

The Impact of PPIs in the Development of Broadband and the Way Forward: Ghana's Case

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Abstract: Telecom infrastructure development has been enabled greatly by different forms of collaborations or synergies between the public and the private sector. These synergies in most cases are exigent measures employed to enable the diffusion of telecom infrastructure into underserved and un-served areas. This paper examines the role of different public-private interplay that exists in Africa that were aimed at developing telecom infrastructure and why this public-private interplay could help in extending broadband connectivity to rural areas. Ghana is identified as a country with almost 80% penetration of mobile telephony. This has been made possible by the public-private collaborations fostered towards telecom infrastructure development. Ghana is used as a case to examine the strategies and identify possibilities for more of these collaborations. Data was gathered qualitatively. The significance of the paper is to narrate the possibility of using PPP to develop broadband infrastructure in Africa.

Key words: public private interplay, broadband, Ghana, Africa, developing countries.

This paper examines the role public-private Interplay (collaborations) can play in the development of broadband infrastructure in Africa and why innovative PPIs are needed for the development of NGNs in rural Africa. The case study used in making the examination is the Ghanaian broadband ecosystem. The reference to Public Private Interplays (PPI) in this paper is on the different synergies or partnerships facilitated between the public and private sector to develop public infrastructure. The main aim of this paper is to support the notion that a combination of public and private interventions will still be needed to develop broadband as we move towards Next Generation Network (NGN) in the continent of Africa and possibly other continents where some developing countries are domiciled. This paper also concludes, although these collaborations exist, the synergies needed to enable the penetration of NGNs in rural areas will have to be innovative.

Ghana is used as a case study based on its acclaimed mobile telephony teledensity of more than 100% and the availability of fixed broadband

infrastructure in some rural areas (NCA, 2013). In examining the case, the question is: what partnerships have brought Ghana thus far in the development of broadband infrastructure and will PPI still be necessary to develop NGNs to benefit rural areas in Ghana and other African countries? Although Ghana can be called a success story, some rural areas in Ghana are either to be served or underserved with broadband. In the adoption of services provided via existing fixed-broadband infrastructure, not much success is recorded as the average Ghanaian prefers having a mobile telephone to a fixed line. Still on the overall teledensity of Ghana, data from the Population Census Statistics (Ghana Statistical Service, 2012) indicates that the percentage of mobile telephone users is 47.7%. Of course, the figure has changed by now, three years later. The 100% tag sounds controversial as some villages are yet to be covered. The most plausible argument could be that people own more than one mobile telephone with different company SIM cards, as identified in the just concluded mobile number registration in Ghana.

Though little has been said about the use of PPI in developing broadband in Ghana, a careful look into the Ghanaian telecommunication and ICT system will reveal the role of various forms of public private interplays. PPIs adopted in Ghana have been enabled by partnerships forged via Partial privatization, turnkey approach, subsidy provision via Universal Access and Funds agency and governance. In the development of fixed-broadband infrastructure, all except Universal Access and Funds approach has been adopted to develop broadband infrastructure. This is mainly because of the huge cost in developing broadband infrastructure. For mobile/wireless, universality funds have played a role in the development of last mile broadband initiatives. The emphasis on cable is because it is cheaper to deploy wireless broadband infrastructure than cable broadband infrastructure. However as mentioned earlier, usage for the cable infrastructure is low.

The adoption of the identified PPIs in Ghana and other developed countries in Sub-Saharan Africa were not pre-meditated but born out of external influence from international donor agencies that encouraged private financing of infrastructure and the presence of legacy infrastructure developed both by public telecom companies or other utility companies (HILL, 1998; JAMALI, 2004). The motivating factor for adopting these measures, as evident in the Ghana Telecommunication Policy of 2005, was to enable the access of broadband (Universal Access) to all Ghanaians. This led to the creation of the telecom regulatory body, National Communications Authority, the Universal Access and Fund agency (GIFEC) and the National

Information Technology Agency (NITA). These structures from 2005 were used by the government of Ghana to begin a gradual upgrade of legacy fixed and mobile infrastructure to broadband.

There have been collaborations between private telecom companies and the government of Ghana via partial-privatization. There have been collaborations between the government of Ghana and private companies via the turnkey approach to infrastructure development. There have also been collaborations enabled through regulations. This paper tells the story of these partnerships and what the results are. It also discusses if there is need for the continuation in this line of partnerships as we move towards NGNs or if there is the need to go for more innovative partnerships that will facilitate NGN infrastructures in rural areas.

