

# **Investing in Infrastructure: Increasing Internet Access in the Developing World**

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## **Abstract**

Wireless growth in developing countries has been explosive in the past five years. More than half of all telephone subscribers in Africa and in many developing countries of Asia and Latin America use wireless; for most, their cellphone is their first and only phone. However, the outlook for the fixed network is much less promising. Access remains low and investment continues to lag. Access to the Internet is still very limited. Where Internet service is available, it is typically priced much higher than in wealthier countries, making it beyond the means of most potential users. These conditions severely hamper exploitation of the Internet's potential for social and economic applications – in commerce, education, health and other public services.

This paper focuses on strategies to increase Internet access in low and lower middle income countries (as defined by World Bank indicators). It includes analysis of the status of Internet access and broadband in developing regions, lessons learned from the explosive growth of mobile wireless in these regions, and from innovative regulatory and policy initiatives.

## **1. Access in Developing Regions**

During the past decade, the Internet has changed the way people around the world communicate, through email and through the worldwide Web for accessing and sharing information in the form of text and graphics, and increasingly audio and video. The past decade has also introduced personal wireless communications, so that there are now more than 1.3 billion wireless telephone subscribers around the world. Disparities in access to telecommunications, and particularly to the Internet, have become known as the “digital divide.” This paper focuses on access status and strategies for the poorer countries, namely 94 countries classified as Low Income and Lower Middle Income in terms of GDP per capita by the World Bank. See Appendix A. These countries represent half of the 189 member states of the ITU.<sup>1</sup>

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The good news is that access to voice services has improved dramatically, thanks largely to newly available and more affordable wireless (mobile) services in many developing countries. The bad news is that Internet access is still very limited, and that broadband, a key requirement for productive use of many Internet resources, is still unavailable and/or unaffordable in most of the developing world.

The poorest countries have less than one computer and three fixed telephone lines per 100 people, and most of these facilities are located in urban areas, so that rural access may be virtually nonexistent. In developing regions, the need for services besides basic voice is now spreading beyond urban areas, businesses and organizations, to small entrepreneurs, NGOs (nongovernmental organizations) and students, driven by demand for access to e-mail and the Internet. E-mail is growing in popularity because it is much faster than the postal service and cheaper than facsimile transmission or telephone calls. Such services can be valuable even for illiterates. A Member of Parliament from Uganda stated that his father sent many telegrams during his lifetime, but could neither read nor write. Local scribes wrote down his messages and read them to him. Similarly, “information brokers” ranging from librarians to staff of telecentres can help people with limited education to send and access electronic information. Telecenters equipped with personal computers linked to the Internet enable artisans, farmers and other small entrepreneurs to set up shop in the global marketplace.

**Table 1: Internet Access Indicators**

<b>Region</b>	<b>Main Tel Lines /100 Pop</b>	<b>PCs/100</b>	<b>Internet Users /100</b>
Africa	2.7	1.3	0.03
Americas	34.8	29.0	14.5
Asia	11.7	4.6	0.4
Europe	36.6	21.4	2.3
Oceania	39.1	42.4	9.7
World	17.1	10.2	9.9

Derived from ITU, December 2003.

Table 1 shows the gap between the industrialized and developing worlds in three indicators that together suggest the limited access to the Internet. The first is estimated Internet users: more than 85 percent of the world’s Internet users are in developed

countries, which account for only about 22 percent of the world’s population. The other two indicators selected are personal computers and telephone lines because Internet access requires both communications links and information technologies, typically personal computers or networked computer terminals. While there is still much less access to telecommunications in developing countries than in industrialized countries, at present, the gap in access to computers is much greater than the gap in access to telephone lines or telephones. High income countries had 22 times as many telephone lines per 100 population as low income countries, but 96 times as many computers.

It should be noted that broadband access is not included in the above table. Recent data from the ITU indicates that some broadband services were commercially available in 82 economies (out of 200) worldwide, but that penetration rates are quite closely correlated with gross national income per capita, so that in developing countries that do have broadband, access is generally very limited.

