Framework for Alternative Broadband Access Service in Ethiopia

Wegderes Beyene
Wura Technologies, Addis Ababa, Ethiopia
wegderes@gmail.com

Dejene Ejigu
Department of Computer Science, Addis Ababa University, Ethiopia
ejigud@yahoo.com

Abstract

Internet Service in Ethiopia is introduced in 1993. Since then a lot of efforts have been exerted to expand this service throughout the country. The government has committed itself as this sub sector could play a significant role in the country's social and economic prosperity. However, it is observed that the country lags from meeting its Internet service demand. Ethiopia, even among the sub Saharan African countries, has low number of Internet subscribers. This is due to lack of infrastructure and knowledge gap.

Even if Ethiopia introduced Internet service decades ago, providing broadband Internet access service is still a challenge. Thousands of kilometers of fiber optic cables have been laid across the country to connect the regions and the country to the outside world. However, this infrastructure is highly endangered to damages caused due to civil works and deliberate sabotage.

Study shows covering large geographical areas to provide broadband Internet service and securing the infrastructure from physical damage becomes a daunting task for the service provider. Taking measures to achieve these goals and finding alternative technologies that are less costly, easy to implement, and less prone to damage would be wise.

In this study, a framework is built for alternative broadband access service which compares the pros and cons of the technologies to be used for broadband access service. Accordingly, WiMAX is selected, simulated and discussed with a detailed analysis of the configuration parameters. Results from simulation of WiMAX depict the performance of the network measured against application demands are acceptable and as a result it is found that WiMAX could be an alternative technology for broadband access services.

WiMAX, as a mature IEEE 802.16 standard wireless metropolitan area network technology, that provides an air interface that covers 50 Km in line of sight or 10 Km in non-line of sight with 45 Mbps to 70 Mbps bandwidth capacity, is a proven technology towards broadband Internet access provision.

Keywords: Broadband in Ethiopia; Alternative Broadband; WiMAX

1. Introduction

Ethiopia is the first in Africa to witness telecommunication technology back in 1894, a century ago [1]. Since then little is known how important it is to have such services in developing the economy and social values. A lot has been changed and new advancements in communication have been discovered globally, even the birth of computers and computer networks fast forwarded these changes. In addition, availabilities, capacity and affordability of computers and applications and the global network, i.e., the Internet services, ease the processing and dissemination of information.

Ethiopia as being classified among developing countries, is struggling with social and economic problems. A lot of issues and constraints in number and type can be listed that impair its development.

The Government of Ethiopia (FDRE) developed a 5 year Growth and Transformation Plan (GTP) in the year 2010/11 [2]. It shows clearly the government's commitment towards the alignment with the MDGs Goals aiming at "a global partnership for development" (Goal 8) and more specifically through Target 8.F "in cooperation with the private sector, make available the benefits of new technologies, especially Information and Communications" and the objective that: "Everyone can create, access, utilize and share the information and knowledge, enabling individuals, communities and people to achieve their full potential and improve their quality of life in a

sustainable manner" [2]. However, achieving this goal doesn't come easily. This requires a lot of investment in infrastructural and human development.

Mobile services were introduced to Ethiopia since 1999 with 0.14% average mobile subscribers per 100 inhabitants [3]. According to ITU's World Telecommunication Indicators Database 2005, by the year 2004, Nigeria has registered 9,147,209 subscribers; Kenya 2,546,157, Ghana 1,695,000, Tanzania 1,640,000, Cameroon 1,536,594 and Ethiopia had only 410,630 mobile subscribers and this rate of mobile density of the country is the least as compared to that of some selected sub Saharan countries [3].

Internet service in Ethiopia began in 1993 when the UN Economic Commission for Africa established a store-and-forward email service called PADISNet (Pan African Documentation and Information Service Network) which connected daily via direct dial calls to GreenNet's Internet gateway in London [1]. At its peak the service had about 1,200 users. In 1996, a broadly constituted cross-sectoral national Internet working group supported by the then Ethiopian Science and Technology Commission (ESTC), called Bringing Internet to Ethiopia (BITE), drew up a detailed national Internet proposal and helped build significant demand for full Internet access which was ultimately provided by ETC in January 1997 [1].

According to the GTP, the telecom and Internet services have a direct impact on delivering public services and good governance [3]. As it is announced on the 5th ICT exhibition and bazaar on June 2012 by the Ministry of Communications and Information Technology, the number of Internet service subscribers in 2010 is above 100,000 and at the end of the year 2012 it is forecasted to be some 2.5 million.

2. Related Work

Almost all households in Trondheim Norway today have connectivity to ordinary phone [4]. In Norway providing broadband Internet using ADSL promises very high performance without a corresponding high cost, and does not require a large investment in infrastructure upgrades. In Norway large number of households is connected by cable TV, of which 45% of households get broadband access via coaxial cable. Scandinavia has the highest market share for fiber access in Europe.

