Strategies for Low Cost Rural Telephony.

Idachaba Francis Enejo, Ph.D.

Department of Electrical and Information Engineering
Covenant University Ota, Nigeria

E-mail: idachabafe@yahoo.com
Phone: +2348039570321

ABSTRACT

This paper presents strategies that operators can employ to profitably provide acceptable and affordable telecommunication services to customers in the rural areas. The strategies discussed include the use of low power/ low cost infrastructure designed and based on the specifications of the rural areas and the shared access concept using the Global System for Mobile (GSM) phone booth. These strategies are based on infrastructure that is modular, scalable, solar powered, and customizable to the operator's specifications. The low cost infrastructure is designed to extend telecommunication services to rural areas enabling users in those areas to link up with the operator's network in the urban areas using their personal phones. These devices (repeaters) can be designed to allow the user's phones to transmit at minimum power thus giving them longer talk time.

With the GSM phone booth, the users don't need to have personal phones. The GSM phone booths are installed within their streets and the users are supplied with re-loadable cards with which they can access the phone booths to make their calls. These phone booths are also designed to be range extenders powered by solar making them suitable for the more remote areas.

(Keywords: GSM phone booths, range extenders, global system for mobile, shared access concept)

INTRODUCTION

The current increase in the teledensity in most developing countries due to the licensing of operators for the provision of telecommunication services has not really affected the telecommunication situation in most of the rural areas of these developing countries [1][2][3][7]. The reason for this situation is largely due to the fact that telecommunication services are expensive to roll out and operators/investors need to be able to expect a high return on investment before deploying service to any area. This expectation is the main reason why operators roll out service only in urban areas and major city centers within their exclusivity period [4]. In Nigeria, the telecom space came alive with the auctioning of GSM licenses in 2001. These licenses were awarded to the successful bidders at a cost of $285 million each with a five year exclusivity period.

CELLULAR TELECOMMUNICATION

The cellular communication standard upon which current telecommunication technologies are built is based on the subdivision of a geographical area into a contiguous group of small cells. These cells have a transceiver system installed in each of them [5]. The available frequencies can then be reused in the cells at distances such that interferences are minimized. A larger cell size implies that fewer transceivers will be required to provide coverage, it also means that fewer users can be accommodated per unit time on the network. Due to the limited nature of the spectrum and the high cost of equipment, operators are forced to evolve strategies aimed at optimizing the available bandwidth for maximum profits.

Expenses incurred by investors/operators in the course of setting up the telecommunication system can be categorized into two major divisions. These are:

(i) Capital Expenses (CAPEX)
(ii) Operating Expenses (OPEX)

CAPEX involves costs incurred in the procurement of the license, infrastructure, cell site equipment, and installation, while the OPEX

involves costs required to keep the networks up, running and profitable. Component parts of this cost include the costs of fuel, salaries, maintenance costs, taxes, etc.

Financing arrangements can be made for the CAPEX due to the fixed and predictable nature of the costs. These can either be paid for upfront or through various financing arrangements that can be made with the equipment manufacturers and suppliers, technical partners, and major finance organizations [6]. The OPEX costs on the other hand are not totally predictable and this is due to the effect of variation in cost of fuel, unstable tax regimes, etc. These costs are affected significantly by the fluctuation in the supply of fuel, fluctuations in price, and the issue of theft as reported by some operators in Nigeria. In Nigeria, over 5,000 generating sets work daily powering the various cell sites across the nation with most cell sites having two generating sets each. Below is a list of the costs that are usually incurred in setting up GSM communications using the conventional base station approach as is currently practiced.

CAPEX Costs Include

(i) Site acquisition
(ii) Fencing
(iii) Earthing
(iv) Antenna systems and installation
(v) Tower construction
(vi) Foundation costs
(vii) Shelter
(viii) Battery banks
(ix) Step down transformers
(x) Radio equipment
(xi) Generating sets
(xii) Stabilizers
(xiii) Air conditioners and A/C controllers

OPEX Costs Include

(i) Fuel
(ii) Maintenance cost
(iii) System upgrades
(iv) Staff training and salaries.
(v) Taxes
(vi) Advertisements and sales promotions 8]

COST STRUCTURE FOR GSM SYSTEMS

An analysis of the components of expense shows that the costs can be reclassified as:

(a) **Infrastructure Costs**: Under this category, the major components include costs for site acquisition and fencing, equipment and installation costs, and power supply system costs. Special financing arrangements can be made with banks, financial organizations and equipment manufacturers to facilitate rapid network rollout.

(b) **Operating Costs:** The costs in this category include the following, fuel, maintenance, advertisements and promotion, training and salaries, etc.

(c) **License Costs**: Costs in this category include costs of the licenses, taxes, levies, etc.

