

WiMAX in the World

Far Reaching Effects Can Close the Digital Divide

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What is the Digital Divide?

The Digital Divide is the vast and growing gap between the level of technology and information present in the developed world and in the developing world. Historically, nations in the “West” and in the Northern Hemisphere have enjoyed more access to digital computers, entertainment, phones, and other tools. The International Telecommunications Union (ITU) is a group devoted to understanding and closing the digital divide. They have stated that this phenomenon concerns many parties from governments, to private sectors, to financial institutions, all the way down to the individual citizen (Digital Divide, 2001).

As more complex technologies are being invented, the disparity between the “haves” and “have-nots” is increasing even faster. “Worldwide, just 14 percent of the population is online, compared with 62 percent for the United States and an even higher ratio in some Western European countries, according to the International Telecommunication Union “ (Associated Press, 2005). Most citizens of the world have never used a telephone, let alone the Internet.

The real gap exists outside of technology, though. Technology is simply a series of tools used to facilitate actions and results. Therefore, cultural differences lead to a disparity between different groups’ results. Digitaldivide.org believes that the real digital divide lies in the benefits connected nations are enjoying that the rest of the world is not (2007). Benefits can include education, travel, medicine, and improved relationships with distant contacts. Advocates for decreasing the digital divide do not care about the technology of the Internet itself, but the new life it can bring to communities falling desperately behind the developed world.

Current Assessment of Internet and Technology Use in the World

Many organizations, businesses, and governments have tried to grasp the scope of Internet penetration across the world. The UN has recently posted studies regarding how many people have Internet access, how they access the Web, and where the biggest growth is located.

The UN has found that Internet use tripled from 200 million people in 2000 to 600 million in 2002. It reached even greater heights in 2005 when 2 billion people throughout the world were speculated to be using Internet technologies (Sehrt, 2003).

This is roughly 1/3 of the world's population. If growth like this is to continue, then it is inevitable that developing countries will join in the Information Age.

Focusing on Internet and Technology Use in the Developing World

People living in developing nations have very different electronic and electrical infrastructures within their communities. Thus, the technology these people will use will have to be different from the PCs and laptops used in developed nations.

In a recent study, the UN discovered that the majority of Internet access is coming from cell phones and other alternative devices in the Third World (Sehrt, 2003). Rather than purchase expensive computers and find ways to power them, the people of these regions are opting for the newest and smallest devices capable of receiving Internet. With technological improvements proceeding at the steady pace they have been in the past, cell phones and PDAs may one day have all the same functions as a normal-sized PC. These mobile devices, however, are only capable of receiving wireless Internet.

What is WiMAX?

WiMAX, Worldwide Interoperability for Microwave Access, is a wireless network that uses radio frequency. It can send signals through buildings and trees to NLOS (non-line-of-sight) receivers and LOS (line-of-sight) receivers (Honig, 2006, p. 34). WiMAX has been designed to be both fixed and mobile, sending its signals anywhere from 1 to 5 miles, with the range increasing for fixed WiMAX stations (Finneran, 2006, p. 21). An efficient feature of WiMAX is that its transmitters build up into a central mainframe (Figure A). This infrastructure allows a receiver to search from the WiMAX signals available for the least-trafficked and fastest connection from among all potential stations (Kuran & Tugcu, 2007).

The History of WiMAX

The technology emerged in the early 1990s when several companies had simultaneously commissioned their engineers to create more efficient wireless network. Intel, Sprint, Samsung, and Nokia were seeking out new territories (Edwards, 2007, p. 58). The research yielded failures at first. However, with the implementation of fixed transmitters for optimum speed and reliability and the standardization of WiMAX with the Institute of Electrical and Electronics Engineers (IEEE), WiMAX was up and running. Initial investors set up a non-profit organization called the WiMAX Forum, in June of 2001, to enforce standardization and ensure that widespread use of WiMAX would actually materialize (Finneran, 2006, p. 20). Over 300 companies are forum members and the number is constantly growing.

