Sustainable Internet access for the rural poor? Elements of an emerging Indian model

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Abstract

Although there are many projects, mainly supported by international donors, demonstrating that the Internet can be supplied to rural areas in developing countries, the real objective is to make these projects sustainable on a commercial basis. Among other things, this type of sustainability will require a project with unusually low costs of Internet delivery to poor, isolated users. In this paper we have examined a case from India, which uses a unique combination of low-cost indigenous technology and a low-cost model of delivery that exploits the ability of the informal sector to respond and adapt to local needs. This model, we feel, may serve as an example, to other developing countries seeking to bridge the global Digital Divide. © 2003 Elsevier Science Ltd. All rights reserved.

1. Introduction

Backed by subsidies of various kinds of differing amounts, demonstration projects supplying the Internet to rural areas in developing countries are not difficult to find. Nor is it difficult to show that the participants in such projects often derive substantial benefits from the technology thus provided.[1] The problem, however, is that if these small-scale, demonstration projects are to be replicated on a much larger scale and hence make more than just a minor contribution to overcoming the digital divide between rich and poor countries, they will need ultimately (if not immediately) to be able to survive on a commercial basis. And indeed it is precisely here that one encounters perhaps the major obstacle to the widespread diffusion of the Internet in

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[1] The Grameen Bank rural telecommunications project in Bangladesh is a good example of this point.

countries where most of those described as being poor reside predominantly in rural rather than urban areas. In brief, the problem is that

> Most of the populations of developing countries live in rural and often isolated areas. Access to information and telecommunications is essential for development of such areas, but is still inadequate or non-existent in many developing countries …

> People in rural areas are generally poor and few people can afford telecommunication services. This is a vicious circle-few potential customers means high price (if cost-based), which further reduces the number of potential customers and so on [1].

In the Indian case, for example, one estimate suggests that "a telephone operator today spends around Rs. 30,000 per line to provide telecom services to a subscriber. Taking into account finance charges on the investment (15%), depreciation (10%), and operation and maintenance cost (10%), an operator needs at least 35% of the initial investment as yearly revenue just to break even. Add to this the license fees and taxes, and the revenue per subscriber needs to be at least Rs. 1000 per month" [2]. At this price, clearly, no more than a very small fraction of the 200 million connections that are still said to be required in India, would actually be supplied. Assuming, as one reasonably can in the short to medium run, that there is no dramatic increase in the incomes of the population, the task of bridging this acute mismatch between costs and demand will need to be borne to a corresponding degree by reductions in the former.

To some extent, such reductions can be effected, as many practitioners now agree, by replacing the goal of providing information technology in general and the Internet in particular to each and every household, with the more realistic objective of bringing such services within reach of the population at the community or village level (that is, by replacing the so-called universal service delegation with the much more modest universal access obligation). Regarding telephones, for example, some progress towards the latter objective has already been made in India, where

> between 1988 and 1998, the number of villages with some kind of telephone facility increased from 27,316 to 300,000 villages (this is half of all of India's villages). By 2000, some 650,000 public call offices providing reliable telephone service, where people can simply walk in, make a call, and pay the metered charges, had mushroomed all over India, including the remote, rural, hilly and tribal areas [3, p. 186].

Or again, in the case of mobile phones, an especially well-known model is the Grameen Telecom project in Bangladesh, which grants loans to women recruited from among the members of the Grameen Bank, who after purchasing a cellular phone on credit, make the service available to entire villages. In its inaugural year,

1996, Grameen Telecom recruited 250 rural women for the mobile phone project, but its ultimate aim is to involve 60,000 such persons in that country.

If the communal access model thus seems to be an important requirement for spreading the benefits of basic telephony to the rural areas of developing countries, it would seem to be all the more essential when one progresses to the Internet, which usually requires costly extra hardware such as computers, modems and so on. In fact, within the typical range of installation costs, it is difficult to conceive the service being provided at a price that is affordable to the majority of rural households even in a communal setting, such as those described above (note that commercial possibilities are referred here rather than the non-sustainable case where such ventures are maintained only by dint of subsidies of various kinds). And to this extent, therefore, other modes of cutting costs and providing reliable service need to be invoked and it is to these that the remainder of the paper is in fact devoted. More specifically we shall focus our attention on the business model adopted by an Indian firm called n-Logue Communications, which is using a unique combination of low-cost technology and a decentralized delivery system to provide a service that is adapted to local needs.[2]

This firm

> believes that Indian small towns and rural areas not only require telecom and Internet, but have enough money to pay for it, provided it is available in the right quantity and price. The total potential of revenue in small towns and rural areas is huge. n-Logue has been launched to tap this potential. It will provide telecom and Internet service in all areas of the country other than the top 100–150 cities [4].

