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Opportunities and Innovations in the Mobile Broadband Economy

BY SCOTT ANDES AND DANIEL CASTRO | SEPTEMBER 2010

Mobile broadband offers a vast array of opportunities to improve quality of life for individuals and society. The advances in mobile networks will create new opportunities for innovative applications, services, and devices that will benefit consumers, businesses, government and the overall economy.

The technology for mobile broadband has reached a tipping point—the point where wireless networking technology allows for speeds fast enough for high-value applications, where mobile devices are fast and powerful, and where the cost of the devices and services are affordable to a large segment of the population. As a result, ubiquitous connectivity is likely to emerge as one of the defining attributes of the Internet economy over the next quarter century. The mobile Internet untethers users so they can enjoy the benefits of the Internet from anywhere. And the result will be an array of new applications, services, and devices available to improve people's quality of life, enhance productivity for organizations, and provide the foundation for entirely new business models that could not exist without the mobile Internet.

The mobile Internet has come a long way. In 2010, for example, an Ericsson study reported a worldwide total of over 5 billion mobile connections from portable devices such as handheld computers and cell phones.[1] A proliferation of new consumer electronics, including smart phones, netbooks, tablet PCs, and mobile media devices such as video players and e-book readers, make it easy for users to conduct a wide array of activities out in the world, away from their desks. Consumers can now access over a quarter of a million applications specifically designed for mobile devices. Moreover mobile devices today are more powerful than ever with the computing power of the latest smart phones rivaling that of the supercomputers from just a few decades ago. And finally the speed of mobile data

delivery and the quality of wireless networks has continued to improve, and will take a large leap forward, with the emerging fourth-generation (4G) networks.

Many of the advances in mobile networks are the result of government action, such as making spectrum available to industry. Spectrum is the lifeblood of wireless technology. Consider the history of wireless technology in the United States. The FCC reallocated the UHF TV channels 70 to 83 in the 1980s which allowed for the development of the first analog cellular networks. In the 1990s, the FCC auctioned the PCS spectrum and again innovation flourished: the per-minute price of cell phone calls dropped by 50 percent; the number of mobile subscribers tripled; the number of cell towers quadrupled; and the cumulative industrywide investment in mobile networks between 1995 and 1999 totaled approximately $70 billion, more than triple all prior mobile network investments.[2] Most recently the DTV transition has allowed the FCC to allocate new spectrum for 4G networks which has given rise to the new mobile broadband networks being launched around the nation this year.

Mobile broadband today is the result of convergence between the cellular telephone networks and the Internet, two networks which evolved along very different paths.[3] While 3G networks were designed primarily for voice, 4G networks are being designed for data. Moreover, 4G networks like LTE and WiMax offer download and upload speeds that rival many wired broadband connections, although exact speeds and coverage of 4G networks vary based on factors influencing signal propagation like frequency, antenna height and geography. However, next-generation mobile broadband networks are not just about increasing speed, they are also about increasing performance with lower packet loss, lower latency, and increased capacity. As a result, consumers will soon be able to run multiple, real-time applications, such as streaming video, over mobile networks.

The mobile Internet is already available in many places, including cars, trains, and airplanes, but cost, speed, and availability are still barriers to wider adoption. Wider deployment of 4G wireless technologies such as LTE or WiMax and their successors will help create the foundation for new applications, services and devices, as the mobile speeds of tomorrow will equal or exceed the wired speeds of today. Increasingly the mobile Internet will be about much more than surfing a Web site while sitting in a park; it will enable engagement in a wide array of Internet-enabled activities and transactions.

One important source of innovation will likely be in more implementation and use of location-based services. Location data can be used to improve the quality of search, communication tools, social networking, games, applications and targeted advertising. As applications like Twitter integrate geo-location metadata with user-generated content, other users can use location-aware applications that allow them to find data submitted by others in a specific location. For example, concert-goers can use this feature to socialize with other attendees or neighbors can use it to share information within a neighborhood.