■ Examples of PPIs in Africa

Before proceeding to examine the specific case, it is important to note that PPI projects are ongoing in Africa. Africa is a very large continent with lots of PPI initiatives aimed towards the development of telecom infrastructure, which has been upgraded to broadband infrastructure. In another sense there have been PPIs that were geared towards broadband infrastructure development. Though the case of this paper is Ghana, it's worth mentioning a couple of international and national PPI efforts in Africa. PPI examples include the NEPAD facilitated EASSy project, the Kenyan TEAMS project, the Ghanaian, Ugandan use of Universal Access and Service funds to fund telecommunication infrastructure development (JAGUN, 2011; YARDLEY, 2012; GIFEC, 2012; FARLAM, 2005). The Kenyan Teams project was facilitated by the Government of Kenya and a private consortium of companies to build international fiber optics from UAE to Kenya. The government and the private consortium invested finance money in the project and they jointly own, operate and maintain the infrastructure. The Kenyans were motivated to build this infrastructure to create competition at international bandwidth level to facilitate the low cost of broadband in Kenya. The EASSy project is facilitated by the New Partnership for African Development (NEPAD), an organ of the African Union and a consortium of private and public telecom companies. The idea was to connect the land locked south and East African Countries to a fiber optic link from Sudan to South Africa as the first phase of linking the whole of Africa. The infrastructure is owned by the consortium which invested in it

while NEPAD, representing the countries involved, provided the regulatory and the operational framework. These projects are completed and functional projects. In various Sub-Saharan Countries like Nigeria, Ghana, Uganda etc., Universal Access and Funds is used to subsidize telecom infrastructure development. In Ghana the building of transceivers to enable co-location by the telecom companies is common. There is room for more innovative forms of PPIs; for example, Kenya is adopting a PPP approach to developing LTE, where LTE license will not be granted to one Telecommunication Company but to a consortium that will share infrastructure ownership in partnership with the Government of Kenya. The Kenyans want to avoid the inability of 4G reaching current underserved and unserved areas of Kenya. Hence the African Union and African countries as a whole, one would say, are already adopting PPIs and there is room for more of such initiatives, possibly geared towards rural development.

■ Public private interplays (PPIs) versus public private partnerships (PPP)

PPIs evolved from the various market reforms and the exigencies of the market. One hard nut that has posed a problem has been the diffusion and adoption of broadband infrastructure in rural areas. This has been the crux of direct public involvement in developing broadband infrastructure of recent to supplement private investment initiatives. (RUHLE, BRUSIC, KITTL & EHRLER, 2011). There have been some earlier studies on how the public and private sectors respectively will facilitate NGN development (BOURREAU, CAMBINI & HOERNIG, 2012; FEIJOO, GOMEZ-BARROSO & BOHLIN, 2011; RUHLE, BRUSIC, KITTL & EHRLER, 2011; RAGOOBAR, WHALLEY & HARLE, 2011). There had also been a study on an analysis of public-private investment dimensions into next generation networks for the EU (FALCH & HENTEN, 2008). In the case of the mentioned analysis, public private collaboration was the locus for assessing the investment dimensions. However, it impossible to really say that beyond the subsidy gap zones (core rural areas), that PPIs have been very effective. Be that as it may, the flexibility of forging PPIs makes it a valuable option. The dilemma lies in how the PPI is designed, financed and operated.

The usefulness of broadband in the development of societies can't be underestimated. Broadband has enabled the pervasiveness of telecommunication services in our everyday life (BLACKMAN &

SRIVASTAVA, 2011). There has been a drastic evolution in the telecommunications landscape in the development of the core and access networks, the services delivered; the applications that use these services and the data rates at which these services and applications are delivered to the consumer. This drastic evolution has led to a shift from the traditional economy to the E-economy thereby creating a new way of handling everyday life. Hence governments have now placed broadband as a priority and have even included broadband as a technology everyone must have access to (ITU STATSHOT, 2011). Development in the capacity of broadband has led to governments utilizing various infrastructure development approaches in involving the private sector in developing broadband. In some cases, it has been direct investment approaches from the public sector while in other cases it has been private sector financing through privatization, outsourcing and other public infrastructure investment approaches (SADKA, 2006; FALCH & HENTEN, 2010). In another case it has been the collaboration of the public and private sector in developing infrastructure (FALCH & HENTEN, 2010; WILLIAMS & FALCH, 2012). The possibility of the progression of the variation of these collaborations in future isn't in doubt. These collaborations can be referred to, be it direct or indirect, as public private Interplays (PPIs).

