

## Forum

# The Next Decade of ICT Development: Access, Applications, and the Forces of Convergence<sup>1</sup>

### Mohsen Khalil

Director, Global Information and Communication Technologies Department  
World Bank and IFC  
USA

### Charles Kenny

Ckenny@worldbank.org  
Senior Economist, Finance, Economics, and Urban Department  
World Bank  
1818 H St, NW  
Washington, DC 20433  
USA  
(202) 473-3540

Developing countries are already driving global innovation in technologies and business models related to information and communications. Ongoing technological change may give new life to business and regulatory models adopted and then abandoned in the era of the dot-com boom in developed countries, and developing countries may take the lead in such changes. As networks and applications spread, catalyzing the impact of ICTs for development will become a challenge of the broader environment for their exploitation.

## Expanding Access, Escalating Applications

The spread to global ubiquity of the telephone has been rapid. More than half of the world's households now own a fixed (wireline) telephone; in addition, there are in the region of 2 billion mobile subscribers, and the mobile footprint covers as much as 77% of the world's population (Keremane & Kenny, 2007). Developing countries now lead the way in the mobile revolution, not least China, by far the world's largest mobile market, and there are considerably more mobile subscribers in the developing than the industrial world. The growth in access was particularly notable in sub-Saharan Africa, where fixed and mobile teledensity expanded from about 1 telephone per 100 people in 1990 to more than 8 in 2005 (ITU, 2006).

Because of great demand, continued technological advancement, and continued reform, developing countries may invest as much as US\$100 billion in information infrastructure rollout each year over the next few years. They will account for the great majority of new network subscribers. As many as 80% of new subscribers added to global mobile networks over the 2004–2009 period will be in Africa, the Middle East, Asia, and Eastern Europe. As a result, it is quite likely that developing countries will be setting trends in applications, revenue models, and cost-saving approaches, especially for mobile networks. In particular, these networks will provide an increasingly important platform for retail services to poor people.

At the same time that the reach of networks—and especially mobile coverage—is growing, the capacity of the spectrum to carry information is also exploding. Over time, technology has evolved in ways that make it possible to build much more efficient and dynamically responsive (intelli-

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1. The views presented in this paper are those of the authors, not necessarily those of the World Bank, its executive directors, or the countries they represent.

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gent) radio systems that can allow many users and uses to simultaneously share the same frequency bands. Technologies like smart antennas, spread spectrum modulation, and cognitive (software) radios are making it feasible for transceivers to dynamically change their frequency, modulation, or power levels to enable more efficient and intelligent spectrum sharing. As a group, these technologies enable users to transmit at the same time, in the same place, on the same parts of the spectrum. Combined with technologies such as 3G and WiMax, they have the potential to significantly increase the capacity of the spectrum to support data applications and wireless broadband.

For developing countries, cheap, simple mobile devices (such as the Global System for Mobile Association's Emerging Market Low Cost Handset) will remain central to extending access to poor people. Given convergence and greatly increased spectrum capacity, however, the number of applications available over those devices is likely to expand. And, if the last few years are any guide, it may be that developing countries will again provide a base of innovation.

Declining costs in mobile technologies, in particular, allow operators in many developing countries to make profits with monthly average revenues per user (ARPU) below US\$10 compared with US\$30 or US\$40 for fixed operators (Oestmann, 2003). Private operators in developing countries have used innovative business models to extend profitable access to low-income users. By 2003, there were more prepaid than postpaid mobile subscribers worldwide, again with the developing world leading the way. Africa was the region with the largest percentage of prepaid customers, accounting for nearly 90% of subscribers.<sup>2</sup> Other innovative business models in the developing world included Grameenphone's combination of microfinance to support the purchase of mobile phones by women in villages who repaid their loans by selling airtime, as well as the model used by Spice Telecom in India that actively recruited entrepreneurs to operate phone shops.

These models worked by providing services in high demand—primarily voice calling—while exploiting local entrepreneurial talent.

Adding together the ARPU of mobile, fixed, pay television, and Internet in India comes to US\$33, compared with a similar figure in the United States of US\$143 (Minges, 2006). Nonetheless, the "triple play" of voice, video, and data may be particularly important to developing country operators to preserve ARPUs and reduce churn. Several developing country companies are exploring the "triple play," looking into the provision of Voice over Internet Protocol (VoIP) and IP-TV over their networks, for example.

In 2005, VoIP carried approximately 70 billion minutes of international voice traffic, which was more than twice the number of minutes as were carried the previous year,<sup>3</sup> and an additional 685 billion minutes of local and national calls were made by VoIP.<sup>4</sup> In 2004, VoIP accounted for more than 14% of all international traffic, and again, this is an area where developing countries are in the forefront of change. For example, about half of inbound international calling minutes to Mexico, Brazil, and Bangladesh are VoIP.