One interesting example of a location-based service is augmented reality (AR). AR is the addition of electronic data to the physical world implemented by overlaying contextual information, downloaded from the Internet, on a graphical representation of the physical world. For example, individuals can use the camera and display features of a smart phone

to display a live view of the world around them with computer-generated information layered on top. Mobile applications, like the Layar or Wikitude browsers, allow smart phone users to combine real-world views with online information, such as Wikipedia entries associated with a specific point-of-interest or reviews about a nearby restaurant. Not all AR applications are limited to smart phones. A driver using a global positioning system (GPS) might view a real-time display of the road with directions embedded on the screen, rather than a simple animated map of the road.

Continued IT advancements will also enable electronics that are increasingly fast, energy-efficient, and low-cost, including wearable computing systems that may someday replace "point-and-click" with "point-and-think." The adoption of IPv6 (Internet Protocol version 6) will mean that Internet addresses will be available for every device, sensor, and even person on the planet. Once IPv6 is fully implemented, there will be more IP addresses than grains of sand on the planet, helping enable the "Internet of things." IPv6 will also provide enhanced security, improved network management, and a better mobile experience. And increased use of cloud computing will reduce the differences between desktop PCs and mobile devices since applications and data will be stored remotely and thus be accessible anywhere.

Perhaps most importantly the next-generation of mobile networking will not be just about person-to-person communication but also about person-to-machine and machine-to-machine communication. Mobile broadband is enabling the Internet to be increasingly integrated with the world around us. Wireless technology combined with advances in low-cost sensors and low-power processors are leading to the creation of an active world that is alive with information. Already we are seeing the beginnings of this trend to merge physical space with cyberspace. In South Korea wireless sensors help monitor the health of bridges to ensure public safety. In the Indian Ocean a network of seismometers, sea-bottom pressure sensors and tide gauges detect abnormal pressure variations indicative of a potential tsunami and send real-time alerts to communities of the potential threat. Companies are offering "smart home" technology that enables individuals to use their mobile device to control their lights, turn on their heaters, and schedule recordings on their personal video recorders. And a world that is alive with information will also mean more personalization. Devices connected to the Internet will be able to deliver services and information customized for each individual.

Finally, mobile broadband is enabling entirely new business models. Amazon has created a new line of business selling e-book because of the success of the Kindle e-book reader that uses mobile networks to receive timely content like the latest *Wall Street Journal*. ZipCar provides consumers with affordable car-sharing by using mobile networks to make reservations, monitor its vehicles and track usage. RedBox offers consumers convenient DVD rentals using mobile networks to manage its inventory in real-time and allow consumers to rent movies from their mobile phone s. Coffee Nation in the UK, which provide self-service coffee kiosks, uses mobile networks to remotely manage their coffee machines to keep them stocked, clean and well-maintained. And local businesses are harnessing geo-social apps like Foursquare or Gowalla to provide location-based ads to

mobile users. A restaurant, for example, might offer a mobile coupon to a first-time customer or use a mobile loyalty program to reward a patron for being a frequent diner.

All of this will mean more investment, more productivity, and more jobs. While many of the applications discussed below are about directly improving the lives of individuals, perhaps the biggest impact on the economy will come from businesses and other organizations adopting mobile broadband applications. For example, the city of San Carlos in the United States is using mobile networks to send construction schematics to firefighters en route to a fire.[4] And Amtrak has empowered its train conductors with handheld mobile devices where they can electronically read tickets. Many workers, especially in sectors like transportation, wholesale trade, health care, and some retail sectors, work far from a computer connected by a wire to the Internet. For the tens of millions of workers who are mobile in their jobs (e.g., taxi drivers, airline pilots, mail carriers, sales clerks, repairmen, construction workers, farmers, ranchers, fishermen, etc.) the mobile Internet means that they can now be empowered with the kind of powerful technologies that only office workers once had, and as a result, do their jobs in much more effective ways.

