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A Public Management Framework for Wireless Broadband Development in Rural Sub-Saharan Africa

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Summary. This paper identifies potential public and private stakeholders needed to help rural communities deliver wireless broadband infrastructure in sub-Saharan Africa. These rural areas are not commercially viable for mobile broadband cellular networks. However, few rural communities in the region have attempted to develop Wi-Fi networks. Few have succeeded and some have failed. A public Public-Private Partnership framework that can be customized to deliver and provide sustenance to these initiatives may hold the answer to curb the failure of such initiatives. This study adopts the stakeholder theory of identification and salience on 6 community-based initiatives in developed and developing countries to find out different stakeholder arrangements in these cases. Based on the findings, the interpretive phenomenological analysis is used to explain how the findings could be utilized by the public sector agencies in Africa to help rural communities develop sustainable Wi-Fi networks. The paper concludes that a triangular relationship between the community, the public sector agency, and attractive incentives for each stakeholder, can serve as the basis for organizing such stakeholders to aid the community develop the networks.

Introduction

This paper presents a Public Private Partnership stakeholder management framework aimed at facilitating wireless broadband internet infrastructure projects in rural areas of sub-Saharan Africa. This framework is necessitated by the fact that rural communities in sub-Saharan Africa are making attempts to provide affordable broadband internet infrastructure for themselves. In most cases, the rural communities are spurred to embark on this venture by local and foreign non-governmental organizations. Examples of such initiatives include, the Macha Works in Zambia, the numerous wireless user groups in South Africa, Bosco network in Uganda, the Ghana wireless Project, to mention just a few (Nungu, Brown, Pehrson, 2011; Williams, 2015; Rey-Morano, Graaf, 2016). Most of these initiatives are Wi-Fi networks, spurred by the affordability of Wi-Fi equipment, the potential for non-orthodox deployment possibilities of the network and the deregulation of the Wi-Fi spectrum in most sub-Saharan African countries.

Unfortunately, few of these initiatives have not been sustainable. An example of such, the Ghana Wireless project, is mentioned in this report. This is mainly because the operators of these networks lack the resources and capacity to economically manage the network. However, the operators have acquired the technical skills to manage the technical aspects of the network (see case of Cape Town WUG – Rey-Morano, Graaf, 2016). As a result of this possibility, they are able to raise volunteers who provide technical support for the network. They also embark on knowledge transfer processes to transfer the knowledge from one volunteer to another.

In order for these initiatives to succeed and become sustainable in sub-Saharan Africa, these communities need technical and knowledge base, as well as financial and organizational support. These forms of support can be provided by one or more groups of stakeholders. Such stakeholders include public sector agencies, NGOs, donor agencies, and the private broadband service providers. However, the interest of the stakeholder will depend on the expected reward (incentives) it will derive from being a partner with the community to develop the Wi-Fi infrastructure. Therefore, the questions this paper seeks to address are: Which stakeholders should collaborate with local communities to develop Wi-Fi infrastructure in rural areas in sub-Saharan Africa? What should be the responsibilities of the stakeholders in this partnership? What should be the role of the community in this partnership?

In order to answer these questions, a research was conducted by the author of this paper to identify a Public Private Interplay (PPI) Framework that would enable the delivery of broadband infrastructure in rural areas in developing countries (Williams, 2015). The findings in this research had global implications but as a form of disseminating the results of this research, the findings is

contextualized towards sub-Saharan Africa. These findings provide an insight towards answering these questions. The earlier research the author conducted was on six cases of broadband development that involved either community cooperatives or NGOs. These were the Magnolia Road Internet Coop (MRIC) (the USA), Djurslandsnet (Denmark), Almhult Municipal Broadband (Sweden), Johannesburg Wireless User Group (South Africa), Dharamsala Wireless network (owned by Airjaldi) India, and the Ghana Wireless Project (Ghana). All of the cases, except for that of Sweden, deployed Wi-Fi networks. Fibreoptic connections were used in the Swedish case. The essence of studying this case was to identity the relationship between different stakeholders and communities which are organized to develop rural broadband infrastructure. Based on the lessons learnt, guided by the research questions in this paper, inspiration can be extracted on their responsibilities; incentives; their potentials as core stakeholders and the potential role of communities in developing broadband networks. Three of the cases are cases of developing countries and the other three concern developed countries. The reason for studying developing countries is the need for a different sources of inspiration on potential organizational partnership arrangements of the stakeholders.

This paper has been written from an interpretivist's perspective. The stakeholder theory of identification and salience is used to present the findings for the cases. Based on this presentation, the definitive (core or direct) stakeholders and the indirect (expectant) stakeholders are identified for each case. Their responsibilities and incentives for being part of the partnership are identified. The interpretive phenomenological analysis is used as an analytical tool to simulate and present the PPP stakeholder framework for rural broadband infrastructure development based on the findings from the stakeholder theory of identification and salience. The paper concludes that the framework presented can be used to deliver broadband infrastructure using Wi-Fi in rural areas with chronic broadband deficiency. The reservation is that it should be owned by communities. It also concludes that the existence of an extensive fibreoptic backbone network presents an opportunity for forming such partnerships to develop such networks. It further calls on governments in sub-Saharan Africa to adopt innovative ways of fostering these stakeholder relationships in their jurisdiction to aid communities develop Wi-Fi networks.

The paper has been divided into 8 sections. Section 1 is the introduction; Section 2 explains the relationship between PPP frameworks the stakeholder theory of identification and salience; Section 3 presents the methodology of the research; Section 4 presents the overview the cases; Section 5 explains the findings from stakeholder theory of identification and salience, Section 6 presents the PPP stakeholder framework; Section 8 is the discussion and section 9 is the conclusion of the paper.

A review of PPP frameworks and the stakeholder theory of identification and salience

An introduction of PPPs and how they are adopted in the delivery of telecom infrastructure and an overview of the stakeholder theory of identification and salience followed by the relationship between PPP frameworks and the stakeholder theory of identification and salience.

Subsection I: PPPs and telecom infrastructure development in Sub-Saharan Africa

A PPP is a synergic partnership that involves in most cases a consortia of public and private partners or stakeholders in a project. A stakeholder implies a group or entity that can have an influence on the activities of an organization or, in this case, a project (Freeman, 1984). PPP projects are often proposed by the manager (often a public entity). The central stakeholder or project manager in the context of this paper designs and provides investment guidelines, the timeframe, and other terms for implementing the project. Different stakeholders, based on the proportionate allocation of risks, resources and rewards are invited to join the project by the project manager (Jamali, 2004). The invitation is often based on their perceived capacity and experience in facilitating similar projects.

