Community Internet Access in Rural Areas: Solving the Economic Sustainability Puzzle

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Introduction

Telecommunications companies, entrepreneurs, and policymakers have regarded rural and poor markets with some combination of too-complex-to-serve and not-interesting-enough (politically or economically) to be worthy of sustained attention. But times—and technologies—have changed, leaving what have been perceived as backwaters poised to become significant growth areas in the next decades.

Stakeholders are beginning to recognize the political and economic significance of the more than half of the world's population that lives in largely untapped rural markets. Governments and nongovernmental organizations are increasingly concerned with addressing economic development goals and stability, stubborn deficits in rural health and learning, urban migration, environmental degradation, and other related trends. The private sector craves new consumers, producers, ideas, and synergies in our rapidly globalizing environment. What most have yet to understand, however, are the tremendous opportunities to address these challenges through new information and information communication technologies (ICTs). Increasingly powerful, flexible, and economical, ICTs present staggering new opportunities for social and economic integration. Achieving the promise of ICTs does not require sacrifice on the part of business, government, or civil society, but it does demand their vision, cooperation, and action to create the environment and mechanisms necessary for ICTs to flourish in the rural areas of the developing world.

One force necessary—albeit insufficient—for the establishment of pervasive and sustainable readiness for the Networked World, especially in developing and rural areas, is the *market*. It is commonly assumed that effective rural ICT access requires economic subsidy and financial loss; however, ICTs should be economically viable if they are to gain wide, robust, and long-lived usage. While the path to realizing such economics will vary across countries, settings, cultures, and technologies, we consider one critical issue: Internet for rural regions of developing nations.

In researching and studying the economic self-sustainability of the Internet in rural areas (particularly in India), we have identified some criteria for success—something of a laundry list. This list suggests that there are at least six broad categories[1]

Figure 1: **Nature and Level of Interactivity Between Factors Affecting Rural Internet Sustainability**

	Costs	Revenue	Networks	Business Models	Policy
Capacity	LOW: Unless access to computer maintenance is limited	HIGH: Business, IT and outreach skills key for new industry	MEDIUM: More users ease awareness raising and training	MED/HI: Capacity suggests limits of model	MED/HI: Education, training opportunities
Policy	HIGH: Competition, taxes and tariffs, requirements for entry, spectrum, interconnection	HIGH: VoIP alone is significant	MEDIUM: Policy broadly affects Readiness, users become political constituency	HIGH: Decides potential for RSP and franchisees, public sector as network client	
Business Models	MEDIUM: Appropriate models reduce costs	LOW: Location guides clientele and applications	LOW: Little direct connection		
Networks	HIGH: Metcalfe Effect costly to leverage (or else it would be done), scale economies grow with network size	HIGH: Size and scope drive content, utility of medium			
Revenue	LOW: Except specialized services requiring extra investment (copier, camera), assuming always on connection				

Source: Information Technologies Group, Center for International Development at Harvard

that must be considered for economic self-sustainability: costs, revenue, networks, business models, policy, and capacity. The groupings are imperfect due to the interrelationship and interdependence among categories, which make consideration of any one category ineffective. A more accurate way to think of the categories might be to imagine them as a balloon, which when pushed in one area, bulges in others. For instance, policy will affect cost, which in turn influences business models and therefore revenue and on down the line; this leads us to the not-so-profound conclusion that everything affects everything else.

In Figure 1 we have artificially isolated the relationships between some of the diverse factors affecting economic sustainability for rural Internet, but it should be noted only when the system is taken as a whole can we describe it accurately. We are only beginning to understand the complex nature of these relationships, but have attempted to suggest the level of interaction and provide an indication of the type of effects we might expect to see.

One important assumption underlying many issues in the effort to achieve self-sustainable Internet service is that, in a poor rural setting, the Internet is likely for some time to be delivered as a community resource, rather than a personal one. In other words, rather than each individual having a network-enabled digital appliance for himself or herself, each village or community might have shared resources that are financially sustained through some combination of user fees and outside revenue. This basic model is often realized through some form of community access point for information and communications services, often known as a community telecenter or telekiosk.[2] While community computer facilities (also known as shared models) are discussed most directly in the business models section below, their basic structure and resource needs underlie many of the arguments made here. This paper gives primary consideration to existing models, but telecenters will certainly evolve in the coming years to include mobile and wireless access via handheld devices, thus offering a new set of opportunities to enhance sustainability and value. The shared model has been applied to ICTs in recent times and to other resources in the past, and we feel that, in many settings, it is not only financially appropriate, but also culturally acceptable.

Telecenters in the developing world have, thus far, been primarily sponsored and undertaken by governments, multilateral institutions, and nonprofits. Because of the desire to create what is essentially a public good (access to information and communications services), only secondary attention has been paid to entrepreneurism and sustainable business. There have been significant achievements under challenging circum-

stances, but generally we have been better at learning about and making mistakes with telecenters than we have been at creating economically sustainable models and universal access to ICT in rural areas. While we agree that access to ICTs is important and that it can, and should be, supported by the international development community, we suggest that collective support for it should come in new forms that focus more on enabling others, rather than on sustaining them. We also suggest that the private sector, from large corporations to grass roots entrepreneurs, has the most significant role in creating and broadening effective use of ICT.

This paper offers early thoughts on some of the challenges policymakers, the private sector, the international development community, and others face in unleashing the power of markets to better serve information and communication needs in rural and poor areas. It is our firm belief that the diverse interests of all the stakeholder groups converge around sustainable rural ICT, and that a market approach driven by the private sector and entrepreneurs is the fastest and most efficient way to include rural communities of developing nations in the Networked World.