WiMAX has Many Benefits

WiMAX has the capacity to transmit vast amounts of data. Using fixed-location technology allows the user to send and receive up to 75 Mbps of data (Axner, 2006). As

stated earlier, WiMAX signals can reach several miles of receivers. This means a massive flow of information to more people than was ever possible.

WiMAX's most innovative feature is interoperability. WiMAX allows users to go from one network to another seamlessly. This feature includes all generations of wireless from 1G-4G, such as WiFi and cellular phone technology (Johnson, 2005, p. 55). Such a smooth transition is possible because of the switching mechanism featured in WiMAX hardware.

Base stations, platforms or towers could host multiple types of radios and manage handoffs among the different media. Then operators would select 3G, HSDPA, WiMAX, Wi-Fi, GSM and other wireless platforms based on capacity requirements and services for their customers, while sharing elements of the network infrastructure (Johnson. 2005).

Lastly, WiMAX is highly reliable. For example, global navigation systems currently rely on satellites. When the weather is rough or the satellite signals are down, GPS can go offline. With WiMAX in place, non-line-of-sight base stations can reliably send signals to navigation systems (Crowcroft, 2006). WiMAX is the first long-range wireless to fully function in any type of weather conditions.

Comparison to Past and Present Wireless Technologies

Wireless does get better. It becomes an increasingly enriched mobile tool with WiMAX. The speed, quality, reliability, and economies of WiMAX far exceed the features of WiFi and other lower generation wireless networks.

The affordances of WiMAX far outweigh those of past and present wireless technologies. The previous mobile wireless could only send voice and data packets to relatively nearby users. WiMAX, on the other hand, is poised to send whole packets of data, including visuals and multimedia, over space (Gebb, 2005). This is a huge leap in connecting mobile devices to the Internet and other application in an efficient and productive manner.

WiMAX surpasses all lower generation and 4G wireless systems in regards to the economy. The cost to set up a base station is just \$35,000 according to Finneran's estimate (2006, p. 21). Because they reach a similar range as cellular phone transmission, WiMAX hardware can be installed along side existing towers. This arrangement can bring wireless access to thousands of single users or hundreds of businesses. In comparison, it was estimated to cost Intel \$1,100 to install fiber-optic cables in residential homes and businesses and fix the landscaping that would be torn up in the process (Edwards, 2007, p. 58). With WiMAX, the cost would be just a fraction of that and the convenience of wireless would add even more value. Choosing wireless over hardware adds up to billions of dollars if the expectation is a fully connected nation. Telecommunication is also shifting in Asia from cables and fibers to wireless. WiMax is the main focus of this shift because it can be cheaply installed. The prospect of huge progress is even pushing Intel in 4G wireless's direction.

Nations and Governments in Focus

The UN Information and Communication Task Force is one of the many non-profits working to change the flow of information throughout the world. Their assessment of the situation leads the organization to believe that the regions in desperate need of the WiMAX technology are Asia, Africa, Latin America, and the Middle East (UN ICT Taskforce, 2004). The greatest obstacles to Internet access exist within these areas. Even though climate, lack of infrastructure, political turmoil, and other issues have obstructed technological progress in the past, it is believed that WiMAX is the only possible solution for developing countries and remote regions to become part of the global information exchange.

Government officials and major business players in several “Western” nations have hosted some of the earliest experiments into the operation of a WiMAX. Business Communications Review highlighted France and Spain, along with several remote communities within the United States, as next-generation wireless pioneers (Johnson, 2005). Telecommunications companies in these regions have risked millions of dollars in order to run trials with WiMAX networks. Whether they have been or will invest in the wireless technology on a larger scale remains to be seen. Most importantly, time and money are being invested into this revolutionary technology from wealthy nations. While most WiMAX interest comes from developing nations, the rest of the world is beginning to see the importance in lending a hand.