PPIs have often been confused with Public Private Partnerships (PPP) as a concept. Both concepts denote certain forms of partnerships, collaborations and relationships. The inability to draw a line of distinction between both concepts has resulted in PPP being muddled with ambiguities and contention (WEIHU, 2006; CDIAC, 2007; KHANOM, 2012). PPP is an evolution of privatization. Hence the practice of privatization, liberalization and even outsourcing has been identified as PPPs (POOLE, 2008). However, it is not entirely correct to identify privatization as PPP since in most cases the private sector takes complete ownership and control of the public infrastructure. Some form of partial privatization, depending on the level of collaboration in the operations and management of the public Infrastructure could be termed PPP. This sounds controversial but worth mentioning.

PPP is a methodology for procurement. It differs from PPIs which denotes the myriad forms of collaborations between the public and private sector are concepts. PPIs denote partnerships but in a broad, blurry and in some cases divergent manner. The only caveat is; there has to be an alliance or partnership. The concept is controversial and still needs a clear definition. Whereas public private partnerships as defined by COOK (2007) "exists wherever there is a contractual relationship between the private

sector and public sector company designed to deliver a project or a service that is traditionally carried out by the public sector." (COOK, 2007) Hence public private partnerships refer to partnerships surrounding specific projects bound by contractual agreements where resources from both sides of the (public and private sectors) are shared to develop infrastructure (JAMALI, 2004). On the other hand PPI covers not only project specific partnerships but sector specific partnerships.

The concept (PPP) began with the search for private finances in the late 1970's and early 1980's to fund public infrastructure development (HEARNE, 2009). Initially the introduction of PPP was to enable 'value for money' on the side of the public sector (JAMALI, 2004; QUIGGIN, 2004). However this purpose in some cases was defeated as the private sector in many cases delivered shoddy work in order to make profit (EPAC, 1995). Some infrastructures delivered were sub-standard due to the fact that the public sector solicited for private enterprises that can deliver infrastructure at a competitive cost; in principle, lower than what the public sector would have spent for the same project (QUIGGIN, 2004). Also the public sector could provide concessions to cover extra costs as a result of increase in original base line cost arising from either increase in exchange rate, increase in price of materials for the infrastructure or any form of external factor not considered in the initial contracting of the PPP project (SADKA, 2006). In these cases, the aim of reducing cost in infrastructure delivery as well as having an infrastructure that is delivered with 'value for money' is defeated. The success of a PPP is measured depending on context. Context could be value for money or the number of projects completed using PPPs. There have been successful PPPs in terms of the increase in the number of projects financed using PPP and the difference between a successful PPP and an unsuccessful one mainly lies in the structural design of the organization and financing frameworks of the PPP (GHOBADIAN, O'REGAN, GALLEAR & VINEY, 2004). One may say; even in the case of unsuccessful PPP's many expensive infrastructures that couldn't be handled by either the public or private sector individually were made possible by PPP, even at huge costs. Some examples are the provision of international bandwidth at the southern and eastern part of Africa (NEPAD e-Africa Commission, 2012), The English Channel project (FLYVBERG, GARBUIO & LOVALLO, 2009), to mention a few. The concept of PPP will continue to diversify as the exigencies of the current infrastructure malady presents itself.

One can say that with the historical perspective of PPP, the concept can be seen as a subset of a PPI and not vice versa. Both concepts share the

common attribute of obtaining 'value for money' for the public sector via the provision of private financing initiatives. However in a PPP contract, 'Value for money' implies providing a quality service at a reasonable or lower cost needed for that service. The 'value for money' entails maximizing the usefulness or impact of the amount spent. This is assessed by both parties (public and private). But for PPIs in general 'Value for money' is of greater benefit to the public sector as they can outsource, privatize, commercialize etc. broadband service development to the private sector. The private sector bears the costs, the risks and the profits whereas the public sector through governance facilitates the provision of the quality broadband infrastructure in a cheaper manner in relation to their finances. The only disadvantage for the 'value for money' concept for PPIs in general is; although the private sector may sign up to Universal Service Obligations, since they bear the risk and if they are not granted regulatory incentives, the universal access of broadband infrastructure may not be achieved.