OPPORTUNITIES

Mobile broadband offers a vast array of opportunities for economic growth and to improve quality of life. The advances in mobile networks will create new opportunities for innovative applications, services and devices. Many sectors from health care to energy to transportation have the opportunity to be transformed by the availability of affordable, high-speed wireless connectivity to the Internet.

Education

Mobile broadband is creating new opportunities in education. Wireless technology untethers the student from the classroom and provides both flexibility and unique opportunities to the educational process. Now that students can take notes, do research or download assignments from anywhere, the classroom no longer needs to be the hub of student education. If students are learning about Renaissance art they could tour an art museum while taking notes on their iPad and listening to the teacher's lecture on each painting. And with new devices such as the iPhone and iPad offering thousands of educational apps that make learning fun and flexible, mobile devices are likely to revolutionize the education process in the coming years the same way the PC transformed the way students learn over the last two decades. Moreover, with the ability to receive live feeds teachers can augment their lesson plans to incorporate current events. For example, NASA's iPhone app provides current information on topics such rocket testing accompanied with Google Maps or the most recent photos taken by the Hubble Telescope. The app also incorporates live Twitter feeds from NASA scientists.[5]

Mobile devices can also make schools safer and better run. In the case of an emergency an instantaneous SMS message can be sent to all students and parents. And if all phones had Near Field Communications (NFC) capabilities students could swipe their cell phones to take roll, check out a book or pay for their lunch. If students are absent or tardy, an email could be automatically sent to their parents.

Energy

One reason for high electricity costs is that utilities can accommodate demand increases only up to a certain threshold; beyond that threshold, they must fire up more generators—a process that is energy-intensive, costly for the utility, and when fossil fuels are the energy source, highly polluting. Another reason for high electricity costs is that utilities must build and run enough plants to meet some portion of peak load power demands. If the peak load power demands were reduced, utilities could generate less electricity. Until recently, local power companies have known very little about how the energy is consumed across a given area. Similarly, consumers have had no way of knowing whether running an extra load of laundry on a hot summer afternoon contributes to pushing their local energy grid over a given threshold; nor has any pricing incentive for consumers to modify their behavior at such times of peak demand been in place. Thanks in part to mobile broadband networks that situation is changing.

Mobile broadband is one of the key technologies enabling the deployment of smart grid solutions. Smart grid uses robust two-way communications, advanced sensors, and distributed computers to improve the efficiency, reliability, and safety of power delivery and use. It also underpins new pricing mechanisms that allow producers and consumers to make better informed decisions about energy production and consumption based on market incentives. With variable pricing, consumers can adjust their energy usage to off-peak times to save money and be more energy efficient. Mobile technology is integrated into advanced metering infrastructure to allow machine-to-machine communication between the consumer and the utility. These "smart meters" are electricity meters that automate a range of energy management functions such as collecting energy usage and starting and stopping services. Mobile communication can allow two-way communication between the consumer and the utility, allowing consumers to sell energy back to the utility and allowing utilities to deploy services like electric car charging stations anywhere they can provide the electricity. Mobile technology is also used to offer real-time monitoring and detection of outages and provide communication to service workers in the field.

Health

Mobile devices are rapidly becoming an important platform for health care because they offer a number of benefits including low costs and widespread usage, even in underdeveloped regions. In addition, mobile devices can provide quick access to expert care even in remote or rural locations. Because of these advantages, researchers have begun developing health care applications for patients and providers using mobile devices as a platform.[6] Obstetricians, for example, can use the AirStrip OB system to monitor the fetal heartbeat and maternal contraction patterns of their patients in the hospital delivery room in real-time directly from their mobile phone. Other doctors use mobile apps to access online databases, such as to review medical research or receive notifications of the latest drug safety warnings.