Along with converged provision of voice, a range of other data-based services over mobile are expanding in the developing world. Perhaps 500 billion SMS text messages were sent worldwide in 2004,<sup>5</sup> with some developing countries leading growth in SMS usage. For instance, the average Filipino mobile subscriber sends 10 text messages a day, accounting for nearly 55 billion messages each year.<sup>6</sup>

The Philippines already has more than 3.5 million M-commerce users, driven by the ability to transfer both cash and airtime between customers, with transfers allowed for amounts as low as 4 cents. Safaricom in Kenya and GLOBE telecom in the Philippines are both experimenting with microfinance via mobile phone, which will allow loan advances and repayments over the phone, providing access to financial services to many individuals who lack them.

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2. EMC insights May 2004.

3. [http://www.infoworld.com/article/05/12/16/HNvoipcompetition\\_1.html](http://www.infoworld.com/article/05/12/16/HNvoipcompetition_1.html)

4. Estimated from [http://www.ilocus.com/ui\\_dataFiles/voipminutes3q05.htm](http://www.ilocus.com/ui_dataFiles/voipminutes3q05.htm)

5. Estimated from <http://www.cellular.co.za/stats/stats-main.htm>

6. <http://www.givemeunlimited.com/main/aboutus.asp>

A similar network is being developed in South Africa. M-commerce systems cost as little as US\$5 million to set up, suggesting that networks as small as 25,000 users could profitably support commerce over mobile phones (Wishart, 2006).

Wireless-based competition at the retail level combining voice, data, and video provision may be supported by a range of new wholesale infrastructure providers. Parts of this wholesale industry are already extremely competitive. In many industrial and developing countries with open competition, levels of concentration in market share of international communications are similar to those for the chocolate industry, for example.<sup>7</sup> Alternate telecommunications networks are one early sign of such growing competition in backbone provision. For example, India's Railways (RailTel), Gas Association of India Ltd (GAILTel), and the national electricity distribution network (PowerGrid) have each built their own trunk line telecommunications systems. These alternate wholesale providers continue to build capacity, and this year will provide railways with 40,000 kilometers of optical fiber cable, power distribution with 20,000 kilometers, and gas distribution with 17,000 kilometers (Hay, 2005). Technological advances allowing the transmission of signals over electricity wires may lead to ever greater backbone competition, even in less attractive areas in developing countries. At the same time, it is possible that we will see consolidation in some parts of the backbone industry, with a few wholesale providers selling capacity to multiple retail operators on the model of Virgin in the United Kingdom and Wal-Mart in Germany piggybacking on T-Mobile's infrastructure.

Despite rapid progress and global leadership in business models in some parts of the ICT sector, developing countries still face many challenges to ensure they can fully reap the benefits of the next decade's changes in ICT provision and use. These challenges are illustrated by the fact that, although the number of secure servers in low- and middle-income countries doubled between 2001 and 2004, reaching above 10,000, this still left the developing world's share of secure servers at about 3% of the global total (World Bank, 2005). Barriers to progress include the need for further regulatory reform, is-

sues surrounding the taxation of ICTs, continued concerns about the extent and quality of backbones, and perhaps most importantly, attention to the broader business environment.

## Regulatory Catch-Up

Many developing countries still have yet to extend the benefits of well-regulated competition throughout the ICT sector. Although 90% of the world's population lives in countries with competition in mobile provision, the figures drop to 78% for fixed local and 60% for international services (World Bank, 2005).

Beyond the basic reform agenda is the need to adapt to an increasingly intertwined set of delivery mechanisms for information. As a result of convergence, separate institutions to cover Internet, broadcast, and other media content will face cases that overlap. For example, South Korea's 1995 Electronic Communication Business Law established a separate Information and Communication Ethics Office with broad powers to censor Internet content. If the content being provided is a podcast of a television show previously shown on free-to-air television, it is not clear who should regulate this content, or why it should go through an additional regulatory hoop.

