Harnessing the Mobile Revolution

Thomas Kalil

University of California Berkeley

The New Policy Institute

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Introduction

The premise of this paper is that the explosive growth of mobile communications can be a powerful tool for addressing some of the most critical challenges of the 21st century, such as promoting vibrant democracies, fostering inclusive economic growth, and reducing the huge inequities in life expectancy between rich and poor nations.

The benefits of mobile communications are particularly profound for developing countries, many of which are "leapfrogging" the traditional fixed telecommunications infrastructure. As a result, billions of people in developing countries are gaining access to modern communications of any sort for the first time. There is no doubt that mobile communications are having a significant impact on the way Americans live, work and communicate with each other. But the impact is no doubt more keenly felt by the African mother who can call ahead to determine whether a doctor is available to treat her sick child before traveling for hours.

Obviously, mobile communications are not a panacea for the daunting challenges faced by the 2.7 billion people who live on less than $2 a day. Like any new technology, it has costs and risks as well as benefits, and some of the promised benefits will undoubtedly fail to materialize. It's worth remembering that 19th century pundits thought the telegraph would inevitably lead to world peace, or that in 1922 Thomas Edison predicted the motion picture would "revolutionize our educational system … and supplant largely, if not entirely, the use of textbooks."[1] But Columbia University's Jeffrey Sachs may well be right when he concludes that "the cell phone is the single most transformative technology for development."[2]

With a few exceptions, the U.S. government is largely oblivious to the ways in which the rapid diffusion of mobile services (and other new technologies) could be used to improve the human condition. I believe that the next Administration should launch a major new initiative to harness the confluence of new technologies and innovative business models as a key component of its global development agenda. This initiative would be designed to serve as a catalyst for policy reforms in developing countries, promote an increased capacity for innovation by developing country entrepreneurs to meet local needs, and stimulate additional investments by philanthropists, foundations and companies.

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[1] Steve Lohr, "When the Alma Mater Ends With ".edu," *New York Times, July 7, 1996.*
[2] Jeffrey Sachs, "The Digital War on Poverty," *Guardian*, August 21, 2008.

Such an initiative could reduce poverty, strengthen democratic institutions, and improve global health outcomes. It could also help restore some of the damage to America's international reputation, boost America's "soft power," and position American businesses and workers to benefit from the growth of emerging markets in Africa, Asia, and Latin America. This initiative would not be limited to mobile services, and might also include decentralized approaches to providing safe drinking water, new vaccines, therapies, point-of-care diagnostics, clean energy, and improved crops that are more productive, nutritious, and drought-resistant.

Obviously, private sector investment in mobile communications for developing country markets will continue to grow. Even in the absence of enlightened U.S. government leadership, mobile services will become more ubiquitous, affordable, and versatile. But the missed opportunity will be the failure to leverage this large and growing private sector investment for public purposes, such as ensuring fair elections, helping a community health worker save the life of a mother or young child, or giving a farmer or small business owner access to the credit they need to build a path out of poverty.

Key Trends

The magnitude of this opportunity is difficult to understand without a grasp of the key business and technological trends at its core – including the rapid adoption of mobile services, the growing versatility and lower costs of mobile devices and services, and the concrete economic and societal benefits.

Explosive growth

There are now 3.3 billion people using mobile phones, a number that is projected to grow to 5.2 billion by 2011.[3] Although it took the industry 20 years to sell the first billion phones, the second billion sold in four years and the third billion sold in two years. There are now more mobile subscribers in developing countries than in developed countries. There are several reasons for this rapid growth of mobile subscribers in developing countries, even among poor households.

- Deploying a cellular infrastructure is much less expensive than investing in a new, fixed infrastructure for landline phones.

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[3] Infonetics Research, "Mobile Subscribers To Hit 5.2B in 2011," August 6, 2008.

- Most governments have allowed private sector companies to obtain a license to provide mobile services, as opposed to the inefficient and sluggish state-owned monopolies that have dominated fixed lines.

- The cost of handsets is now down to $15 in some developing countries, and researchers are exploring the possibility of $5 to $10 handsets.