Consumers also have access to a variety of mobile apps to help them manage their health. For example, the Pill Phone is a mobile app that helps patients take their medication properly by displaying reminders on their cell phone when it is time for another dose. The app shows what the pill looks like and includes dosage amounts, usage notes and side

effects for easy reference. Other apps allow patients to look up nutrition information, calculate their body mass index, and track other health indicators. Health care workers are also using use text messaging on cell phones as a tool to educate patients about diseases and send them medical alerts. In one study, health care workers experimented with an 11-week protocol to educate parents of children with type 1 diabetes using the mobile phone short message service (SMS) and received high user satisfaction.[7]

Self-management and remote monitoring technologies help increase patient independence and reduce health care costs by allowing individuals to live independently longer and stay in their own homes thus avoiding costly hospital stays. For example, "smart bandages" that adhere to the skin can monitor, record and transmit information about a patient's health to a doctor or health service allowing 24-hour monitoring of a patient's health from the privacy of their own home. Self-managed treatment and remote monitoring are useful for many chronic health conditions from obesity to diabetes to depression.

Many technologies focus on improving health outcomes, such as increasing drug adherence since many patients do not take medicine as prescribed. Smart pill bottles, like GlowCaps, alert patients when it is time to take their medication. The pill bottle will automatically light-up or play a ringtone to signal to the patient that it is time to take a dose. If the pill bottle is not opened within two hours of the scheduled dose, the bottle can call a cell phone to remind the patient. The bottle can even call a pharmacy to order a refill when medication runs low.[8] One study found that using a smart pill bottle increased medication adherence to 98 percent compared to just 71 percent among participants using only standard pill bottles.[9] However, smart pill bottles are only the first step. Eventually smart pills that are activated as they are digested will send signals to wireless transmitters allowing patients to share detailed information with their doctors about their medication adherence and their physiological response. This information will allow doctors to monitor their patients more closely, such as identifying if a drug is too strong or not strong enough.

Many new health products and applications using mobile networks are on the horizon. Recently, for example, researchers have begun developing a virtual speech therapist that runs on a cell phone to help the estimated 40,000 people who suffer from a stroke every year in Malaysia. This application will address both the shortage of speech therapists in Malaysia and the difficulty patients face with traveling to a therapy centers.[10] Other applications of telemedicine may make use of sensor networks and portable global positioning systems (GPS) to report personalized medical hazards to patients. Thus, for example, asthmatic patients may carry a GPS-enabled mobile device that can alert the patient when the ambient air quality reaches dangerous levels from allergens or pollutants.[11]

Transportation

Mobile broadband is helping to transform transportation. Toyota recently debuted the LTE Connected Car concept which it called a "smartphone on wheels." Using mobile broadband, the car integrates features to improve safety and provide access to information such as maps and directions, destination highlights and weather details. Passengers can also

enjoy better entertainment and more productivity tools with video streaming and access to corporate networks.

Mobile phones also provide access to important transportation information in real time. Checking the status of a flight to see if it is on time or has been canceled is easily accomplished by mobile phone or using an app like TripIt to receive alerts. Similarly commuters can use their mobile devices to find travel information on buses or trains. Cities like San Francisco are using mobile networks to deploy smart parking system that allow users to locate an open parking spot or pay for parking using a mobile phone. Both Google and Microsoft provide traffic information in real time. Google Maps provides a "traffic" button on its maps in metropolitan areas that shows red-yellow-green indicators for current traffic speeds and allows the user to learn "normal" traffic levels by the time of day or day of the week. Microsoft offers Clearflow, a service that uses artificial intelligence to provide navigation advice that takes into account expected traffic conditions on a roadway-by-roadway basis.[12] Intelligent transportation systems integrated with GPS navigators such as Telenav on smart phones let users know about real-time traffic conditions and advise drivers on optimal route navigation patterns to take less congested routes. Future advances will make these systems bi-directional, integrating traffic patterns with traffic signal lights. Finally, mobile broadband is being used to improve commercial transportation. Businesses can use mobile networks to track and trace their fleets and better manage their inventory.