In modern times, PPPs were contracted via long term concessions or lease agreements (Worldbank, 2014). The aim was to attract private investment and management expertise in developing public infrastructure (Hearne, 2009; Savas, 2000). PPP concession business models included the variations of the Build-Operate-Transfer (BOT), Design-Build-Finance-Manage-Operate (DBFM), Design-Build-Operate (DBO) and other Public Financial Initiative (PFI) business models (Williams, Falch, 2012; The World Bank, 2011). The private sector often forms a consortium to leverage their competences to participate in the projects (EPEC, 2012). An example of an involvement of a consortium in telecom network infrastructure is the case of NBNco (Australia) (Bedi, Brown, Gasser, Wanjau, Webb, 2016).

Today, the need for PPPs is driven by the desire to facilitate the supply of broadband and Next Generation Networks (Kushida, 2013; Feijoo, Gomez-Barroso, Bohlin, 2011). This desire has led to the public sector to:

1. Co-finance PPPs: Examples of publicly funded PPP initiatives include the Singapore Next Generation Nationwide Broadband Network, the RAIN Project in Lithuania, and broadband developments in Sweden, the Netherlands, Japan, etc. to mention a few (Yardley, 2012; Kushida, 2013; Lindskog, Johansson, 2005; Sadowski, Nucciarelli, de Rooij, 2009).
2. Allow new stakeholders to become part of PPPs: Traditional telecom PPP stakeholders were public organizations and telecom network operators. Tele-

com operators often led a consortium consisting of partner network operators, banks, donor agencies and other economic and managerial stakeholders (EPEC, 2012; Worldbank, 2014). In recent times, other stakeholders including municipalities, civil society groups and housing cooperatives have been visible players. Examples of such cases can be seen in the United States and in specific EU countries, such as the Netherlands, Denmark, Sweden and the UK to mention a few (Williams, 2015; Sadowski, Nucciarelli, de Rooij, 2009; Tapia, Maitland, Stone, 2006). In the global South this has not been the case, and although civil society groups have been involved in facilitating networks, they have not been partners in a PPP.

This new approach was facilitated on the foundation of older and evolving PPP business models. In the EU, Africa and Asia, the popular PPP Business models used for facilitating telecommunication infrastructure include variations of the DBO aimed at facilitating NGNs (Williams, 2015). This includes Private DBO and Public DBO business models. The private DBO implies the private sector retaining ownership of the network (Yardley, 2012). The network may or may not involve public funding. Examples include the mobile infrastructure project in the UK, InfraCo (Nigeria) and National Broadband Initiative in Malaysia (Bedi et al., 2016). The public DBO implies public funding and ownership of the network while the private sector is contracted to manage it (Yardley, 2012). Examples include the National ICT Backbone (Tanzania), Western Cape Government Broadband in South Africa and Metropolitan Area network in Ireland (Bedi et al., 2016).

Subsection ll: Overview of the theory of stakeholder identification and salience

The dynamic nature of PPP business models makes room for more creative business models that can aid rural broadband development in the global South. The dynamics can be modified using the theory of stakeholder identification and salience. The theory provides an insight into how managers can identify stakeholders worth prioritizing for specific objectives (or projects in our case) (Mitchell, Agle, Wood, 1997). Mitchell, Agle and Wood (1997) present three characteristics of stakeholders. These are stakeholders with power, stakeholders that require urgency and stakeholders that are legitimate (ibid). Power is the ability a social actor possesses to get another social actor to perform an action (Foucault, 1982). Urgency implies "the degree for which a stakeholder's claim call for immediate action" (Mitchell, Agle, Wood, 1997). Legitimacy implies "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed systems of norms, values, beliefs and definitions" (Mitchell, Agle, Wood, 1997).

Different stakeholders possess one or more of these characteristics. And these characteristics determine the type of the stakeholder as seen in Table 1 below.

Table 1

Stakeholder typology based on the theory of stakeholder identification and salience

Type of stakeholder	Stakeholder characteristic	Class of stakeholder	Salience
1. Any	power, legitimacy, urgency	definitive	high
2. Dominant	power, legitimacy	expectant	moderate
3. Dangerous	power, urgency		
4. Dependent	legitimacy, urgency		
5. Dormant	power	latent	little or none
6. Demanding	legitimacy		
7. Discretionary	urgency		
8. Non-stakeholder	none	none	none

Source: Mitchell, Agle, Wood, 1997.

The stakeholders of interest to the manager are the definitive stakeholders. This is because they possess power, urgency and legitimacy – hence they have high salience. There are other stakeholders whose salience is moderate. They possess any of the two stakeholder characteristics. The central manager views them as expectant stakeholders (Mitchell, Agle, Wood, 1997). Mitchell, Agle and Wood (1997) explain that they always expect something. The manager sees a potential in them but does not grant them the same priority as the definitive stakeholder. The stakeholder of little or no interest to the manager is the latent stakeholder (ibid). It possess only one stakeholder characteristic. If an entity possesses none of the three characteristics, then it is not a stakeholder.

Subsection lll: PPPs and the theory of stakeholder identification and salience

The organization and financial arrangements of PPPs can be viewed in the light of the theory of stakeholder identification and salience. This is because PPPs in general, be it concessions or lease agreements, are designed for stakeholders relevant for the project. The relevance denotes the importance of the stakeholder to the project. This is evident in the delivery of telecommunications infrastructure in Africa, from the International Gateway to the last mile networks.

In facilitating international Gateways, notable PPPs in Africa are the EASSy the TEAMS and the SEAS projects (Williams, Falch, 2014; EU Africa Infrastuctura Trust Fund, 2016). The EASSy project was transnational, while the TEAMS and SEAS project were initiatives led by the Kenyan Government (Williams, Falch, 2014). The important stakeholders for these projects were the public (government agencies) and the private sector (network operators, banks and international development agencies).