Another study by Bengesai states that in Zambia, due to the growing demand for huge bandwidth and the limit of availability of current telecommunications technology, there is a need for fiber backbone in the country [5]. This has prompted a number of institutions to start planning for fiber cable roll outs as a new business. Zesco, a power service provider, planned to cover the whole Zambia with OPGW installation on all of its 66 – 330 KV lines of pylon.

Mandioma discussed VSAT's role in minimizing the digital divide and show the help of VSAT in Dwesa-Cwebe, Eastern Cape, South Africa a rural area that is disadvantaged in Internet access. The study has provided insight into practical deployment issues of Internet connectivity in rural disadvantaged communities. In this case VSAT technology has proven to offer backbone Internet connectivity in Dwesa-Cwebe with most of the prevalent characteristics found in rural areas [6].

Reviewing related works done in other countries showed that implementation of WiMAX as a broadband access solution has tremendous success in bridging the digital divide. As stated by Chowdhury *et al*. [7], Bangladesh got connected to the global information super highway long ago. However, since it is costly and time taking to cover the entire nation with cables, it was difficult to utilize the available bandwidth and to provide broadband access. Therefore, they showed WiMAX's potential to achieve wider coverage. This notion is supported by another article by Qureshi and Schaeffer [8], in Islamabad, Pakistan, stating that it is better off by implementing this state of the art WiMAX technology for its future broadband needs. It is not only very inexpensive source of communication but a system that can be implemented easily with relatively low cost and in a very short time.

WiMAX provides the quintessential answer to broadband wireless access in India and its immediate deployment presents a golden opportunity to leapfrog

other developed nations by providing seamless connectivity [9]. WiMAX's superior performance, lower cost, and defined evolutionary path gives it an edge over other cellular technologies.

In Pakistan, another publication indicates WiMAX's ability in providing a high speed data rate as compared to other solutions and penetration strategy in competitive markets among Internet service providers [10]. The ability to give service while on the move is another capability of WiMAX.

Chakraborty and Bhattacharyya [11] discussed about an end to end WiMAX network architecture, saying the WiMAX system simply becomes an extension of the IP network to the mobile user. Leveraging simple IP-based backbone connections, service providers can very readily service a myriad of WiMAX base sites (e.g., large, medium, sectorized, omni, micro, pico) for varying coverage and capacity profiles addressing outside environments, inside buildings, fixed and fully mobile connections. Service Providers will very simply grow their networks based on system usage leveraging standard IP components.

3. The Proposed Solution

In reality, there seems to be no networking technology which comes out with absolute win to be the preferred alternative for broadband access service. However, it is with no doubt that based on the facts to specific scenarios, the selection would be much more simple and appropriate. For this, a framework is developed having 9 criteria which are based on extensive literature review and some recommendations that enable appropriate broadband access service technology selection.

Accordingly, we propose a framework that presents a comparison matrix of available technology against the criteria for comparison. The criteria are grouped into two. Criteria group 1 have score point that is preferred to be high while those in group 2 have score point that is preferred to be low. Table 1 shows the schema of the framework we propose.

Table 1: Framework for alternative broadband access services

Broadband Technology	Criteria (Group 1- preferred to be high)					Criteria (Group 2 preferred to be low)					Total CIV	Remark
	Suitability of Transmission Medium	Existing Coverage in Ethiopia	Suitability for Edge networking	Suitability for Backbone networking	Maximum Bandwidth support	Initial or Expansion Infrastructural cost	Prone level to damage	Security Exposure	Legal and Regulatory Restrictions	Dependency on third party		
ADSL												
Fiber Optics												
WiMAX												

Two groups of criteria; those whose score value is preferred to be high in the preferred order of (XXX, XX, X, −) in group 1 and whose score value is preferred to be low in the preferred order of (−, X, XX, XXX) in group 2. Values in bracket indicate Comparison Index Value (CIV) associated with each score. The Total CIV column shows the sum of CIV for every technology. The Remark is the rank of the technology. Possible values in each cell are scores represented by −, X, XX, or XXX where: −=None, X=Low, XX=Medium, and XXX=High for each combination of technology and criteria. Each score will have its corresponding CIV in bracket.

These consideration criteria are discussed in different literatures and here in this study, they are organized to constitute the criteria of the proposed framework. First the framework is developed for alternative broadband access service, alternatives are compared with the comparison matrix and the better alternative is peaked and discussed thoroughly and if not used in Ethiopia yet, the reason why this alternative is not implemented in Ethiopia so far will also be investigated.

The core components of the framework to recommend alternative broadband access services are criteria for comparison. The criteria include types of transmission medium, existing coverage in the country, infrastructural cost, suitability for use, bandwidth support, prone to damages, security exposure, legal restrictions, and dependency on third party.

