (-)
Guider	The establishment of the USPF	Geographic Dispersion (+); Sectoral Absorption (+); 2*Constituent Technologies (-)
Leader	Establishment of Various Bodies/Ministries/Collaboration	Pervasiveness (+); Connectivity Infrastructure (+); Cost(-)
Integrator	Prevalence of Internet Fraud; Establishment of Regulatory Framework	Organizational Infrastructure (-)
Controller	Setting up of NCC	Geographic Dispersion (+); Pervasiveness
Builder	Setting up NITEL; SNO	Pervasiveness (-); Dispersion (-); Connectivity Infrastructure (-)
Regulator	Sector Reforms	Pervasiveness (+); Dispersion (+)
Investor	ICT investments	Entrepreneurship (+); Sectoral Absorption (-)

Table 14: Linking Government Roles to Determinants

The crafting and adoption of the National Policy on IT in 2010 depicts the role of the government as that of a *Strategist*. However, the impact of *Strategist* role in the development of the NII has clearly been minimal in the Nigerian society. In fact, the late crafting and adoption of a national vision and the establishment of an institution to realize its implementation may have impacted negatively on some dimensions such as *Pervasiveness* and *Geographic Dispersion*. For instance, the early concentration of Internet POPs in the two main urban centres of Lagos and Abuja may have contributed to the social exclusion of large segments of the rural population in the early years of Internet development, when access was mainly

being provided through fixed telephony. However, the government as **Guider** may have played a role in influencing *Geographic Dispersion* by creating a proper environment for innovation and growth through channelling resources to the ICT sector. The role has been evident through the continuing democratization of the Nigerian society which has impacted on the business environment, thus the proliferation of ISPs and other operators since 1999.

The proliferation of ISPs, an indication of market attractiveness, has resulted in improvement in Sectoral Absorption (especially in the commercial sector). However, the effectiveness of the government as a **Guider** has been dampened by the negative impacts of *Constituent Technologies* linked to low PC and electricity penetration levels. The recognition of the government as **Leader** has mainly been visible in terms of the initiation and legitimization of various activities that show that ICT is recognized as a national priority. For instance, the establishment of a ministerial role at cabinet level; involvement of the government in various mobilization activities and establishment of parastatals for implementation of diverse NII policies, are possible indicators of the Leader's role. One of the biggest failures is the role that played by the government as a **Builder** of physical infrastructure for everyone to access information. However, this is not unique to Nigeria and is a common failure across many countries in Africa. For instance, the establishment of NITEL as the first national backbone operator was expected to significantly impact on the rollout of fixed telecommunications infrastructure in Nigeria. However, 95% of the NII infrastructure is linked to the mobile operators and the more than 80 operators who also provide some form of fixed/wireless connectivity in Nigeria (Budde, 2011). Through the years when NITEL and even after licencing the SNO, the role of government as a **Builder** remained ineffective. The failure of the government in this role has negatively impacted on a probable enhancement in the *pervasiveness* of the NII; *dispersion* that is exclusive to certain segments of the Nigerian society and a *connectivity infrastructure* enhances this exclusion.

However, the role of government as **Regulator** in which the intention is to create a competitive environment for organizations to thrive is one of the phenomenal successes in Nigeria. At a broader level, the embracing of democratic ideals by the Nigerian society since 1999 continue to play a big role; while specifically, the successful establishment and funding of the NCC as well as the championing role that has been played by the individuals who have headed NCC have had a significant contribution to sector reforms. Further, the entrepreneurial culture in the Nigerian society, with the prevailing democracy has seen the emergence of various providers poised to further enhance the pervasiveness and dispersion of the Internet in Nigeria. However, given the large population in Nigeria, the role of the government as **Investor** is also in question, since; as the entrepreneurial forces

were ‘unleashed’ as a result of an enabling environment due to effective regulation of the sector, the entrepreneurs focused majorly on the profitable segments of the society (commercial, major urban centers), while the rural populace remain underserved to a large extent.