- People can share phones, use multiple SIM cards on the same phone, and purchase a very small number of pre-paid minutes. People also lower their charges by hanging up before the person they are calling answers their phone. This may send some pre-negotiated message, such as "pick me up now."

Increased performance and functionality

Most mobile phones sold in developing countries are primarily used for voice calls and text messaging. However, "Moore's Law" (the ability of the semiconductor industry to double the number of transistors on a computer chip every 12 months to 18 months) means that the capabilities of today's smartphones (e.g. an Apple iPhone or Nokia N95) will be more affordable over time. Smartphones have a variety of different capabilities, including operating systems that can support sophisticated applications, e-mail, miniature keyboards, full-fledged Internet access, touch screens, accelerometers, built-in cameras, GPS, media software for playing or recording audio and video, secure electronic commerce, barcode readers, WiFi connectivity, and the ability to display information on a television screen.

Carriers are also deploying more advanced networks capable of sending and receiving data at higher speeds. As people gain access to high-speed data services on a mobile device, they also gain access to more of the global Internet's resources. This means that people and businesses in developing countries will have access to the capabilities of "cloud computing" (computing, data storage, and software available over the Internet) that is being created by companies such as Google, IBM, and Amazon. With a network of more than one million computers, Google can allow its users to search the World Wide Web (which has now surpassed one trillion pages) for the most relevant information in a fraction of a second. Small businesses are able to host their applications or data on Amazon, paying only 15 cents per gigabyte per month, or as little as 10 cents per hour of computer processing.[4]

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[4] Peter Wayner, "Cloud Versus Cloud," *InfoWorld*, July 21, 2008.

Of course, depending on the population that one is trying to serve, simplicity and ease-of-use may be much more important than functionality. It is also possible that the "mobile Web" will be fundamentally different from the desktop experience. Some researchers believe that people will use voice commands and speech-to-text translation to navigate the Internet.

Greater openness

Traditionally, mobile subscribers have only been able to use devices, content and services that are authorized by carriers. These "walled gardens" (online environments controlled by carriers) limit innovation. By contrast, the Internet allows anyone to develop a new application, enables many-to-many communication as opposed to one-to-many communication, and empowers individuals to be producers as well as consumers of information.

There are signs, however, that the industry is beginning to move toward greater openness for applications and devices.

- Google and its partners in the Open Handset Alliance have announced an open platform for the development of new mobile applications.

- Software Developer Kits such as the one Apple launched for the iPhone enable innovators to create new applications, and Apple's App Store is making it easier for iPhone customers to download new software applications.

- Verizon Wireless has announced that it will allow its customers to connect to any device that meets "minimum technical standards" to its network, regardless of whether it is a phone.

- Contests like AT&T's Fast Pitch and Open Call provide opportunities for developers to accelerate getting their applications to carriers quickly.

Real economic and societal benefits

Policymakers need to pay greater attention to mobile services because of their demonstrated and potential economic and societal benefits. Some of these benefits (broadly shared growth, better healthcare, and a more democratic society) are discussed in greater detail below. But there are many other potential applications as well, including education and life-long learning, delivery of government services, disaster management,

environmental monitoring, information services for smallholder farmers, and creative use by non-profit organizations. There are also broader social benefits that flow from geographically separated family members being able to stay in touch, and the ability of people with shared interests to collaborate and share information.

It is worth repeating that mobile services are not a "magic bullet" for any of these challenges. Furthermore, it is not access to technology *per se* that leads to economic and societal advances; it is new ways of, for example, delivering healthcare or financial services that are enabled by the technology.

Mobile Health

Today, the average life expectancy of a baby girl born in Zimbabwe is 34, compared to 86 in Japan. If we believe that every human life has equal value, then these huge disparities in life expectancy between rich and poor nations are unacceptable. Global health practitioners are increasingly excited about the variety of different ways that mobile communications can be used to strengthen health systems and delivery in developing countries. For example, increasing the effectiveness of community health workers, creating new mobile diagnostics, improving the collection of public health data, and persuading people to adopt healthier behaviors are all ways in which mobile services can improve health care in developing countries.