The adoption of PPIs by developing countries has not been without some external drivers. The adoption of PPP as a Public Finance Initiative (PFI) for infrastructure development to a large extent has been as a result of external influence of international donor agencies like the World Bank towards developing countries (JAMALI, 2004). The same could be said of PPIs. The concept of assistance provided by World Bank can be explained using the modernization theory, which is a subset of the development theory (HILLS, 1998). The traditional concept of the modernization theory explains that with assistance, developing countries can be brought to the same level of development as the developed countries (HANNAN & CARROLL, 1981). Aside introducing market reforms to Africa, international financial institutions like the World Bank and other development partners have been instrumental in advising African governments towards market reforms as well as funding development initiatives. In the development of broadband, international donor agencies have been known to co-fund international broadband bandwidth initiatives such as NEPAD EASSy projects and national broadband backhaul initiatives. This influence has been the driving force towards public involvement in the co-financing of broadband infrastructure initiatives.

There are mixed reactions to the effectiveness of PPIs in the development of infrastructure in general, including telecommunication infrastructure. The central point of contention has been the cost of infrastructure development with PPPs. However in Ghana, the case of this research, PPIs have geared towards more of private sector financing and management of infrastructure, while the public sector provides governance

and in some cases co-finances the provision of infrastructure provision. As would be seen in the result section, Ghana has favored more of PPIs than PPPs in the development of telecommunication infrastructure.

■ Methodology

In developing this research, the case study approach was used. Sub-Saharan African countries were selected as possible case studies, Ghana was chosen because of the success in the level of mobile penetration as reported by the regulator. It was important to find out what PPI initiatives were adopted in Ghana and what the prospective would be for the use of PPIs to fund broadband development in future. Data gathered were through unstructured face-to-face interviews and meetings with ICT stakeholders in Ghana and from online information portal of relevant agencies in Ghana. Information obtained was also verified by both online and offline research literature on the issue at stake. There was also consultation with academic professors who have ideas about the Ghanaian telecommunication landscape. The researchers' personal knowledge of Ghana, one being a Ghanaian ICT stakeholder and the other being a resident researcher in Ghana for 4 years, also played a role in the analysis being made. The limitation of this research rests on the inability to meet with all representatives of the broadband sector in Ghana to interview them. Secondly, there are some other broadband infrastructure developments in Ghana not captured in this research, either because it is at its development stage or access to information on the investment approach for the infrastructure was classified.

■ Overview of PPI in broadband infrastructure development in Ghana

In the telecommunications sector HILLS (1998) and JAMALI (2004) mentioned the introduction of liberalization and regulation in the development of the telecommunications sectors of developing countries. The concept of market liberalization began in the west in the late 1970's as the western countries moved away from the Keynesian economic form of government to the neo-liberalism 'less Government' approach in infrastructure governance (HEARNE, 2009). The idea behind liberalization

was that market forces alone could lead to the rapid and efficient development of infrastructure (HEARNE, 2009). This social evolution was adopted in the development of telecommunications infrastructure in Africa in the early 1990's (WALLSTEN, 2001). Many African countries deregulated their telecommunications sector by breaking the national telecommunication monopolies where they separated the regulatory organ from the operational organ of the monopoly to create separate entities. These paved the way and also granted open access to new network operators to improve the telephone penetration in some African countries.

In the case of Ghana, from independence to 1994, the country had approximately 50,000 telephony subscribers (FREMPONG & HENTEN, 2004). These were lines provided by the state Monopoly (Ghana Telecoms). They were one of the first countries to liberalize their telecommunications sector in the mid 1990's (ALHASSAN, 2007; FREMPONG & HENTEN, 2004). The licensed fixed line operators were Ghana Telecoms and Westel. The mobile network operators were Space to Space (Now MTN), Milicom Ghana Ltd and Kasapa (now Espresso). Today there are 6 network operators in Ghana (Glo, MTN, Milicom, Espresso, Vodafone and Airtel). It was also one of the first to adopt the Internet in Africa (SEY, 2011). From the liberalization of telecommunications in the 1990's till April 2012 Ghana now records 21,945,884, subscribers (National Communications Authority, 2012). Ghana has been one of the pacesetters in the development of ICT in Africa. Out of which 21,660,021 are mobile telephony subscribers and 285,863 are fixed telephony subscribers. With the technology neutral policy currently adopted by the National Communications Authority (NCA), the telecoms regulator in Ghana, one can say that the telecommunication landscape in Ghana has been modernizing, with the availability of broadband enabled by 3G fixed, mobile wireless broadband access networks, and fiber optics backbone connectivity. If the result of the network effect produced by the proliferation of mobile telephony in Ghana is measured in economic, political and social terms, one might rightly say that liberalization of the telecommunication sector brought about social change and that social change is on a continuum.