At the national level in Africa, the prevalent mode of facilitating national and last mile infrastructure is by promoting a competitive market. However, in Africa PPPs are also adopted in the facilitation of fibreoptic backbone infrastructure. These are private and Public DBOs. An example of a public DBO is the National ICT Backbone in Tanzania (Bedi et al., 2016). An example of a private DBO is InfraCo in Nigeria, the Kenya LTE and the Eastern Corridor project in Ghana (ibid). In addition to facilitating fibreoptic backbones at the national level, Universal Service Funds in Africa use PPPs to facilitate mobile and fixed backbone infrastructure. Examples of such initiatives can be found in Uganda, Ghana, Sudan and Nigeria (ITU, 2013). Rural areas are often the target of these Universal Service Fund initiatives. These PPPs are Public DBOs and Private DBOs. For public DBOs, the network operator's capital expenditure is greatly reduced as the public sector leases its microwave towers to the network operator to deliver and manage their services. In the case of a Private DBO, the Universality Fund, such as USPF (Nigeria), co-finances the private sector's network infrastructure development (Williams, 2015). There are also municipal and regional governments' efforts in South Africa where municipalities utilize Public DBO to connect schools, public buildings and government offices (Bedi et al., 2016). Here Wi-Fi networks and fibreoptic networks are used in the Isizuwe Municipality and Western Cape Government initiatives respectively (ibid).

There are no known last-mile PPP initiatives in sub-Saharan Africa. The important stakeholders for the PPP initiatives were the public sector (Universal Service Funds, regulators, and government agencies) and the private sector (network operators).

The public sector agency serves as the manager. In the case of the Private DBOs in Nigeria, this is still the case as the USPF and the regulator, the NCC, often leads the initiative. Using the theory of stakeholder identification and salience, the stakeholders with high salience are those who bear the risks, provide resources and earn the rewards from the project. In Africa, as identified earlier, these are a mix of both public and private stakeholders. Public stakeholders include public agencies that provide governance to the project and public agencies that actually join private SPVs to invest into the project. An example is the TEAMS and EASSy projects. Private stakeholders include network operators, financing institutions and international development partners. Each of these public and private stakeholders earn different rewards based on their agreed percentage in the project or the SPV they belong to. The public sector agency providing governance may earn indirect benefits via the provision of universal access for the infrastructure. It is important to note that this assessment is based on the current PPP and previous PPP efforts in telecom infrastructure delivery in Africa. It is not reflective of all PPPs.

Stakeholders with moderate salience identified in PPPs in Africa are interest groups. These groups do not earn, provide resources or bear the risks of the

project. However, they will indirectly earn the reward of being connected. They are expectant stakeholders. They could be dangerous stakeholders who lack legitimacy but they have the power to disrupt the project. These are civil society groups who feel that the project disturbs the agenda they promote. They could be dominant stakeholders with power and legitimacy who feel aggrieved by the project. These are network operators not involved in the project but who feel the project is discriminatory. They could stall the project with a court case. They could be dependent stakeholders who are legitimate but who lack power and urgency. The best example is of this is the subscriber or the end user. The telecom service is for them but they cannot influence decisions regarding the delivery of the service to them.

However, the possibility a PPP provides, using the theory of stakeholder identification and salience, is that the Manager decides which stakeholder has high or low salience for a project. This is evident in a telecom related PPP as there is no universal PPP arrangement or business model. Different stakeholders are granted salience based on the importance given to them by the manager. This offers the possibility of producing bottom-up PPP initiatives as well, as will be seen later. However, new stakeholders that should be granted high salience are communities and groups of people. Communities in different parts of the world, including Africa, have exhibited a potential to facilitate telecom and broadband infrastructure in the right regulatory and financial environment. These cases have been studied and documented by the following authors, among others (Hudson, 2014; Kakekaspan, O'Donnell, Beaton, Walmark, Gibson, 2014; Salemink, Bosworth, 2014; Williams, 2015). What is important though is how different African countries and possibly developing countries define the scope of such projects, allocate resources, risks and rewards to the communities invited into PPPs.

In the next section, what was learnt from the six cases studied and an explanation of the PPP model will be explained. Furthermore, how this form of PPP could aid Wi-Fi over fibreoptic in rural areas to provide data rates of 2Mbps and above is explained. Though the model was developed under a much elaborate work, these six cases provide an insight into the possibilities of the model.

Methodology

The methodology outlined only applies to an aspect of the bigger research being disseminated here. This aspect of the research was a multi-case study. The process began with a 'how' research question. Cases that would reveal the "how" were selected via a combination of purposive sampling and the snow ball sampling technique. 6 cases were selected because there was a feedback from contact persons from these cases during the duration of the research. The cases are mentioned in Table 2.

Table 2

The cases studied

Case	Country
1. Djurslandsnet	Denmark
2. Almhult Municipality Broadband	Sweden
3. Magnolia Road Internet Cooperation (MRIC)	United States
4. Johannesburg Wireless User Group (JAWUG)	South Africa
5. AirJaldi	India
6. Ghana Wireless Project	Ghana

Source: Williams, 2015.

The cases with no feedback were suspended for future research. In the main research, a semi-structured interview guided by the actor network theory and the stakeholder theory was administered. The results presented in this paper are those derived from the stakeholder theory of identification and salience and aspects of the unstructured part of the interviews. The semi-structured approach was used to elicit additional information that may not have been catered for in the theory. The bulk of the interviews can be accessed in the main research (see ref). The interviews were administered to 9 respondents. These were the municipality officer in charge of the Swedish project, the former chairman and volunteer of Djurslandsnet, the chairmen of Airjaldi and JAWUG and a board member of Magnolia Road Internet Coop. Face-to-face interviews were conducted with the respondents from Denmark and Sweden. Skype video interviews were conducted with respondents from India, Ghana and South Africa. Multiple exchange of documents and follow up questions via emails was conducted with 2 board members from the MRIC USA. The interviews used for this aspect of the research were analysed using narrative analysis. But in this paper, interpretive phenomenological analysis is used. The idea is to provide a first person point of view of how the perceived interpretations of the findings in this research can help solve the challenge tackled in this paper. The analysis is made in an explanatory manner. The explanation provides an overview to the cases. It also highlighted the various stakeholders in each case, the functions of the stakeholders, their responsibilities, their incentives and how they collaborate to develop the broadband infrastructure. Based on the outcome of the research, a report is generated for each case. This is followed by a cross synthesis on the outcome of each case aimed at identifying definitive stakeholders, expectant stakeholders and latent stakeholders. In this design, a definitive stakeholder is indispensable to the PPP project. An expectant stakeholder is not indispensable but necessary. A latent stakeholder is highly dispensable. Based on the outcome of the cross-synthesis, an argument is made for why a member of a sub-class of stakeholders should be indispensable to

the development of a PPP project for developing rural broadband in sub-Saharan Africa. This forms the bases for introducing the PPP framework.

Overview of the cases

In previous attempts to disseminate the aspects of this research, the background of the cases has been described in detail (Williams, 2015). The emphasis in this description is on stakeholders, their responsibilities, their incentives and how they collaborate.

