Technical and policy advances in rural telecommunications

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Abstract

Providing access to telecommunications services in rural areas continues to challenge policy makers and telecommunication operators alike. The problem is complex and solutions require an understanding of the technical issues as well as the policy instruments used to create incentives for rural service providers. To that end this article presents a brief overview of both technical and policy innovations in rural telecommunications. Technologies discussed include both wireline and wireless networks while policy instruments are presented as following either an 'obligation' or 'incentive' strategy.

Introduction

In 1985 the study of the Independent Commission on telecommunications and development - *The Missing Link* - carried out for the International Telecommunications Union, raised awareness of the great differences that exist in access to telecommunications infrastructure across the globe. Nearly two decades later, while developing countries make significant progress in providing access in urban areas, access in rural areas continues to be sparse. This scarcity of rural service is partly attributable to the unique characteristics these areas present to a telecommunications provider: large geographical distances, low population densities, low levels of economic development, and low levels of skills. In addition to these challenges, it was previously believed that the lower incomes in rural areas must translate into low levels of demand. However, recent studies have demonstrated that despite lower incomes rural residents have a high demand and willingness to pay for telecommunications services.

Combined with this recognition of the demand for rural services, recent innovations in both technologies and policies are setting the stage for an era of network deployment that will enable a greater number of rural inhabitants to access not only telephone facilities, but a variety of communication media. Below we discuss these innovations.

Technical Developments in Rural Telecommunications

In evaluations of rural telephony systems it is usually assumed that technology plays an important role. Indeed, the long distances to the nearest "connection" point of the urban telecommunication networks create special requirements for appropriate technology that can be operated profitably. Despite the significance of technology for the development of rural networks, it must be seen as just one of many links, using a chain metaphor, contributing to the success of a complex system. This point was demonstrated at the ITU Telecom Africa 2001 Policy Development Forum, where in response to the question: "What is the most important barrier to the provision of access to all Africans?" participants ranked four possible reasons as follows: Lack of funding (47%), Regulation (23%), Lack of public and private sector co-operation (18%) and only as a last item Inadequate technology (12%). In spite of possibly being one of the least important 'links' in the rural telephony system, it seems important to understand the development of technology and recent innovations that provide more options than ever.

The oldest telecommunications technology, copper wire, has evolved over the past few decades and has presented new options for rural telephony. When rural systems were first developed, service over long distances was provided with open wire connections, suspended on poles or trees. In some areas to save on copper, single line open wires were used, where the earth served as the return conductor. When the number of users increased, copper pairs were shared (party line). As the infrastructure developed, carrier systems were introduced. Through frequency multiplexing and the use of coaxial cables the calls of many users were transported on the same line. With the introduction of digital technology this system was augmented by the use of time division multiplexing (digital loop carrier). With properly conditioned feeder cables, multiplexing allowed economic extension of the network.

Radio systems

Although multiplexing enabled network extension it did not resolve the issue of low cost service at large geographical distances. In order to serve distant rural areas, particularly those with very sparse populations, radio systems present the advantages of scalability and easy deployment. However, while radio systems solve the problems of poles and copper wire theft, they require an external source of power, which is not an issue for fixed line service. Solar power may be a solution, although it is not deployable in all locations and may also be subject to theft.

Radio systems have also undergone an evolution from analog to digital technology. In rural areas a widely deployed system is the so-called Point-to-multipoint system. Unfortunately standardisation of these systems has been limited and many manufacturers have ceased production.

Cellular mobile networks (Fixed access)

With the arrival of cellular mobile telephone systems new options for rural areas came into view. Already in an early stage it became clear that investments made in mobile networks to serve a different group of users could benefit rural subscribers (Westerveld, 1994). At first these systems were deployed using a variety of analogue standards, whereas today digital systems are in use in many developing countries. Apart from the placement of single telephone booths, another implementation uses large metal shipping containers connected to the mobile network to provide local access through a managed telephone service (a phone shop) This system has proved to be a good solution in areas were cellular coverage is available.