Keeping Costs Low

It goes without saying that one of the keys to achieving economic self-sustainability is keeping capital and recurrent costs low. Capital costs include hardware, software (if purchased), network equipment, the physical premises, setup license and connection fees, and the like. Recurrent costs lie mostly with Internet and telephone usage fees, electric power, rent, maintenance and repair, and salaries.

Reducing capital costs with new devices and wireless

At present, the most significant capital costs in offering community Internet are for hardware and network access equipment.

A range of low cost Internet-enabled digital appliances have been developed, and these can be far cheaper, and indeed, better adapted to the developing world context in their form and function, than traditional desktop computers. While they remain the dominant access device, personal computers (PCs) are inappropriate for the developing world across many dimensions, due to relatively high cost, low reliability, unsuitable user interface, environmental sensitivity, and high power consumption. Handheld appliances such as the Simputer (http://www.simputer.org) or Pengachu (http://www.media.mit.edu/~rehmi/pengachu/v3_ document.htm) have shown that network-enabled computers can today be priced at under US$300. Longer-term research, at the Massachusetts Institute of Technology (MIT) Media Laboratory and elsewhere, prices next generation appliances at dollars or even pennies.

Additional high fixed costs are due to the network infrastructure. Connections achieved via the public switched telephone network (PSTN) often carry high fixed costs.[3] Both fixed and mobile wireless technologies fundamentally change cost structure because they reduce the time, effort, and expense of last mile service delivery, which typically comprises the majority of all infrastructure costs.[4] Moreover, wireless allows new entrants to compete against incumbent providers with their own facilities, and the operator has an increased incentive to maximize the number of users because the marginal cost for each additional user is lower than with wireline networks.

New low-cost network technologies are fundamentally rewriting equations of economic self-sustainability for rural Internet connectivity. Those rural communities within microwave radio reach of existing fiber optic cable links can effectively make use of Wireless Local Loop (WLL) last mile solutions (Kibati and Krairit 1999). At today's price of under US$300 per subscriber line, WLL solutions such as the corDECT technology can provide both telephone and Internet connectivity up to 10 km away from the base station, and 25 km from a relay base station. The corDECT system is engineered primarily for low price, rather than added (and often unnecessary) features, and is therefore designed for developing world needs. The system offers 35.5/70 Kbps simultaneous voice/data transmission (http://www.tenet.res.in).

For rural communities too distant from fiber backbones or in terrain too rough for the line of sight required between terrestrial microwave antennas, Very Small Aperture Terminal (VSAT) satellite is a common approach for connectivity. Today's prices for send/receive units range from about US$4,000[5] to over US$10,000, thus making this approach inappropriate for many poor or small communities.

VHF or UHF wireless solutions are a potentially compelling option for narrowband connectivity that can also function in remote and rough terrain (e.g., see http://www.arrownetworks.net), or relatively depopulated, settings. These can cost under US$800 per subscriber line, transmit over 200 km distances, and provide upwards of 9.6 Kbps connectivity.

Using appropriate technologies to reduce recurrent costs

The main factors contributing to recurrent costs include telephone, Internet access, power, and personnel costs. These costs are primarily related to issues of government policy and competitive environments, and we will only address them to the extent that they directly affect economic sustainability.

Telephone toll charges can make up a heavy percentage of recurrent costs if a regular telephone call is necessary to connect to the Internet, particularly given the prevalence of time-metered calling and Internet Service Providers (ISP) that require long-distance calls. Telephone and Internet access technologies that separate voice and data, such as the corDECT system, can reduce costs by handing voice off to the PSTN while switching data directly to an ISP (Jhunjhunwala 2000). Such a simple techno-

logical accommodation that does not bill Internet access as a phone call can allow substantial savings in telephone toll charges, and does so in the absence of a policy decision that bills Internet at a different rate or offers flat rate calling.

Research suggests that for both power and Internet charges, costs for solar photovoltaic (PV) power and wireless connectivity will incur lower recurrent operating costs as compared to grid power sources and wireline connectivity. Indeed, when amortized over a period of years, the savings in operating costs will make up for the added capital costs (Best et al. 2001). In other words, being off the electricity grid does not necessarily imply higher net present valuation. Moreover, due to the fact that grid power is commonly unreliable in the developing world, backup power supplies and batteries imply additional costs and frustration that can be reduced under systems such as solar PV. It should be noted that alternative energy supplies may have implications for related electrical infrastructure, such as air conditioning or photocopiers.

More compelling than PV power or other renewable sources, however, are new advances in very low-power consuming digital appliances. The Pengachu device, mentioned above, consumes roughly 50mW of power, and has been fitted with a hand winder that can provide all of its power needs. Similar to the well-known wind-up radio (http://windupradio.com/freeplay3.htm), wind-up Internet appliances are genuine technological options.

Finally, in an assessment of rural Internet services for Tamil Nadu in India, McKinsey & Company-Delhi (Davies et al. 2001) has argued that recurrent costs can be reduced by 30 percent in rent, electric power, and salaries if the service is provided within an existing business. Commonly observed examples include telephone call centers, temples, small grocery stores, schools, post offices, and government offices.

Depending on the local labor market, availability and competitive remuneration for qualified employees varies widely. One commonly observed strategy for telecenters is to hire secondary and tertiary students at low wages to serve as facilitators and perform other tasks such as repair and research, and to make the position more appealing by offering free Internet access.

Summary

With today's technologies, a village in India can be brought online and provisioned with Internet, telephone service, a computer, and so on, for under US$1,000 in capital costs and with ongoing recurrent costs approaching US$60 per month (Davies et al. 2001). It is likely that these figures can be reduced by an order of magnitude over the next decade. It goes without saying, however, that costs are intimately related with other aspects of the community and business model, including culture, geography, population density, services, technologies, and other factors, and that their interaction will dictate observed cost.