Therefore, while efforts to ensure social equity is attained through initiatives such as the USPF (means?), there are still many sectors (in education, health) that require direct government interventions that remain excluded. Thus, despite impressive efforts of the government as investor, sectoral absorption remains a challenge in a number of the sectors. Lastly, an assessment of the role of government as *Integrator*, in which the government ensures that various programs and projects are well integrated into a coherent strategy can be seen in the recent adoption of the Nigerian National Policy for Information Technology in 2010 (NNPICT, 2010). The adoption of the policy document provides evidence organizational capability since the government was able to marshal participation from various stakeholders in order to craft such a strategy. However, there are certain areas that the government’s role has been lukewarm, especially in promoting legislation (Bills & Acts) for the protection of on-line, business transactions, privacy and security. The image of Nigeria as the abode of cyber-crime continues to bedevil Nigeria as a ‘brand’, and the failure by the government to marshal support by integrating the organizational capabilities of various organizations and interest groups in order to encourage ethical Internet practices is an indication of her weak role as Integrator.

CONCLUSIONS

The development of the NII in Nigeria has largely been fuelled by changes that have been occasioned by her transition from military dictatorship to civilian rule. This is evident from the number of determinants which are linked to *change* and *enablers*. Of course, the establishment of NCC and its CEOs has played a significant contribution in championing the change process since 2003 which has resulted in a stable *regulatory* regime of the sector. The early recognition of the *value* of the Internet (as a cluster of technologies) by the first civilian government in 1999 has continued to provide a firm base for continued and persistent transformation of the Nigerian economy. The government’s continued involvement has resulted in significant *resource* inflows into the sector which has spurred *demand* for Internet services and subsequent registration of companies to offer services (*entrepreneurship*). The positive developments in the telecommunications sector since change from military rule continue to be dampened by persistent constraints linked to *constituent technologies* by a large segment of the population. In addition, bandwidth costs still remain a concern as well as regulatory independence of the regulator (*execution*), inadequate resource allocation in fast-tracking the completion of the undersea cables in line with other

African regions which consequently affect potential *demand* for Internet services. The total internet user base of 44 million needs to be considered against a total population of more than 168 million.

What comes to the fore is the critical role that the civilian governments have played in influencing the trajectory of Internet development in Nigeria. Overall, the government has played a direct role (***Direct Intervener***) of ensuring effective regulations (*regulator*) as well as attempting to create effective telecommunications market conditions for industry to follow (*controller*). There are also continued commendable attempts to play the role of builder (though inadequate) through direct involvement in building the Internet infrastructure by making the service provision mode robust through various government parastatals such as NigComSat, NITEL and Globalcom. Thus its success to date stems from a direct involvement of the government to ensure that the telecommunications section becomes one of the key economic drivers. The indirect role of government (***Indirect Facilitator***) is noticeable in efforts by the government to create a proper environment for innovation and growth (*guider*) as well as in their attempt to establish ICT as a national priority through the formulation and adoption of various sector policies and legislations (*leader*). The government's indirect role is primarily visible in how it has managed to galvanize support for telecommunications as one of the key economic pillars to ensure diversification of the Nigerian economy. These roles have been effective in pushing Internet diffusion trajectory and the overall NII development in Nigeria.

However, we also pinpoint out that the federal government has been ineffective in indirectly facilitating the sector in the roles of *strategist*, *guider* and *integrator*. As was revealed in the analysis above, these roles are critical in ensuring that the government effectively plays the role of champion through its national vision(s): interpreting, mobilizing and legitimizing the national ICT vision to be part of the national psyche; crafting the national system of innovation to take cognizance of the role of ICT in the Nigerian society; as well as integrating ethical Internet practices by galvanizing the support of all the stakeholders in order to improve the Nigerian 'brand'. While it may be early to make premature conclusions, the signs are there that the 'giant of Africa' is rising after years of political turbulence. The Internet shall and will continue to be one of the pillars for attaining its giant status in Africa. Nigeria has since surpassed all the countries in sub Saharan Africa in the sector's growth, with the highest recorded number of Internet subscribers, even though it has the highest population. However, it is hoped that policy initiatives that are being undertaken by the government and other stakeholders in the telecommunications industry will change the negative determinants of NII development.