Subsection I: Djurslandsnet

This network has evolved into 10 distinct networks. They share the same network infrastructure but they are owned by 10 different communities. In 2005, when the network was created, it was originally a single Wi-Fi networkmesh owned by residents of the Djursland peninsula in Denmark. Connectivity to their Wireless Access Network (WAN) was provided by a regional fibreoptic network. The peninsula is home to about 80, 000 people. It is mostly a rural agriculture and fishing community with few semi-urban areas. They were compelled to deploy this network because broadband providers did not find the area commercially viable. The community received an EU subsidy to help them offset 50% of their cost once the installation process ended. The network is sustained by income from annual membership fees and monthly access fees. The network is maintained by volunteers. The initial organizational setup comprised a central committee of democratically elected representatives who oversaw 8 sub-committees representing the 8 communities in the peninsular. In 2010, the network evolved to the sub-committees becoming independent but sharing the same network.

Subsection II: Almhult Municipality Broadband

This is a municipal initiative in Sweden. The aim was to offer communities their own FTTH access networks. Almhult is an area that the dominant FTTH operator TeliaSonera did not find commercially viable. The municipality had to design a Public Private Partnership framework involving the municipality, a private infrastructure and service provider, and the local communities in the municipality. The municipal representatives were compelled to embark on this project because they had an existing fibreoptic network that interlinked their outstations. The infrastructure was in close proximity to the residents in rural areas. Based on this opportunity, the municipality secured funding for the project, they procured an infrastructure provider, Zitius with a platform provider, quadracom to Design, Build and Operate the FTTH on its behalf for three years. The municipality also encouraged the formation of cooperatives in local parishes and 9 of them were formed. EU funding was facilitated by the municipality to help

the co-ops in providing ducts for the fibreoptic. The co-ops also raised money by charging for FTTH access to the household of their members and charging an annual membership fee among other charges. Nine cooperatives were raised. Installations have been made and a lot of homes in Almhult have access to FTTH via this initiative. The takeaway from this case is that communities can be supported and enabled to own broadband infrastructure with the aid of an innovative public sector initiative.

Subsection III: Magnolia Road Internet Coop

This is one of many community-based broadband initiatives in the United States. The initiative was started by residents of Magnolia who were in need of broadband internet services. Magnolia road is located in a mountainous region and the population density is low. However, the entrance of new ISPs to the area led the neighbours to think of a way of extending connectivity to most residents in the area, with the ISPs providing the bandwidth. Inspired by the possibility of being funded by the state of Colorado, the neighbours formed a cooperative called Magnolia road Internet Coop. Using their personal resources, they performed trials as a proof of concept to their neighbours, using events such as pot luck etc. to advertise themselves. This activity paid off overtime, as their volunteer base grew so did their attempt to create backhaul networks by themselves. Once they had a clear proof of concept they were able to convince neighbours to sign up to the coop to gain access to the network. The network was governed by the democratically elected members of the cooperatives. The network still exists today having about 400 members.

Subsection IV: Johannesburg Wireless User Group

JAWUG is one of the many community networks in South Africa. In 2001, the cost of broadband connection in South Africa at the turn of the century was exorbitant. A group of computer science students, living within a neighbourhood in Johannesburg, had the need to collaborate remotely for academic reasons and to play games online. They needed a broadband connection with the capacity to meet their needs. Using their allowances, they purchased routers and antennas to connect their homes using the unlicensed Wi-Fi spectrum (2.4 GHz – 5.8 GHz). Bandwidth was provided via an existing broadband connection to their homes. Based on their technical knowledge of setting up a radio equipment, they did set up network successfully. Other neighbours saw the need for having free network with enhanced data rates compared to the existing data rates. The ad-hoc network had no form of organization, it was operated by volunteers. This network extended through most parts of the eastern Johannesburg. Before 2006, other smaller networks in Johannesburg decided to merge their network with the network established by these students. In 2006, this unorganized confederation of networks led by the

network built by the students was named as Johannesburg Wireless User Group (JAWUG). A critical factor for this network is the provision of free bandwidth by ISPs. Unfortunately they cannot interconnect with Public Switched Telephone Network (PSTN), as it is not permitted by law in South Africa.

Subsection V: Airjaldi

This is a social enterprise that grew out of the Dharamsala wireless network in India. At present social enterprise owns a set of 4 wireless meshes. The social enterprise began as an NGO facilitated by Yahel Ben David, an IT expert and an entrepreneur. He moved to Dharamsala with his family with the sole aim of developing a broadband network for the community. The only access to the Internet in rural Dharamsala was via V-sat owned by a few NGOs. He accessed bandwidth from a nearby town to Dharamsala where he developed a wireless mesh from his own resources. He had help from volunteers from the western world visiting the area at different intervals. His aim was to connect anchor tenants such as orphanages, schools, local NGOs and other anchor tenants. He could not commercialize the network because the Wi-Fi spectrum in India then was not licensed. The deregulation of the Wi-Fi spectrum occurred in 2006. Coincidentally, there was a conference in Dharamsala to compare notes on various rural wireless broadband initiatives. The conference attracted investors who found commercial value in the network and invested in it. The NGO was converted to a social enterprise which serves rural Dharamsala until today.

Subsection VI: Ghana Wireless Project

Ghana Wireless project was a project in the eastern region of Ghana initiated by CbLit, an NGO in Ghana. The aim was to deliver broadband to residents of the Akuapim ridge. The NGO was inspired by personal effort of a Peace Corps member, John Atkinson, from the United States. He used his resources to facilitate a proof of concept. He redistributed a bandwidth from the V-sat using a wireless Wi-Fi mesh to few households. Based on the proof of concept the NGO decided to commercialize the network. 1 MB was purchased from an NCS, an ISP and then redistributed to 20 customers. The decline of the network occurred when the 512Kbps was not enough for the needs of the user. Users here adopted more of OTT entertainment and communication services. This led to the degradation of the Quality of Experience (QoE) of the customer which resulted in the loss of customers and the eventual closure of the initiative. Had it had similar resources as the other cases, it would have succeeded. Their network could not succeed due to lack of resources and degraded bandwidth. There were challenges in capacity building and amassing more users. This is where a PPP would have helped.

Subsection VII: Lessons derived from the case descriptions

Broadband infrastructure ownership, deployment and management by communities: in the developed economies, communities own, deploy, operate and manage their individual broadband networks. In the developing countries being an object of study - apart from South Africa - community participation in broadband infrastructure development in low. In India, a social enterprise had to manage the network. In Ghana, an NGO had to manage the network.