Internet access in Africa is particularly limited and expensive. Broadband is virtually nonexistent even for business and institutional customers in most African nations. This lack of local and domestic high speed connectivity prevents Africans from connecting to the SAT-3 undersea cable that now lands at most African countries bordering the Atlantic and Indian Oceans. This \$650 million 120 Gb/s cable is estimated to be operating at only 3 percent of its capacity.<sup>2</sup> And despite the fact that the price of international bandwidth has dropped with the increase in capacity, the price of Internet access was higher in Africa than anywhere else in the world, and completely out of reach of most Africans. See Table 2.

**Table 2: Internet Access Pricing**

<b>Country Classification</b>	<b>Internet Access (20 hours per month)</b>	<b>Internet Price as % of GNI/capita</b>
Africa	\$60.09	241.3%
Americas	\$31.39	27.5
Asia	27.02	48.7
Europe	21.50	6.8
Oceania	39.84	39.9

Derived from ITU, *World Telecommunications Development Report*, December 2003.

## 2. Wireless Growth

In many developing regions, wireless growth has been explosive, with mobile phones becoming the first and only telephones for many new subscribers. In Africa, and in many developing countries of Asia, now more than half of all subscribers are wireless subscribers. See Table 3.

**Table 3: Wireless Access Indicators**

<b>Region</b>	<b>Wireless subscribers /100 population</b>	<b>Wireless subscribers /all subscribers</b>
Africa	4.6	62.4%
Asia	12.4	50.9
Americas	29.9	46.3
Europe	51.3	55.1
Oceania	48.9	54.7
World	19.1	51.5

Derived from ITU, *World Telecommunications Development Report*, December 2003.

Yet these wireless services provide very limited bandwidth, typically a maximum of 9600 bits per second, and often as little as 2400 bits per second. They can be used for text messaging and simple e-mail, but are not really suitable for Internet access (although cellular service has been used for Internet connectivity at a Uganda telecenter where no fixed line service was available). They may, however, provide lessons about how to extend broadband services in developing regions.