The Republic of Korea and Wi-Bro

The expected leader in 4G adoption is the Republic of Korea. The UN posted a recent survey that found that South Korea has the highest growth of Internet use among all other nations (Sehrt, 2003). However, the majority of developed nations still view Korea as a member of the less developed countries. Korea has simply used the resources it has to bring its citizens the tools and Internet so many other countries have access to.

South Korea is currently one of the most digitally connected and technologically knowledgeable nations. The WiBro standard is very similar to WiMAX and yet had been developed, installed, and in use a lot longer. Johnson reported that the standard would hit Korean markets in 2006 while WiMAX was still looking for more development before being officially released (2005). The Republic of Korea’s quick adoption of WiMAX exemplifies how quickly a nation can obtain information access once a government offers its support.

What Can Fix The Digital Divide?

Eliminating the information deficiency and increasing the range of knowledge present in developing nations is going to take several initiatives before Internet technology can even be installed. It is important to remember that many Asian nations, the U.S., and other well-known technology hubs have taken years to install the necessary equipment, infrastructures, and computers on which the Internet runs.

The UN suggests those willing to close the digital divide must address the core needs of the developing regions they hope to reach. It is essential that water, food, and

education reach these developing areas first (Sehrt, 2003). Since WiMAX falls within the higher realm of human needs, the members of these target communities need to have safe and secure living standards.

In order for any technology to be adopted, adequate training must be designed and slowly introduced into society. Since many of the areas sited to obtain WiMAX service have little to no experience with computers or wireless Internet, instructors must be deployed there to train members of the community, as the UN has pointed out (Sehrt, 2003).

Another step that complicates adoption of WiMAX morphing the current training tactics and programs to fit the language, cultural practices, norms, and styles of the people in the developing nations. Initially, Sehrt emphasizes the need for websites in the world's languages (2003). WiMAX will only be beneficial to these new users if the Internet it accesses contains materials they can understand.

The training provided for computer users in many of the developed nations must be modified to fit the lifestyles of citizens within these developing communities. Again, it is important to take into account that most trainees will be adults with little time left over after completing household chores (Sehrt, 2003). Most users will also need patient tutors and very clear directions because it is more difficult for adults to learn a new concept such as the Internet.

Communication technologies experts at Delft University of Technology in the Netherlands support the need for user assessment when disseminating new devices. Bouwman & Van Der Duin (2007) predict that many past, present, and future studies into information access may fail because researchers focus on the technology and ignore other factors (p. 381). Social norms and trends can have as much of an impact on technology adoption as technology determinism. A successful study of WiMAX use in developing nations will require a study of the lifestyle and customs of the people in addition to the study of the technology itself. For example, in China, free press has historically not been afforded to the general public.

Adapting to the Environment

A major step before the digital divide is closed is designing and delivering the hardware on a mass scale to Third World countries. As mentioned before, the regions obtaining Internet for the first time have geographical, economical, and natural obstacles to overcome. Hardware designers must create Internet receivers that are affordable, require as little hardware as possible, and can operate under extreme weather conditions (Sehrt, 2003). For instance, the traditional personal computer would not work in much of Africa. Remote regions of the continent have hot and dusty climates and do not have electricity; electronics will not operate under these conditions (Otter, 2007). Many regions within developing nations do not have any reliable Internet or electrical infrastructures in place. These, too, must be created and tested before the digital divide can finally begin to narrow.

An interesting solution to this problem was developed at Massachusetts Institute of Technology. MIT researchers have recently designed a computer that can be produced at an extremely low cost and sold for \$100 each to developing nations' governments and schools (Reuters, 2005). The computer is a hand-cranked device that has some, but not

nearly all of the functions of a traditional PC. The hundred-dollar computer is great for regions so underdeveloped and remote that there is no electricity.

Backbone infrastructure is yet another criteria for Internet access in any area. The lack of communication channels would be a major concern in the target nations, since many do not have any wired technologies at present (UN ICT Taskforce, 2004). However, because WiMAX is wireless, the need for major equipment installation is drastically lessened. The only components needed in this regard are transmitters, receivers, and electricity to power the tools.

