INTERNATIONAL TELECOMMUNICATION UNION and
KOREA AGENCY FOR DIGITAL OPPORTUNITY AND PROMOTION
1ST DIGITAL BRIDGES SYMPOSIUM

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CHAIRMAN'S REPORT

Introduction

The International Telecommunication Union (ITU), together with the Korea Agency for Digital Opportunity and Promotion (KADO), jointly organized the 1st Digital Bridges Symposium September 10-11, 2004 in Busan, Korea on the occasion of Asia Telecom 2004. Some 105 participants took part in the meeting, representing a range of regulatory agencies and policy-making bodies, operators, manufacturers, industry analysts, user representatives academics and others. Dr Larry Press, Professor of Information Systems at California State University, Dominguez Hills, chaired the meeting.

The symposium is one of the activities outlined in the Digital Bridges Initiative cooperation agreement between KADO and the ITU. Its objective is to generate original research and stimulate debate on ways to expand the benefits of Information and Communication Technologies (ICTs) to the entire world. The first day focused on issues related to the measurement of the digital divide. It specifically discussed a number of national and international indices, and compared their methodologies, strengths and weaknesses. A number of best practice case studies on ICT data collection and dissemination were presented and discussed. The second day focused on new ICTs and how these can help expand access and bridge the digital divide. All of the documents and presentations from the meeting are available on the ITU website at: **www.itu.int/digitalbridges**.

Indices for measuring the digital divide

Introductory background papers presented both a national index (as applied in the Republic of Korea) and an international index. The national background paper, presented by Dr Chung-Moon Cho) KADO, highlighted the different stages of the digital divide from early adoption, to take-off, to saturation. In the Republic of Korea, Internet use has reached saturation stage. The presentation emphasized that the digital divide can be looked at either vertically, which highlight the gaps that exists between users and non-users of ICT; or horizontally, which analyzes the gap among ICT users. Although we know how many people subscribe to the different services available within a given country, there is little information on how individuals, households and other sectors of the economy actually use these services and in how far they have changed the way they work, communicate and live. There is an obvious need to develop a composite measure to analyze differences in access and utilization. It is specifically important to develop an index that will allow for the comparison of national as well as international differences and achievements. One example of such an index is the Personal Information Index (PII), which was developed by KADO, and which is built upon three sub-indices: access, capacity and application indices. The sub-index scores are plotted using a Lorenz curve, a useful tool to graphically visualize inequity. KADO also reports Gini coefficients, which summarize a Lorenz curve in a single number, indicating deviation from an equal distribution.

The international background paper, presented by Dr George Sciadas (Statistics Canada) further discussed existing international benchmarking tools to measure the digital divide. Indices differ with regard to the data they use to measure, compare and benchmark countries and may include qualitative as well as quantitative data, e-readiness assessments, individual variables, as well as composite measures. Indices may also focus on varying aspects of the digital divide like access, use, and quality. Composite measures vary according to the purpose of analysis, country coverage as well as the number of indicators used to construct the index. The Orbicom Index and the ITU Digital Access Index (see: http://www.itu.int/ITU-D/ict/dai/index.html) were discussed in detail.

Subramaniyam Venkatraman (UNESCO) looked at the broader question of "Why measure the digital divide?" and in particular highlighted the divide in the field of education. He highlighted also measurement difficulties and the need for better gender-disaggregated ICT indicators.

In addition to the background papers, three country case studies of best practice in the collection and presentation of ICT indicators were presented for Australia (Vanessa Gray, ITU), Hong Kong, China (Esperanza Magpantay, ITU) and Republic of Korea (Prof. Heung-Suk Choi, Korea University). The country case studies highlighted a number of points that countries need to take into consideration when collecting ICT statistics and that may help them expand available information, minimize costs, and improve the quality of data. These include:

- Before starting to collect ICT data, the government agency in charge should make sure that it is aware of all the existing surveys that are being carried out within the country. It is important to identify the existing data collection channels, methodologies etc in order to decide on the best way of collecting ICT data.
- If possible, ICT data can be collected by adding certain questions on an existing survey. This would allow cutting costs and minimizing resources. It would also reduce the burden on those who are addressed by the survey (this may include households, businesses, operators etc)
- Experience in a number of countries has shown that the national statistical office is often in the best position to collect ICT data. In this case the government should strengthen the NSO and perhaps put the NSO in charge of collecting data and coordinating with other agencies
- User-funded surveys would allow different government agencies interested in a specific question or survey to pay the NSO for carrying out a survey or adding certain questions to existing surveys
- It is important to set up a formal mechanism for cooperation. This would allow the key players interested in ICT data (the operators, the Ministry in charge of telecommunication, the regulator, the NSO, etc) to agree on a concerted strategy and the most important indicators and prevent duplication of efforts.
- In certain cases the private sector can fill information gaps and collect specific ICT data. This is particularly useful for ad-hoc studies and areas where the results should be produced in a limited amount of time. For this it is also important that governments keep track of how much a survey costs. This will allow the comparison of costs and help the government decide whether it is more reasonable to hire a private consulting company or to carry out the study/survey in-house. International private consulting companies that carry out research in the ICT area might also be interested in cooperating with governments.
- Finally, it is imperative for countries to be precise about definitions and methodology. Only if it is very clear what exactly ICT terms refer to can the results of the studies/surveys be compared. It is also advisable to use existing definitions (for example. ITU, OECD).

The presentations highlighted the importance that statistics have for policy-makers and the usefulness of indices for countries to compare and benchmark their achievements.

Sherif Hashem (Ministry of Communications and Information Technology: MCIT) presented the results of Egypt's ICT usage survey, which is one of the very few ICT usage survey conducted in Africa. The MCIT survey (which was carried out by the Ministry itself, not the NSO) was conducted in October 2003 and covered households, educational institutions, businesses and the government.

Based on presentations and discussions, the conclusions that emanated during the first day of the symposium include the following:

- While the digital divide certainly exists, there is not enough data available to measure or analyze the extent of the divide comprehensively.
- ICT usage surveys in developing countries are almost non-existent, and when available, problems of comparison exist due to differing survey modules.
- Too many competing indices exist and there is a need to harmonize them to improve comparison among and between nations.
- A core set of ICT indicators is needed and should be used by countries that are planning to start ICT survey design and data collection.
- Model survey questionnaires exist and should be used as a minimum reference of future ICT data collection.
- Coordination among government agencies is necessary in data collection and analysis of survey results.
- Traditional technologies such as radio and television sets (TV) are still the primary source of information for some households in developing countries. Availability and usage of these technologies should be included in any ICT usage surveys and should be included in the ICT indices.

Technologies for reducing the Digital Divide

The second day focused on technologies to reduce the digital divide that had been identified during the first day. The day began with a background presentation outlining various technologies (DR Taylor Reynolds, ITU). This was followed by country case studies covering India (Dr Ashok Jhunjhunwala, India) and Malaysia (Eric Lie, ITU), more detailed technology presentations and discussions of pricing and policy.

In absolute terms, the digital divide is growing. While there have been gains in increasing access to ICTs, the divide we are shooting at is a moving target. A few years ago, we hoped for dial-up access to the Internet at up to 56 kbit/s; but today, one is "behind" if without broadband access to the Internet (at speeds of 256 kbit/s and greater) and the applications higher-speed connections can provide.

Furthermore, as the technology changes, developing and rural areas are often slower to adopt newer technologies as they struggle to increase access using older technologies. For example, while many economies in the world are still struggling to put in simple copper wires, leading broadband countries Japan and Korea are pushing fibre optic cabling direct to homes and offices. This leaves the developing economies and rural areas further and further behind as later adopters.

There is hope that new, wireless technologies may help developing nations accelerate their progress. A new wave of standards has allowed for mass production of some wireless equipment, bringing costs down while raising the level of interoperability.

Some operators in developing economies have used fixed wireless to branch out from the last "wired" segment of their networks to end-users and distance community access centres. Many

developing economies have also embraced wireless as a technology for bringing mobile communication to areas traditionally out of the reach of wires. As current and emerging technologies arrive in markets, policy-makers will need to decide how and when to implement these technologies.

Once a nation has high-speed international links and a fibre backbone, underserved rural users may be reachable using new and evolving wireless technologies like WiMAX (Worldwide Interoperability for Microwave Access). This architecture is illustrated in Figure 1, in which points of presence (POPs) in rural villages are connected to a fibre backbone through a wireless mesh.