Accessibility for Individuals with Disabilities

The widespread digitization of information through mobile devices enables multiple modes of communication, each with its own unique features and benefits. Thus, it reduces barriers to communication for people with disabilities and provides new opportunities for social interaction. Many technologies offer high levels of flexibility and customization for users with different needs. Thus, for example, people with hearing disabilities, who have little use for voice telephone features on a cell phone, can instead opt to use the texting, instant messaging, and e-mail features on these devices. In fact, some cellular phone companies offer mobile phone plans exclusively for individuals with hearing disabilities.[13] Users with hearing disabilities can similarly bypass traditional media that rely on voice communication and instead use videoconferencing services to communicate through sign language or lip reading. Using speech-to-text software, broadcasters can offer closed captioning for all of their programs, even live programs, at a lower cost than that of using a human stenographer. Speech-to-text technology is also being used to produce automatic closed-captioning on YouTube videos and deliver transcribed voicemails to Google Voice users.

Similarly, the widespread digitization of information has created a paradigm shift that benefits people with disabilities. Information is no longer constrained to a single medium. Instead, information technology has created a world where users can choose the form in which they want to consume information. Twenty years ago, for example, only a paper copy of the *New York Times* was available. Now individuals can choose to read the newspaper in print, online, or on a cell phone or other mobile device. Visually impaired subscribers can use text-to-speech applications to hear the newspaper and subscribe to podcasts from leading *New York Times* columnists.

Some technology developers have adapted handheld PCs for use by visually impaired users. Using add-on peripherals such as a Braille display or voice synthesizer for output, users can customize their personal digital assistants (PDAs) for their needs. Thus, for example, a user with a visual disability can equip his or her PDA with an optional bar code reader to electronically identify objects in a store. Once radio-frequency identification (RFID) tags become widely used for individual consumer items, identifying consumer goods will be even easier for such shoppers. Engineers have even developed an improved version of the classic magnifying glass: a portable video device that can magnify objects, make light print darker, and increase the contrast between lettering and the background.[14]

Digital technology is also empowering people with visual disabilities by providing them with much more information when they are outside their home. A technology combining a global positioning system (GPS) with an accessible PDA, for example, enables users with visual disabilities to navigate and orient themselves, even in unfamiliar settings. With this technology, the PDA issues voice prompts, telling the person where he or she is and how to get to their destination (e.g., "turn right"). In addition, users of this technology can connect to databases containing information about points of interest, such as restaurants or transit stations, to find their way to previously unvisited locations. Some regions, including Fairfax County, Virginia, have even compiled databases of obstacles such telephone poles, fire hydrants, and sidewalk cracks to aide with mobility.[15] Although a GPS is certainly not intended to take the place of mobility training, it does serve as a helpful electronic guide and tool.

Increased Access for Low-Income Individuals

Mobile broadband can help close the digital divide by increasing access to the Internet for low-income individuals. Because of the lower cost of mobile devices like smart phones compared to PCs and laptops, mobile devices are reducing the digital divide and expanding access to technology to all segments of the population. And as mobile devices become more advanced they are able to substitute at least some of the functionalities of PCs for a lower cost. Indeed, more low income households access the Internet solely through mobile device than any other income bracket. While 8, 10 and 12 percent of families earning above $75,000, $50,000-$74,999, and $30,000- $49,000, respectively, solely access the Internet through mobile devices, 17 percent of households earning less than $30,000 do so. This is one of the reasons why use of wireless Internet has grown fastest amongst lower income households (see Table 1).[16]

ANNUAL HOUSEHOLD INCOME	April 2009	May 2010	% Change
Less than 30,000	35	46	+11
$30,000-$49,999	53	55	+2
$50,000-$74,999	63	67	+4
$75,000+	72	80	+8

Table 1: Growth in the percent of households that use wireless Internet, 2010, Source: *Mobile Access*, PEW Internet Use and American Life Project.