The possibility for capacity building to facilitate sustained supply: one could easily conclude that it is not a wise idea for communities or in sub-Saharan Africa to deploy broadband networks. But that would be a hasty and false conclusion and it would stifle innovative delivery of broadband networks. Basically, one could have said so about the Swedish case. FTTH is an expensive network technology to be deployed. People living in Swedish communities are not trained to manage FTTH networks. They do not have the resources to manage such networks. But the municipality made a conscious decision to provide capacity building for the cooperatives and sources for funding the project, as well as to develop a business model for the collaboration and to supervise the initiative. In sub-Saharan Africa, public sector agencies can also adopt innovative initiatives aimed at involving the communities in developing affordable wireless broadband infrastructure for rural areas. Currently, there are organized groups and rural social structures (such as village/traditional councils) with whom public sector agencies could partner. In the Ghana wireless project, if the effort of the NGO was supported by relevant public agencies, it would have survived.

Preference for Wi-Fi: the second take away from the findings is the utilization of Wi-Fi as the wireless broadband access technology of choice aside FTTH. Wi-Fi is adopted because it is cheaper to deploy and some aspects of the equipment can be locally fabricated (Williams, 2015). The technology operates in an unlicensed band and it can deliver data rates beyond 54mbps at 5.7 GHz and 2.4 GHz frequency bands (Carter, Lahjouji, McNeil, 2003). At 2.4 GHz band, Wi-Fi transmission spans a greater coverage area of about 250 feet to 400 feet in closed spaces. This enables point-to-point and point-to-multi-point mesh backbone networks (Carter, Lahjouji, McNeil, 2003). Also it is a much cheaper broadband technology to deploy as compared to other wireless broadband technologies. These are possible reasons why Wi-Fi was chosen.

Based on this lessons, one needs a collaborative effort between the public sector, private sector the non-profit (civil society and communities) to develop a PPP arrangement for delivering broadband infrastructure in rural areas. In the next section, the stakeholder theory of identification and salience are applied to identify the responsibilities, as well as the incentives needed to develop the collaboration.

Findings from Stakeholder Theory of Identification and Salience

Subsection I: Stakeholder identification

In the cases studied, there were stakeholders who were directly involved in the broadband projects and those who had an indirect influence on the broadband projects. The direct stakeholders based on the description in the previous section are listed in Table 3.

Table 3

Direct stakeholders

Case	Country	Stakeholder group			Type of broadband network
		public	private	non-profit	
1. Djurslandsnet	Denmark	No	Access network provider	Cooperative organization	Wi-Fi mesh
2. Almhult broadband network	Sweden	Almhult Municipality	Zitius/ Quadracom	9 parish cooperative organizations	Fiber to the home (FTTH)
3. Magnolia Road Internet Coop	USA	No	Private ISPs**	Neighbourhood cooperative	Wi-Fi mesh
4. Airjaldi	India	No	Social enterprise	Group of volunteers	Wi-Fi mesh
5. JAWUG*	South Africa	No	Private ISPs	Neighbourhood cooperative	Wi-Fi mesh
6. Ghana wireless project	Ghana	No	Private ISP	Non-governmental organization	Wi-Fi mesh

* Johannesburg Wireless User Group.
** Internet Service Providers.

Source: Williams, 2015.

These direct stakeholders based on the stakeholder theory of identification and salience were definite stakeholders for each project. They were granted power, legitimacy, and urgency granted by owners of the project who in most cases constituted the community. In the Swedish case, the owner of the project was the municipality. However, it is important to note that apart from the communities; NGOs etc., the only remaining constant definitive stakeholders are the ISPs which provide bandwidth to these networks. This implies that communities, NGOs can always collaborate with ISPs to extend connectivity from the ISPs network via the community network to rural households. In sub-Saharan Africa, rural communities may not be able to make these deals. So they will definitely need the assistance and guidance of a relevant public sector agency such as the telecoms regulator, etc.

Table 4 identifies indirect stakeholders. These stakeholders are expectant stakeholders for various projects. In some cases, they were meant to be definitive stakeholders. It was because they possessed the power to influence the project and were legitimate participants for the project.

Table 4

Indirect stakeholders

Case	Country	Stakeholder group			Type of broadband network
		public	private	non-profit	
1. Djurslandsnet	Denmark	Danish government, European Union	No	Danish Business Authority,	Wi-Fi network mesh
2. Almhultbroadband network	Sweden	European Union via Kroneberg county,	Duct diggers	No	Fiber to the home (FTTH)
3. Magnolia Road Internet Coop	USA	State of Colorado	No	Informal pot luck gatherings	Wi-Fi mesh
4. Airjaldi	India	Government of India	No	No	Wi-Fi mesh
5. JAWUG*	South Africa	No	No	No	Wi-Fi mesh
6. Ghana wireless project	Ghana	No	No	No	Wi-Fi mesh

Source: Williams, 2015.

However, the projects could proceed without them or without their direct influence. As an example, Djurslandsnet did not have direct support of the Danish government. But Danish government permitted cooperatives. MRIC could not secure funding from the state of Colorado, yet the project was delivered by the coops.

What the indirect stakeholder needs in order to become a direct stakeholder is to be granted a sense of urgency by the designers of the project. This implies that they are seen as indispensable. Based on this premise, one can easily shift these stakeholders around depending on the incentives and responsibilities made available for the stakeholders in the PPP arrangement.

Subsection II: Stakeholder incentive

Direct stakeholders: each stakeholder group in each of the cases studied had similar incentives. The public sector stakeholders were interested in achieving universal access to their chosen broadband technology. The private sector group

was interested in making profit. The non-profit group was interested in the availability of affordable broadband infrastructure in their locality.

Indirect stakeholders: the incentives to participate in the project or otherwise for each stakeholder group were not similar. In the Danish case, the Danish government had no incentive to participate in the initiative. The Danish government adopted the market based approach, so telecom infrastructure development was an affair for the market. The Danish business authority also had no incentive to participate in the project. They did not see the project as viable. They are mentioned because they were approached and identified as a stakeholder by the cooperative (Williams, 2015). However, the EU did participate in the project, as the EU has a policy of providing assistance in order to extend broadband infrastructure to areas where the market forces cannot cater for. In the Swedish case, the indirect stakeholders had incentives to provide peripheral support to the project. The EU also offered support for the project without participating directly in the project. The reasons were the same as in the Danish case. The diggers had the opportunity of being remunerated. In the case of the US, the state of Colorado had the incentive to fund universal service. However, the total cost of the project was USD 13,000.00, i.e. less than minimum subsidy requirement of the state amounting to USD 100,000.00. The organizers of the potluck were incentivised because they would have more participants at their event. In the South African case, there was no incentive at that time in order to provide aid to such groups by the government of South Africa. Situation was similar in the case of Ghana and India.