Given that building NII is a long' term project that can take years to develop, governments in developing countries need to focus on certain priorities in order to incrementally build an evolving infrastructure. This requires that governments understand the likely impacts of the role that they play in this process and there should be a consciously assessment of the national status to determine the *current installed base* that can be used as a foundation for evolutional of the NII. This is necessary to avoid re-inventing the wheel by adopting completely new technological infrastructures, while existing infrastructures may provide better and more affordable alternatives. For instance, Rwanda, referred to as a country of a thousand hills is hinging its development of an information infrastructure on the use of wireless technology in order to take advantage of the physical terrain of the country. This provides a much more cost-effective alternative to the traditional copper wire and expensive fiber optic infrastructure that underpin most Western information infrastructures.

ACKNOWLEDGMENTS

We thank all the reviewers for their contribution towards ensuring a quality paper. We would also like to thank Prof. Irwin Brown for his invaluable comments and contribution as editor.

REFERENCES

- Abubakar, S. (21st November, 2008). Nigeria: Country Satellite in Graveyard Orbit – Issues We Cannot Wish Away. Retrieved on 5th November, 2011 from <http://www.balancingact-africa.com/news/en/issue-no-542/internet/nigeria-nccs-fresh-p/en>
- Achimugu, P., Oluwagbemi, O., & Oluwaranti, A. (2010). Adoption of Information and Communication Technologies in Developing Countries: An Impact Analysis. *Journal of Information Technology Impact*, 9(1), pp. 37-46.
- Adepetun, A. (16th May, 2012). Link between Policies and Broadband Penetration in Nigeria. *Nigeria Guardian News*. Retrieved on 11th July, 2011 from <http://www.ngguardiannews.com/>
- Akinsola, O.S., Herselman, M. E. & Jacobs, S. J. 2005. ICT provision to disadvantaged urban communities: A study in South Africa and Nigeria. *International Journal of Education and Development using ICT (IJEDICT)*, Vol. 1, Issue 3, pp. 19-41, Retrieved on 4th November 2011 from <http://ijedict.dec.uwi.edu/viewarticle.php?id=57>
- AllAfrica (17th May 2012). Nigeria: Bridging Digital Divide through Broadband. Retrieved on 11th July, 2012 from <http://allafrica.com/stories/201205170746.html>
- Amaefule, E. (2008). “Why we want to license new operators-Ndukwe”. Puchn. 4th May, 2008. <http://www.punchng.com> (Accessed May 4th 2008).
- Amuwa, J. (2010). “Policy and Regulatory Imperatives for Efficient Broadband Services”. Report On The Communications Session Of The Nigerian Bar Association Section On Business Law Held On 07 April 2010, Retrieved on 4th November, 2011 from <http://www.nba-sbl.org/articles/Report%20on%20the%20Communications%20Session.pdf>