Increase the effectiveness of community health worker

In many developing countries, few people have access to doctors and nurses. In Mozambique, for example, there are only three doctors and 21 nurses for every 100,000 people.[5] Even when low-income countries go to great expense to train doctors and nurses, they often have a difficult time retaining them because of low salaries and poor working conditions.

In these countries, community health workers (CHWs) play a critical role in the diagnosis, treatment and prevention of disease. Unfortunately, CHWs receive little training and have high staff turnover. Researchers from the University of Washington and University of California Berkeley are developing software dubbed CommCare to increase the effectiveness of CHWs. CommCare will help CHWs screen members of the

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[5] "Lack of Doctors and Nurses Killing AIDS Patients, Says MSF," *International Herald Tribune*, May 24, 2007.

local community for illnesses such as TB or malaria, provide advice on issues such as family planning and safe drinking water, and register births or deaths that have occurred since the last visit. The software will also help CHWs plan their day by generating automatic reminder notices for follow-up visits.

Create new mobile diagnostics

Microscopes are a vital tool in hospitals and clinics for disease screening and analysis of patient samples. Many developing countries have little access to microscopes or the trained personnel needed to use them and interpret the images.

A project that grew out of a University of California Berkeley undergraduate course in bioengineering and is now supported by the Blum Center for Developing Economies and Microsoft, is designed to address this. Faculty and student researchers have developed an attachment for cell phones that can take high-resolution images of blood smears, infected skin, or crop blight, and transmit the images to experts anywhere in the world. They are also developing software that can automatically analyze those images, which might allow an unskilled health worker to immediately provide a diagnosis for a disease such as TB.[6]

Other mobile diagnostic systems that have been developed can monitor electrocardiograms and glucose levels for patients with diabetes. For example, the GlucoPhone developed by a South Korean firm allows people with diabetes to measure their blood sugar and send the results to an online medical management database and physicians.

Improve the collection of public health data

Better collection of public health data, particularly if it is used to drive decision-making on the allocation of resources, can save lives. One initiative supported by the Canadian government reduced child mortality in two districts in Tanzania by 40 percent. Better data collection allowed district health managers to allocate a greater share of their budgets to the major causes of mortality in their community, such as pneumonia, malaria, and other common childhood diseases.

A non-profit organization, DataDyne, has created EpiSurveyor, open source software for mobile data collection. Typically, this software is developed by expensive IT consultants from developed countries. EpiSurveyor allows public health officials to create their own

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[6] See http://blumcenter.berkeley.edu/telemicroscopy-disease-diagnosis

surveys, and install the resulting electronic forms on PDAs and smart phones. For example, Kenyan officials were able to use the software to help launch an emergency polio vaccination campaign after fighting and political unrest brought waves of unvaccinated refugees from Somalia. Zambian public health officials learned of the outbreak investigation form, downloaded it from the project Web site, and adapted it to Zambia's needs.[7] With support from organizations such as the UN Foundation, Vodafone, and the World Health Organization, health professionals in 10 developing countries will be trained to use the software for disease surveillance.

Increase adherence to drug treatments

Many patients with infectious diseases fail to consistently take their medication, which results in lower cure rates and the emergence of drug resistant strains of the disease. This is a major problem for tuberculosis, which requires more than six months of treatment. The recommended practice is to directly observe patients taking their medicine, but this places a considerable burden on public health systems in developing countries with a high incidence on TB.

Dr. David Green of Cape Town, South Africa, has developed a simple and cost-effective approach to solve this problem. He enters the names of all of his TB patients in a database, and a computer automatically sends them a personalized text message reminding them to take their medication. When his patients complained that the messages were boring, he created a database of jokes and lifestyle tips that he changes on a daily basis. This reduces the workload of the public health staff in Cape Town, and allows them to focus on the patients with the poorest rates of compliance.[8]

The United States has a strong self-interest in preventing the spread of drug resistant strains of TB and other infectious diseases. With the dramatic increase in global air travel, infectious diseases can quickly cross national boundaries. A single case of multi-drug resistant (MDR) TB can cost $500,000 to $1 million and take 18 months to 24 months to treat in the United States. In New York, for example, the cost of responding to the MDR epidemic in the late 1980s was $1 billion.[9]

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[7] Sheila Kinkade and Katrin Verclas. *Wireless Technology for Social Change.* Washington, DC and Berkshire UK: UN Foundation – Vodafone Group Foundation Partnership, 2008.
[8] See www.compliance.za.net.
[9] Julie Gerberding, "Drug Resistant TB: CDC's Public Health Response," February 27, 2008. Available online at http://www.cdc.gov/Washington/testimony/2008/t20080227.htm.

