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Technical Aspects of Rural Telecom

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Evaluations of rural telephone systems assume that technology plays an important role. Indeed, the long distances to the nearest connection point of the urban telecom 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, following the chain metaphor popularised by the Maitland Report (Independent Commission for World-Wide Telecommunication Development 1984), contributing to the success of a complex system. This point was illustrated 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 lack of funding (47%), regulation (23%), lack of public and private sector cooperation (18%) and inadequate technology (12%) as the barriers. In spite of being one of the least important links in rural telephony, it is useful to understand the development of technology and, in particular, recent significant innovations.

In any particular rural application the choice of technology depends on the local conditions. Subscriber density, clustering possibilities, distances to the nearest national network connection points and terrain characteristics have to be considered, in addition to local technical expertise and adoption capacity.

Wireline Systems

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

Radio Systems

Although multiplexing enabled network extension it did not resolve the issue of providing low-cost service over large distances. Radio systems have the advantages of scalability and easy deployment in serving distant rural areas, particularly sparsely populated ones. 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 lines. Solar power may be a solution, although it is not deployable in all locations and may also be subject to theft.

Radio systems have evolved from analogue to digital technology. So-called point-to-multipoint systems are widely deployed in rural areas. Unfortunately standardisation of these systems has been limited and many manufacturers have ceased production.

Fixed Access Cellular Networks

With the arrival of cellular mobile telephone systems new options for rural areas have emerged. Early on, it became clear that investments made in mobile networks to serve urban users could also benefit rural subscribers (Westerveld 1994). At first, these systems were deployed using a variety of analogue standards. Digital systems are now in use in many developing countries. Apart from telephone booths with one line, another implementation uses large metal shipping containers connected to the mobile network through multiple lines to provide local access through a managed telephone service (a phone shop). This system has proved to be a good solution in areas with cellular coverage.

Wireless Local Loop

A third category of radio-based service is Wireless Local Loop (WLL). Although standard implementations have not evolved, vendor specific solutions, both analogue and digital, have been used for some time. They continue to suffer from a relatively high cost per line. The Indian design and deployment of corDECT, a system based on the original digital cordless system, DECT, offers a potential solution. The corDECT system provides extended coverage of about 10 km for about half the price of standard WLL. The corDECT system also provides some mobility, which the WLL systems do not. This, however, gives rise to disputes between corDECT operators and mobile operators who have paid high licence fees. Another advantage of corDECT is its ability to provide data connections with speeds up to 70 kbps.

Satellite Services

When Global Mobile Personal Communications by Satellite (GMPCS) systems were announced there were high expectations of use in rural areas. Various

consortia offered developing countries free use of access channels in return for the necessary authorisations. By 2002, Iridium and Globalstar, the only two firms in operation, were struggling to attain profitability. Consequently, their deployment for general access in rural areas has been limited. The only other alternative is Very Small Aperture Terminal (VSAT) systems that are being deployed in many countries. These systems are a good solution for isolated areas, particularly where terrestrial connections would be costly.

Maintenance in a Rural Context

Providing a technological solution to the rural telecom problem is one thing; providing a working and sustainable solution is another. An obvious negative consequence of a newly installed system breaking down is loss of revenue. However, little is said about the demotivating effects of breakdowns, particularly when the time to restoration is measured in months. In such conditions it is difficult to persuade people to use a system, let alone pay for that use. The rural environment puts a lot of stress on equipment. Beyond climatic conditions, there are failures of power systems and problems created by unforeseen human interventions. The level of reliability of rural systems has to be higher than normal, because the higher costs of reliability can be recovered through lower maintenance costs and higher revenues. An effective maintenance strategy must be adopted from the beginning of the design of a rural network. This includes use of remote monitoring and maintenance centres, the reservation of sufficient funds for spare parts, and the logistics for getting these parts at the right time to the technician who needs them.