■ Results and analysis

The results gathered portray the PPI scenario in Ghana focusing on different broadband technologies both cabled (DSL and fiber optics)

mobile/wireless broadband infrastructure. The table below is a summary of qualitative data gathered on each PPI aimed at broadband infrastructure development in Ghana. The analysis of each component follows

Table 1 - PPI in the development of DSL infrastructure in Ghana

<i>Collaborating Institution</i>	<i>Form of Collaboration</i>	<i>Broadband Service Provided</i>	<i>Bandwidth Provided</i>
Vodafone/ Government of Ghana	(Equity Partnership) Government of Ghana owns 30% stake while Vodafone owns 70 % stake in the former Ghana telecoms company	Fixed broadband via DSL and mobile broadband via 3G network	Backhaul and Last Mile (Nationwide Coverage)
Huawei/ Government of Ghana	Build design turnkey Contract. Partial funding from Government of Ghana and Chinese Government Loan	Construction of national fiber optic national backbone	Backhaul (nationwide coverage)
Mobile Network Operators/ Government of Ghana	Government partners mobile telecom networks by providing governance via regulation	Construction of competing fiber optic backbones Provision of 3G and above mobile connectivity to some cities	Backhaul and Last Mile (Nationwide Coverage)
Internet Service Providers/ Government of Ghana	Government partners mobile telecom networks by providing governance via regulation	Provision of broadband internet connectivity to subscribers	Last mile

Sources: Vodafone Ghana, NCBC, Chinese Embassy Ghana, National Communications Authority

Cabled infrastructure

DSL

DSL infrastructure in Ghana is provided by the incumbent fixed-line operators Vodafone. The advantage of DSL to the network operator is the ability to reuse the last mile copper loop. However in Ghana it is difficult to get the accurate statistics on the number of DSL subscribers or the actual access of DSL to subscribers. Vodafone has indicated that it has offered the service only in areas with existing copper loops. Hence presently the DSL infrastructure is available in Accra, Kumasi, Takoradi, Cape Coast, Ho, Tamale, Koforidua, Sunyani, Bolgatanga, Wa, Obuasi, Akosombo, Swedru, Winneba, Nsawam, Tarkwa, Elubo, kaso, Konnongo, Abetifi, Navrongo, Techiman, and Hohoe (Vodafone Broadband, 2012). According to the

National Communications Authority (NCA), Vodafone had 276 514 fixed line customers as at March 2011 (National Communications Authority, 2012). These are areas where the former state monopoly, Ghana Telecoms (GT) had covered with the PSTN before Vodafone bought the company - GT. The interest in this sector for this paper stems from the fact that DSL infrastructure is available in not just the cosmopolitan cities of Accra, Kumasi and Tamale but in district capitals and rural areas as well.

The success factor to the penetration of DSL through partial privatization arose not exactly from a single action but a by different attempts to expand telecom infrastructure via the vehicle of privatization. The then government (NPP), against the will of the opposition, saw the need to privatize Ghana Telecom (the state public telecom Company, now Vodafone) due to the inefficiency in the management of the company and the need to improve the legacy telecom infrastructure. Previous privatization initiatives were not successful. Telekom Malaysia was unable to achieve their target of providing 400,000 fixed lines (they provided 240,000 lines) by the end of their shareholding agreement. Hence the then government had the political will to embark on another privatization effort. The public sector gave up 70% lease of the company and retained 30%. Although the target wasn't achieved, Telekom Malaysia did enable Ghana to triple its landline teledensity from about 80,000 lines in 1997 to 240,000 lines in 2002. The expansion of infrastructure by Telekom Malaysia and the later Management consultancy of Telenor laid the groundwork for Vodafone. The second factor, based on the improvement of infrastructure by earlier privatization initiatives, was the freedom granted to Vodafone to manage, operate and maintain the telecom infrastructure. This sense of ownership coupled with the 99 year lease enabled Vodafone to consider upgrading the existing copper loop to DSL knowing that they will earn Return on Investment (ROI) before the lease runs out. Ghana is technology neutral; hence Vodafone has the flexibility in deciding its scope of investment in both wired and cabled broadband infrastructure. The outcome of this privatization initiative has been the reduction in the cost of access to fixed broadband using DSL in Ghana.

In the development of the DSL infrastructure, The Government of Ghana could be seen as a collaborator in two different ways. First as the public sector provides governance and the private sector invests. Vodafone Ghana, invested in the provision of the broadband network by upgrading legacy Ghana telecom existing last mile copper loop to DSL. This PPI has led areas like Obuasi and Swedru that are not as cosmopolitan as Accra and Kumasi to have access to broadband.