Mobile persuasion

A number of researchers and companies are exploring the use of mobile technology as a means to persuade people to engage in healthier behavior.[10] Using insights from social psychology, it is possible to identify a set of design principles that can increase the effectiveness of mobile health applications that lead to changes in beliefs and behaviors. This is an important direction to pursue because of the huge impact that a healthy diet, physical exercise, quitting smoking, and avoiding risky sexual activity can have on reducing the burden of disease.

Mobile Services as an Engine of Growth

Mobile communications can be an engine of economic growth, job creation, productivity, and poverty alleviation in developing countries. Studies show that:

- A rise of 10 mobile phones per 100 people is associated with a growth in GDP of 1.2 percent.[11]

- Every one percent increase in mobile penetration boosts foreign direct investment as a share of GDP by 0.5 percent.[12]

- Telecommunications investment in African countries such as Kenya and Senegal accounts for more than 10 percent of private sector investment in fixed capital.[13]

- The mobile industry has created 3.6 million jobs in India, not only through mobile operators but through retail sales of airtime, handsets and SIM cards,[14] the mobile industry has created 3.5 million jobs in sub-Saharan Africa.

- Chinese workers who travel for their work (e.g. taxi-cab drivers, plumbers, salespeople) have been able to reduce traveling by six -- a productivity payoff worth $33 billion in 2005.[15]

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[10] See http://mobilepersuasion.org/program/program.html.
[11] Deloitte, *Global Mobile Tax Review 2006-2007*, 2007.
[12] M. Williams, "Mobile Networks and Foreign Direct Investment in Developing Countries," Vodafone Policy Paper Series, Number 2, March 2005.
[13] Bhavnani, Chiu, Janakiram, and Silarszky, *The Role of Mobile Phones in Sustainable Rural Poverty Reduction*, World Bank, June 15, 2008.
[14] Ibid.
[15] Ibid.

- Mobile communications increase demand for investment in complementary infrastructure, such as backhaul fiber networks and electricity.

- People who are self-employed or run small businesses (e.g. rickshaw drivers, shopkeepers, porters, day laborers) report increases in their income once they acquire a cell phone.

As described below, mobile phones can also increase the efficiency of markets, harness the power of remittances, and develop more inclusive financial systems.

Increase the efficiency of markets

Mobile communications can improve the efficiency of markets, as vividly illustrated by an economic study of fishermen in Kerala, India. Prior to the introduction of cell phones, a fisherman might arrive at the beach with his catch, only to discover that the buyers had already left and thus be forced to throw away his catch. Prices could vary between 0 to 10 rupees per kilogram. After mobile service was available, fishermen would carry lists of dozens of potential buyers, and negotiate with different buyers before deciding where to sell their catch. As a result, fisherman increased their profits by eight percent. In addition, consumer prices for fish declined by four percent because fishermen no longer had to throw away five percent to eight percent of their catch.[16]

In Bangladesh, a service called CellBazaar provides a mobile equivalent of eBay or Craigslist. Although Internet penetration in Bangladesh is only 0.03 percent, CellBazaar already has more than one million users who are buying and selling everything from rice, fish, motorcycles, and used goods. For illiterate users, a voice-message option reads out posts in Bangla, the national language.[17]

Mobile phones are also being used to improve the efficiency of labor markets. In Kenya, the KAZI560 service allows employers to post job listings and job seekers to get personalized text messages based on the kind of work they are looking for.

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[16] Robert Jensen, "The Digital Promise: Information Technology, Market Performance, and Welfare in the South Indian Fisheries," *Quarterly Journal of Economics*, 132 (2007) 879-924.
[17] "Selling Potatoes by Phone in Remote Bangladesh," *Wall Street Journal*, September 8, 2008.