Additionally, several other factors must be addressed. The UN Information and Communication Technologies Task Force has worked to identify the conflicting issues surrounding the digital divide and planned to look deeply into them by 2005. First, the people living in the developing nations must go through a needs assessment (UN ICT Taskforce, 2004). The information needs we perceive in our culture may not correlate with the needs present in the Third World. While the U.S. and other developed nations have the ability focus on technological innovations and business efficiency, developing nations still need to find ways to provide basic needs, such as adequate health care and food distribution, to its people. The best way for proponents of WiMAX to encourage adoption of any kind of technology is to make it applicable to the target audiences' lives. Following this same thought path, the UN also emphasizes that it is necessary to assess the demand for more information access in these societies. The leaders of each region must be asked if their people even desire to be more connected with the rest of the world. Could the Internet possibly pose a threat to certain cultures? This will determine how much access, equipment, and investment is needed, if any at all.

Why WiMAX?

Telecommunications corporations are looking to penetrate the third-world market with their technologies. Those that can provide the easiest and cheapest to implement will win in the end. Businesses pushing wireless access, both from WiFi and WiMAX transmission, are going to have the most success. In 2004, Keuhn said, "it's much less costly to add a new wireless subscriber than a hard-wire subscriber" (2007, p. 66). It only makes sense that the technology to bring the Internet to developing nations would be this economical. Other estimates project that WiMAX capable devices may fall below the \$100 mark eventually (Johnson, 2005). This is exciting because these figures bring hope to the poorest communities in need of Internet access. An example of this can be found in many Asian nations.

Wireless technologies, especially WiMAX, are a giant leap in technological achievement. Therefore, if equipment can be delivered and installed in developing nations, the information-starved people in those regions will be able to instantly leapfrog over generations of telecommunication and finally reach an even playing field with the rest of the world (Sehrt, 2003). Technology generation skipping is an essential characteristic of WiMAX because the developed world has had a two-decade head start at getting Internet upgrades in order to get where it is. If Third World nations are ever to reach the point where the most-connected regions are, they must be able to skip earlier versions of Internet.

WiMAX has the ability to create networks among transmitters. The great potential here lies in the ability to make Wide Area Networks (WANs) cheaply and with the smallest amount of equipment (Otter, 2007). WANs have the potential to reach up to 30 miles, meaning the most isolated communities will now be able to receive an Internet signal. Other Internet devices can deliver a connection to this wide range but need vast amounts of equipment. WiMAX is the optimum choice because towers need to be installed only every few miles and the computers receiving service do not need additional connecting parts. A future outlook into WiMAX shows that while it is simply this portable now, it may also eventually become mobile and accessible.

Private Sector Will Drive WiMAX Further Than Governments

Many theories exist to predict just how and when WiMAX will begin to make its impact upon the world. Digitaldivide.org believes in equal access to information and is offering its own ideas about the what must occur for this to happen. Members of the group have formulated a 4-stage theory based on private businesses serving as the main drivers of WiMAX. The first stage is philanthropy. Humanitarians have called upon wealthy telecom companies to bring aid to those underprivileged in the digital divide and businesses desire to help out. This, however, is unrealistic in the business, political, and social sense. The second stage is called the “Pralhad Thesis,”:

The public sector has neither the expertise nor the resources to provide goods and services on a scale sufficient to reach the four billion people who currently earn less than \$2,000.... The fact is that the private sector is better suited to serve as a catalyst for development than government (Digitaldivide.org, 2007).

Essentially, all the money and progress that was created in the developed world during the “Digital Age” may flow into developing nations in the form of greater access to information resources. This prediction made by a consultant named Peter Schwartz during the dot-com boom may soon come to fruition because of WiMAX.

The third stage of narrowing the digital divide is “quasi-business initiatives.” Because business is destined to become the primary force for this change, successful implementation of the Internet into remote regions will take many businesses putting millions of dollars at risk to research and test the potential of new technologies such as WiMAX. By 2002, Hewlett-Packard was putting a great deal of money into research and development for the creation of affordable wireless devices for the poor. Since then, IBM has begun conducting educational research into members of these remote and developing communities so they could better understand how to meet the needs of the end user (digitaldivide.org, 2007).