The second form of interplay is that of equity partnership. Vodafone owns 70% equity stake while Government of Ghana has 30% of the stake (Vodafone Ghana, 2012). Part of Vodafone Ghana infrastructure is still owned by the government of Ghana. Besides that, the Government still has regulatory oversight over the activities of the telecommunications industry through the National Communications Authority, who is the regulator. The two forms of interplay arrangement are both direct and indirect relationships. It is direct as an equity holder and indirect as a regulatory partner.

Optical fiber

One area where public private interplay has played a major role in broadband infrastructure in Ghana has been in the development of optical fiber networks. The investments from the public sector have been both direct and have involved public financing. This has been a very costly affair for the public sector. From the public financing point of view, the Government of Ghana in 2007 was to invest \$70 million in connecting all regional capitals and the 36 major towns in Ghana by fiber optics link (Chinese Embassy Ghana, 2007; National Information Technology Agency, 2012). The private Company involved in the design-build partnership was Huawei Technologies and the Public agency involved in the management of the project was the National Communications Backbone Company (NCBC) which was initially owned by Ghana Telecoms but now owned by Vodafone. Government funding for the infrastructure was facilitated by a loan from the Chinese Government. Huawei was to upgrade the existing Voltacom intercity Fiber optics, now owned by NCBC, by designing and building the network. The advantage of this PPI stemmed from the fact that, the incumbent operator Ghana Telecom (GT) and new mobile telephony entrants had this backbone incentive available for them for deploying their services before some mobile network operators decided to build their individual networks.

Another way the Government collaborated with private telecom network operators in this regard was to grant open access to mobile network operators to build their fiber optic networks. MTN, Millicom Ghana Ltd, Vodafone and GLO are some of the network operators with functional fiber optic backbones. In this form of PPI, the private sector funded the infrastructure development and actually owns and manages the infrastructure development. Government actually provided the regulatory framework to enable this development. Despite this progress, the present fiber infrastructure in Ghana is the FTTN (Fiber-To-The-Node). FTTH (Fiber-To-The-Home) is not common in Ghana at the moment, even in the city

centers, due to initial high installation subscription and fees. The advantage of building competing fiber optic backbone was; the network operators would save costs in the long run by reducing interconnection charges on the NCBC backhaul. The operators would be able to expand their services and lease capacity to Internet service providers. The cost of accessing the Internet has been reduced as a result of the ensuing competition.

In Ghana, the utility sector has also invested in the development of the fiber optic network. The first fiber optic network was owned Volta Communications (Voltacom) a subsidiary of the Volta Riva Authority (NCBC, 2012). The network was initially developed to aid big multinational companies in Ghana whose business thrived on the speed at which information is delivered to be connected. The Volta River Authority initially was the public agency that generated, distributed and transmitted electricity in Ghana. But 2005 the new VRA act redefined their function to electricity distribution (Volta River Authority, 2012). They used the electricity Grid as the transmission carrier of the fiber optics cables. However, in 2007 Voltacom was separated from VRA and NCBC was set up to manage the fiber optics facility. VRA distributed the fiber optic network using existing electricity grid lines. Hence one can say that the utility companies also played a role in the development of broadband in Ghana. The PPI here can be said to have taken place when the facility was unbundled to allow mobile telephone networks to use the infrastructure to deliver broadband.

The success factors, one would say, stem from the fact that the government of Ghana invested money in the project, not just relying on private financing. Secondly before the establishment of telecom regulatory body, National Communications Authority, VRA (an electricity producing company) could operate a telecommunications infrastructure. That served as a basis for the development of fiber optic backbone in Ghana. Unlike in the case of DSL, where infrastructure development for the legacy copper lines leading to the upgrade to DSL were developed by telecom companies, a non-telecom utility company played a role in the development of fiber optics.

Mobile and wireless networks

One network technology that has really led to increased teledensity in Ghana has been the proliferation of mobile and wireless networks. These networks provided range from 2G to 3G standards of mobile networks. However it is very difficult to ascertain the population density that has access

to any of these separate mobile standards. It is also not wise to assume that every mobile service delivered in Ghana is broadband. However, areas of Accra, Kumasi and some regional capitals do have access to mobile technology standards of 3G and above. The geographical availability is a point of distinction where it is true that the penetration of mobile broadband network infrastructure is high.

4G has not been really gained grounds in the country but there is a gradual usage of WiMAX technology. Internet Ghana, an ISP, was one of the first service providers to use the standard but recently other ISPs have followed suit (OSIAKWAN, 2009).