Harness the power of remittances

Remittances (the transfer of money by foreign workers to their home countries) are becoming an increasingly important source of finance for developing countries. From 2002 to 2007, the flow of remittances to developing countries more than doubled from $116 billion to $251 billion.[18] Remittances are now more than twice as much as all foreign aid provided by major donors, which was $103.7 billion in 2007.

Remittances have a number of economic and social benefits. Remittances have reduced poverty by as much as 11 percent in countries such as Uganda. They tend to rise during times of economic crises, conflicts, and natural disasters, as migrants send more funds to their families during times of need. Remittances can also improve a country's creditworthiness and lower the cost of international borrowing for governments and commercial banks.

Mobile carriers can play an important role in this market by making it quick, cheap and easy to transfer funds. Currently, sending funds through traditional money transfer operators such as Western Union and MoneyGram is expensive, with fees as high as $16 to send $100.[19] Poor migrants send small amounts of money, so these fees are very regressive. In the Philippines, wireless providers like Smart Communications allow Filipinos working overseas to send money home in minutes with a text message for a fraction of the cost of money transfer operators. Overseas workers can also use text messages to directly pay specific expenses, such as school tuition, insurance premiums, hospital bills, and mortgages.[20]

The mobile industry has even more ambitious plans for the future. Nineteen mobile operators with 600 million customers have teamed up with MasterCard, with the goal of doubling the number of recipients of remittances to 1.5 billion and quadrupling the value of remittances to $1 trillion by 2012.

Building inclusive financial services

Nearly three billion poor people in developing countries lack access to basic financial services such as savings, credit, insurance, and money transfers. As CGAP (Consultative

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[18] World Bank, "Revisions to Remittances Trends 2007," Migration and Development Brief 5, July 10, 2008.

[19] Dilip Ratha, *Leveraging Remittances for Development,* Migration Policy Institute Policy Brief, June 2007.

[20] Elvie Grace Ganchero. *Smart Communications: Low-cost Money Transfers for Overseas Filipino Workers*. United Nations Development Programme. 2008.

Group to Assist the Poor) notes, "Access to financial services enables the poor to build their own path out of poverty …. When poor people have access to financial services, they invest in assets such as sending their children to school, buying medicines and more nutritious foods, fixing a leaky roof, or building income-earning potential by investing in their own enterprises."[21]

By allowing the individual to transact with anyone (with governments, businesses, other individuals, across borders), mobile payments and mobile banking are critical to the success of other mobile services – in the same way that secure credit card transactions over the Internet allowed e-commerce to take off in the United States.

Mobile technology has the potential to expand the reach of financial services to the poor. Branchless banking using mobile phones and a network of third-party agents (e.g. post offices, small retailers) can reduce the two biggest costs associated with providing financial services: building and maintaining a physical presence, and handling small transactions.

One of the more popular services in a developing country is M-PESA, offered by Safaricom, Kenya's leading telecommunications company. Currently, only 10 percent of Kenyans have formal bank accounts. M-PESA allows people without bank accounts to complete simple financial transactions, primarily person-to-person money transfers. Since the service was introduced in March 2007, three million users have registered, a number which is expected to grow to five million by the end of 2008. One researcher saw a small shop in the rural village of Bukura with 20 people waiting outside to use the M-PESA service. "It is always like this," the shop-keeper complained. "Since we have become M-PESA agents we have no time to rest."[22]

It is interesting to note that M-PESA grew out of a public-private partnership between the Vodafone Group (which owns 40 percent of Safaricom) and the United Kingdom's development agency. As Nick Hughes, Vodafone's internal champion for M-PESA observed, "Private sector organizations such as Vodafone are legally bound to use their shareholder capital to achieve the best returns … As a result, any initiatives that relate to the development agenda are squeezed out." By successfully competing for a challenge

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[21] Available online at http://www.cgap.org/p/site/c/aboutus/

[22] Olga Morawczynski, "Why Has M-PESA Become So Popular in Kenya?" June 17, 2008. Available online at http://technology.cgap.org/2008/06/17/why-has-m-pesa-become-so-popular-in-kenya/.

grant provided by the UK government, Hughes was able to get approval for the project from his senior management.[23]

Much more remains to be done to realize the potential of mobile financial services and mobile payments in developing countries. Current success stories involve money transfers as opposed to financial services with longer-term benefits, such as savings. The regulatory environment is also unclear. Kenyan banks are threatened by the low cost of the M-PESA service, and are arguing that the services should be frozen until there are rules to address money laundering and the compensation of clients in the event of losses.