Generating Revenue from Diverse Fees and Services

If equipment, connections, rent, and salaries, are the economic pains needed to offer rural Internet service, user fees for applications and remote services, and income resulting from the aggregation of many users are the economic gains. Given that the technology components and public access business model is essentially a platform capable of facilitating a wide range of activities, more applications and content will allow revenue generation from a greater variety of sources and effectively lower the level of income necessary for the sustainability of each unique application. There will also be associated benefits arising from the wider and deeper integration of the telecenter and ICTs within the community, as suggested in Chapter 7 by Eggleston, Jensen and Zeckhauser.

User fees are particularly difficult to generate in some cases, but as we will later suggest, they are not the only source of income. User fees, however, yield other benefits besides the generation of financial support; they also ensure economical use of the infrastructure and offer a market incentive and feedback for content, applications, and services that are appropriate to the users in that community. User fees generate challenges, however. We note that a market mechanism may lead to externalities that some consider negative, including the development and diffusion of games, adult content, and other potentially controversial applications. It may result in unequal access for different members of the community, such as children and (particularly) poor people, who may require subsidies or discounts to address their needs effectively.

We believe that there are three main classes of revenue production for rural Internet services. First is fee-for-services such as core communications, education, commerce, government applications, entertainment, training, and so forth. Second is a variety of remote services and back office activities. Finally, the aggregation of services and users provide opportunities for revenue (described below).

Focusing first on core communication applications

Core communication services are the *killer applications,* acting as a pathway to other uses of information and communication technology. This was true in the nations of the Organisation for Economic Co-operation and Development (OECD) and in urban areas, and it will be true in the rural South. In other words, the core revenue generators are information systems that connect people to each other despite barriers of time, distance, written literacy, and ownership of a telephone or computer.

Synchronous and asynchronous text and voice services such as e-mail, voice mail, chat, and Voice over Internet Protocol (Internet telephony or VoIP) are particularly relevant in many developing world contexts. This is due to commonly observed

characteristics such as high call charges (relative to both income levels and comparable rates in the OECD), high rates of national and international migration, weak postal systems, and limited direct access to communications devices (i.e., like a telephone in the home). With public Internet access sometimes costing less per hour than a local telephone call (and much less than the exorbitant long distance rates), e-mail, chat, voice mail, and VoIP are appealing cost savings measures. In Peru, for instance, rates for public Internet access are often less than US$0.50 per hour, while telephone card rates for local calls are approximately US$0.60 per hour; long distance costs US$0.80 per minute and upwards, as compared to less than US$0.20 for VoIP calls. Note that VoIP is illegal in many countries (more information in the policy section.)

These text and voice services have been shown to be strong revenue sources for those providing access to Internet services in rural areas. In rural Bangladesh, for instance, International Telecommunications Union (ITU) models argue that *not less* than 1.5 percent of Gross Domestic Product (GDP) per capita will be spent on core communication services (Kayani and Dymond 1997), while estimates for India suggest communications spending of up to 5 to 6 percent of GDP per capita (Jhunjhunwala 2001). Early Internet trends in Bangladesh show that 82 percent of the online traffic is going to e-mail. Thus, in Bangladesh, there is both the demand and willingness to pay for communication services and these services seem to comprise the majority of Internet usage. Moreover, in the previously cited McKinsey (2001) study, a survey of cybercafés in urban India has shown that upwards of 50 percent of usage time is spent on e-mail and in chat rooms. As trends toward increased labor mobility continue and agricultural production becomes more linked to urban markets, rural "organic communication networks" (Heeks 1999) and and their communication demands will only expand further.

Communication is both a core desire of most communities and a relatively straightforward process to support with the use of ICTs. Whereas, for instance, designing a Web interface to manage a supply chain and integrate it into business can be quite complex, voice and text communications applications, being fairly simple and requiring minimal localization, can quickly begin running in communities.

While many applications are already available, additional innovations in core communication applications are required if user demands in rural areas are to be fully satisfied. The MIT Media Lab, for instance, has been exploring new multiliterate keyboardless systems that support threaded voice discussion for new VoIP systems particularly suited for rural areas in developing countries. These new technologies, and business models to deliver them, are designed to flourish in rural developing areas by fulfilling the unique needs of their communities and networks.

Promoting gradual growth of other revenue sources

In our estimation, at least 50 percent (and possibly much more in the early stages of connectivity) of revenue from user fees for rural Internet services will arise from the provision of core communication services. These services will enable people to better address their basic needs to communicate with family, with remote trading partners, with their government or others. E-commerce, e-government, entertainment, education, and health show promise for additional specific applications and services that reach beyond basic communication. We will now discuss these areas only to evaluate how they might provide additional services based on user fees.

E-commerce for rural developing areas has often been seen as a problem of porting the existing e-commerce models of the OECD, framed by concepts such as "B2B," electronic payment systems, and so on. Just as *konbini*, the Japanese convenience store, recognized the opportunity to allow consumers without credit cards to order online and pay upon delivery, we argue that e-commerce needs to be newly conceptualized for this new context. E-commerce environments must offer different services and employ alternative delivery and exchange mechanisms**,** and they must provide relevant and worthwhile support to the agricultural, informal, and micro- and small business sectors. Private sector groups are also interested in other potential commercial applications including insurance sales, remittance transmission, and other financial services. These groups pursue their goals in the face of subsistence economies, little access to capital, no credit cards, and the absence of effective tools for consumer protection and dispute resolution.