In this case the PPI investment approach of the government of Ghana is more of investment in policy and regulation, which at this moment is the policy of open access and network neutrality. This has not been the only case of such a PPI but it cuts across the approach to other mobile and wireless networks. These include, WIFI, GSM, CDMA, GPRS, EDGE, WCDMA, etc. (WILLIAMS & BOTWE, 2010).

The success of this PPI approach has been enabled by the public sector in Ghana adopting the competition approach to developing mobile and wireless network infrastructure. This mobile wireless infrastructure development has been more successful than the fixed cable infrastructure development as 6 mobile companies (MTN, Vodafone, GLO, Airtel, Millicom and Expresso) operate mobile networks compared to 2 fixed line networks (Vodafone and Airtel). In 2012 there were 25.6 million mobile telephone subscribers compared to 284,981 fixed line users (NCA 2013). The significantly low adoption of fixed line telephony isn't hinged exactly on insufficient infrastructure, in the case of the fixed line telephony, but on the relatively low cost, mobility and flexibility presented by mobile telephony. Ghanaians prefer to own more than one mobile telephone with different mobile networks than a fixed line telephone.

■ Implication of results

The role of PPI in Ghana as seen by the results, has been approached in different ways. It is mainly an approach geared towards propping and developing the telecommunications market in Ghana. This has continued to the development of broadband technologies, thereby enabling the availability of new broadband technologies in Ghana. Fiber optic networks are being

used in most parts of Ghana for the international bandwidth connectivity and national backhaul. Ghana is yet to develop FTTH. Wireless networks like WiMAX, VSAT and Wi-Fi networks are provided mostly by Internet service providers.

The objective of the Government of Ghana is found in the Ghana telecom policy of 2005 (Ministry of Communication, 2005) which is the attainment of the Universal Access and service of broadband and other telecommunication services. To achieve this goal a three way collaborative approach is adopted. These approaches differ slightly in the provision of DSL, fiber optics, and mobile broadband infrastructure. However, one approach has not been very visible in Ghana in the development of Broadband Infrastructure and that is network infrastructure sharing. The three identified approaches are:

The partial privatization approach

The Partial Privatization investment approach as seen by the results has enabled the development of DSL in areas of Ghana, where it did not exist. Now residents of areas, in regional capitals and small towns, where there was former Ghana Telecom fixed line infrastructure, they now have access to broadband through the DSL connectivity provided by Vodafone.

Although Ghana has had failed partial privatization initiatives in time past, it is too early to access the success of the Vodafone deal. But if one has to look at the advancement made in the development of DSL despite the high fixed cost of the rolling out of infrastructure, then one can say that the partial privatization investment approach worked well. Here legacy cable infrastructure from the former state monopoly was upgraded to DSL. Rural areas where these infrastructures were available now have access to DSL.

Turnkey approach

The PPI investment approach which has enabled public fiber optic development, as seen in the result, has been the injection of finance by the Government of Ghana into the project. This partnership did take place before the development of private backhauls by mobile and fixed telecoms operators. Aside from the provision of national backhaul connectivity using fiber optics from private mobile service providers, this turnkey PPP has

enabled the provision of fiber optic connectivity in the northern part of Ghana, which is poorer than the south. The private mobile service providers have only provided such connectivity mainly in the southern part of Ghana and a termination or two in the north, mostly at Bolgatanga. If the Government of Ghana hadn't adopted this approach, mostly the southern part of Ghana would have enjoyed this service.

Regulatory framework approach

The first investment approach is via the establishment of sound regulation to enable private investment in the development of broadband. This is evident in the case of mobile broadband services. In Ghana the National Communication Authority is the telecommunications regulator. The Ghana National Telecom Policy, which is the policy tool for regulating the market, provides the following opportunities to the private sector (Ministry of Communication, 2005).

- Open non-discriminatory and transparent licensing approach.
- Ensuring competition through a "comprehensive interconnection and equal access regime that guarantees network access to all service providers and end users".
- Operators with Significant Market Power (SMP) provide non-discriminatory interconnections charges to networks connecting to them. To ensure this, "the operators with SMP are required to publish reference interconnection offers indicating all conditions (price, technical, administrative etc.) of interconnections to their networks, which will be available to all potential interconnecting operators".
- The policy further encourages facility sharing which entails right of way, sharing of towers, local loop unbundling, etc.

These regulatory incentives, in addition to others not mentioned here, have played a major role in attracting private investment into mobile and wireless broadband development as seen in the results. There would be more players, but the NCA deem 6 operators to be enough for the Ghanaian population for now. These regulatory incentives also work for DSL and fiber optics but more for mobile in Ghana. MTN, GLO, Millicom Ghana all have national fiber optic backhaul as a result of this open access regulation. However as wireless networks are cheaper to deploy, these companies focus more on only building fiber optic backbones to support their networks and reduce interconnectivity charges to other networks.