Mobile Communications and Democracy

There are a growing number of examples of mobile communications being used to topple governments, improve election monitoring, report on human rights abuses, strengthen civil society, and democratize the flow of information. A few of the more prominent examples are described below.

Of course, the spread of the Internet and mobile technology does not automatically result in democratization and the free flow of information. As documented by the OpenNet Initiative, more than three dozen states around the world "use various mechanisms of Internet filtering, targeting a broad range of websites addressing political and social topics as well as many Internet tools and technologies."[24] Authoritarian governments such as China's are able to enlist global multinationals to help them. Leading Internet search companies engage in self-censorship to block politically sensitive information, and other leading IT companies have helped built China's "Golden Shield Project" for Internet filtering and surveillance.

Second People Power Revolution

In January 2001, Philippine President Joseph Estrada was driven from office by hundreds of thousands of angry citizens mobilized by millions of text messages and e-petitions. After 11 pro-Estrada senators voted to block evidence of the corruption in an impeachment trial of the President (Estrada was taking money from an illegal numbers racket), citizens began to circulate messages like "The 11 senators are pigs! S&@t,

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[23] Nick Hughes and Susie Lonie, "M-PESA: Mobile Money for the "Unbanked," *Innovations*, Winter and Spring 2007, 63-81.
[24] Faris, Wang and Palfrey, "Censorship 2.0," *Innovations*, Spring 2008, 163-187.

Estrada is acquitted! Let's do People Power! Pls. pass."[25] Text messaging and cell phones become powerful tools for the people organizing demonstrations in the main thoroughfare of Manila, and one carrier reported that the daily volume of text messages increased from 45 million to 70 million. Estrada called it a "coup de text."

Orange Revolution

In October 2004, the Ukrainian state used fraud and intimidation to move 2.8 million votes in the direction of Victor Yanukovych, the presidential candidate favored by his authoritarian predecessor Leonid Kuchma. This resulted in civil disobedience, sit-ins, and general strikes, with hundreds of thousands of orange-clad protestors gathering in the center of Kiev. Ukraine's Supreme Court ordered a revote, and the opposition candidate Victor Yushchenko won the election.

Analysts believe that the Internet and mobile phones played two important roles in the Orange Revolution.[26] First, the Internet allowed an alternative media to flourish that was not subject to self-censorship or overt control by Kuchma and his allies. Second, pro-democracy activists were able to use mobile phones and the Internet to coordinate election monitoring and mass protests. Prior to the election, pro-democracy movements such as Pora (It's Time) had created political networks throughout the country, including 150 groups responsible for spreading information and coordinating election monitoring, 72 regional centers, and 30,000 registered participants. This allowed Pora to mobilize protestors after widespread reports of electoral fraud.

Shining a light on human rights abuses

Organizations such as Witness are enabling human rights activists from around the world to capture video that documents human rights abuses and share it with the world. This footage has been used in advocacy campaigns, for news broadcasts, as evidence in courts, and as a deterrent to future abuses. A cell phone video that showed Egyptian police beating up a prisoner was viewed 112,000 times on YouTube. As a result, two police officers were convicted of torture and sentenced to three years in prison. As one human rights activist observed, "The power of visual images can go along way in making people wake up."[27]

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[25] Jennifer Bagalawis, "How IT Helped to Topple a President," *IT World*, February 1, 2001.
[26] Joshua Goldstein, "The Role of Digital Networked Technologies in the Ukranian Orange Revolution," Berkman Center Research Publication 2007-14, December 20, 2007.
[27] Lawren Howey, "Digital Activists Expose Abuse," *BBC News,* December 11, 2007.