The case of agribusiness and agricultural management support systems has been given considerable attention in the ICT and development community. And indeed, there appears to be scope for agricultural services based on user-fees (in addition to aggregation approaches as defined below). However, although market price information for the agricultural sector is often touted as a substantial value addition of rural Internet services, the promise and economic self-sustainability of such a service has recently been called into question (Aral et al. 2001). Market prices can be valuable, but their importance will depend on other community characteristics including availability of transport, credit, and alternative markets.

E-government services can also support economic self-sustainability via user fees (in addition to aggregation approaches discussed below). In the Gyandoot project of Dhar district, India (http://gyandoot.nic.in/), a collection of telekiosks run by local operators offer e-government services to consumer-citizens. A study of one such telekiosk showed that the grievance system, a facility for citizens to lodge complaints against the government with a guaranteed response within one week, was the third most popular information service of the program. (The most sought-after information was around market prices and job availability.)

Entertainment, as it relates to rural Internet service, is a fundamental application area that has not been sufficiently studied. One indicator of the power of entertainment content, however, is the penetration of cable television into rural India.[6] In India there are roughly 32 million cable television subscribers as compared, for instance, to 26 million fixed telephone subscribers. In rural India there are at least 10.5 million cable subscribers, making up 32.5 percent of the country's total subscription base and 8 percent of all rural households (note that it is possible that the total number of subscribers is underestimated by up to 50 percent). Small, independently operated businesses provide cable television in rural villages at a cost of only dollars per month. Clearly, rural cable TV is economically self-sustainable, indeed is flourishing, given the large demand and willingness to pay for entertainment products in rural and poor India, and the reasonably low costs. Furthermore, the entire existing cable network was rolled out in less than a decade.

Education and health are critical application areas if the Internet is to directly address core development objectives in rural areas, and they also can help with economic self-sustainability through powerful public-private collaborations. The World Links project (http://www.world-links.org/), for instance, has been developing an after-school community telecenter program in Uganda. Under this program, schools in rural Uganda that are equipped with computer labs and VSAT-based Internet connections are opening up their labs to outside clients in the afternoons and evenings on a cost-recovery basis. Funds are then used to cross-subsidize daytime educational use. In other words, educational use of the Internet has become economically self-sustaining by leveraging the existing school infrastructure, all the while allowing the surrounding community to benefit from ICTs; the outside community, in turn, supports the educational mission of the computer laboratory. Similar creative partnerships with rural health clinics have been envisioned.

Furthermore, delivery of training, in particular computer training, is increasingly in high demand for rural Internet centers. NIIT, a multinational computer training and service corporation, has franchised five hundred thirty rural ICT training facilities situated in villages throughout India. These facilities offer mostly basic and short-term training in computer literacy, Microsoft products, and so forth. These rural ICT training facilities educate forty to fifty students per year in small laboratories, and are operating as financially viable businesses.

Creating jobs and revenue with remote ICT-enabled services

A variety of remote services and back office activities may be performed anywhere and delivered anywhere, given adequate Internet connectivity and available people with the relevant communications capacity (primarily literacy in the appropriate language) and skill set (ranging widely from accounting to medicine to ICT problem solving).

Spryance, an India-based remote services company with headquarters in the United States, has developed a pioneering home and rural medical transcription program that allows people with an adequate connection to the Internet in any part of the globe, to participate in the knowledge economy. Spryance employees, mostly women, work out of their own homes, providing transcription services over the Internet. The program has been growing at a rate of 25 percent per month over the last year and average earnings are more than twice those of comparable "factory-style" environments. While the home-based workforce program started mostly in metropolitan areas, it continues to expand into submetropolitan and rural areas.

Summary

This diverse range of activities and interactions allows the telecenter to become a hub for the rural community; serving existing needs while creating additional business opportunities including ICT training, photograph printing, Web design, computer repair services, research services for businesses and students, book selling, or serving as a shipping location.

Benefiting from Network Effects, Scope, and Scale

A variety of network effects will drive economic self-sustainability of rural Internet. The number of Internet users overall, and particularly those in rural areas and developing nations, are an important factor in its sustainability—not only because they will pay user fees, but because of their effect on others. That is, each additional user increases the value of the network to all other users quadratically, offering more opportunities for interaction, seeding incentives for content, and service creation, all the while sharing the infrastructure cost burden more broadly.

Aggregating markets and leveraging the Metcalfe Effect

Bob Metcalfe, inventor of the Ethernet, has identified a critical type of network effect which now bears his name. The Metcalfe Effect (or "law" [Gilder 2000]) argues that the value of any complete network such as the Internet (where all things connected to the network have access to all other things) grows with the square of the number of users, as opposed to a simple linear growth.[7] Put simply, the Metcalfe Effect tells us two things. One is that the value of the Internet grows very quickly with the number of users, but, conversely, the value of the network is quite small when there are a small number of users connected.

The Metcalfe Effect suggests that the value to users, and thus self-sustaining demand for the network, will only be substantial when a sufficient number of interrelated groups are connected. As long as rural Internet connections are left to isolated pilot projects or small scale efforts—one here and one

there—they will never leverage the Metcalfe Effect and the real value of the Internet. When entire rural regions are networked, so as to connect communities to their neighbors, families, friends, governments, markets, and intermediaries, regardless of where they are, true value can be delivered.

In addition to creating value for users, this aggregation of users, their needs, and the integration of their markets, provides another attractive source of revenue. Much as a magazine becomes increasingly interesting to advertisers and contributing writers as its circulation rises, even a rural user community becomes a viable market for outside organizations, in the public, private, and nonprofit sectors. Prahalad and Hart (1999) have shown that fast-moving consumer goods (FMCGs) manufacturers can gain a great deal by attending to rural, poor markets previously thought to provide no opportunity. Because reaching these consumers can be challenging, Indian firms, such as detergent makers Nirma and Hindustan Lever, are interested in and willing to pay for enhanced access to those populations via the Internet.