Private sector interest includes, as identified by JAMALI (2004), the source of capital, technical expertise and incentive structure to the partnership. And this has worked perfectly in developing infrastructure to cater for more than 21,945,884 million telephony units out of the population of 24,658,823 million Ghanaians who subscribe to mobile telephony and a large chunk of those to mobile broadband (National Communications Authority, 2012; Ghana Statistical Service, 2012). The mobile operator with the largest subscriber base is MTN, with 10,394,363 numbers of subscribers. They are the largest operator with almost 50% share of the mobile market. They provide mobile broadband in all the major cities of Ghana by deploying between 3G to 3.5G standards of mobile broadband.

The three approaches have enabled the public sector to deliver infrastructure in areas where Government budget and financing would have been limited to cater for it. It has also enabled the provision of broadband services in areas where the private sector would not have catered for it if these collaborative initiatives were not put in place. However, one can say, in the development of broadband infrastructure, these adopted PPI initiatives proposed by the international donor agencies helped. Nonetheless, the basic problem noticed in the process of this research was; African governments and the telecommunications private sectors have not thought of more ways of collaborating to develop infrastructure by themselves

Africa is a huge market in terms of broadband development. In deploying broadband infrastructure, especially in rural areas to attain universal access, innovative PPIs can't be over looked. It is the best possible way to develop broadband and NGNs based on its flexibility of association, aims and objectives. However, for these collaborations to be developed, African governments should facilitate further research as to how these collaborations can be designed to deliver 'value for money', and enable sustainable life span for specific projects or the telecom sector. However it is worth noting that the adoption of mobile broadband is greater than that of cable broadband.

■ Conclusion

This paper was designed to examine different public private collaboration approaches to the development of broadband in Africa. Ghana was chosen as a case study based on its success in fixed broadband infrastructure

development in rural areas and mobile telephony teledensity. In the process of researching, it was discovered that the idea that culminated to PPIs came from the international donor agencies. In an effort to modernize developing countries and Sub-Saharan African countries being a domicile for developing countries, these donor agencies proposed liberalization, privatization and PPP. From modernization theory, this is seen as assistance granted to developing countries to develop the telecommunication industry and now the move is towards broadband.

The results presented in this research have been able to identify various modes of public private interplay and its significance to various broadband access infrastructures. In the discussions, it was evident that Ghana's PPP effort was enabled via governance (regulation), Subsidy/Turnkey and partial privatization. The success of the PPIs identified in this paper stemmed from the fact that there was more private sector involvement than public sector involvement. The private sector was given the opportunity to invest in public infrastructure by enabling the feasibility of return on investment, management of risk and ownership of infrastructure. Hence with these incentives, including the presence of legacy infrastructure that could be easily upgraded, the public sector was willing to part with these infrastructures as in the case of Vodafone.

The collaboration between the public sector and private sector in the development of broadband and Next Generation Networks is here to stay. Despite the African preference to the usage of mobile networks, this is not an indictment of PPIs on fixed line networks in rural areas. Rather it is an opportunity to think beyond just infrastructure delivery when developing PPI frameworks. It is important to take into consideration the social ecosystem of the rural area, identify their needs and fashion PPIs that will pitch broadband to their needs. In this manner the private sector could see the market potential and invest in these areas.

PPIs are the best way to harness resources to achieve common goals. Although Ghana has been successful in the development of mobile telephony, there is every likelihood that if an innovative PPI is not adopted, the extension of NGNs to rural areas may not be feasible in the future. Hence resource sharing through PPIs, as in the case of Kenyan LTE, may hold the key to extending NGNs to rural areas. The lesson learnt from the Ghanaian experience is; competitive markets have its limits, since most rural areas are unserved. If a competitive market is to exist in an underserved area, then innovative PPIs may be the way out. It is important to note that the downside of network infrastructure sharing will stem from the

unwillingness of incumbent operators to share resources. The fear of losing a customer base is paramount, hence in any new PPI, this factor has to be factored in.

Having assessed the case of Ghana, one might say had it not been for these collaborations these investments in developing broadband may not have occurred, as costs are shared. Hence, the way forward for investing in broadband infrastructure in Africa should be the conscious and deliberate facilitation of PPI frameworks that will enable these broadband infrastructure developments as in the case in Kenya, South Africa, etc.

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