Wireless local loop (WLL)

A third category of radio-based services is wireless local loop. Although standard implementations have not evolved, vendor specific solutions, both analogue and digital, have been used for some time. They continue to suffer however from a relatively high cost per line. An answer to this has emerged in the Indian design and deployment of *corDECT*, a system based on the original digital cordless system, DECT. The corDECT system provides an extended coverage area of about 10 km for about half the price of a classical WLL system. Furthermore, the corDECT system provides low cost service with some mobility, which the WLL systems did not allow. This feature gives rise to disputes between corDECT operators who can operate without a special mobile license and those mobile operators who have paid a high license fee for this privilege. Another advantage of the corDECT system over other WLL systems is that it can provide data connections for Internet access with speeds up to 70 kbps.

Satellite

When Global Mobile Personal Communications by Satellite (GMPCS) systems were announced there were high expectations for the use of these systems in rural areas. Consortia offered developing countries free use of access channels. Naturally in return for this use the countries were expected to grant licenses to use frequencies and operate in their countries.

Currently, both Iridium and Globalstar, the only two GMPCS firms in operation at the global level, struggle to attain profitability. Consequently, the deployment of these systems for general access in developing country rural areas has been severely limited. One other alternative is Very Small Aperture Terminal (VSAT) systems, which have now been installed in various countries. These systems provide a good solution for isolated areas, particularly where a connection over land would be too costly.

In any particular rural application the choice of technology depends very much on the local conditions. Subscriber density, clustering possibilities, distances to nearest national connection point and the characteristics of the terrain have to be considered. Also local technical expertise and adoption capacity have to be taken into account.

Maintenance in a rural telecommunication context

Providing a "technological solution" to the rural telecommunications problem is one thing. To provide a "working and sustainable solution" is something else. An obvious negative consequence of a lack of system availability is a loss of revenues. However, little is said about the demotivating effect of breakdown of service after a few months, particularly when it takes several months for service to be restored. In these situations it is difficult to persuade people to use a system and even further to pay for that use.

The rural environment, in developing countries in particular, puts a lot of stress on equipment. There are not only the harsh climatic conditions, but also failure of power systems and unforeseen human interventions can cause interruptions of operation. Furthermore, in these conditions, the level of reliability should be higher than for ordinary telecom equipment, considering that the higher costs of this reliability will be paid back through a reduction in maintenance costs and higher revenues.

An integral component of reliability is a proper maintenance strategy, which has to be adopted from the beginning of the design of a rural network. This includes use of a remote monitoring and maintenance centre. And also the reservation of sufficient funds for the acquisition of spare parts and logistics for the getting these parts at the right time, in the right place, by the right technician.

Policy Developments in Rural Telecommunications

Just as innovations in technology hold promise for increases in rural access to telecommunication services, policy innovations also have a role to play. Policy solutions are seen as appropriate for addressing the problem of rural telecommunications both because the sector is typically distorted by its history of state intervention through ownership, restricted entrance and geographical price averaging and because the likelihood of higher costs for serving rural areas contributes to a restriction of purely market-based incentives for telecommunication services provision. Policies to address these problems follow two general strategies: obligations and incentives.

The policy instrument of obligation is typically employed through the licensing process. Rural area coverage was traditionally the obligation of fixed line monopolists, whether state or privately owned. As markets become increasingly competitive two trends are evident. First, the obligations are being spread over a larger number of players, including new fixed and mobile service providers. Additionally the concept of universal access has in many cases been expanded beyond voice telephony to include Internet access. Both trends are evident in South Africa where the liberalization of the market for fixed services has created the possibility for a second national operator (SNO). The licensing process, currently under way, calls for the SNO to fulfill 'community service obligations' by providing both school-based Internet laboratories and community telephones in rural areas[1].