The fourth, and final, stage is realizing that corporations investing time, resources, and energy into this movement are not funding the poor. The technologies are being built to provide information access to governments, schools, healthcare, businesses, and banks that, in turn, will serve the poor. In reality, all initiatives lead by big corporations will first serve to increase revenue paid to them by these organizations. The goal that comes

second to this is that big businesses are trying to help certain infrastructures of these poor societies bring better aid to the people within them.

Many mobile operators and telecom companies are pulling together support and resources. An article featured in *Business Communications Review* states that spending for upgrades to next-generation wireless is growing quickly. "Carriers spent an average of \$2.9 billion each last year on next-gen infrastructure, and plan to increase this total by 41 percent by 2007, to \$4.1 billion" (Anonymous, 2006, p. 6). Business is putting itself at risk by investing so much into an emerging technology like WiMAX. However, the potential benefits far outweigh what is at stake.

World-renowned writer for *TechRepublic* and Verizon Wireless expert, Mark Kaelin echoes this very same sentiment. He has said that cynicism is necessary towards this noble movement, stating, "The company will always be motivated by the market and the potential to make money. If pushing WiMAX to the developing nations increases the bottom line, Verizon will be there" (personal communication, November 29, 2007). The movement to close the gap between the developed and the developing world can succeed; however, we must not forget that business' nature is to maximize profits. That may mean business will profit from social change.

Intel is Leading the Drive for WiMAX

The critics have agreed that if WiMAX is to succeed in the task of serving the underserved, then the Intel Corporation will be the group to make that happen. Intel is the frontrunner in WiMAX investments and has commissioned more research and development projects than any other IT corporation in the world.

Intel has committed itself to support many existing WiMAX initiatives throughout the world. In a recent article posted in *Wired Magazine*, CEO of Intel emphasized that the corporation will pledge a great deal of mind power and money towards helping Sri Lanka Telecom bring Asia its first long-range WiMAX network (Reuters, 2005). This is a breakthrough in the WiMAX movement. With Intel partnering with Sri Lanka Telecom, this merges two wealthy organizations together and brings a powerful force for real social change unheard of until now.

Government Has an Essential Role

There is no denying that business must use its power and capital to invest in WiMAX throughout the third-world. However, political conflict and market protectionism that are common throughout many developing nations could potentially ruin even the most thoughtful initiatives (Kaelin, personal communication, November 29, 2007). WiMAX success will be thwarted if governments are not consulted.

Governments are key players in closing the information gap. Businesses need to work alongside the ruling system of each country to which it wants to bring WiMAX. While governments will not be the parties to initiate an Internet access program, they can stop it before it starts. The role of governments is to grant permission for corporations to install WiMAX transmitters. Then, it is necessary that police forces be hired to protect them in volatile regions. Political leaders must also license frequencies and write policies regarding Internet use. As the UN has formally stated, policy framework is an issue that

can make or break information technology adoption (UN ICT Taskforce, 2004). A close alliance should be formed between the IT corporations, WiMAX Forum, national governments, and powerful NGOs (Digitaldivide.org, 2007). This is the key to closing the digital divide in developing nations.

National governments also have something to gain from bringing WiMAX to their citizens. According to Digitaldivide.org, national governments and “aid agencies are beginning to see these wireless alliances as their best hope for bringing skills and jobs to the rural poor” (2007). By spending time and money to implement wireless Internet in their regions, governments will gain even from increased productivity and decreased mortality.

Other Key Players

Several other groups have vested interests in WiMAX’s success. One such group is the UN. They have promised to work towards a widely known objective called the “Millennium Development Goal” or MDG. As Sehart has explained, this initiative will seek to make technology and communication more widely available to developing nations (2003). The assumption is that both computers and information access can lead to great achievements. The UN has a vast amount of funding and global support to make this goal a reality.