Many grassroots organizations have also used the explosion of mobile devices to reach underrepresented communities. For example, VozMob a non-profit organization in Los

Angeles helps immigrant workers with limited computer access gain greater participation in the digital public sphere by allowing people to tell stories about their lives and communities over their cell phones which are automatically uploaded online.[17]

Mobile Wallets, Mobile Banking and Mobile Commerce

In some nations mobile devices are increasingly used as a substitute for a wallet (i.e. an ID, cash and a credit card), to bank online and to conduct e-commerce. Mobile wallets will enhance consumer convenience through the potential to replace a litany of artifacts of analog life designed to convey money or information (e.g., credit cards, loyalty cards, transit cards, ID cards, keys, key fobs, tickets, passes, etc.) with a single, more powerful digital device. For example, moviegoers can buy tickets to a movie on their mobile phones, and then when they get to the theatre simply swipe their phone at the ticket gate to enter. Already in the United States some airlines allow customers to use an electronic boarding pass on their mobile phone in lieu of a printed boarding pass.

Mobile devices also present an opportunity to expand the reach of online banking. The number of mobile banking customers in the United States is anticipated to have increased by 2,000 percent between 2006 and the end of this year, and given the relative price of mobile devices to PCs it is reasonable to assume a greater number of these new customers will be from lower-income consumers.[18] And new services like Amazon's TextPayMe allow individuals to quickly and easily send money to anyone with a phone or email address using a text message.

Many nations are taking advantage of Near Field Communications to enable customers to "tap and pay" with their mobile phone (rather than swiping a credit card). Contactless mobile payments were worth $10 billion in 2009 and they are expected to reach $52 billion by 2010.[19] Mobile payments represent a transformative digital application that will benefit consumers, merchants, and the economy and society at large through productivity enhancements and innovative applications and services. Japan and South Korea lead the world in terms of per-capita number of contactless-enabled mobile phones and POS terminals deployed, the total number of contactless transactions, and market value of contactless payments. In Japan, 17 million citizens make contactless mobile payments from their cell phones, with 65 million regularly using contactless smart cards, and 73 percent of mobile phones having electronic wallet capability. In South Korea, close to 4 million citizens use their mobile phones to make contactless payments, with 12 million phones having the capability to do so. Thirty-three million contactless transactions are made daily using either smart cards or mobile phones in South Korea. While the United States has made some progress in fielding NFC-enabled credit cards and POS machines, virtually no mobile phones are equipped with NFC-enabled electronic wallets.

Mobile commerce or m-commerce is also the next stage of e-commerce. While m-commerce is in a relatively nascent stage in the United States, other countries are further ahead. For example, Japan has a particularly strong mobile commerce market, including an $8.4 billion market for contactless mobile payments in 2008.[20] Although many of these payments come in the form of kiosk transactions through mobile phones, the portion of Japanese using mobile devices for traditional e-commerce is much larger than in the United

States or Europe. Of enterprises selling to customers online, 46 percent have platforms for mobile devices, and another 10 percent of firms are in the process of developing mobile platforms (see Figure 1).[21]