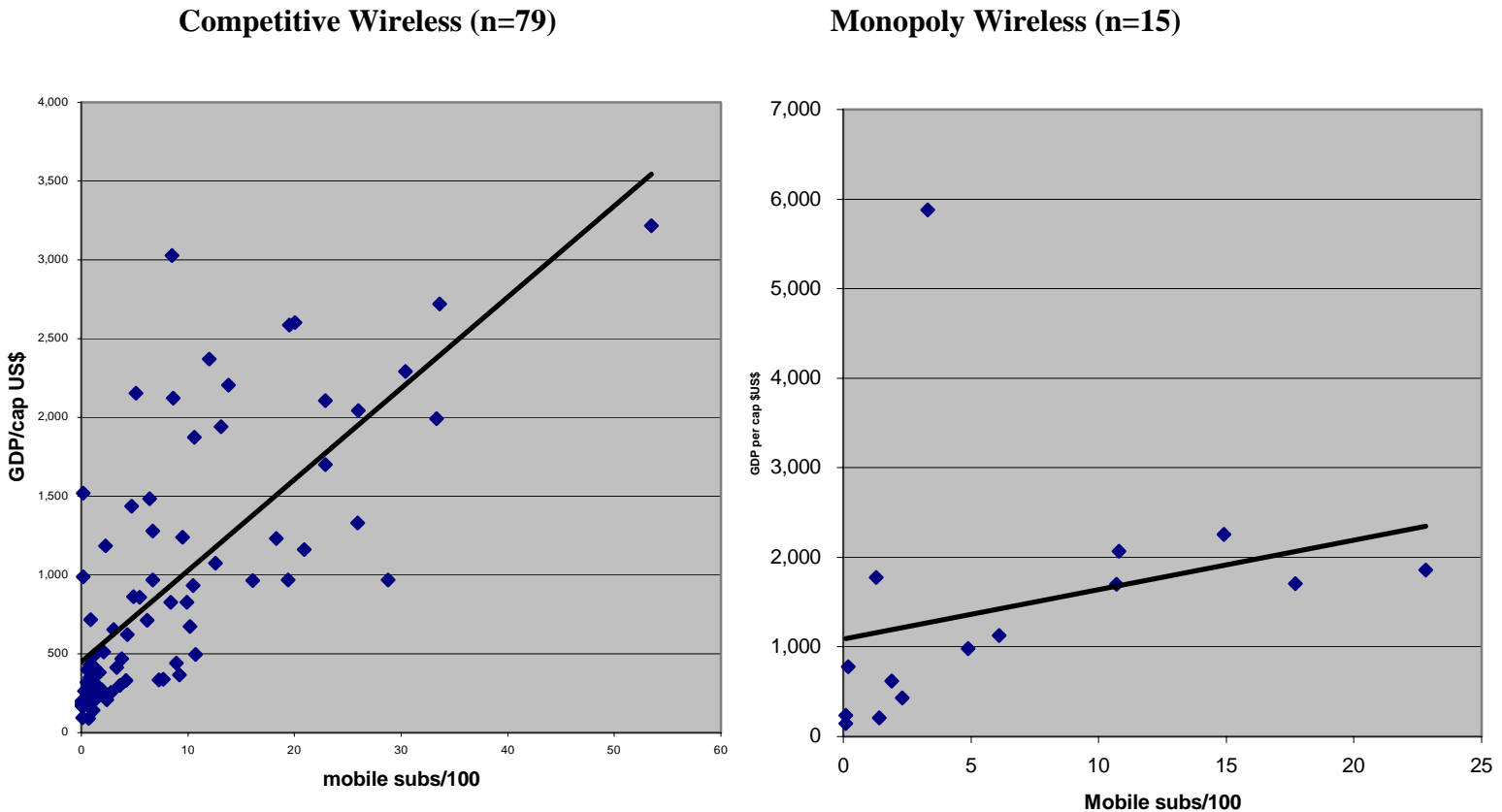
It should be noted that wireless can also be used for public access. For example, cellular operators in South Africa were required to install 30,000 wireless payphones within five years as a condition of their license.<sup>3</sup> This policy, plus rollout requirements placed on Telkom, the monopoly fixed operator, contributed to a significant improvement in access to telephone service. By 1998, 85 percent of South Africans, including 75 percent of those living in rural areas, said that they had access to a telephone. In townships and rural areas, access typically meant an available payphone within a short walk.

### 2.1. The Impact of Competition

What has driven the explosive growth of wireless in developing regions, despite the anemic growth of fixed networks? It appears that the key driver is competition. Wireless competition has resulted in innovative pricing and service offerings. Rechargeable smart cards make phone service accessible to people without bank accounts

or credit histories. Cheap messaging can substitute for many e-mail functions; for example, Filipino wireless subscribers send more SMS (short message service) messages than texters in any other country. Low and lower middle income countries with at least two wireless providers have significantly higher wireless growth rates than countries with a wireless monopoly. See Figure 1. Countries with wireless competition are not wealthier than low growth rate countries; in fact, both categories include some of the world's poorest countries.