In the Democratic Republic of Congo, children are subject to serious human rights abuses, including sexual violence, attacks on schools, maiming, and the use of children in military groups. An NGO called Ajedi-ka has created grassroots Village Committees for Child Protection. Each committee is equipped with cell phones so that they can all in reports of abuses, and each verified case is submitted to the Watchlist on Children and Armed Conflict.

Harnessing the Mobile Revolution – An Action Agenda

Given the large economic and societal payoffs from the widespread adoption and creative use of mobile services, there is a strong case for increased collaboration among developed and developing country governments, the private sector, philanthropists, and non-governmental organizations. Below are some of the most important steps that different stakeholders can take to make the most of the mobile revolution:

1. Promote private sector investment and competition in mobile services

There are huge differences in the cost of mobile services among developing countries – as low as a penny per minute in India and 46 cents per minute in the Congo. Some of this is due to differences in the density of customers, since a higher population density allows a carrier to amortize its capital and operational expenditures needed to provide mobile service over a larger customer base.

However, competition can play an important role in lowering prices and increasing private sector investment in expanded coverage and advanced services. The impact of competition can be dramatic. Eritrea and Ethiopia have one mobile carrier each, and the lowest mobile penetration on the African continent. Liberia has four mobile carriers and a mobile penetration that is six times greater than that of Eritrea and Ethiopia, despite the fact that Liberia is emerging from a civil war and has a lower per capita income.[28]

Governments can increase competition by making spectrum available to multiple carriers, making it easier to obtain a license to operate, reducing barriers to foreign investment in the mobile sector, ensuring that universal service policies do not discriminate against

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[28] International Telecommunications Union, *African Telecommunication/ICT Indicators 2008*, 2008.

mobile services by supporting only landlines, and safeguarding against anti-competitive behavior.

Developing country regulators should also be willing to support unlicensed services. University of California Berkeley computer scientist Eric Brewer has modified WiFi software so that this inexpensive technology can be used to support long-distance networks as opposed to local hotspots.[29] Regulators should take advantage of these and other innovative approaches to providing inexpensive rural connectivity and grassroots community networks.

Donors (e.g. developed country governments, multilateral development banks, foundations) should champion pro-competitive regulatory reform by investing in training and technical assistance for developing country policymakers, creating case studies of public policy successes and failures, and improving the collection and dissemination of cross-national information and communications technologies benchmarks and indicators. Donors should also invest in the capacity of business users of telecommunications services and consumer organizations to effectively advocate for pro-competitive policies. Developing countries often fail to pursue sensible telecommunications policies because the costs of bad policy are widely distributed, whereas the benefits may accrue to a single, politically connected firm that is seeking an exclusive license. A Minister of Finance may favor a monopoly or a duopoly as a way of maximizing short-term revenue from a spectrum auction. Understanding (and potentially influencing) the "political economy" of telecommunications policy is critical.

2. Reduce or eliminate taxes that disproportionately target the mobile industry

Given the economic and societal benefits associated with mobile services, there is a strong case to be made that governments should reduce or eliminate taxes that disproportionately target the mobile industry, such as special taxes on airtime, or high import duties on handsets and network equipment. In sub-Saharan Africa, eight governments levy luxury taxes on air time and 24 governments levy luxury taxes on handsets. The industry argues that luxury taxes are no longer appropriate given that a mobile phone is increasingly a necessity. An industry-sponsored study also concludes that because the demand for mobile services is so responsive to price reductions, governments could actually collect more tax revenue by eliminating mobile-specific taxes.[30]

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[29] See http://tier.cs.berkeley.edu/wiki/Wireless.
[30] GSMA, *Taxation and the Growth of Mobile Services in sub-Saharan Africa*, 2008.

3. Increase the capacity of developing countries to create and enable applications that address their own needs

Mobile communications will have a greater economic and societal impact if developing countries have more entrepreneurs, programmers, researchers, government agencies, and non-profit organizations that are capable of designing and implementing mobile applications that address local needs.