The possibility of a stakeholder being transferred from an indirect stakeholder to a direct stakeholder is incentive dependent. Therefore, it is possible to enhance incentives to enable indirect stakeholders become direct stakeholders. But this will depend on the designer of the collaborative framework.

Subsection III: Stakeholder's responsibility

The responsibility of each stakeholder group in each case is represented in Table 5.

For all the cases except Sweden, the public sector's significant responsibility was the governance of the market. The significant act of governance was deregulation of the Wi-Fi spectrum. In the Swedish case, the public sector was involved in the design, planning, implementation, building and providing governance for the project. The role of the private sector in some cases has been passive, except for the cases of Sweden and India. In the Swedish case, the private sector operates and manages the municipal infrastructure. In India, the private sector actually owns the infrastructure. However, the role of the non-profit stakeholder is significant. Here they finance, own, build, design, operate and maintain the network. Communities, as mentioned earlier had to take matters into their hands to implement an affordable broadband network for themselves.

Table 5

Stakeholder responsibility

Case	Public sector responsibility	Private sector responsibility	Non-profit
Denmark (Djurslandsnet)	Financing via EU funding. Deregulation of Wi-Fi spectrum by Danish government	Provision of bandwidth	Coop financing. Infrastructure design. Infrastructure building. Infrastructure implementation. Infrastructure maintenance. Infrastructure operation
Sweden (Almhult municipality/ Zitius/ Hallaryd coop)	Municipality funding EU funding. Regulation for public funding. Infrastructure design. Backhaul building. Backhaul implementation	Private sector infrastructure outsourcing. Private sector infrastructure maintenance. Private sector infrastructure operation	Coop financing. Coop access network design. Coop access network building. Coop access network implementation. Coop access network operation. Coop access network maintenance
India (Airjaldi)	Market reforms aimed at lowering market entry barriers. Deregulation of Wi-Fi spectrum	Private infrastructure financing. Private infrastructure design. Private infrastructure building. Private infrastructure implementation. Private infrastructure operation	Initial network design, infrastructure building. Infrastructure financing
USA (Magnolia Road Internet Coop)	Public financing if the project is worth a minimum of $100,000. Deregulation of Wi-Fi spectrum		Coop financing. Coop network design. Coop network building. Coop network implementation. Coop network operation. Coop network maintenance
South Africa (Johannesburg Wireless User Group)	Deregulation of Wi-Fi spectrum		Coop financing. Coop network design. Coop network building. Coop network implementation. Coop network operation. Coop network maintenance
Ghana Wireless Ghana Project	Deregulation of Wi-Fi spectrum		NGO financing. NGO network design. Coop network building. Coop network implementation. Coop network operation. Coop network maintenance

Source: Williams, 2015.

However in sub-Saharan Africa, one would be expecting too much, if rural areas were expected to build a network. But they can be made to partially contribute financially on a long term basis, as well as to help in the construction and most importantly to own the networks through community groupings under the supervision of a public sector agency. Maintenance and the operations of the network can be outsourced to a private sector entity for a limited period under the supervision of a public sector agency. Next section explains how this could be done.

PPP stakeholder framework

Based on the findings, the analysis is conducted using the perspective of an interpretivist, similar stakeholders, their incentives and thus the responsibilities can be identified. This process is not a copy-paste model, rather it is based on the fact that similar direct stakeholders exist in sub-Saharan Africa. It is also based on the fact that rural communities and NGOs in sub-Saharan Africa make some form of an attempt to facilitate broadband connectivity in their locality. Examples of such initiatives include Macha works in Zambia, Bosco Uganda, etc, mentioned earlier in the introduction. If that is the case, using the inspiration from the cases studied a collaborative PPP framework can be suggested to help such communities and many others to deliver Wi-Fi over fibre optic networks. Potential stakeholders, their incentive and responsibilities are as follows:

Subsection I: Stakeholders and their incentives

Definitive stakeholders: In rural sub-Saharan Africa, a definitive stakeholder should have a strong incentive to become a part of the project.

1. Members of non-profit stakeholder groups:
   Communities, village councils, local NGOs, donors, agencies, etc.
   Their incentive:
   They need broadband for their constituents, locality and local initiatives respectively.
2. Members of public stakeholder groups:
   National governments, regional/provincial governments, universal service funds and national network regulators.
   Their incentive:
   Every sub-African government has various dimensions of universal service policies in broadband policies (ITU, 2013). These policy initiatives will not be achieved if certain localities in their jurisdiction are disenfranchised from having access to an affordable broadband infrastructure. Therefore forming innovative partnerships to deliver affordable broadband infrastructure is of importance to these group of stakeholders.

3. Members of private sector stakeholder groups:
   Internet network and service providers.
   Their incentive:
   They do not have a strong incentive to join the partnership. But they would not mind earning additional income from community networks accessing their networks. They would also not mind providing technical assistance to communities. This opportunity presents a low market entry and exit barriers for them. In order to lower the market entry and exit barrier further, this paper proposes that the infrastructure be owned by the community.

Based on this framework, the study proposes a three way relationship between the public, private and non-profit stakeholder groups with the identified members as preferred definitive stakeholders as seen in Figure 1. This Figure is extracted from the main research, based on the analysis explained here.

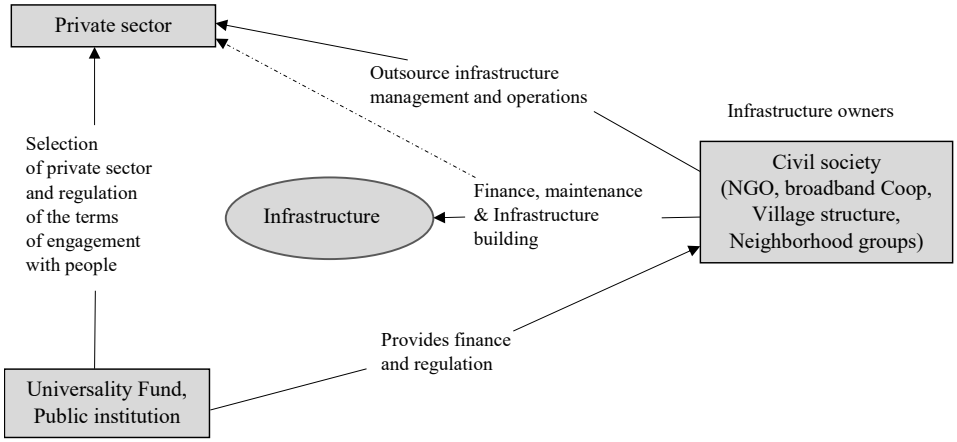

Figure 1. PPP framework for Rural Broadband Development

Source: Williams, 2015.