**Figure 1: Wireless Growth Rates in Low and Lower Middle Income Countries: Monopoly vs. Competition**



**2.2. Demand Greater than Assumed**

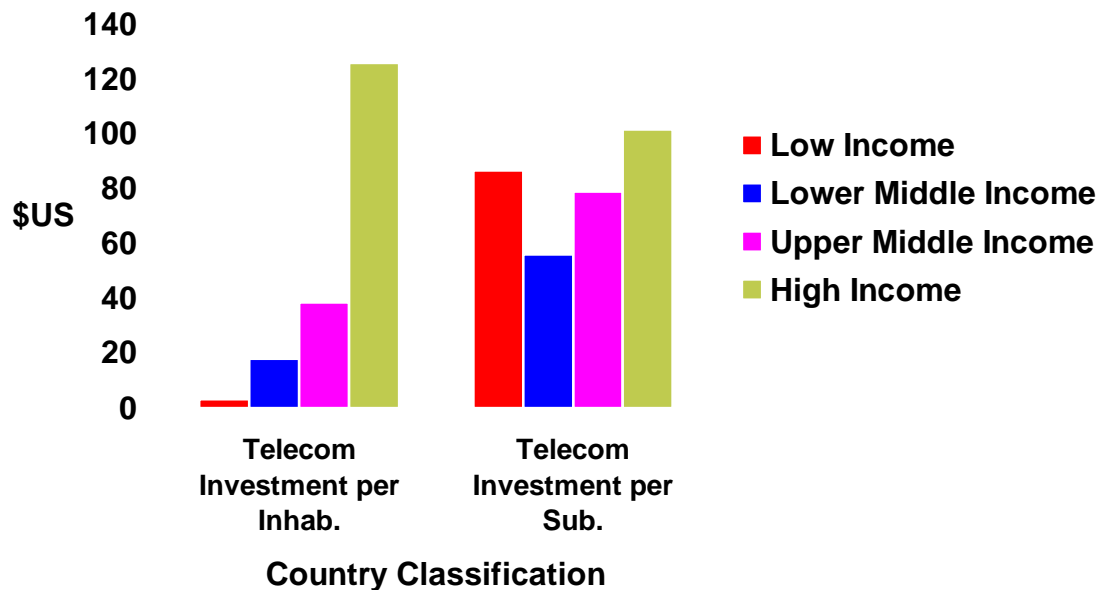
In designing networks and projecting revenues, planners often assume that there is little demand for telecommunications in developing regions. The take-up of wireless services in many developing countries has also demonstrated that there is significant pent-up demand for telecommunications services, even among relatively low income users. While demand for broadband is likely to be more limited, it is certainly not negligible. For example, entrepreneurs may want Internet access to order parts and supplies, check on international prices, and arrange transport of their produce to foreign markets. There may also be significant demand from government agencies and NGOs operating in rural areas to administer health care services, schools, other social services, and development projects, particularly in rural areas.

### 3. Financial Issues: Investment and Revenues

#### 3.1. Investment Indicators

Investment in the telecommunications sector in poorer countries has lagged investment in wealthier countries. While investment per subscriber is comparable, the number of subscribers in most developing countries is relatively low. A more useful comparison is investment per inhabitant. See Figure 2. Here we see that investment in the poorest countries is only \$3.3 per inhabitant, and \$18 per inhabitant in lower middle income countries, compared with \$126 per inhabitant in high income countries. Note that these figures apply primarily to fixed networks.