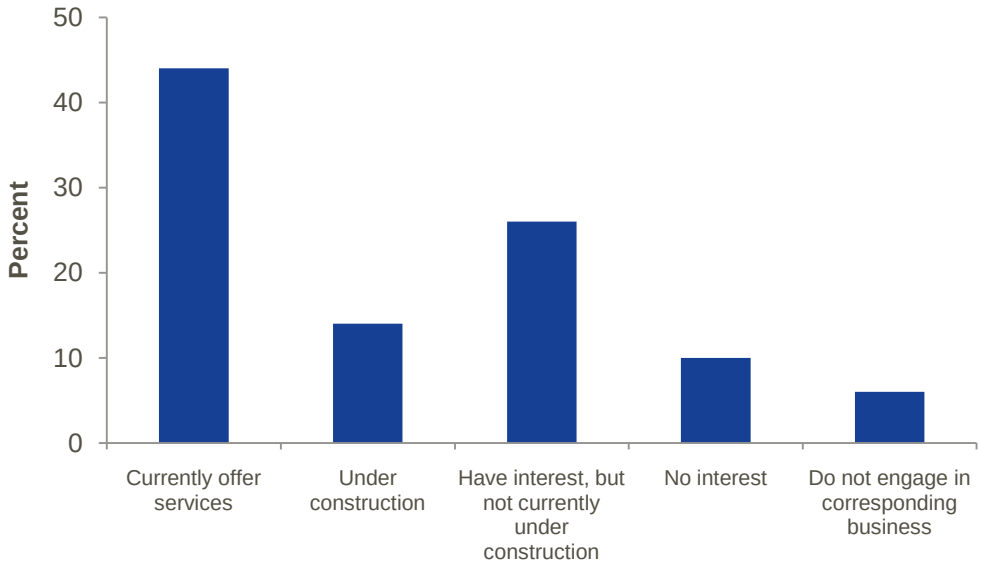

Figure 1: Percent of e-commerce sites in Japan, by readiness for mobile devices. Source: Ministry of Economy, Trade and Industry[22]

In Japan and South Korea, ubiquitous high-speed broadband networks along with the most robust mobile communication infrastructures in the world have made uploading high-quality content via mobile devices extremely popular. However, in developing Asian nations such as China and Thailand, where first generation cell phones still dominate the market, fewer than 15 percent of mobile subscribers use their devices to go online.[23]

Globally mobile commerce is booming for mobile app developers. Users downloaded nearly 7 billion mobile app last year and that figure is expected to rise to 50 billion by 2012. Similarly the revenue from mobile apps is anticipated to go from $3 billion in 2009 to $18 billion by 2014. One of the reason mobile apps have been so successful is because the barriers to entry are so low compared to traditional software designers.[24] In addition, there is a strong demand from smart phone users for better apps to take advantage of their connectivity. Between the end of 2008 and 2009 the number of mobile phone subscribers in the United States with unlimited data plans increased by over 25 percent and the number of smart phone owners increased by over 50 percent.[25]

Developing Economies

The mobile Internet economy will likely continue to grow in many developing nations as the cost of mobile devices continues to decline and individuals gain higher incomes and are able to more easily afford mobile Internet service. For example, in 2008, the number of Internet users in the developing world grew five times faster than in the developed world.[26]

As mobile phones' capabilities increase and costs decrease, mobile technology can address some unique challenges of the developing world. Poor infrastructure coupled with large

numbers of impoverished rural communities create information deserts for many living in developing nations. But mobile phones help bridge this information gap by providing farmers market conditions, rural medical clinics access to global health experts and small entrepreneurs access to small, just-in-time loans. For example, one study by an economist at Brown University, found, for example, that new phones positively impacted the fish industry in southern India by increasing profits for sellers by 8 percent and bringing down consumer costs by 4 percent.[27]

Mobile technology has helped grow the economies of developed and developing nations alike. One 2005 study found that a developing country with an average of ten more mobile phones per 100 inhabitants between 1996 and 2003 would have enjoyed per capita GDP growth that was 0.59 percent higher than an otherwise identical country.[28] As shown in Figure 2, updating this research in 2008, the World Bank found that a 10 percent increase in mobile phone penetration in low- and middle-income economies adds 0.81 percent to annual per-capita GDP growth.[29]