Agricultural firms are similarly interested. EID Parry is an Indian firm that manufactures and markets fertilizer, among other activities, and has been providing Internet kiosks to their sugar farmer customers in Nellikuppam, in rural Tamil Nadu. These facilities help EID Parry reach out to local growers, offering them technical assistance and information (currently in the form of an online portal), developing new sales opportunities, and providing logistical support and credit services. Their online Cane Management System, which offers farmers a personalized account, including details on their fertilizer needs, outstanding credit to EID Parry, acreage, and so forth, has proven to be their most popular service.

Thus, fee-for-service on applications is not the only possible revenue model for the Internet in rural areas. Access to users can be provided for a fee to outside businesses, while respecting privacy and protecting communities. Agricultural companies, FMCG companies, the government, NGOs, and the like, all have an interest in these aggregations. But the value comes only when enough members of the target community and enough communities are aggregated.

Returning to the magazine analogy, increased circulation, prestige, and certain demographics will motivate contributors. By the same token, a sufficiently attractive userbase can also offer an incentive for content to be generated and applications designed for them, thus potentially creating additional value and revenues for telekiosks.

Exploiting economies of scale and scope

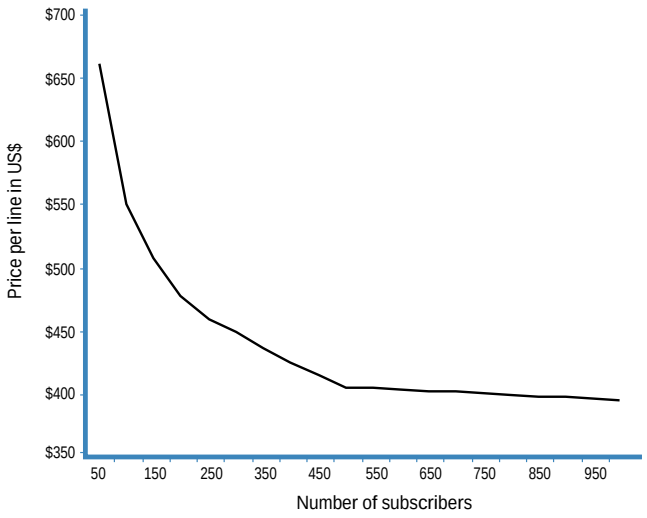
Rural Internet services clearly enjoy certain economies of scale and scope: significant numbers of users lower production and distribution costs, and awareness and breadth of use offer increasing returns. This suggests that while some small, boutique telecenters may be able to realize economic self-sustainability, most will be hard-pressed to leverage any economies and will suffer from higher costs and less content.

As PCs become more and more like commodities and profit margins go towards zero, economies of scale associated with purchasing PC hardware begin to vanish. (Most scale economies are built into the price to begin with.) However, infrastructure, particularly for the Internet, benefits significantly from economies of scale. For satellite-based connectivity, savings are realized in particular when scale is achieved in the space segment (i.e., the use of transponder space on the orbiting satellites). Here also, however, such scale economies are diminishing as new technologies and business models support smaller deployments (Lusignan 1999).

For terrestrial systems, economies of scale are enjoyed as the number of subscribers increase per radio access tower erected, or copper or fiber cable laid. The corDECT system, a Wireless Local Loop (WLL) technology manufactured by the Midas Corporation, is an example that demonstrates these scale economies.

In Figure 2 we see that the price, in U.S. dollars, per subscriber for the corDECT WLL system plummets as the number of subscribers increases.

Figure 2: **Price per Subscriber for the corDECT Wireless Local Loop System**



Source: Midas Communications Technologies Private Limited, "CorDECT Wireless Access System," December 2000

Economies of scope allow revenues and risks to be spread over a variety of potential sources. One of the strengths of the community computer center model is that it easily allows for such economies of scope. The costs for power, rent, salaries, and so

forth are all shared across a variety of services, such as entertainment and communication. The cost to the operator to deliver each additional service approaches zero, yet it may attract additional users. As service offerings become more diverse and context-appropriate, use becomes more intensive, and as more users within that society access these services, the need for educating new users decreases, while risks of offering service are distributed more widely across the community.

Designing context-appropriate business models

The creation and implementation of innovative business models that are low cost, dynamic, and responsive to local needs in their delivery of ICTs is at the core of achieving economic viability and creating value for the community. As mentioned in the introduction, economic self-sustainability of the Internet in rural areas over the next few years will depend on one key business decision: making facilities shared, rather than focusing on individual use. For instance, Internet services and facilities are provided at multipurpose community telecenters or telekiosks. These facilities aggregate the demand of an entire rural community, take advantage of economies of scope, and can be situated in existing structures (e.g., temples, schools, government offices, and small markets), thus reducing recurrent costs, while increasing traffic and helping to integrate the facility into the social fabric of the community.

Creating rural service providers

We have been working with Professor Ashok Jhunjhunwala of IIT-Madras (inspired by his original work with Bhaskar Ramamurthi) to develop local Internet and telephone business models in rural India that are small, entrepreneurial, and leverage the informal sector, while also achieving economies of scale and scope. These businesses will look very much like the Indian rural cable television operators described earlier. In this business format, a local entrepreneur is able to quickly and inexpensively receive a license as a Rural Service Provider (RSP). Such providers can offer computer applications, Internet services, and basic telephone services through public access centers (which are effectively franchises) and private connections, and use some combination of WLL, fiber, VSAT, or other technologies to connect to networks operated by an ISP and/or other telecommunications companies. The RSP license would require fair and equitable revenue sharing between the rural provider and a major formal-sector basic service operator such as the incumbent voice provider.