**Figure 2: Telecommunications Investment**

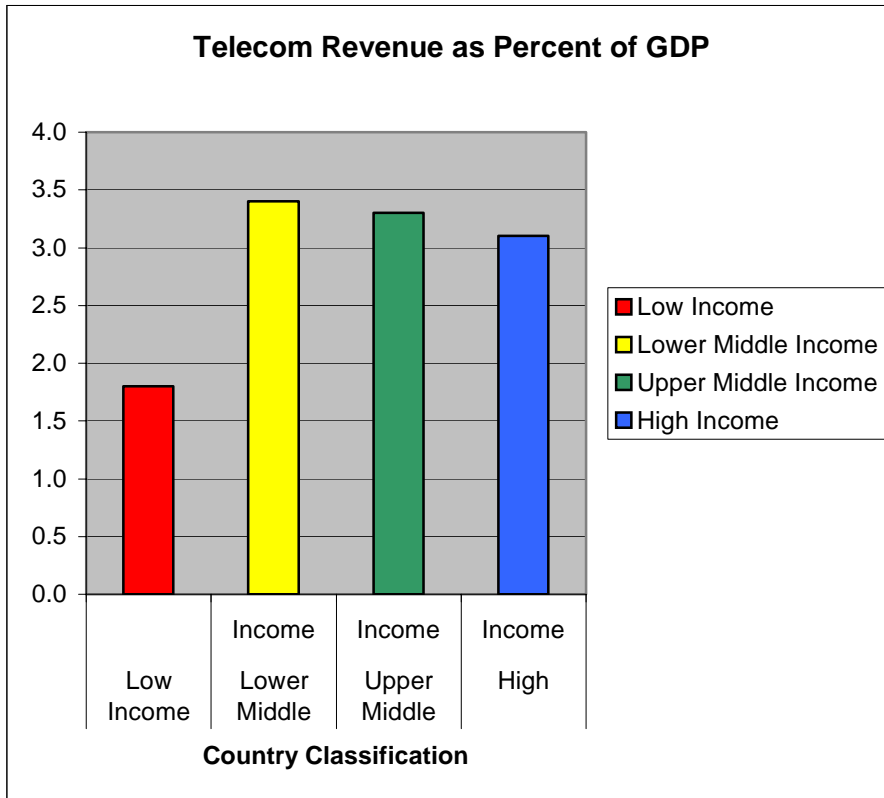


#### 3.2. The Revenue Gap

Of course, we would expect revenue to be lower in absolute terms in lower income countries, but in fact revenue averages about 3.1 percent of total GDP in all but the poorest countries, where revenues are just 1.8 percent of GDP. See Figure 3.

What would be the financial impact if telecommunications revenues in the poorest countries could be increased to 3.1 percent of GDP, the average for all other nations? (Lower middle income countries actually generate revenues of 3.4% of GDP). The total population of the low income countries is about 1.1 billion. Thus, such an increase would generate an extra *\$14.3 billion* per year of revenue.

**Figure 3:**



#### **4. Closing the Revenue Gap**

Drawing again on the lessons of wireless growth, it appears that better marketing including pricing and service options could significantly contribute to generating funds to close the digital divide. Other strategies and policies that could also create incentives to generate more revenue include:

##### **4.1. Improving Telecommunications Management**

Why might investment in fixed networks be so low, given the evidence of pent-up demand shown by the growth of wireless networks? Most fixed networks in developing countries remain monopolies, even in countries that have made some regulatory commitment to introducing competition. Well managed monopoly networks could provide good opportunities for investment. However, these networks are generally very poorly managed. Consider reliability. Fixed networks in low income countries had ten times as many faults per 100 lines as networks in high income countries. Thus many of the limited number of available lines were likely not to be working properly and not generating revenue.

Also, management is much more efficient in wealthier countries, which have about 4 times as many subscribers per employee as do networks in the poorest countries. Some of this difference may be due to the lower price of labor in low income countries, but another factor is likely the tradition or requirement of using the telecom network as a means of creating jobs in countries where there is still significant government ownership in the telecommunications sector.

Another important management indicator is revenue generated per employee. Not only is absolute revenue greater in high income countries, but revenue per employee is more than 13 times as much as revenue per employee in the poorest countries. See Table 4.

**Table 4: Management Indicators**

<b>Country Classification</b>	<b>Faults/100 lines per year</b>	<b>Subscribers per Employee</b>	<b>Revenue per Employee</b>
Low Income	105.1	113	\$21,624
Lower Middle Income	20.8	243	\$73,568
Upper Middle Income	15.1	382	\$157,243
High Income	10.5	453	\$299,356

#### **4.2. Limiting Periods of Exclusivity**

In a liberalized environment, the length and terms of operator licenses can impact the pace of growth of networks and services. Regulators typically face choices concerning how long to protect incumbents to enable them to prepare for competition, and how long to grant periods of exclusivity or other concessions to new operators to minimize investment risk. Yet exclusivity and long time periods may be the wrong variables to focus on if the goal is to increase availability and affordability of telecommunications services. Instead, investors cite a transparent regulatory environment with a “level playing field” for all competitors and enforcement of the rules as key to their assessment of risk. It is highly unlikely that fixed line providers will have an incentive to roll out broadband services beyond large businesses and some upscale residential areas if they see no near term threat to their monopoly. Some jurisdictions<sup>4</sup> have negotiated terminations of exclusivity periods with monopoly operators in order to enable their economies to benefit from competition in the telecommunications sector.