- Arzika, M. (2000). National Policy on Telecommunication. [Online] Available at: <http://www.ncc.gov.ng>
- Awe, J. (2011). Nigeria: Bridging the Infrastructure Divide. Retrieved on 5th November, 2011 from www.jidaw.com/telecom/telecomm8.html
- Ayo, C.K., Adewoye, J.O., & Oni, A.A. (2011). Business-To-Consumer E-Commerce in Nigeria: Prospects and Challenges. *African Journal of Business Management*, 5(13), pp. 5109 - 5117
- Branscomb, L. M., & Kahin, B. (1996). Standards, processes and objectives for the National Information Infrastructure. In Branscomb, L & Keller, J (Ed), *Converging Infrastructures: Intelligent Transportation Systems and the National Information Infrastructure*. Cambridge, MA: MIT Press.
- Brock, J. (2012, February 13). Nigerian Poverty Rising Despite Economic Growth. Reuters, Retrieved on 10th June from <http://www.reuters.com/assets/print?aid=USTRE81C0KR20120213>
- Brown, I., Collins, T., Maleka, B., Morrison, D., Muganda, N. & Speig, H. (2007). Global diffusion of the internet XI: Internet diffusion and its determinants in South Africa: The first decade of democracy (1994-2004) and beyond *Communications of the Association for Information Systems*, 19(9), March, 2007.
- CIA Fact Book (2012). The World Fact Book: Nigeria. Retrieved on 11th July, 2012 from <https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html>
- Connectivity Scorecard (2011). The Call for Useful Connectivity. Retrieved on 4th November, 2011 from <http://www.connectivityscorecard.org/>
- Cordeiro, C. & Al-Hawamdeh, S. (2001) .National Information Infrastructure and the realization of Singapore IT2000 initiative, *Information Research* 6 (2) (2001)
- Dada, J. (2011). Global Information Society Watch: Nigeria. Retrieved on 4th November, 2011 from http://www.giswatch.org/sites/default/files/GISW_Nigeria.pdf
- Dalhat, L.W. (2007). Services capacity and export potential study: ICT and Financial Services in Nigeria. In: Proceedings of the Bridges across Border: Fostering Outsourcing Partnership in Financial Services and Information Technology Conference, November 2007. Accra, Ghana.
- EIU (2010). Economic Intelligence Unit: Digital Economy Rankings 2010: Beyond e-readiness. *A Report from the Economist Intelligence Unit*.
- Fomin, V.V. (2004)"The Role of Standards in the Information Infrastructure Development, Revisited," Workshop on Standard Making: A Critical Research Frontier for Information Systems, Seattle, WA, pp. 302-313
- Freedom House (2011). Nigeria: Freedom on the Net 2011. Retrieved on 4th November 2011 from www.freedomhouse.org/uploads/fotn/2011/FOTN2011.pdf
- Galliers, RD and FF Land (1987) Choosing an appropriate information systems research methodology, *Communications of the ACM* 30 (11), pp 900-902
- Gegere, E. (2011). Rural Telephony Project May Not Meet 2015 Target. Retrieved on 5th November, 2011 from http://234next.com/csp/cms/sites/Next/Home/5617193-146/rural_telephony_project_may_not_meet.csp
- Hanseth, O. (2002). From systems and tools to network and infrastructures - from design to cultivation. Towards a theory of ICT solutions and its design methodology Implications.