The RSP business model allows small and informal-sector enterprises, operating with extremely favorable cost structures and committed to providing high levels of local service, to offer very economical rural ICT services via telecenters. The combination of the entrepreneur's flat cost structure, service commitment, and understanding of the local market, together with other like entrepreneurs or RSPs who can offer the aforementioned benefits of scope and scale is at the core of this model.[8]

It is also significant that the RSP model will be able to help governments and telecommunications companies achieve universal access by offering voice telephony in rural areas at a cost and level of service that is currently unachievable in many communities. Indeed, many incumbents require or request subsidies to serve these markets, thus squandering scarce resources and opportunities for smaller and local entrepreneurs, and often leading to poor service at a high cost with questionable economic sustainability.

Adding telecenters to existing businesses

Combining telekiosks with existing organizations can indeed lower recurrent costs while sharing capital costs across more users and services. In the case of a school (exemplified by the World Links example described earlier), an administration may offer the computer lab for community use in the school's off hours, thus ensuring more effective use of infrastructure and resources and generating revenues to help pay recurrent costs. Alternatively, an operator may sell blocks of time, instruction, or services in her cybercafé to local institutions such as schools, businesses, and hospitals. These institutions have better resources than individual families, and they can thus be used as a sort of anchor tenant, allowing the establishment of a base level of income in the café while providing a valuable service to the community.

As part of the Schools Program in Tamil Nadu, the government issued a tender to private companies to create computer labs and offer instruction in all twelve hundred public higher secondary schools. Private operators retained ownership of the equipment (and responsibility for its functioning) and were able to supplement the state fees by using the facilities to generate additional revenue outside of nonschool hours (http://www.elcot.com).

Adding businesses to telecenters

Telecenters will also improve viability by delivering an extended suite of services relevant to the community, depending on the available information infrastructure and human capital. In other words, in addition to providing online access to information and communications, they may also offer ICT training, business center services, computer repair, Web design, and back office services such as accounting. The basic premise is that their capacity, both technical and human, should be leveraged fully in order to best use these resources. Capital goods, such as hardware, quickly depreciate, some or all Internet costs are fixed, and employees must be paid regardless of their work level; savvy business owners will, therefore, seek ways to keep their workers and equipment fully employed. Full employment will not only generate additional revenue, but also gradually

may help move the business and its capabilities up the value chain. At a community level, the range of services offered creates greater acceptance of ICTs and further embeds them within the social and business culture.

Promoting rural-urban cooperation

Relationships with organizations from outside the community, whether by formal business ties, investment, or grants, can play important roles in financial viability. Private sector supply-side participation is a key component for entrepreneurs' access to capital, equipment, networks, applications, and expertise.[9] Likewise, developing this cooperation improves access to previously hard-to-reach rural markets for these organizations, allowing them to serve new consumers, build networks, and create new economies of scale and scope.

Guarding against potential negative externalities

As with any business, other factors affect the success of the business approaches discussed above, including location, marketing/awareness, and staff composition. These considerations present potential dilemmas from a development perspective, because there may be a tendency to locate facilities in wealthier areas, advertise in the language and location of certain consumer groups, or create an atmosphere that is unwelcoming to particular members of the society. One important safeguard against business owners taking this approach is a genuine potential for competition, which may make them more inclined to maximize their market share. Varied regional experiences and limited relevant data do not allow us to suggest a systemic solution. It is important for development organizations and government to remain vigilant in order to stem increased disparities in access to ICT.

Supporting Rural Access with Policy

Shared access models have been able to operate in many different regulatory environments (sometimes illegally), but have depended on flexibility to address market needs within the existing framework, regardless of whether the framework appeared welcoming. Telecenters exist where there is a state-owned monopoly provider and where there is complete openness and competition. They offer VoIP when they are able, and chat and e-mail when they are not.

The telecommunications policy and regulatory framework as well as the overarching business environment present key opportunities for, and challenges to, rural ICT provision in general, and the telecenter model in particular. These factors affect everything from investment in infrastructure to availability of capital, and directly and indirectly dictate the range and profitability of services. As suggested by Beardsley et al. in Chapter 11 of this report, a government will determine its particular mixture of regulatory policy according to its ICT objectives (i.e., to deepen universal access, increase government proceeds, raise Networked Readiness). We will not enter into a detailed description of the regulatory and business environments here, but will mention some of the significant aspects with direct implications for telecenter operators, RSPs, and similar businesses.

Adapting to dynamics of rural markets and limited competition

The number and nature of the participants in the telecommunications industry affect costs, speed, and service quality and have substantial financial and business model implications for providers. Generally speaking, competitive environments and multiple backbone providers will offer lower costs and higher service quality and range, and be more inclined to create and adapt to a dynamic communications environment.

Large telecommunications companies are attracted to large urban areas, and are reluctant to enter smaller and rural markets where they are less profitable and often lose money. Governments have required and cajoled them to serve these areas through a combination of service requirements and subsidies, but have had limited success in creating competitive rural markets. In much of the developing world, rural access remains limited in scope, consistency, and quality. New entrants typically give priority to the lucrative urban markets, and may meet rural service requirements with infrastructure that is insufficient for effective Internet access.

While Peru's fixed line telephony market is officially liberalized, for instance, incumbent Telefónica del Perú offers the only wireline service outside Lima. Monthly rates for leased lines to telecenters are US$560 for 64 Kbps and US$780 for 128 Kbps, and many operators complain about bottlenecks, delivery at much lower speeds, and slow response to problems. Informal surveys suggest that telecenters in Lima, where there are multiple service providers, were more likely to lease faster connections (128 and 256 Kbps rather than 64 or 128 Kbps), and pay lower rates (US$350, US$620, and US$1,200 for 64, 128, or 256 Kbps, respectively). Some operators outside Lima reported that they were reluctant to switch to satellite service, fearing that it would be inadequate for the needs of their business and that, upon returning to the incumbent, the operators outside would be punished. The results are that line costs comprise nearly half of spending for most telecenters in smaller cities, and that the increasing commoditization of Internet access means service problems result in not only lost business, but also lost customers.