STRATEGIES FOR LOW COST RURAL TELEPHONY

The advantages and importance of telephony for development makes it imperative for both the Government and the operators to fashion deliberate policies that makes a business case for rural connectivity [7]. Based on the cost structure discussed above, the strategies for low cost rural telephony can be driven under two fronts and these are:

(1) Government driven strategies
(2) Operator driven strategies

Government Driven Strategies

These are deliberate polices that can be pursued by government agencies. They are aimed at making the rural telecom market economically attractive for the investors and existing operators. These strategies include the following:

(i) Tax exemption as a function of rural penetration by existing operators: Under this strategy, existing operators get some form of tax exemption or rebate which is made proportional to the provision of service at acceptable levels in designated rural areas.

(ii) License refund as a function of rural penetration by existing operators: Under this strategy, existing operators get a refund of a percentage of their license fee which is also made proportional to the provision of service at acceptable levels in some designated rural areas.

(iii) License-fee free licenses for operators dedicated to rolling out service in designated rural areas: This strategy will enable investors interested in rural areas roll out services and also encourage financial institutions to fund such investors since the capital expenses will be greatly reduced due to the elimination of the license fees.

(iv) Provision of a telecom fund for the funding of rural telephony: Under this strategy, a percentage of the license fee paid by the major operators can be set aside and used to provide a funding support for operators dedicated solely for rural telephony.

(v) Provision of broad band infrastructure to rural areas: This will encourage investors as they will not have to add the cost of a network back bone to the capital expenses required.

Operator Driven Strategies

The focus of this paper is on the operator driven strategies. There are three major strategies operators can employ for low cost rural telephony. These are:

(i) The shared access concept
(ii) The use of customized transceivers
(iii) Investment in research and development of low cost/low power communication systems.

The Shared Access Concept (GSM Phone Booths)

This concept is based on the system efficiencies which can be greatly enhanced when access is separated from ownership [9]. Under this strategy rural dwellers do not have to own phones to have access to telecommunication services. A telephone center or call center is installed to cater to a locality and everyone within that locality can come to the call center to make use of the phone. Payments are made in accordance to the prevailing tariffs. A very popular and successful implementation of this approach is the Grameen Village Telephone Project in Bangladesh and the MTN, CELTEL and GLO rural telephony projects in Nigeria.

Grameen Village Phone

The Grameen Village phone project uses Grameen Phone's technology, phone lines, and administration, and it buys bulk airtime from Grameen Phone. The village phone project is aimed creating ICT centers in rural areas, creating employment for the ICT provider, and stimulating entrepreneurialism and business development in poor rural areas. Currently, the village phone project is open only to Grameen Bank members and the selection criteria include: at least 2 years as a Grameen Bank member, a record of on-time payments, knowledge of English digits, a centrally located house or place of business, 1 or 2 other sources of income, and access to electricity (to charge the phone). If qualified, the member is lent the necessary capital (the phone and accessories cost an estimated $420) at 22% interest to purchase a Grameen mobile phone on the assumption that the amount will be repaid within three years. Grameen Telecom markets the Village Phone only in rural areas and uses the conveniently existing network of Grameen Bank branches as its administrative quarters [9].

A major feature of this rural telephony approach is the fact the network provider must have service in those areas. The GSM phone concept being proposed in this paper does not require that an operator's service is available for telecom service to be provided.

The GSM Phone Booth

The GSM phone booth [11] aims at eliminating the need for the acquisition of personal handsets by the users thereby eliminating problems of discharged phones and cost of mobile phone acquisition among the rural dwellers.

The phone booths are designed in accordance with the GSM standard and operate as a fixed terminal so the system design is simplified as the distance between the phone booth and the nearest base station is fixed. The cellular phone platform used is integrated into the phone booth and powered by both the solar cells and cheaper, larger sized batteries. Interference is also reduced due to the use of Space Division Multiplexing as the various phone booths are placed in different locations with antennas facing the nearest base station.

Rural dwellers access the phone booths using specially designed cards and calls from theses phone booths can be subsidized by the operators. Advantages of the GSM Phone booth include:

(i) Shared User design with users having individual load able calling cards.

(ii) No dedicated management required as with the Grameen phone systems

(iii) Phone booths can be customized the any network

(iv) Ability to extend service to uncovered areas

The Use of Customized Low Power Transceivers

Rural areas of developing countries are characterized by a lack of basic infrastructure like roads, water supply, electricity supply, etc., coupled with the low economic power of the rural dwellers, low economic activities in those areas, and the low population densities comprising hamlet settlements separated by large uninhabited open areas in the north to thick vegetations, rivers, and mountains/hills in the south. These factors are further complicated by the constant rural urban drift experienced in those areas make the setting up of base stations in those areas an uneconomic decision.

The main reason for the lack or the inadequacy of telecommunication services in rural areas is the potential non-viability of these services. Telecommunication is an infrastructure-based service; limited number of subscribers and limited usage in sparsely populated and predominantly low-income rural areas do not induce a rollout of networks into these areas.