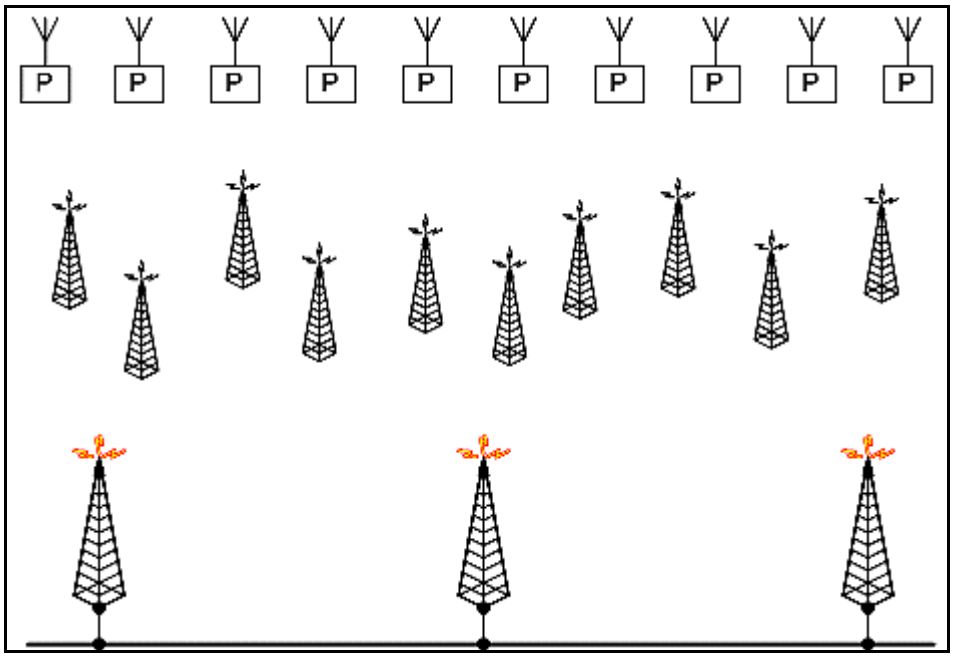

Figure 1. Three tiers: backbone, wireless mesh and village points of presence.

Other wireless technology like Wi-Fi and IMT-2000 (third generation mobile) may extend the network around village POPs.

No one technology will offer the best connectivity in all situations. Finding the right mixture of technologies and applying them to a given geographic and economic situation will remain a difficult, but achievable task.

Policy-makers in developing economies face difficult decisions in how far to extend wire-line infrastructure. The consensus was that fibre networks should be installed as far out as economically possible, with wireless networks branching out from the furthest wired nodes. But where copper-based networks already exist, these should be used to their full potential, through broadband technologies like DSL)

India has a relatively well-developed fibre infrastructure that reaches deep into county towns (*taluka*). Wireless technologies can then extend access beyond the last node of the fibre network to Internet cafés and kiosks. Some 85 per cent of villages in India are within a 15-20 kilometre radius of the nearest *taluka*, putting them in reach of evolving long-range wireless technologies such a CorDECT, WiMAX, HDR, and HSDPA. Terrestrial wireless technologies can service individual villages with a dedicated 1-5 Mbit/s bandwidth link. As bandwidth needs in the village increase, fibre and microwave technologies may become cost effective.

Nigeria's Wire Nigeria (WiN) Project is also working on extended fibre infrastructure to all the states of the federation, which would drastically increase the range of current wireless offerings.

Wireless mesh networks were seen as a promising technology for use both as a backbone layer, as illustrated above, and for last mile connectivity within urban settings. A reconfigurable mesh with dynamically reconfigurable bridges or IP routing capability in each node may reach remote villages reliably and efficiently. An urban mesh, in which each node is both an access point and a router, might be a means of providing connectivity without costly cables.

Proprietary mesh networks are available today. These are based on IEEE 802.11 and other microwave communication. The most effective use multiple radios with different frequencies for backhaul and access to reduce delays at nodes, but they are expensive and yet largely untested. The WiMAX mesh mode may bring the benefits of interoperability and economies of scale, but at this time no vendor is known to be planning a WiMAX mesh implementation.

Smart radios, which can detect noise and respond by changing transmission frequency, power and antenna focus under program control, also hold promise once they are developed and more widely available.

Applications and kiosks

Once a connection reaches a village or town, it must be dispersed in an economically viable and socially responsible manner. Internet kiosk entrepreneurs have done this in India and elsewhere. By aggregating demand within a village, they can create a profitable business based on small revenues from individual customers. The entrepreneur, in addition to running the business, helps bridge the PC literacy gap by setting up connections and helping users get accustomed to the PC and applications.