Some Indian private sector Basic Services Operators (BSO) are experimenting with variations of the aforementioned RSP model because of government requirements to serve entire Indian states, including rural areas. By effectively subcontracting a smaller company with a flatter cost structure to deliver service in these less appealing markets, the private sector BSOs hope to be able to meet their service coverage targets more effi-

ciently. For their part, RSPs have a direct incentive to offer a context-appropriate range, cost, and quality of service, are able negotiate their coverage obligation, and would not be required by the central government to post a cash guarantee.

Removing regulatory barriers to rural service

Many regulatory regimes are designed to address for large operators primarily interested in delivering service in urban areas, and certain requirements have negative implications for operators interested in rural areas. The specific regulations governing entry into telecommunications services that have particularly profound cost implications for rural operators include universal service and access requirements (to deliver service to a broad geographic area—i.e., an entire state or country—at a certain level of density), cash deposit requirements (this is particularly harmful for less profitable markets and medium term market development strategies), and wireless spectrum allocation (which may effectively punish rural operators because of the lower user density).

A strong and independent regulator is commonly held to be one of the cornerstones of a competitive and efficient telecommunications market, and while reforms are showing progress, there are still significant deficits related to the size and resources of many monopolies, including their national political and economic significance, and the relative inexperience of many regulatory entities.

In this age of telecommunications convergence, the policies for service classification determine which services operators at any level are permitted to deliver, and the technologies that they may use to do so. The most relevant considerations here are whether or not Internet service provision is considered a value-added service and operators are allowed easier entry (as opposed to the common barriers for basic telephony, for instance), whether VoIP is legal (it is not, in many cases), and if it is legal, whether it is considered a data or voice service.

Promoting universal access policies and supporting incentives

Requirements for universal access can be key drivers for government and telecommunications providers to reach rural areas, but because rural markets are not as appealing as urban ones, providers tend to neglect them. Setting appropriate and attainable target service levels has proved difficult, and enforcing timetables has been equally so. Countries are experimenting with new regulatory approaches that blend rural service incentives and requirements, with many nations instituting telecommunications taxes that reserve a portion of earnings for rural service subsidy. In Bolivia's recent market opening, no-fee licenses were offered in exchange for commitments to rural service and education. Chile created a fund for rural service to attract private operators who, upon closer study of the market, actually determined that no subsidy was necessary.

Requiring interconnection—and enforcing It

Many smaller ISPs must expect uneven regulatory enforcement, and are frustrated by the unpredictability of their environment. One of the central and most difficult challenges facing smaller ISPs is that of ensuring timely interconnection between national carriers, regional providers (if they exist), and telecenters, all at fair rates. Both actual interconnection and rate setting are essential for competition, particularly where one carrier is the primary holder of the infrastructure, but have proved difficult even in developed markets where regulatory capacity is greater, and should be accorded significant attention.

Being wary of time-metered calling charges

While many rural Internet facilities depend on "always-on" connectivity for access to the Internet, some use dial-up connectivity. The negative impact of time-metered calls for Internet access, versus the flat rate used in the U.S. or discounted rates in Chile, Colombia, and elsewhere, cannot be underestimated. Metered rates in many Latin American nations, for instance, effectively double the cost of Internet access (ITU, 2000).

Using VoIP to promote competition

The drastically reduced costs of VoIP represent a significant financial threat to long distance and international service incumbents, and a tremendous revenue source for telecenter operators and RSPs. Many governments are wary of reducing incumbents' overall revenues, whether by diminishing income from outgoing international long distance (often used to cross-subsidize local telephony) or changing the balance of incoming versus outgoing international calls. Developing nations commonly have as much as four times more incoming traffic, and this generates substantial earnings from call termination fees. VoIP can drive communication costs down rapidly, while providing much needed revenue and foot traffic for telecenters.

Ending spectrum allocation regimes that punish rural wireless

The metrics of urban areas are commonly used for wireless spectrum allocation procedures and calculations of rates, and are accordingly inhospitable to rural operators. Rural areas typically have lower population and business densities and higher rates of poverty, and these characteristics likely translate into both lower user density and fewer users per capita. It is important to reconcile these practices in order to take advantage of the opportunities for wider service and more competition in rural areas that wireless technologies present. Spectrum needed for wireless technologies in rural areas may also be allocated for other purposes, and therefore unavailable (or excessively expensive), even if it is in fact unused in the rural areas that require it most.

Improving the overall business environment

Businesses are subject to a series of ongoing interactions with both government and financial institutions. Important broad considerations for new businesses include ease of starting a business registration procedure (registration procedures, time required), ease of running a business (burden of reporting, time spent with government, relevant labor laws), and cost of running a business (import duties, taxes).

Regardless of how positive the business climate may be, new businesses and their clients must be able to access funding on fair terms from banks, the government, private equipment or service providers, or from other lenders. As we have mentioned, telecenter startup costs can be quite moderate, but many will still require outside funding. In some cases, special grants or loans are available to support technology diffusion. In other instances, traditional bank funding can actually be more available for telecenter startups than it is for many other ventures because telecenter equipment serves as collateral. Equipment leasing offers potential for similar reasons. Rural entrepreneurs may face greater hurdles in accessing capital through these sources than those in urban areas, both because of the perceived novelty of their request and because rural entrepreneurs may be unfamiliar with formal financial institutions. Nonprofits, such as India's Dhan Foundation, have developed programs to assist their self-help groups in applying for loans from banks and government programs (http://www.dhan.org).