- Unpublished Manuscript*, Retrieved on 1st August, 2008 from <http://heim.ifi.uio.no/~oleha/Publications/bok.pdf>
- Hanseth, Ole, & Eric Monteiro. (1998). *Understanding information infrastructures*. Unpublished Manuscript, Retrieved on 6th September from <http://heim.ifi.uio.no/~oleha/Publications/bok.pdf>
- Heeks, R. (2002). "E-Government in Africa: Promise and Practice". *Information Polity*, 97(x), pp. 97-114.
- IWS (2011). Nigeria Internet Usage, Population and Telecommunications Reports. Retrieved on 6th November, 2011 from <http://www.internetworldstats.com/af/ng.htm>
- Juwah, E. (2012 May 10). EVC – NCC Presentation at the Nigeria Broadband Forum Lagos [Web Log Post]. Retrieved from <http://afridigital.blogspot.com/2012/05/evc-ncc-presentation-at-nigeria.html#!/2012/05/evc-ncc-presentation-at-nigeria.html>
- King, V. Gurbaxani, F.W. MacFarlan, K.S. Raman and C. Yap. (1994) Institutional factors in IT innovation, *Information Systems Research* 5 (5) (1994), pp. 139–169
- Lanvin, B. (2003). The role of governments in ICT: Leaders and facilitators. In: Dutta, Lanvin and Puaa, Editors, *Global IT Report 2003*, Oxford University Press, Oxford, England (2003) INSEAD, World Economic Forum, infoDev
- Longe, O.B. & Chiemeka, S.C. (2008). Cyber Crime and Criminality in Nigeria – What Roles are Internet Access Points Playing? *European Journal of Social Sciences*, 6(4).pp. 132-139
- Muiruri, W. (2004). *Negotiating the Net. The Kenyan Case Study*. Retrieved on 20th February, 2005 from <http://www.cidcm.umd.edu/ntn/>.
- National Population Commission of Nigeria (2012).
- Ndukwe, E. (2005). Telecom liberalization in Nigeria: Opening up the Market and Sector Reform. In: *Proceedings of the SATCOM 2005 Conference*.
- NCC (2012). Nigerian Communications Commission Website. Retrieved from www.ncc.gov.ng
- NPC (2011). National Population Commission of Nigeria. Retrieved on 4th November, 2011 from <http://www.population.gov.ng/>
- Ndukwe, E. (2008). Facilitating African renaissance through communications infrastructure development. In: *Proceedings of the 2nd Edition of the Stanford Africa Business Forum*, University of Stanford, May 2-4, 2008
- Ndukwe, E. (2007). Promoting Internet-Based Businesses in Nigeria. www.ncc.gov.ng. (Accessed 1st June 2008).
- Obura, F. (11th July, 2012). Kenya High Cost Hinder Internet Usage. *East African Standard*. Retrieved on 11th July from <http://www.standardmedia.co.ke/?id=2000047139&catid=14&articleID=2000047139>
- Ofose, G. (16th April, 2011). Nigeria: Competition Has Developed Telecommunications Market. *Daily Independent*. Retrieved on 6th November, 2011 from <http://allafrica.com/stories/201104180845.html>
- Oketola, D. (15th May, 2012). Government Must Set Agenda for Broadband Penetration – Urua. *The Punch*. Retrieved on 11th July 2012 from <http://www.punchng.com/business/technology/govt-must-set-agenda-for-broadband-penetration-uruu/>

- Onuba, I. (14th February, 2012). 112.5 Million Nigerians Live in Poverty – NBS. *The Punch*. Retrieved on 11th July 2012 from <http://www.punchng.com/business/business-economy/112-5-million-nigerians-live-in-poverty-nbs/>
- Ochara, N.M., Bankole, F., & Brown, I.T.J. (2008). Internet diffusion in Nigeria: is the ‘giant of Africa’ waking up? In P.A. van Brakel (ed.), *Proceedings of the 10th Annual Conference on World Wide Web Applications, 3-5 September 2008, Cape Town, South Africa*. Cape Town: IW3C2.
- Shin, D.H. (2007). “A critique of Korean National Information Strategy: Case of national information infrastructures”. *Government Information Quarterly*. Volume 24, Issue 3, July 2007, Pages 624-645
- Stiglitz, J., Orszag, P., & Orszag, J. (2000). The role of government in a digital age. Report commissioned by the Computer and Communications Industry Association. Retrieved on 4th November, 2011 from http://www.ccianet.org/govt_comp.php3.
- Tele Times (28th December, 2011). *Study Ranks Nigeria High on Internet Usage*. Retrieved on 4th November, 2011 from <http://teletimesinternational.com/africa/1514/study-ranks-nigeria-high-in-internet-usage>
- UN (2008). United Nations e-Government Survey 2008: From e-Government to Connected Governance. *United Nations Publication*, Department of Economic and Social Affairs, New York, 2008.
- UN. (2012). “UN E-Government Survey 2012: E-Government for the People.” United Nations Publication. Retrieved from <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf>
- UN-WPP (2008). Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision*, <http://esa.un.org/unpp>.
- Uzor, B. (29th July, 2010). *Nigeria May Become the Leading Supplier of Bandwidth in Sub-Saharan Africa*. Retrieved on 4th November, 2011 from <http://www.businessdayonline.com/NG/index.php/news/>
- Wolcott, P., et al (2001). A framework for assessing the global diffusion of the internet, *Journal of the Association for Information Systems*, 2(6), http://mosaic.unomaha.edu/GDIIntro_2003.pdf (Accessed March 19th, 2005).