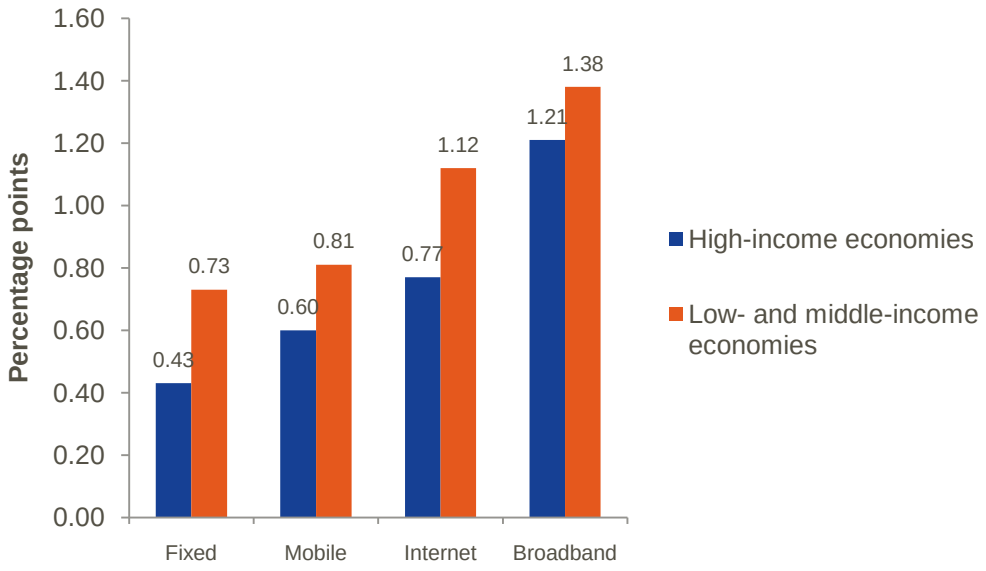

Figure 2: Change in GDP provided by a 10 percent increase in various Internet technologies, by type of economy.

POLICY CONSIDERATIONS

Given that mobile broadband has and will continue to have a substantial impact on quality of life and economic growth, it is not surprising that debates about policy issues regarding mobile broadband have become so vibrant. While many debates about technology and regulation may not ever be fully resolved, some actionable principles and next steps are clear.

The general approach we recommend is for the government to facilitate the mobile Internet by removing impediments to further build-out and adoption. Worries about speculative harms have played too large a role in the Internet regulation debates of the last

decade, and it is more productive to shift the emphasis toward the government's role in facilitating progress. Specifically, there are a number of steps governments can take.

First, it would be a mistake to impose "net neutrality heavy" guidelines on mobile networks. Rather than enacting overly prescriptive regulations against experimenting with new wireless transport service and business models, the governments should rely on transparency, disclosure, and minimum standards to protect consumers from speculative harms.

Second, policymakers should embark on a program of spectrum modernization to ensure that mobile services can continue to thrive. As mobile broadband continues to grow, ensuring that there is enough spectrum available will be a critical issue in every nation. A special focus should be placed on the transfer of licenses from inefficient over-the-air digital television (DTV) use to the general pool of spectrum available for auction. Spectrum modernization should also be employed to replace inefficient government uses and release unneeded spectrum to the pool.

Third, regulations should encourage technical solutions to come forward and be deployed that enable consumers to obtain the best possible service for the best prices. Doctrinaire net neutrality formulas simply do not accomplish that end within the constraints of mobile networks.

Fourth, government should ensure that universal service programs support the expansion of next-generation wireless networks throughout most geographic areas. For example, in the United States universal service funds should support the deployment of cell towers in unserved areas.

Fifth, policymakers should avoid enacting privacy regulations that would restrict consumer use of mobile broadband applications. For example, data privacy legislation proposed this year in the U.S. Congress would impose additional restrictions on the use and handling of geolocation information for users, potentially limiting the growth of these exciting applications.

Finally, governments at all levels should be first adopters, transforming their operations through next-generation mobile broadband, such as equipping first responders, sanitation workers, and other mobile workers with mobile devices that can allow them to work more productively.

CONCLUSION

Mobile technology is expanding the digital frontiers far beyond what was even imaginable a few short years ago. To ensure that mobile broadband reaches its full potential, nations must continue to support both the deployment of mobile broadband technologies and the proliferation of mobile computing devices through which to access the Internet; to remain vigilant to ensure the trust and security of mobile networks; to ensure that companies have incentives to invest in mobile technology; and to ensure that their citizenry becomes digitally literate so they can enjoy the benefits made possible by the mobile broadband economy.

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