Table 2: Comparison of Alternative Broadband Access Services (using the proposed framework)

Broadband Technology	Criteria (Group 1)					Criteria (Group 2)					Total CIV	Remark
	Suitability of Transmission Medium ↑	Existing coverage in Ethiopia ↑	Suitability for Edge networking ↑	Suitability for Backbone networking ↑	Maximum Bandwidth support ↑	Initial or Expansion Infrastructural cost ↓	Prone Level to Damage ↓	Security Exposure ↓	Legal and Regulatory Restriction ↓	Dependency on third party ↓		
ADSL	X (1)	XX (2)	XX (2)	– (0)	X (1)	XX (1)	XX (1)	X (2)	– (3)	– (3)	16	3
Coaxial Cable	X (1)	– (0)	XX (2)	– (0)	XX (2)	XXX (0)	XX (1)	X (2)	– (3)	– (3)	14	6
Fiber Optics	X (1)	X (1)	X (1)	XXX (3)	XXX (3)	XXX (0)	XXX (0)	X (2)	– (3)	– (3)	17	2
OPGW	X (1)	X (1)	X (1)	XXX (3)	XXX (3)	XXX (0)	XX (1)	X (2)	– (3)	XXX (0)	15	4
VSAT	XX (2)	X (1)	XX (2)	X (1)	X (1)	XX (1)	X (2)	X (2)	XXX (0)	– (3)	15	4
WiMAX	XX (2)	– (0)	XXX (3)	XXX (3)	XX (2)	X (2)	X (2)	X (2)	– (3)	– (3)	22	1

– = None X=Low XX=Medium XXX=High ↑=Preferred to be high (Group 1)
↓=Preferred to be low (Group 2) ( ) =Comparison Index Value

Two groups of criteria; those whose score is preferred to be high in the preferred order of (XXX, XX, X, –) are in group 1 and whose score is preferred to be low in the preferred order of (–, X, XX, XXX) in group 2. Values in ( ) indicate Comparison Index Value (CIV) associated with each score. The Total CIV column shows the sum of CIV for every technology. WiMAX has the highest total CIV of 22. Next CIVs are 17 for Fiber Optics and 16 for ADSL.

From the previous discussions considering the framework for alternative broadband access services and the resulting Table 2 for comparison, WiMAX, with the total CIV of 22, would come out to be the best preferred alternative solution to provide broadband Internet access services in Ethiopia. This conclusion is based on the criteria of the framework which is proposed to be used as a reference document and using the comparison table of the framework. WiMAX is the best alternative to render the services intended with least cost, acceptable service quality and an investment worth to generate return on investment given the Ethiopian scenario used under the study. The framework can be used for scenarios in any country provided that the criteria are setup based on the local situations.

4. Conclusion

To provide Internet services, adequate infrastructure should be there, but in Ethiopia the existing telecommunication infrastructure coverage across the country is very low and that makes it challenging to achieve connectivity. Even the existing infrastructure is damaged due to recurrent civil works and deliberate vandalism.

The Internet service quality is degraded due to the disconnection resulting from the damage mentioned above and this in turn has caused loss of millions of Birr in terms of financial and maintenance costs. This is an indication to look for other alternative solutions to provide Internet services. In addition to the damages caused, running cables in every corner would be costly in terms of initial, expansion, and maintenance expenses. Wireless technologies would be an alternative to significantly reduce these costs and as well it is easy and fast to deploy these networks requiring less civil works.

Based on the criteria in the proposed framework, WiMAX became the best alternative technology for broadband access services in Ethiopia. In this research, WiMAX is studied as alternative broadband access service as it is a wireless technology that could serve as a backbone network for the last mile solution connecting rural areas to bridge the digital divide or used by subscribers at the edge network to get connected to the Internet services provided by the service provider.

References

[1] International Telecommunication Union, "Internet from the Horn of Africa: Ethiopia Case Study", 2002, pp. 18-20.

[2] Ministry of Finance and Economic Development, "Growth and Transformation Plan 2010/11-2014/15", Vol. I: 2010, pp. 75-100.

[3] Ethiopian Telecommunication Agency, "Annual Statistical Bulletin (2005/2006)", 2005, pp. 3-5.

[4] Awais Ejaz Ahmed, "Market for the Sales of Wireless Broadband in Trondheim", 2010.

[5] Tamara Bengesai, "Establishment of National Research and Education Network (NREN) in Zambia", 2009.

[6] Martin Mandioma, "Rural Internet Connectivity: A Deployment in Dwesa-Cweba, Eastern Cape, South Africa", 2007.

[7] G. S. Chowdhury, M. A. Qurashi, and I. B. Muhammad, "Achieving Broadband Internet Access with WiMAX in Developing Countries (e.g., Bangladesh)", 2006.

[8] I. Qureshi and D. Schaeffer, "WiMAX as an Inexpensive Source of Effective Communication for Islamabad", 2005.

[9] Protiviti, "WiMAX: The Quintessential Answer to Broadband in India", 2008.

[10] Greenpacket, "WiMAX, a Wireless Solution for Fixed Wireless Access in Emerging Markets", 2010.

[11] Mohuya Chakraborty and Debika Bhattacharyya, "Overview of End-to-End WiMAX Network Architecture", 2010.