The UN has another organization committed to bridging the digital divide. The previously mentioned “UN ICT Task Force” was created in the hopes of bringing low-cost Internet access to the poor and remote regions of the world (Sehart, 2003). The organization also supports a subcommittee with more strategic goals called “Wireless Internet for Underserved Populations and Local Communities.” This group focuses on obtaining governments, civil groups, private organizations, and specialists that will join the project to bridge the digital divide (UN ICT Taskforce, 2004). It is encouraging participants to advocate the adoption of broadband wireless, such as WiMAX, in the underserved communities.

Obstacles to Implementation

The ideal of accessible and affordable technology can revolutionize the flow of information throughout the whole world. However, the quality of the tools and Internet connections may suffer under a tight budget. The lowest quality materials will be implemented that cut costs but ultimately also cut into Internet connection reliability.

As stated earlier, MIT has designed a \$100 hand-cranked computer for developing nations. These devices have been called “gadgets” by many of Intel’s senior managers. Intel has made a promise to make computers and Internet accessible to the poor nations, but will not sacrifice the quality and usefulness of its computers to do so. “Potential computer users in the developing world will not want a basic \$100 hand-cranked laptop due to be rolled out to millions, according to Craig Barrett, ECO [sic] of Intel” (Reuters, 2005). Intel surveyed peoples of the developing regions they wish to bring the digital era to, and most agree that a computer equal to those used in the developed world would be more desirable than one cheaply made.

The difficulty posed by this desire is the cost. Who will pay and how much it will eventually cost is still up in the air. However, not enough people, corporations, and governments have signed on to contribute to this essential effort. *Wired Magazine* reported in 2005 that the U.N.'s "Digital Solidarity Fund" dedicated to bringing technology to less developed countries (LDCs) has only raised \$6.4 million in its funds. Meanwhile, the U.S. spends \$2.25 billion a year on E-grants for schools and libraries in rural and low-income areas (Associated Press, 2005). The sad truth is that the only nations, other than France, that contribute to narrowing the digital divide through this important fund are African and have the least amount of money to sacrifice. Those that need help obtaining Internet and computer access have to help themselves.

Why It's Worth It

The challenges posed here cannot be overcome in a matter of days, weeks, or even months. It will be years before the infrastructure, government support, technology, training, and funds needed to bring WiMAX to the Third World can be gathered. The task is daunting and will require a great deal of faith on investors' parts, but it will all be worth it in years to come.

The possibilities WiMAX can bring to people across the globe are endless. For example, the right technology can extinguish poverty, diseases, and illiteracy (Associated Press, 2005). A significant goal, these three human tragedies can be stopped with the right knowledge and tools already available to the digital world. Much of these problems have lessened dramatically in developed nations since the Internet entered the global scene. A correlation exists between knowing the right ideas and implementing them to solve real issues.

The Final Stage of Closing the Digital Divide

Access to the Internet will no doubt benefit developing nations. However, this is only one half of the conditions needed to evenly spread information throughout the world. The next step is empowering people of developing nations to contribute to the world's information, too.

In order to truly close the digital divide, third world cultures must become creators of information on the Internet. One-way communication grants access to information but continues to keep the developed world from understanding previously unconnected cultures. This type of interaction leads the developed world to believe groups from remote regions have nothing to contribute to knowledge and may harm relations between the two divisions even more.

What's more is, implementing Internet into indigenous cultures may change their way of life. Receiving and sending information opens people up to new ideas, values, and ways of doing things. Life as ancient cultures know it will be forever changed.

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Figure Aⁱ



Figure A. Wireless transmission of data using a WiMAX network. The signal begins in the Internet backbone and travels through several stations until it reaches the final receiver. Here, the user must have a WiMAX receiver and another wireless device, such as WiFi, in order to create a Local Area Network (LAN) within their structure.

ⁱ From "How WiMAX Works," by Marshall Brain and Ed Grabianowski, 2007, Howstuffworks.com