One response to the process of convergence has been the creation of "converged" regulators covering both telecommunications and media more broadly. The United States' Federal Communications Commission (FCC) heads in this direction, covering telecoms and broadcast media. Because the FCC is responsible for covering all electronic communication, it has theoretical regulatory responsibility over Internet content as well, although the nature of legal institutions in the country means that the limited cases of content control (governing pornography, for example) are enforced by the legal system and law enforcement agencies. The United Kingdom's Ofcom and South Africa's Icasa are other examples where Internet regulation falls under the same institution as broadcast regulation. A second approach would be to split functions between a "pure" infrastructure regulator and a content regulator, the first basing decisions on economic issues related to pricing and to market dominance, while the second reg-

7. As measured by the Herfindahl-Hirschman Index, see Rosotto, Wellenius, Lewin, & Gomez (2004).

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ulates on the basis of cultural and social norms. It should be noted that drawing an exact dividing line between two such institutions and their tools for enforcement may be complex.<sup>8</sup>

Regarding the activities of these new regulators, it is a developing good practice that licenses are issued for services and spectrum wavelengths rather than for technologies. If the sector moves further toward a model of network wholesalers supporting numerous competing retail service providers, movement toward universal, technology-neutral licensing will make even more sense. The model will also provide new challenges for regulators working in an IP-centric world where multiple small retail ICT players with innovative approaches need reasonable and fair interconnect to the backbone.

Reform of spectrum allocation procedures will become increasingly important in developing countries, and may prove more straightforward if regulation of the entire spectrum falls under one body. By one estimate, about one half of the total value of the spectrum in the United States today is wasted because it is underutilized by those with spectrum rights. Auctions account for only about 2% of all spectrum assignments, and spectrum allocation using the new technologies that allow shared access is limited. Improving spectrum administration would yield significant benefits, but governments may wish to consider moving straight into property rights or commons approaches. New Zealand, Guatemala, the United Kingdom, and the United States are all experimenting with spectrum trading (Wellenius & Neto, 2005). Developing countries also can become fertile testing grounds in the early stages of commercial deployment of spectrum-sharing systems.

### Taxing Progress

It is worth noting that the continuing decline in the cost of providing service under the combined pressure of competition and technology change increases the influence that taxation has over who can and cannot afford access to infrastructure. As a result of the sector's rapid expansion and the image of telecommunications as a luxury good, it has become an increasingly important source of general corporate tax and special additional tax revenues. Nine-

teen of the 50 countries surveyed in a recent study levy additional taxes on mobile phone users over and above the standard sales taxes (GSM Association, 2005). Some of these additional taxes are telecom specific, such as service activation taxes. These special taxes average US\$13 per annum, per subscriber.

Any undifferentiated special tax on telecoms may well turn out to be highly regressive. In Chile, for example, the poorest 20% of the population spends about 3.5% of its income on telecommunication services compared with about 2.5% for the richest quintile of the population (Forestier, Grace, & Kenny, 2002). Poor people with access will pay a larger percentage of their income than rich people on these special taxes, and many poor people will be denied access at all by the additional cost barrier put in place by the tax.

Creative taxation policies covering special taxes on infrastructure, handsets, terminals, and service might allow for a progressive impact, which limits the tax burden on new, poor telecommunications service consumers. Perhaps expensive, new handsets could be taxed at a higher rate than cheaper, old models more likely to be used by poor people. Lower taxes on wholesalers who resell time to village phone operators or on providers rolling out access to areas previously without service might also be appropriate.

### Developing the Backbone

Internet bandwidth per million people is 4 Mbps in low-income countries compared with 3,657 Mbps in high-income countries, and broadband prices are 53 times as high. Limited competition and few scale economies due to a considerably smaller customer base account for some of this difference, but many developing countries, especially in Africa, face the additional barrier of limited fiber connectivity to international telecommunications networks.

There is a significant role for government support of the development of backbone connectivity, particularly at the regional level. This government support is required not least to help to overcome the significant transactions costs and political risks associated with an investment with a long payback pe-

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8. At the same time, content regulation will become increasingly complex in a context of a worldwide content transfer over the Web, and a potential disadvantage of converged regulation may be that political concerns related to content may spill over into interference in the regulation of infrastructure provision.

riod serving more than one country. But intervention is also required to ensure that consumers benefit when fiber connectivity is provided. For example, West Africa is currently connected by fiber to the global network through the SAT-3 cable, but prices remain nearly as high as they do in East Africa where there is no fiber backbone connectivity. The prices of dial-up Internet access in countries connected to SAT-3 remain twice as high as in other developing countries, and operators in South Africa get charged 8 to 10 times more than operators in India for wholesale access to the international gateway (Neto, Niang, & Ampah, 2005). This pricing asymmetry is related to the closed ownership structure of the SAT-3 cable and the fact that prices for traffic over the cable are unregulated. Thus the role for government spans policy reform and regulatory interventions as well as (where appropriate) public-private partnerships to extend rollout or prepurchase agreements to guarantee demand.