Mechanisms and legal provisions for billing, settling accounts, issuing credit/smart cards, and transferring funds determine the appropriateness, cost, and quality of certain services (e.g., e-commerce, national and international remittances). This business backdrop is a combination of government policy, the legal and regulatory environment, and practices within financial institutions, and therefore depends on diverse stakeholders to ensure its effectiveness.

Building Local Capacity

There is a clear consensus among development professionals that training and capacity-building are key components for telecenter success. We will not attempt to summarize that growing body of literature here; comprehensive treatments are available from Colle et al. (2001), Jensen and Estherhuyt (2001), World Links, and others. Some of the main elements of capacity-building and effective functioning of telecenters can be broken down into the major areas of business skills, ICT skills, employee management, and outreach skills.

As with any other business, basic techniques for business management and account tracking, some of which may be ICT-enabled, are essential for running a telecenter. Small businesses often operate in an informal way, which makes important processes such as tracking spending patterns and sources, income sources, and costing, difficult. These practices negatively impact available information for managers, and therefore the decision-making and planning process, which is particularly important when offering and developing a new suite of services (and paying associated costs). Poor or incomplete records and substandard management practices adversely affect relationships with existing or potential funders, who expect (and reward) complete and accurate records.

Operators require a sound understanding of the potential and uses of ICT, as well as the skills necessary to explain and deliver services to their users; operators effectively act not only as a provider, but also a champion. To capitalize on their knowledge of the local community and its ICT needs, it is important for operators to understand available ICT tools, identify the resources needed to deliver the level and type of service necessary, and to design the associated business model.

Unlike more traditional businesses in which products are more widely understood, employees may be called on to act as guides and facilitators for those unfamiliar with the technology. Managers must be able to inspire enthusiasm for ICT, as well as teach their employees the skills to instruct users. Secondary school and college students are adept facilitators, and are often willing to either volunteer or work in a telecenter at relatively low wages, in exchange for ICT access. These types of arrangements, however, may generate a new set of challenges to managers.

Outreach, marketing, and interaction with the community are key elements to achieving the economic sustainability of a shared resource; if word of available services does not reach wide enough or is met with resistance, success is unlikely. Outreach efforts will include businesses, individuals, nonprofit and public organizations, as well as civil society groups. Creating awareness, interest, understanding, and acceptance of these new technologies is challenging, particularly in rural areas, and these components have often been closely linked to training. Red Científica Peruana offers an example at the entrepreneur level. The company held training sessions for telecenter operators on a weekly basis at its own telecenters for years, offering free advice and support to anyone who was interested in setting up a telecenter. Similar efforts have been undertaken at the user level.

Conclusion

With more than half the world's population living in rural areas, rural communities promise essential new markets, new producers, and new ideas. Helping them to help themselves develop also offers security for urban areas and the developed world by contributing to the grander goals of social and economic stability (and prosperity) through increased

economic opportunity, new channels for learning, better communication with government, and improvements in health and wellness.

Economic self-sustainability for the Internet in rural areas is key if we want to avoid common development failures associated with donor initiatives, empower local communities, use the market to vet demand and interest, and ultimately link to real and legitimate development objectives. Our research has suggested that there are a handful of crucial issues determining the economic viability of the Internet in rural areas: costs, revenues, networks, business models, policy, and capacity. Business, government, and nonprofit institutions have different roles and capabilities in pushing these drivers, and while they may have occasionally competing interests, they have an overriding and common goal in economically sustainable access to ICT in rural areas.

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Endnotes

1 While this chapter uses a narrow definition of sustainability, Colle et al. (2001) offer an excellent list of key themes for telecenter development (gleaned in their "Modules for Telecenter Management Training"). Jensen and Esterhuysen (2001) provide deep insight into the nuts and bolts of telecenter development in their "Telecenter Cookbook," available at <http://unesdoc.unesco.org/images/0012/001230/123004e.pdf>.

2 Telecenters typically have one or more personal computers, and some access to the international telecommunications network. Telekiosks typically have only a single computer. They are often staffed with a facilitator or guide of some sort.

3 Before the 2001 liberalization, some Bolivian telecommunications cooperatives still charged as much as US$1500 to purchase a line (Brian Reale, IFX Networks, interview with Colin Maclay on 9 February 2001).

4 Copper and digging wireline local loop costs are estimated at over 80 percent of the total cost of a telecommunications network (Midas Communications Technologies Private Limited 2000).

5 For more information, see <http://www.gilat.com/gilat/corporate/News/HTML/comsys/Comsysdw.htm or http://www.stmi.com/>.

6 In another example of interest in entertainment, a recent study by IDC found that 45 percent of Chinese Internet users participated in online gaming, and that game fees alone would generate hundreds of millions of dollars per year by 2004 (Ghahremani 2001).

7 This claim comes from the simple observation that in a complete graph of *N* nodes (in other words, *N* users) the number of pair-wise connections between each node goes as, *N(N-1)/2*. Multiplying out and simplifying to the prevailing term leaves us with *N*2.

8 The Red Científica Peruana's (RCP) well-documented success involves a central body with varied and context-appropriate relationships (including mixes of service provision, training, and content creation) to telecenters around the country, and has helped create Peru's estimated fifteen hundred telecenters.

9 Compelling arguments and more detail are developed in the National Telephone Cooperative Association's Initial Lessons Learned About Private Sector Participation in Telecenter Development online at <http://www.ntca.org/intl/FINAL.pdf>.