On the one hand, that is to say, cost savings have been effected by the specific character of the R&D efforts undertaken by certain Indian scientists; efforts which have given rise to numerous and complex hardware innovations in the area of information technology. On the other hand, costs at n-Logue have also been reduced by less dramatic, but nonetheless highly effective organizational innovations, involving, by contrast, relatively unskilled labour drawn from the informal sector. Yet further cost reductions are realized by combining these different types of innovations in a communal mode of Internet delivery that, as in the examples cited above, provides access to, rather than ownership of the service. Let us now consider each of these elements of the n-Logue model in turn, beginning with the hardware innovations that it embodies. It is well to emphasize, even at this stage of the paper that the uniqueness of this model lies not in the technology alone, but rather the combination of this technology with a low cost, decentralized delivery system at the village level, which is closely adapted to local requirements.

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[2] This model has begun to attract attention in major scientific journals such as Nature. See, for example, *Nature*, 24 January 2002, 358.

2. Pro-poor innovations in information technology

In India most of those described as living in poverty are located in the rural areas. Yet, R&D in that country has often been criticized as being oriented to urban rather than rural areas and to the needs of developed rather than developing countries. Indeed, in common with most of the latter countries, R&D efforts in India have tended to be "concentrated in large firms, or on large scale or inappropriate technologies in the public sector" [5, p. 24]. And even such R&D as is undertaken in agriculture has "been mainly focused on rather, high cost, input-intensive technologies" [5], p. 24. In the area of information technology itself, a recent survey of R&D activity by multinational firms in India by Reddy [6, p. 1828], indicates that "an overwhelming majority of new technologies firms are involved in developing products for the global markets, e.g. computers, communications equipment, etc". A global R&D focus of this kind could hardly be more different from the type of R&D which sought instead to design such products for the benefit of the low-income rural majority.

Whether the direction of R&D performed by the numerous institutions in India other than multinationals is on average much different from that which emerges from foreign-owned subsidiaries is a question still to be investigated in the IT context. What can be said, however, is that to a far greater extent than elsewhere in the Third World, IT institutions in India (or more accurately, a subset of them) have generated genuinely pro-poor innovations in a deliberate effort to narrow the digital divide with the rich countries as well as within the country itself. It is not my intention to review all such cases, which range from small-scale rural telephone exchanges and ultra low-cost computers that are accessible to the illiterate, to alternative low-cost modes of wireless communications. I shall focus instead on two innovations that are directly relevant to the n-Logue model (both of which have been developed by the Telecommunications and Computer Network Group at the Indian Institute of Technology, Chennai).

3. 'CorDect' wireless local loop technology

Wireless local loop (WLL) technology was originally conceived to supply narrowband telephones services in developing countries lacking a telephone infra-structure. In essence, WLL is a system that connects subscribers to the public network with radio signals as opposed to traditional copper wire for part or all the connection between the subscriber and the switch. WLL systems tend to be especially well-suited for an expansion of telephony in rural areas of developing countries, where the cost of laying copper wire from the exchange to the end user may be prohibitive [3].

In association with a number of other firms, scientists and engineers at the Indian Institute of Technology, Chennai have developed an indigenous (fixed wireless) version of the WLL system, which makes it even more attractive as a means of expanding telephony in rural areas. Known as CorDect, this locally adapted WLL,

has been highly appreciated by UNDP as a fast and cheaper mode of accessing Internet in developing countries, soon after being conferred the national award for successful commercialisation of indigenous technology…

The technology is claimed to bring down the cost of per line telephone connection from Rs. 40,000 to Rs. 10,000 and facilitates both voice and data transmission…

The CorDect system has all the features of an exchange and has been successfully installed in India and abroad.

…It is claimed to be the only system in the world that provides simultaneous toll quality voice and 35 or 70 kbps (kilo bytes per second) Internet access to wireless subscribers.

The technology replaces the wires or copper in local loop (standard telephone lines) with a wireless system. It requires a compact base station, mounted on a rooftop or poles in the street, which is used for transmission on a wireless medium to homes and offices [7].