## The Broader Business Environment

As competitive network provision has spread, the most significant barrier to adoption of advanced Internet applications has become the broader business environment. For example, existing M-commerce operations in developing countries have cooperative arrangements with banks for both practical and regulatory reasons, but this highlights the importance of ensuring that banking regulations permit such innovative approaches.

It is clear that this broader environment becomes ever more important with convergence. Recent World Bank surveys of more than 20,000 businesses in roughly 50 different low- and middle-income countries suggest that firms using ICT see faster sales growth, higher productivity, and faster employment growth (Qiang, Clarke, & Halewood, 2006). At the same time, the record is clear that the introduction of ICTs is highly complex, with evidence from both developed and developing countries alike of significant failure rates. One study of the introduction of online purchasing systems, for example, found that only 40% of companies saved money when they deployed systems as part of a change management process. Even more revealing is that only 3% of companies managed to save money from online procurement systems, if they were introduced without an accompanying process of change

management. The introduction of advanced IT applications requires an enabling environment of business process change and human resource development, as well as the careful design of appropriate applications themselves. If the applications are to interact with the wider world, a range of technology, financial, and skills requirements needs to be satisfied by suppliers and consumers as well. All too often, these requirements are lacking.

This phenomenon highlights the vital importance of factors such as skills and business processes within companies and governments as well as the level of education in the workforce. The institutions required to facilitate online financial systems and commerce in the broader economy are also central to the success of Internet applications. In essence, the message is that it is not just the infrastructure any more; rather, in a converged environment, firms working in the ICT sector, and governments overseeing that sector, have to be attuned to a far wider range of influences and trends that will drive the successes or failures of projects.

## Predicting the Future

Perhaps the next 10 years will see the revival of business and regulatory models launched in the past 10 years that were before their time. For business, the sad history of the AOL-Time Warner merger dampened hype surrounding converged industries, but perhaps recent developments, such as developing country telecoms operators' moves toward the triple play model, suggest that the time may yet come for such models. Again, this might leave infrastructure providers as wholesalers to applications and content providers.

For policy and regulatory agencies, if spectrum scarcity really does come to an end while competition spreads, and countries follow the model of controlling content through law enforcement agencies and the courts rather than an industry-specific body, the role for an independent regulatory body for telecommunications infrastructure may become questionable. The market may become so competitive that regulation is not required, or so complex and fast-changing that regulation cannot keep up. While New Zealand may have jumped the gun in its attempt to abandon specific regulatory institutions for the sector in the 1990s, the new century might see the return and spread of this idea. At the same

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time, if there is considerable consolidation in wholesale provision, it is equally possible that regulators will have new and considerable responsibilities, ensuring a level playing field for retail provider access to the backbone. The history of communications is littered with past failures to predict the future; at a time of such dramatic change, confidence regarding the particular direction of future change might be particularly unwise. ■

### Bibliography

- Forestier, E., Grace, J., & Kenny, C. (2002). Can information and telecommunications technologies be pro-poor? *Telecommunications Policy*, 26.
- GSM Association. (2005). *Tax and the digital divide*. London: GSMA.
- Hay, K. (2005). Expanding broadband access in rural India: The role of alternate telecommunications networks, mimeo, GICT Department, World Bank.
- ITU. (2006). *World telecommunications development indicators*. Geneva: ITU.
- Keremane, R., & Kenny, C. (2007). Toward universal telephone access: Market progress and progress beyond the market. *Telecommunications Policy*, Forthcoming.
- Minges, M. (2006). New business plans, mimeo, Telecommunications Management Group, Inc., Arlington, VA.
- Neto, I., Niang, C., & Ampah, M. (2005). *Fostering pro-competitive regional connectivity in sub-Saharan Africa*, mimeo, World Bank.
- Oestmann, S. (2003). *Mobile operators: Their contribution to universal service and public access*, mimeo, INTELECON Research & Consultancy Ltd., Vancouver.
- Qiang, C., Clarke, G., & Halewood, N. (2006). The role of ICT in doing business in World Bank, *Information and Communications for Development*, Washington, DC: World Bank.
- Rosotto, C., Wellenius, B., Lewin, A., & Gomez, C. (2004). *Competition in international voice communications*, World Bank Working Paper 42.
- Wellenius, B., & Neto, I. (2005). *The radio spectrum: Opportunities and challenges for the developing world*, World Bank Policy Research Working Paper No. 3742.
- Wishart, N. (2006). *Micro-payment systems and their application to cellular networks*, mimeo, infoDev/GSM, Washington, DC.
- World Bank. (2005). *Financing information and communication infrastructure needs in the developing world: Public and private roles*, World Bank Working Paper 65.