Dr. Ashok Jhunjhunwala of the Indian Institute of Technology, Madras, described such kiosks and their applications. The kiosks deployed by Dr. Jhunjhunwala and his colleagues are open 16 hours per day. They cost about US$ 1'000 to build and then face continued operating expenditures. The operator must typically gross US$ 100 a month to break even. Many reach this point after only a few months of operation, and some are bringing in as much as US$ 300 a month. Once a kiosk is put into a village of 1'000 or so inhabitants, roughly 30 per cent of inhabitants use it for services such as remote eye care and other e-medicine, online learning, e-agriculture and e-government.

Cybercafés and community access centres play a key role in expanding access throughout developing economies. KADO research surveyed cybercafés in the vicinities of organizations they visited in 23 countries. Some 53 per cent of the organizations had between 1-10 cybercafés close by. Another 35 per cent had more than 10 but less than 50. Finally, in four areas the density was between 50-100 per 100 inhabitants. In the KADO survey, all cybercafés used wired connections and had total shared bandwidth ranging from less than 56 kbit/s to 512 kbit/s.

Several developing economies are making use of community access centres to provide Internet access to users. In countries like East-Timor, Mongolia, Bulgaria, Cambodia and Peru, community access centres provide connectivity to roughly 100 users a day, for free or a very low price.

Government initiatives can be fundamental in extending ICT access to rural and developing areas. In Malaysia, SchoolNet and the USP Programme are connecting schools, libraries, and clinics to the Internet in remote areas. Follow-up initiatives such as the Rural Internet Centres Programme teach ICT skills in local post offices.

In addition simply to developing connectivity, there should also be an effort to increase the amount of local content, in local languages, available to users. KADO's survey of access in developing economies found that English is the primary language used to access web content, despite it not being the local language. Only 4 of the 23 surveyed countries (Uzbekistan, Mongolia, China, Laos and Bulgaria) had their local language as the primary language for web usage.

KADO's study of the telecommunication environments in 23 developing countries has allowed a glimpse into the technologies currently in use to bridge the digital divide. Of the organizations surveyed, 95 per cent receive their Internet connection by means of a wire line, while the reaming 5 per cent use wireless technologies. This finding is in line with worldwide broadband figures that show 95 per cent of connections over cable or DSL with the remaining 5 per cent over other technologies such as wireless and fibre.

Several presentations focused on specific technologies: WiMAX, WiBRO and mobile phones.

WiMAX is a fixed wireless technology that may become pervasive in long-haul, high-capacity Internet connections. WiMAX is based on the IEEE 802.16 series of standards for high-speed wireless data. The evolving standards promise high speed connectivity to remote areas and could help extend the reach of backbone infrastructure in developing economies. In addition, mobile versions of WiMAX are under consideration that would allow for fast data access from mobile terminals such as phones and PDAs.

Under ideal circumstances, some WiMAX configurations will be able to transmit 70 Mbit/s over a range of 50 km. Intel has chips for point-to-point WiMAX today, and predicts that it will have chips available for portable WiMAX devices as early as 2006/7.

The WiMAX forum is hoping to replicate the success of Wi-Fi, which is based on the IEEE standard series, 802.11 (for wireless local area networks). Wi-Fi certification on wireless products shows that the devices have been tested to be interoperable with all other Wi-Fi standard equipment. This has allowed a large number of manufacturers to compete over a range of products, and has quickly reduced prices. The WiMAX Forum is hoping that by working on a common standard and verifying interoperability, WiMAX equipment prices will fall and penetrations rate will soar. Backing for WiMAX is strong with more than 140 companies currently supporting the WiMAX Forum, an industry group with the charter to promote and certify the compatibility and interoperability.

The Korean government has set aside spectrum for a new mobile technology called "WiBro". They hope that WiBro will be adopted as the WiMAX mobile access standard, and economically fill the gap between the nomadic/fast access of Wi-Fi and the highly mobile/slower access available through 3G mobile networks. Users can expect a minimum data throughput of 512 kbit/s at the outer edges of the network while traveling at 60 km/h. The government plans on having 90 per cent of the population covered with a WiBro signal within three years of WiBro's introduction.