3.1. 'Minnow'-Internet service provision in a box

If the indigenous WLL system developed by the Indian Institute of Technology, Chennai bears favourably on the cost of Internet provision, so too (albeit in a different way) does another important innovation from that same institution, namely, a small low-cost Internet Service Provider known as Minnow. This particular local innovation is based partly on the recognition that the use of proprietary technology (such as the Microsoft Windows operating system) may be inappropriate to the needs of developing countries (especially the poorest of those countries). In the specific context of Internet servers, that is to say, "The proprietary solutions have two problems…it increases the cost of the servers, and one needs trained manpower for maintenance, which may not be available locally. Low-cost and local serviceability is necessary for the widespread development of ISP servers" [8].

As the local engineers also appear to have recognized, low-cost information technology in developing countries usually requires instead, the use of relatively inexpensive open-source hardware and software solutions such as Linux, on which the Minnow ISP is in fact based. Running on just two independent personal computers,

Minnow provides state-of-the-art technology at a low price. Minnow includes the complete suite of services that an ISP needs. It runs on inexpensive PC hardware, but provides very high uptime through simple redundancy techniques. It is easy to administer and operate all of which contribute to low operational expenses. Subscriber Services provided by Minnow include e-mail, web-hosting, browsing, net-news and the ability to handle local languages [8].

The potentially crucial importance of Linux to low-cost computing in developing

countries, one should note, is recognized by many more industry participants than those involved in this particular project. One observer of the African situation, for example, has gone so far as to argue that the open-source model "is the only way for Africa to ever leapfrog its status as an undeveloped continent" [9]. Supporters of this point of view can persuasively use as evidence examples such as the 'Silicon Bazaar' in Kenya which has adapted (free) open-source software to suit the needs of small and medium-sized firms at a price of only US$6.50 (as against the price of US$100 for the Windows operating system in that same country [9]. In Mexico, some US$3 million has reportedly been saved in proprietary Microsoft licenses by a program to install the Linux operating system in public schools (an amount which is likely to rise substantially by the time this software has been installed in all 140,000 schools at the end of 2003.[3][10])

It is worth stressing here that the CorDect technology is already in use in other parts of India and thus its embodiment in the n-Logue model is itself not what makes this model unique. Rather, as noted above, it is the combination of this indigenous technology with a decentralized system of delivery that adapts continuously to the demands of users in small, isolated, rural villages.

4. Pro-poor IT innovations and technological determinism

The two previous examples and others that were cited earlier as belonging to the category of pro-poor innovations (such as the low-cost 'Simputer'), clearly illustrate that there is no inherent scientific reason why innovations in information technology have to assume the same form as those in developed countries (where they are shaped by the prevailing socio-economic circumstances, such as high per capita incomes, skilled labour and an urban-based population). Although there are certain technological rigidities, having to do with speed, temperature, scale, and other factors, that in some cases limit the degree to which innovations can be adapted to the conditions prevailing in the rural areas of developing countries [11], in many sectors these considerations do not appear to pose a major constraint on the adaptive possibilities.

Far more important seems to be the nature of R&D institutions in the Third World and the actual as opposed to their stated research goals. Many such institutions, for example, appear to be much more concerned with the international reputational effects of research conducted at the global scientific frontier, than with issues that are critical to their own particular country circumstances. The Indian Institute of Technology at Chennai, on the other hand, has managed to depart from this familiar pattern, partly, it would seem, because of the alternative vision held by the leading figures there. However, it would be useful to study the nature of this institution in detail if one is better to understand the workings of an 'appropriate' research institution in a developing country (much the same can be said, one should note, of the

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[3] Linux has begun to be widely used in other Latin American countries, most notably Argentina. See the Linux home page at www.Linux.com

M.S. Swaminathan Research Foundation in India, which has also conducted important research into pro-poor rural innovations in information technology). For the moment I can do no better than refer the reader to the literature that has emanated from these institutions [12].

4.1. The political economy of pro-poor innovations

The introduction of low-cost innovations such as those described above is far, however, from being a purely scientific, engineering or economic issue. On the contrary, it usually has a rather pronounced political economy dimension, which, in common with technical change in general, has been aptly summarized by Mokyr [13]. Thus, in describing what he refers to as 'the political economy of technological change', he makes the crucial point that,

> Although technological progress is by definition a net improvement to the economy, it is almost always the case that there are some groups whose welfare is reduced because of it, or who at least believe so ex ante.

> …Once an invention is made, an inventor often needs protection from those who stand to benefit from the suppression of the invention. The dilemma is sharpened by the fact that the benefits are usually heavily diffused, while the costs are concentrated [13, p. 178].

As recounted by Jhunjhunwala [2] of the Indian Institute of Technology in Chennai, the experience with CorDect well illustrates not only this general point, but also the fact that the social forces trying to preserve the status quo often comprise a quite diverse group of opposing interests.