The expectant stakeholders: this stakeholder group consists of relevant national and regional stakeholders who do not have direct influence on the project, even though they have the power to stop the project. These stakeholders also do not have the incentives to be directly involved in the project. These stakeholders could be a bank (especially if money was borrowed), public regulatory agencies and competing network operators, etc. Some other stakeholders could be stakeholders who must be solely informed. Examples include civil society groups, pressure groups, etc. For the definitive stakeholders to function unhindered, the relevant expectant stakeholders should be identified and changed management processes

should be implemented by the designers of the project. However, expectant stakeholders who will contribute directly to the project should be elevated to become a definitive stakeholder in the project by granting the stakeholder either power, legitimacy or urgency depending on the deficiency of the stakeholder. As an example a stakeholder may be needed for this project. But the national law does not allow the stakeholder to be involved in the delivery of any telecom infrastructure. For this project to be implemented, laws have to be enacted to enable that stakeholder to participate in the project.

Subsection II: Potential responsibility of the identified direct stakeholders

In Figure 1 above potential responsibilities of each class of stakeholder are outlined. They are as follows:

1. Public stakeholder: the primary responsibility of public stakeholders should be to protect the community network. They design in collaboration with the community to build the network, finance the network with the community and monitor network sustainability. They have to do so by serving as a proxy between the private sector stakeholder and the community. In order to fulfil their task they have to do the following:
   a) regulate the terms of engagement for the project for each stakeholder;
   b) allocate responsibilities in the project by deciding which stakeholders should be involved;
   c) allocate ownership of the infrastructure for the community;
   d) develop a favourable business plan for the community or outsource management of the infrastructure to the private sector on behalf of the community;
   e) facilitate capacity building for the delivery of certain aspects of the infrastructure by the community;
   f) facilitate capacity building;
   g) identify and source for funding to subsidize greatly the cost of the project for the community. This could be done via soft loans;
   h) partially fund the project if necessary;
   i) provide the risk allocation for the project including regulatory risk, political risk, technological risk, commercial risk, fiscal risk, etc.;
   j) identify potential conflict regulatory mechanisms needed for the project. These suggestions are inspired by the role of the municipality in the Swedish case.
2. Non-profit stakeholders: they own the infrastructure. If they have the competences, they can design, build, manage, operate, maintain and finance the network. If they do not have the competences, they can either be trained by the public sector or outsource the building, operations, management and mainte-

nance of the infrastructure to the private sector. What is also recommended for this group is that they have to contribute to the co-funding of the project. This will provide a sense of ownership for the project as well.

3. The Private sector group: private sector group in this case does not own the network. They can assist to build, manage, operate and maintain the network in cases where groups of people cannot do so. This happens if the public sector entity or group of people decide to engage them. If they are to be engaged, that can be done in a form of a short term lease so that people may have a choice of outsourcing to another entity, on condition that they are not satisfied with the current operator. They are not supposed to invest in the project as well. The idea here is to save the network from the desire for immediate profit. If the network becomes profitable and the private sector intends to purchase the network, on the approval of the public sector the groups can sell the network. Though this responsibility sounds variable if the greater role of the private sector is in the provision of access to their fibre optics infrastructure.

Discussion

The outcome of the interpretive analysis has an implication to broadband delivery in sub-Saharan Africa. It serves as a clarion call to rethink how broadband infrastructure is being delivered to rural areas in the region. Currently, the public sectors management approach towards broadband infrastructure delivery has been market based approach and the encouragement of technology neutrality. This approach enables governments in the region to redirect their focus to other sectors of the economy. This approach worked well with the delivery of 2G standards of mobile telecom networks. But if one takes a closer look at that phenomenon, this technology grew indeed because this technology on liberalized African market was uninterrupted for 14 years (1990–2004) (Frempong, Braimah, 2008; Skouby, Williams, 2014).

Currently rapid evolution of mobile broadband networks does not allow for the market maturity of the existing network before another is launched. Most network operators have to reconsolidate their market position in urban areas, once there is competition from a newer network provider, delivering an upgrade of the existing mobile networks. An example can be seen in the case of 3G. Though 3G market in Africa is at its infancy, 4G is already being deployed in many cities in Africa (Williams, 2015). In Ghana as an example before MTN acquired the spectrum, they had already built 400 operational 4G sites in regional capitals (MTN Ghana, 2016). In countries such as Kenya, Ivory Coast, Gabon and in some African countries, LTE has been launched (Williams, 2015; World Time Zone, 2016). This has disenfranchised rural dwellers in sub-Saharan Africa as seen in figure 2 below.

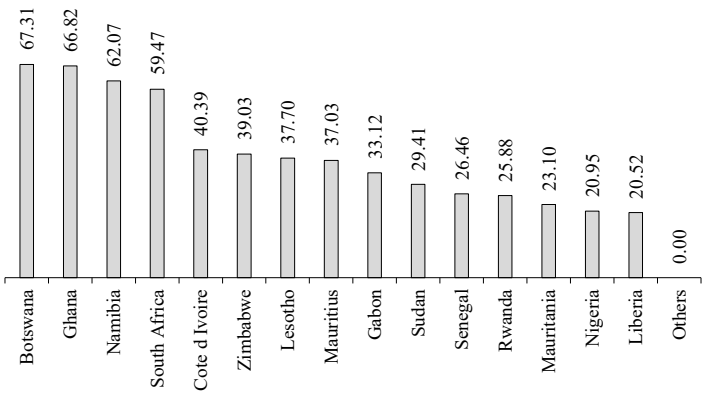

Figure 2. Mobile broadband subscription per 100 inhabitants in sub-Saharan Africa
Source: extracted from Broadband Commission, 2016.

Based on Figure 2 above, one may notice that 15 out of 49 countries in sub-Saharan Africa record mobile broadband subscription of about 20%. The estimated population of subscribers with subscription in these countries is approximately 133.2 million people. See the table below. In a region (sub-Saharan Africa) with a population of 974 million people (PRB, 2016) this is low.