This strategy utilizes transceivers designed to be run on solar cells covering a small area [10] [13]. A directional antenna is used to link the cell to the nearest base station and a sector antenna provides coverage to the cell. The transceiver design eliminates the need for high power amplifiers, generator sets, stabilizers, etc. This approach not only reduces the capital expenses (the radio equipment accounts for about 70% of the network costs) [8], it also reduces drastically the operating costs due to the elimination of the need for fuel for the generating sets and the generators as the repeater was designed to run on solar energy. Advantages of the approach include the following:

(i) It is customizable to suit the site specific features

(ii) It can be designed to be solar powered

(iii) It has a higher efficiency/return on investment rate when compared with the conventional approach of setting up telecommunication services in the rural areas.

Investment in Research and Development of Low Cost/Low Power Communication Systems

The lack of investment in research and development aimed at producing low cost systems and technologies suitable for profitable rural telephony by operators in developing countries often places them at the mercy of international equipment manufacturers who would not have taken the specific conditions of the developing countries into consideration in the design of these equipments. Most of the software used in network planning are based on readings and experiments carried out in foreign countries, (the Hata model for pathloss estimation for example) and to adapt these models to our environments would add additional margins. Some of these margins lead to inaccurate estimates which in turn leads inaccurate specifications for the designed networks [10].

The standardization policy on the international scene allows manufactures to design equipment which may not be the best in terms of the environmental conditions of the rural communities in developing countries. Power consumption becomes very important to radio equipment manufacturers when the equipment has to be portable. For non portable devices or non-hand held radio equipment, interference and spectrum management are the most important [5] design constraints; as such their equipment are designed using parameters that makes them require high operating costs when deployed in the developing countries.

Operators in developing countries can tow the path of companies abroad by funding Masters and Doctoral research programs in areas where

the results will be utilized by them to develop customizable and novel systems which can be deployed to enhance service delivery.

CONCLUSION

It is an undisputable fact that telecommunication service is expensive and at the same time its advantages can not be over emphasized. Both the government and the operators need to make deliberate plans and pursue them to ensure that telecommunication services at acceptable grades of service is made available to rural dwellers at a cost they can conveniently afford in a manner that is profitable to the operators/investors. The GSM phone which is based on the shared access concept eliminates the need for rural dwellers to have phones before they can have access to the telecommunication services.

The use of low power transceivers based on the fact that for rural areas with the basic demand being voice traffic, an extension of service from the urban areas to the rural areas using low power transceivers, is the optimum approach to rural telephony and the research and development option can be used by the operator to adapt the unique features of the rural areas which serve as a disadvantage and convert them to provide a basis for the design of customized systems for extending telecommunication services to the rural areas.

ACKNOWLEDGEMENT

I wish to acknowledge the invaluable contributions of my research supervisor, Prof. F.O. Edeko, in the Department of Electrical and Electronics Engineering at the University of Benin.

REFERENCES

1. World Bank. 2003. "ICT at a Glance". *Nigeria Development Data*.

2. International Telecommunication Union. 2003. *World Telecommunication Report.*

3. Microsoft Encarta. 2006. "Nigeria". Microsoft: Redmond, WA.

4. Karla, S.S. and B. Borghain. 2004. "An Enquiry into the Impact of Policy and Regulation on Rural Telephony in India". *International Journal of Regulation and Governance*. 4:113-138.

5. Goldsmith, A. 2005. *Wireless Communication*. Cambridge University Press: Cambridge, UK.

6. International Finance Corporation. 2005. "Summary of Project Information". SPI.

7. Telecom Regulatory Authority of India. 2005. "Growth of Telecom Services in Rural India: The Way Forward: A Consultation Paper". October 2005.

8. Ericsson. 2005. "Communication for all: A white paper". Ericsson: Stockholm, Sweden.

9. Prahalad, C.K. and A. Hammond. 2003. *What Works: Serving the Poor Profitably: A Private Sector Strategy for Global Digital Opportunity*. World Resources Institute: New York, NY.

10. Nokia. 2003. "Accelerating Telecommunication Growth World Wide". Nokia: Finland.

11. Idachaba, F.E. 2006. "Design of a GSM Phone Booth for Rural Mobile Communication. International Conference on Engineering Research and Development.

12. Idachaba F.E. 2006. "Low Cost Approach for Extending Mobile Communication to the Rural Areas of Nigeria". International Conference on Engineering Research and Development.

13. North African Wireless Communication. 2007. "Namibian Cell Site Becomes First to be Powered by Sun and Wind". 6(1):February/March: 32.

ABOUT THE AUTHOR

Idachaba Francis Enejo obtained his first degree in Electrical/Electronics Engineering from the Federal University of Technology Yola in 1997 and his Master of Engineering Degree in Electronics and Telecommunication (Distinction) from the University of Benin in Edo State. He recently defended his Ph.D. at the same University of Benin. He has taught Electronics at the Federal Polytechnic Idah in Kogi State Nigeria for six years before proceeding to Covenant University, Ota where he has been a Lecturer for the last three years. His current research interests include rural tele-communications and design of low power bidirectional transceiver architectures.

SUGGESTED CITATION

Idachaba, F.E. 2009. "Strategies for Low Cost Rural Telephony". *Pacific Journal of Science and Technology.* 10(1):256-261.


Pacific Journal of Science and Technology