'To begin with', he writes, there was the familiar and near total disbelief that "such efforts which would reduce costs substantially below those prevalent in the West could ever succeed". This is a bias, one should emphasize, that has beset attempts to create indigenous technologies ever since the advent of the appropriate technology movement in the early 1970s and one that has scarcely diminished since then. 'The opposition' against CorDect only really began in earnest, however, when

> …Egged on by competing companies, all kinds of obstacles were put up to prevent the product from being commercially deployed in India. One suddenly found out that the spectrum in which we were asked to develop the product was not even available with the telecom department. Specifications were framed for the Wireless in Local Loop product making it as different as possible from the indigenous product. Competing (and expensive) imported products were given tax concessions such that a locally manufactured product paid more taxes than imported ones. Questions were raised whether the product was really Indian and investigations were started. Court cases were filed to prevent the telecom department from placing even a meagre order, claiming that our system was an obsolete analog wireless technology, when in fact it was a fully digital system [2].

Powerful though these varied forms of opposition undoubtedly were, however, it is equally apparent that the commercial and political inexperience of the product's inventors made matters even worse. These scientists and engineers had hoped, for example, that the privatization of the telecom industry would help promote their product insofar as private operators should definitely prefer a lower-cost higher per-formance system. We were obviously novices in business. We had no understanding of the role that finance plays in such decision-making. Vendor financing was key to such sales' [2]. Or again, in spite of the ongoing negative campaigns against the local product, "We failed to realise the importance of lobbying and did not even set up a one-person office in Delhi till early this week" [2]. A final example concerns the state-owned telecom operator which places large orders "for less functional and much more expensive imported products. This would help these products to mature, catch up on functionality with our product and eventually compete with us on price. Once again we consider it as our failure to stop such orders" [2].

CorDect managed, nevertheless, to survive and ultimately to flourish, as evidenced by orders that now stand at around 100,000 lines. Some orders in fact have been received from a range of developing countries such as Fiji and Iran.

5. Involving the informal sector

The cost of delivering Internet to the rural areas in India, as elsewhere in developing countries, depends as stressed above not only on hardware design (described above) but also on the particular manner in which the service is delivered to users. In this area as well, however, Jhunjhunwala [2] has argued that there is much that can be done to reduce costs and he points to the cable television industry in India as a model of what can be achieved. More specifically he argues that much of the rapid growth in this industry in recent years can be ascribed to the organiza-tional model it has adopted and the role of the informal sector in the delivery process. A he himself puts it, "There are not many areas of activity where rapid growth has taken place in India in recent times. Cable TV is however as exception. From zero in 1992, the number of cable TV connections today is believed to have grown to over 50 million." [2]. Part of the reason for this exceptional experience has to do with the use of second hand, black and white, as opposed to new colour televisions. For, while the latter may cost as much as Rs 15,000 the former are available in rural India at a price of just Rs 1200.

> The second reason for this rapid growth is the nature of the organisation that delivers this service. Cable TV operators are small entrepreneurs (at least when they start providing service). They put up a dish antenna and string cables on poles and trees to provide service in a radius of 1 km. The operator goes to each house to sell the service and collects the bill every month. He/she is available even on Sunday evening if any repair is needed. This level of accountability has resulted in less-trained people providing better service using a far more complex technology, than that used by better-trained technicians handling relatively simple

telephone wiring. However, what is even more important is that such a small-scale entrepreneur incurs a manpower cost several times lower than that in the organised sector. Such lower costs have been passed on to subscribers making cable TV affordable [2].

Before describing in the next section how the informal sector is used in the specific context of the n-Logue project, it is well to emphasize here that other Indian institutions have also begun to recognize the value of this sector in delivering information technology services to remote areas of the country. Consider, for example, the 'e-Post' initiative of the Department of Posts, which enables customers to hand a postal worker a message destined for an ordinary 'snail mail' address. The message is then typed and e-mailed to the post office nearest the recipient, where it is printed out, placed in an envelope and delivered by courier, who, presumably is paid a relatively low wage for his participation in the service (which costs US$0.2 per message of A4 size) [14].

5.1. A decentralized model of internet delivery

As noted above, n-Logue has been inspired by the rapid growth of the Indian cable television system. In particular, a recent article by Howard et al. [15] suggest that the firm

aims to utilize the plentiful labor available in emerging markets and the relationship-based selling that has been successful in drawing in local subscriber bases. The Indian cable industry grew from non-existence to 40 million subscribers over 8 years due, in large part, to the *power of local operators*. Operators employ direct sales, billing and collection techniques to establish and retain a customer base. By remaining continuously on-call for customers, *operators develop personal relationships and loyalty with subscribers*. Because it recognizes that push marketing does not work for dispersed markets with tight capital constraints, n-Logue imitates this decentralized, scalable model (emphasis added).