#### **4.3. Extending Access through Resale**

Authorization of resale of local as well as long distance and other services can create incentives to meet pent-up demand even if network competition has not yet been introduced. Franchised payphones can be introduced in developing countries in order to involve entrepreneurs where the operator has not yet been privatized and/or liberalized. Indonesia’s franchised call offices known as Wartels (Warung Telekomunikasi), operated



by small entrepreneurs, generate more than \$9,000 per line, about 10 times more than Telkom's average revenue per line. In Bangladesh, Grameen Phone has rented cellphones to rural women who provide portable payphone service on foot or bicycle to their communities. Franchised telephone booths operate in several African countries; in Senegal, private phone shops average four times the revenue of those operated by the national carrier.<sup>5</sup> In the Philippines, entrepreneurial wireless subscribers resell small increments of time transferring them to "pay as you go" customers who cannot afford the price of a phone card.

Resale of network services can also reduce prices to customers. Most interexchange carriers in industrialized countries are actually resellers that lease capacity in bulk from facilities-based providers and repackage for individual and business customers, offering discounts based on calling volume, communities of interest, time of day and other calling variables. Similar strategies can be used to resell broadband when networks that are upgradeable (such as for DSL) or that have excess capacity (such as optical fiber or satellites) are available.

#### **4.4. Legalizing Bypass**

Facilities that are not offered by an incumbent wireline operator may be the least expensive means to extend access. For example, a VSAT may be an ideal solution to bring high speed Internet access to a rural school or telecenter. A WiFi "hotspot" may be a low cost means of providing broadband to a village or neighborhood. However, in some developing countries, even if the wireline provider does not provide broadband services in the area, or possibly does not even serve the area, such as VSAT connection would be considered illegal bypass.

Many monopoly operators claim that bypassing their networks effectively siphons off revenues that they need to expand their networks, which would also probably create more jobs. However, the relationship is not so simple. As noted above, without competition, there is likely to be little incentive to roll out broadband, to choose the most cost-effective technologies where broadband is deployed, and to price broadband services reasonably. Thus, policy makers will not further the goal of extending access to affordable broadband by preserving wireline monopolies.

Protecting dominant carriers may also hinder economic growth. For example, a West African Internet service provider pointed out that he needed relatively inexpensive international connection to the Internet in order to provide affordable Internet access for his customers. By using bypass, he is creating new jobs in value-added services as an Internet provider, as well as providing an important information resource for economic development of the country.<sup>6</sup>

#### **4.5. Reducing Local Barriers**

Some developing countries set duties on imported equipment including computers and components for telecommunications networks. These duties may generate revenue

for the government, but they increase the cost of network facilities and end user equipment, and thus increase the cost of access for its citizens. The economic benefits of having available and affordable access are likely to outweigh substantially the value of such fees and duties.

Governments may also inhibit network build out by making it difficult for operators to secure permits for rights of way or use of existing poles or conduits, or by charging fees for such permits or other services that place a significant financial burden on the operator. While such fees may also be attractive sources of revenue for the government, they may have the effect of delaying access to the Internet for its residents. In the U.S., the FCC and some states such as Michigan are working to reduce local barriers in order to facilitate buildout of broadband networks.<sup>7</sup> Michigan's plan calls for a 45-day turnaround to process rights of way permits and eliminates redundant charges if a provider wants to offer more than one service on its lines, such as cable Internet access as well as cable video.<sup>8</sup>

## **5. Is the Fixed Network facing Extinction?**

The above analysis indicates that various strategies could succeed in generating more revenue from existing fixed networks and encouraging more investment to upgrade and extend them. However, these networks face numerous threats ranging from bad management and monopolistic complacency to threats to their revenues from wireless carriers and VOIP. Given these problems and the cost advantage of wireless in regions without existing infrastructure, developing countries have an opportunity to leapfrog wireline solutions such as DSL and cable to wireless broadband.