Many see WiBro as a complement to existing Wi-Fi and 3G networks. WiBro will be capable of carrying voice traffic but 3G networks handle voice traffic more efficiently and require less battery power from devices. WiBro's niche will be data transmission outside range of a Wi-Fi hotspot or wired connection. WiBro should be more spectrally efficient for data than CDMA 2000 1x EVDO.

While many think that new technologies such as WiMAX will drastically change communication in developing and rural areas, others pointed out that WiMAX and similar technologies may not live up to the recent hype. There were questions of what the new high-speed networks would be used

for. If the applications users want are e-mail and simple browsing, existing 3G networks may be sufficient.

One recent success in tackling a divide between developing and developed economies has been the astounding rise of mobile penetration rates throughout the developing world, particularly in Africa and other areas with very little fixed-line infrastructure. Mobile phones have been successful for a variety of reasons, including low infrastructure costs and pre-paid calling plans. This has helped users throughout the developing world gain access to ICTs that were previously out of their reach.

Since the growth in penetration rates worldwide have been astounding, many are now asking if mobile phones might be the key to bridging the digital divide in large areas of the world where infrastructure, PCs and computer skills are in short supply. Currently the correlation between broadband penetration and the number of mainlines per 100 inhabitants is high at R^2=0.60, leaving many developing economies with few choices for a wired Internet experience. However, throughout the developing world, the number of mobile phone subscribers far outpaces the number of fixed lines, even by a factor of 30 to 1 in countries like Cambodia.

Mobile phones may be one of the best ways to connect users to ICTs as phones now outnumber PCs worldwide by a factor of 3 to 1.

Services like Blackberry are helping users in developed areas replace their laptops with a small portable device. Similar services in developing areas could help unleash connectivity.

Mobile phone manufacturer Samsung predicts that "in the coming years, the mobile handset will be the hub of all other devices, enabling people to access information and technology anywhere at any time." This is important, as Intel has explained because "[mobile phones] are relatively small, you don't need a desk; you don't need to be in a particular place. You don't have to be literate to use them or speak English. These are all constraints when it comes to operating a computer".

Asia/Pacific is leading the world in terms of high-speed data over mobile networks. For example, 84.5 per cent of mobile subscribers in Korea are on a high-speed data network. Nearly 23 percent of mobile subscribers in India have high-speed services, which is very high for a developing nation.

Mobile operators are quickly expanding their networks throughout the developing world but tariffs are often very high for mobile data access and billing is often limited to post-paid subscribers. This severely curbs access for users in developing economies without access to credit.

Mobile devices suffer from input/output bottlenecks including: the size of the screen, the keyboard, and language input methods. Voice-enabled entry may help alleviate some of these problems but mobile phones will not be good for document handling for some time.

Current mobile phone networks do not have the bandwidth available to allow users good access to streaming content. If basic music delivery requires 30 kbit/s and video requires 100 kbit/s, then 2G (10 kbit/s – shared), 2.5G (100 kbit/s – shared) and even 3G (several hundred kbit/s – shared) networks are not capable of efficiently handling data needs in developing areas. New fixed wireless technologies to mobile phones could offer much better data connectivity.

Mobile growth, particularly in Africa, has been phenomenal. Nigeria has gone from no digital mobile users in 2000 to over five million users in July 2004. Wireless technologies are playing a key role in bringing voice and data to users throughout the country. As an example, voice is mainly handled by GSM while fixed services are provided over a CDMA 2000 1X network. In addition, the 450 MHz band of spectrum has been set aside for extending access to rural areas.

Video and multimedia will play a key role in providing information over the network. Motorola points out that video is moving to its third screen. Video started on TVs, moved to computers, and now is making its way to mobile phone screens.

Low computer penetration is a big problem in many developing economies. In Cambodia, computer penetration is nearly zero outside of Phnom Penh. Barriers include the high price of computers relative to income, a lack of affordable Internet connectivity, no Khmer language content or Khmer operating systems, and finally a lack of stable electricity. These are common difficulties faced in other developing economies as well.

Pricing

Rural India has nearly 6'000 rural villages with roughly 1'000 inhabitants per village. The villagers have an average per-capita income of US$ 0.40 per day. Extending ICTs to these people requires low cost equipment a business model that is sustainable with low revenue per user.

As the Indian model has shown, Internet kiosks and cybercafés can play a key role in extending access. However, in order to have an effect, cybercafé prices must be affordable to local users. KADO research found that average hourly cost of cybercafé use in 23 developing economies was US$ 1.20 – a price out of reach for many low-income users.