In fact, the decentralized delivery model adopted by n-Logue has two basic components, both of which reflect the general descriptions that have just been cited. The first component consists of a franchise relationship with a Local Service Partner (LSP) in every area where the firm operates. "The LSP works with n-Logue to set up an access center or node around which individual kiosk operators will be connected. Each access center caters to around 500–1000 customers in a radius of 25 km (around 2000 sq. km). The LSP provides a connection in every small town or village in that area employing marketing strategies to draw in kiosk owners" [15]. The local entrepreneurs thus recruited to establish kiosk franchises at the village level, offer Internet and telephone access to the village population.

Through the LSP, n-Logue offers low-priced 'kiosk packages' consisting of a subscriber wall set (that connects the kiosk to the access center), a computer,

printer and backup battery. The kiosks essentially function as combination rural Internet cafes and pay phone booths. While n-Logue provides kiosk owners with training, support, and technical assistance, local franchise owners themselves are responsible for developing additional product and service offerings (eq. computer courses) and marketing strategies [15].

The freedom and flexibility thus afforded to the local entrepreneurs appears to be crucial to the viability of the entire model. For it is on the local knowledge and innovatory capabilities of these small-scale entrepreneurs that the attractiveness of the service to local consumers heavily relies.
In particular,

Allowing kiosk operators to develop their own business strategies has resulted in locally appropriate solutions and new offerings difficult to develop within a centralized business structure. In some villages, operators rent DVDs of movies for $0.50 and screen them in their kiosks, earning $4.50. Others have provided computer instruction courses or created music CDs for sale [15].

In yet other cases, kiosk owners are known to offer classes not only on basic e-mail and Internet use but also more advanced software instruction. The main point, therefore, and the one that needs to be emphasized, is that because this type of distribution system fits much more naturally with what is already available at the village level, the possibility of a more widespread distribution of the Internet is considerably enhanced (in comparison with the usual Western model). Another important lesson, arguably, is that the vast appropriate technology movement of the 1970s and 1980s, failed to achieve as much as was hoped, partly because it focused too heavily on the nature of the actual machinery and too little on the appropriateness of the institutions through which the technology was to be disseminated to isolated, rural areas of developing countries.

6. Conclusions

There is certainly neither shortage of projects demonstrating that the Internet can be supplied to rural areas in developing countries, nor is it difficult to show that the benefits thus provided can be substantial even to those with relatively low incomes. The problem, however, is with the sustainability and replicability of such projects. If, that is to say, these ventures are to be replicated on a large scale in a poor country they will need ultimately to be commercially viable. This in turn, however, means that the price of Internet access has to be low enough to be affordable at low-income levels and yet high enough to yield a profit to potential suppliers. And assuming, as one reasonably can in the short to medium term, that income levels of the lower deciles of the population will not rise dramatically, this gap between demand and supply (or costs) will need to be borne by reductions in the latter.
Even with the cost reductions effected by supplying the Internet to communities

rather than to individuals, however, it is doubtful that project sustainability and replicability can be achieved in poorer developing countries such as India (that is to say, with no other deliberate efforts to reduce the costs of access). To this extent, therefore, other modes of cost reduction need to be invoked and it is to these that the paper has mainly devoted itself. Rather than discuss such possibilities in the abstract, we have chosen instead to focus on one particular endeavour that is currently taking place in India, which, under the aegis of a local firm called n-Logue Communications, represents a potentially effective existing approach to providing Internet to rural areas and small towns on a sustainable basis. On the basis of numerous innovations affecting the hardware of information technology, as well as a simple but effective organizational model, this firm has managed to reduce costs to the point where, in the form of an Internet kiosk costing some US$800, it is possible to provide the owner with a reasonable return (of Rs 3000 net per month) and Internet access in a village for Rs 15/20 per h. Exactly how far and how fast the n-Logue model will spread across rural India is difficult to estimate at this point. What can be said, however, is that progress so far has been encouraging, with some 300 odd villages already involved in the scheme, a number which are expected to rise to between 1000 and 1500 by 2002. Much will depend on the attractiveness to rural Indians of the services that Internet connectivity can provide. Possible benefits include making more informed economic decisions, finding the best prices for farm products, searching for job opportunities or negotiating daily wages more effectively. Furthermore, "intranet classifieds provide an online market for used equipment and products" [15].[4]

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