As a policy instrument obligations are criticized as distorting market forces. It is argued that service areas are best defined by telecom managers, or better yet the localities themselves, rather than bureaucrats. In the case of South Africa the rural areas targeted for service obligations are identified by the Universal Service Agency, presumably with input from a variety of stakeholders. Coverage obligations are further criticized as providing incentives for temporary solutions that fulfill commitments but do little to foster long term solutions for rural telecommunications. Answering these criticisms is difficult. In some cases policy makers are complementing or replacing obligation-oriented strategies with policies aimed at making rural service an attractive business prospect. Incentives for providing rural service can be financial, as in the case of subsidies, or may include particular market conditions established through special licensing programs.

Policies that provide incentives through subsidies must address both the source and collection of the funds as well as the means of distribution. This process must be handled carefully as the calculation and distribution of subsidies can lead to lengthy disputes (Garnham, 1997). Sources of funds in existing models include revenue- or per-minute-based contributions from telecom operators (see Peru, USA and France for examples), contributions based on interconnection charges, and contributions from the government's general fund (see Chile)[2].

The distribution of subsidies has been an area of significant innovation in the past decade. Using traditional methods, rural service subsidies are paid to incumbent operators based on complicated cost of service calculations. Since the true cost of providing rural service is difficult to ascertain, establishing a fair level of subsidy is also difficult. To circumvent this problem innovative policies that use auctions to distribute subsidies have been developed.

Subsidy auctions, particularly when combined with the issuance of new licenses, create incentives for greater transparency in the calculation of costs and support efforts to increase competition in the sector. This method has been used with some success in both Peru and Chile where reverse auctions were used to issue both licenses and subsidies to the firms with the lowest subsidy bids.

To be successful this policy instrument should include mechanisms to reduce the risk of under-bidding for the subsidies and subsequent default through requirements such as performance bonds, as well as guarantees for interconnection of the new entrants (Cannock, 2001). Furthermore, policy makers should be aware that bids for subsidies may be constructed to protect existing market shares or to develop a presence, instead of reflecting the actual costs of rural service. This behaviour was observed in the Chilean case (see Wellenius, 2001) where in the first round some firms bid zero for a subsidy to increase their chances of winning a license whereas in subsequent rounds, after market positions were solidified, subsidy bids increased significantly.

In addition to combining rural access and competition goals, innovative polices for rural access can also address rural economic development or diversity in ownership among telecommunications operators. One model, proposed by Lusignan (1999), notes that in existing models the profits from rural communications networks are reaped by firms from urban areas. To keep profits in the rural areas not-for-profit 'rural communications corporations' can be established. These corporations, owned and operated by locals, can be mandated to reinvest profits in local economic development projects. A similar effort to combine rural service goals with other social objectives is embodied in the South African government's proposal to increase diversity in service provider ownership through special under-served area licenses. In the proposed legislation the government plans to make licenses for under-served areas (< 5% teledensity) available exclusively to small, medium or

[1] The licensing of the SNO is scheduled to be completed at the end of November 2002. A draft copy of the license can found in the May 24, 2002 edition of the national government's Gazette, Vol. 443, No. 23460, Notice 786, via the ICASA web site (www.icasa.org.za). Downloaded September 25, 2002.
[2] For an in-depth discussion of the pros and cons of these systems see Wellenius (2000; 2001).

micro enterprises (SMMEs), particularly those owned by persons from historically disadvantaged groups and women.

Conclusions

The past two decades have witnessed dramatic changes in telecommunications markets. The developments are largely attributed to innovations in both technology and policy. These innovations have made available a broader range of low cost technical solutions for serving rural areas. Through policy innovations these technologies are being deployed by a larger variety of organizations which in turn increase diversity of business models and hence their chances of success. As we look to the future continued attention to the issue of rural telecommunication service will hopefully foster further development of innovative technologies which can be deployed in market conditions established through new policies.

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