Donors should provide additional funding to programs such as MIT's EPROM (Entrepreneurial Programming and Research On Mobiles). MIT researchers have developed a mobile phone programming curriculum that they have been teaching across computer science departments in East Africa. They also offer a "boot camp" that gives young African entrepreneurs the skills they need to design and launch new mobile services.[31]

Donors should also support the development of open source software tools that can be modified and adapted to be useful in many different contexts. High-impact examples identified by Joel Selanikio, founder of DataDyne, include mobile data collection, continuing education and training using newsfeeds, tagging of information and interactive quizzes, and software for increasing the effectiveness of teams.

4. Invest in the global ICT4D (Information and Communications Technologies for Development) research community

Many universities (e.g. University of California Berkeley, University of Washington, Carnegie Mellon University, the India Institutes of Technology) and companies (e.g. Microsoft Research India, IBM India Research Laboratory, Nokia Research Africa) have teams of researchers that are committed to understanding and advancing the role that information and communications technologies can play in development. These groups can:

- Train the next generation of leaders in research, industry, civil society, and government.

- Rigorously evaluate the effectiveness of mobile solutions in areas such as health, poverty alleviation, education, and the delivery of government services.

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[31] See http://eprom.mit.edu.

- Develop new technologies, software tools and applications that address unmet needs.

- Promote interdisciplinary collaboration among researchers in fields such as computer science, the social sciences, business, education, and public health.

Donors, funding agencies, and companies should strengthen the field by supporting research, education and training for undergraduate and graduate students, "twinning" programs between developed and developing country universities, real-world demonstrations of prototypes, conferences, and peer-reviewed journals.

5. Fund challenge grants to support innovation in mobile services with social benefits

One of the important points that Nick Hughes makes in his case study of M-PESA is that technology-based companies tend to "keep R&D focused on the technology rather than the marketplace." Innovation in the way technology is used is equally if not more important.

Challenge grants require companies to put up half or more of the funding would encourage more companies to pursue mobile services with broader societal payoffs, such as access for remote rural communities or applications related to health, education, agriculture, small businesses, and financial services for the poor. The grants could also encourage multi-sector partnerships among companies, universities, NGOs, and development agencies.

An example of such a program is the Consultative Group to Assist the Poor, which is providing funding and technical assistance to banks and micro-finance institutions in developing countries. For example, by partnering with XacBank, CGAP is working to extend the availability of deposits, withdrawals, loans, remittances, and cash transfers to rural Mongolia, a country with one of the lowest population densities in the world.

6. Demonstrate private sector leadership in expanding mobile access and its economic and societal benefits

There is a great deal that industry (e.g. equipment manufacturers, handset manufacturers, operators, application developers) can do to maximize the economic and societal benefits associated with the mobile revolution, including:

- Support continued innovation around low-cost equipment, handsets, and services, such as future versions of the GSM Association's "Emerging Markets" handset, or a base station developed by an Indian company that is less than one-tenth the cost of current equipment and uses the same amount of electricity as a light bulb.

- Create financial instruments that allow companies to invest in projects that have high social payoffs but modest financial returns. French yogurt maker Danone has done this, which has allowed it to invest in "social businesses" such as a joint venture with Muhammad Yunus' Grameen Group.[32]

- Devote more people and resources to groups within the firm that can partner effectively with NGOs, social enterprises, universities, and development agencies. Examples of such efforts include Vodafone's collaboration with the UN Foundation and Qualcomm's "Wireless Reach" initiative.

- Pursue a business mission or concrete goal that speaks to the potential of mobile communications to improve the human condition. For example, Serious Materials, a California-based cleantech company, has a stated mission goal of reducing the emission of greenhouse gases by one billion tons per year! Mobile companies could undoubtedly set and meet similarly ambitious goals.

- Embrace openness and interoperability so that it is easy for application developers to make their software and content available to mobile subscribers across multiple networks.

Conclusion

The world is in the midst of a mobile revolution. By the end of the next president's first term in office, more than five billion people will have access to a mobile phone. In developing countries, mobile devices will be the gateway to a global information network. In low-income communities, it might be used to arrange for life-saving medical care, obtain a loan for a small business, and allow a farmer to get a better price for his crops. Working with the private sector, non-profit organizations, and developing country governments, the next Administration can help people around the world make the most of these new opportunities.

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[32] See http://www.danonecommunities.com.