Mobile costs can also be high for low income users. The costs of sending data over mobile networks are often higher in developing economies than developed markets. For example, in KADO's survey of 23 developing economies, the average price of a text message was US$ 0.21. However, the same text message in the Republic of Korea would cost only US$ 0.03, one-seventh the price.

Mobile phone prices in developing economies are very high. The average cost of a mobile phone in the 23 countries surveyed by KADO was US$ 480, far out of the reach of many potential ICT users. If the most basic mobile phones were available for US$ 25, the market in India alone would reach 500 million. In Cambodia, penetration rates have increased because users buy second-hand phones for US$ 10-15. That allows them to spend US$ 5 on monthly communication.

While the mobile Internet may offer the best connectivity to users, operators may be unwilling to allocate more of their existing spectrum to Internet use given its low return per bit compared with other services. Operators in India earn four times the amount per bit of voice carried than they do on Internet traffic. The difference in SMS and Internet is much greater at 80 times the revenue for a bit of SMS versus a bit of Internet traffic.

Pricing for routing calls in developing economies may follow trends in developed markets of making the connection over the lowest available cost network. Examples include the "Blue phone" in the UK and "One Phone" in Korea.

Singtel in Singapore has a flat-rate plan where mobile data users can move freely between broadband, Wi-Fi and mobile networks. Users have an incentive to stay on the least-cost portions of the network because their available speeds are so much higher.

By some estimates, users are willing to pay 8.5 per cent of their household income for communication services. That figure represents a very large market for new and emerging services over high-speed networks.

Satellite technologies are used in Malaysia in very remote areas but their high costs make them a last option in terms of ICT access. VSAT projects in Sabah and Sarawak, the two most unserved districts require CAPEX of US$ 263'000 per system with annual OPEX per site reaching US$ 5'200.

Policy and Regulation

India is moving towards a unified access licensing system for delivering content and data access in an effort to simplify the licensing process, reduce legal disputes, ensure a level playing field for all providers, and to stimulate development. The unified license allows an operator with a connection to a home to deliver whatever services they find profitable over the line. This can include voice, TV, or Internet access for example.

The move from receiving-party-pays to calling-party-pays in India coincided with a drastic increase in the number of cellular mobile subscribers. Many more users can afford mobile phone service once they no longer pay for incoming calls.

Regulators and operators must decide whether licensed or license-exempt bands of spectrum are better for new technology rollouts. While the license-exempt 2.4 GHz band has been a major factor in the success of Wi-Fi, questions remain about using license-exempt bands for higher-capacity backbone infrastructure such as WiMAX. Dedicated spectrum would allow for higher-speeds and better quality of service for critical infrastructure.

Policy makers throughout the world are faced with the harsh reality of economic scarcity; there is simply a limited amount of resources that must be allocated in an economy. However, bridging the digital divide may not need to be an "either/or" proposition. Rather than choosing between telecommunication investment and health care, targeted telecommunication investment could build infrastructure that could help reduce medical costs and make care more efficient. Similar arguments can be made for education. Connecting schools with fast Internet connections gives students much better access to educational materials and can make their school time more productive.

Conclusions

The first day of the Symposium focused on measuring the digital divide. We heard of efforts to identify precisely defined indicators that could be measured in all nations on a regular basis. Presenters also described indices constructed as weighted averages of indicators and we heard reports of several recent case studies.

While there were several approaches to the task of measuring the digital divide, there was consensus that it existed in 1990 when we first began collecting this sort of data and that it still exists today. It is clear that there are digital divides both within and among nations regardless of how we measure them.

The second day presented promising technologies for reducing the digital divide and case studies showing that Internet connectivity can lead to improvement of the quality of life in rural areas in developing nations. For example, the presentation of Dr. Ashok Jhunjhunwala illustrated meaningful applications and a business model that appears scalable using small amounts of locally accumulated capital.

We concluded that the digital divide exists, reducing it would be beneficial, and there are promising technologies, business models and policies for doing so. Moving forward, we would like to see a comprehensive, independent assessment of the kiosks from IIT Madras and the development of a

detailed plan for a backbone network (like that illustrated in Figure 1) for an entire nation. If the Madras application assessment proved positive, we would be in a position to implement the connectivity plan.