This calls for a new way of thinking with respect to the delivery of broadband infrastructure in rural sub-Saharan Africa; a new thinking related to: (a) a type of broadband network that should deliver the services, (b) maintaining this infrastructure in rural areas; (c) harnessing demand for broadband in rural areas in these countries. This way of thinking should include active participation of the communities living in rural areas. In order to do so, inhabitants of this area have to feel that they own this infrastructure, they should learn to have the sense of belonging by partially investing into this infrastructure; partially building and determining its fate. The proposition of Wi-Fi over fibre optics was made because most rural initiatives in Africa utilize Wi-Fi. And Africa is now home for extensive fibre optics networks that run across villages in the process of linking two towns and regions. Therefore this is an opportunity for developing such broadband infrastructure, it is an opportunity for encouraging newer ways of delivering broadband infrastructure in rural areas. This is why this PPP framework is vital and this framework can be utilized in any rural area with the definitive stakeholders intact.

Table 6

Outlook on broadband subscription in Africa, 2016

Country	Mobile broadband subscription per 100 inhabitants*	Population**		
		national (millions)	with subscription (millions)	without subscription (millions)
Botswana	67.31	2.2	1.48082	0.71918
Ghana	66.82	28.2	18.84324	9.35676
Namibia	62.07	2.5	1.55175	0.94825
South Africa	59.47	55.7	33.12479	22.57521
Cote d' Ivoire	40.39	23.9	9.65321	14.24679
Zimbabwe	39.03	16	6.24480	9.75520
Lesotho	37.70	2.2	0.82940	1.37060
Mauritius	37.03	1.3	0.48139	0.81861
Gabon	33.12	1.8	0.59616	1.20384
Sudan	29.41	42.1	12.38161	29.71839
Senegal	26.46	14.8	3.91608	10.88392
Rwanda	25.88	11.9	3.07972	8.82028
Mauritania	23.10	4.2	0.97020	3.22980
Nigeria	20.95	186.5	39.07175	147.42825
Liberia	20.52	4.6	0.94392	3.65608
Others	0.00			
Total		397.9	133.16884	264.73116

Source: * extracted from Broadband Commission, 2016; ** PRB, 2016.

What is needed is a political will from the public sector, a sustainability plan for the initiative, a proper risk assessment and innovative ways of organizing the resources of various stakeholders by the public sector. Rural areas in sub-Saharan Africa may never be commercially viable for existing mobile network operators. But it could be commercially viable for small communities whose sustenance of the Wi-Fi network hinges on the local economic activity of the area.

The limitation of this PPP framework is that it is designed for local projects. The public agencies in sub-Saharan African countries possess finite and insufficient financial resources. However, such initiatives can be handled by universal service funds. It can also be handled by specialized agencies whose duty is to map the rural areas in their respective countries and develop the project in phases. Over time the project would have catered for the access of gap areas. Governments from sub-Saharan Africa can also look to the West to identify potential initiatives, where they could be inspired to organize such initiatives with the use of framework of this paper. A good recommendation is the broadband delivery UK initiative since it also uses framework similar to the Swedish case examined in this paper.

Conclusions

This paper aimed at identifying innovative partnerships in the West that could serve as an inspiration for delivering wireless broadband networks in rural areas of sub-Saharan Africa. Proposed network was Wi-Fi mesh interconnected with fibre optics network. Six cases, 3 from developed countries and 3 from developing countries have been analysed using the stakeholder theory of identification and salience. The theory was used to identify stakeholders that were important in the delivery of different broadband networks in above-mentioned 6 rural cases, as well as recognize their functions, responsibilities and how they collaborated with other stakeholders to deliver the infrastructure. Apart from one case, they all deployed Wi-Fi mesh networks. Three classes of stakeholders were identified. These were public, private and non-profit stakeholders. Within these group of stakeholders, using the stakeholder theory of identification and salience, communities (in the not for profit stakeholder), public sector agencies (public stakeholders) and Internet service and network service providers were identified as the definitive stakeholders. Based on these three groups and inspired by the studied cases, a triangular relationship between the stakeholders was presented alongside the responsibilities of the stakeholders.

Based on the findings, this paper concludes that developing such collaborative frameworks for developing rural broadband infrastructure in sub-Saharan Africa is possible. This is because communities are already making efforts to develop their infrastructure. Some have failed, however this network if properly planned should help mitigate the rate of failure of standalone community broadband initiative in Africa. The paper also concludes that this approach will serve as a good supplementary effort to the market based approach, which has not been successful in rural areas in the region. However, more research is needed into how specific projects in Africa can be developed out of this framework.

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Publiczne ramy zarządzania dla rozwoju bezprzewodowych łączy szerokopasmowych na obszarach wiejskich w Afryce Subsaharyjskiej

Słowa kluczowe: zarządzanie publiczne, nowe zarządzanie publiczne, PPP, łącza szerokopasmowe na obszarach wiejskich, zarządzanie

Streszczenie. W artykule dokonano identyfikacji potencjalnych publicznych i prywatnych interesariuszy potrzebnych, aby pomóc społecznościom wiejskim w dostarczaniu bezprzewodowej infrastruktury szerokopasmowej w Afryce Subsaharyjskiej. Te obszary wiejskie nie są komercyjnie opłacalne w przypadku mobilnych sieci szerokopasmowych. Jednak niewiele społeczności wiejskich w regionie próbowało rozwijać sieci wi-fi. Niewielu się udało, a niektóre z nich poniosły porażkę. Ramy partnerstwa prywatno-prywatnego, które można dostosować w celu dostarczania i zapewniania wsparcia dla tej inicjatywy mogą stanowić odpowiedź na niepowodzenie takich inicjatyw. W artykule przyjęto teorię identyfikacji interesariuszy i jej znaczenie w 6 inicjatywach społecznościowych w krajach rozwiniętych i rozwijających się, aby zidentyfikować różnorodne podejścia dotyczące interesariuszy w takich przypadkach. Bazując na uzyskanych wynikach wykorzystano interpretacyjną analizę fenomenologiczną do wyjaśnienia, w jaki sposób osiągnięte rezultaty mogą być wykorzystane przez agencje sektora publicznego w Afryce, aby pomóc społecznościom wiejskim w rozwijaniu zrównoważonych sieci wi-fi. W artykule stwierdza się, że trójkątne relacje między społecznością, agencją sektora publicznego z atrakcyjnymi zachętami dla poszczególnych zainteresowanych stron, mogą służyć jako podstawa do organizowania takich interesariuszy, aby pomóc społeczności w rozwijaniu sieci.

Citation

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