One option would be to upgrade existing networks to 2.5 G (or 2.5 generation) facilities, typically GPRS for the GSM networks that are prevalent in most of the developing world. This approach builds on existing infrastructure, and is much less costly than full upgrades to 3G networks. However, recent technological innovations offer several other wireless possibilities. WiFi (IEEE 802.11 standards) is a low cost means of covering small villages or public spaces. WiMAX (IEEE 802.16) may be attractive because it covers a larger area and does not require line of sight for transmission. Another option is CDMA 450 that can be deployed in cells of 50 to 60 km in diameter, and can provide data speeds up to 2.4 Mbps, making it suitable for rural areas as a fixed wireless deployment for voice and alternative to DSL or cable for Internet access. In addition, satellite links may be the most practical means to reach truly isolated communities and to provide the backhaul links for various wireless last mile (or first mile) technologies.

Is wireless ringing the death knell of traditional fixed wireline networks in the developing world? It seems likely that not only voice but also higher bandwidth services will be available primarily through wireless networks in poorer countries. The fixed wireline network may first face extinction in the developing world.

## Appendix A: Low Income and Lower Middle Income Countries

(GDP per capita ranges from <\$100 to \$5800; average GDP per capita is \$1010)

Afghanistan	Ghana
Albania	Guatemala
Algeria	Guinea
Angola	Guinea-Bissau
Armenia	Guyana
Azerbaijan	Haiti
Bangladesh	Honduras
Belarus	India
Belize	Indonesia
Benin	Iran (Islamic Rep. of)
Bhutan	Iraq
Bolivia	Jamaica
Bosnia and Herzegovina	Jordan
Bulgaria	Kazakhstan
Burkina Faso	Kenya
Brazil	Kiribati
Burundi	Kyrgyzstan
Cambodia	Lao P.D.R.
Cameroon	Lesotho
Cape Verde	Liberia
Central African Rep.	Madagascar
Chad	Malawi
China	Maldives
Colombia	Mali
Comoros	Marshall Islands
Congo	Mauritania
Congo (Democratic Republic of the)	Micronesia (Fed. States of)
Cote d'Ivoire	Moldova
Cuba	Mongolia
Dem. People's Rep. of Korea	Morocco
Djibouti	Mozambique
Dominican Rep.	Myanmar
Ecuador	Namibia
Egypt	Nepal
El Salvador	Nicaragua
Equatorial Guinea	Niger
Eritrea	Nigeria
Ethiopia	Pakistan
Fiji	Palestine
Gambia	Papua New Guinea
Georgia	Paraguay

Peru	T.F.Y.R. Macedonia
Philippines	Tajikistan
Romania	Tanzania
Russia	Thailand
Rwanda	Togo
Samoa	Tonga
Sao Tome and Principe	Tunisia
Senegal	Turkey
Sierra Leone	Turkmenistan
Solomon Islands	Uganda
Somalia	Ukraine
South Africa	Uzbekistan
Sri Lanka	Vanuatu
St. Vincent and the Grenadines	Viet Nam
Sudan	Yemen
Suriname	Yugoslavia
Swaziland	Zambia
Syria	Zimbabwe

## NOTES

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<sup>1</sup> Data used in this research was derived from the ITU's World Telecommunications Indicators Database for 2003.

<sup>2</sup> Goldstein, Harry. "Surf Africa." *IEEE Spectrum Online*, January 30, 2004.

<sup>3</sup> ITU, *World Telecommunication Development Report*, Geneva, 1998, p. 50.

<sup>4</sup> For example, Hong Kong, Singapore, and India.

<sup>5</sup> ITU, *World Telecommunication Development Report*, 1998, pp. 77-78.

<sup>6</sup> Personal communication, July 1997.

<sup>7</sup> See [www.fcc.gov/broadband](http://www.fcc.gov/broadband).

<sup>8</sup> Garretson, Cara, "Broadband group wants unified rights of way plan." *Infoworld*, May 30, 2002. See also [www.linkmichigan.michigan.org](http://www.linkmichigan.michigan.org).