Chapter 2

Global Diffusion of ICT: A Progress Report

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The views expressed here are the author's personal opinions and do not necessarily reflect those of the World Economic Forum. The author wishes to acknowledge invaluable research assistance from Catherine Vindret, Saadia Zahidi, and Victor Echevarria Icaza.

"Bridging the digital divide in and among countries has assumed a critical importance on our respective national agendas. Everyone should be able to enjoy access to information and communications networks."

"Okinawa Charter on Global Information Society," adopted at the G-8 summit meeting in Okinawa and Kyushu, July 2000

Recognizing the potential of information and communication technologies (ICT) for accelerating economic development and enhancing the lives of individuals, the international community has stressed the importance of improving access to technologies, particularly in the developing world. Attention to this issue reached a turning point in 2000, when the G-8 Digital Opportunity Taskforce (DOT Force) was created to focus on bridging the digital divide. It was also at this time that the World Economic Forum initiated work on the first *Global Information Technology Report*,[1] which focused on assessing the preparedness of individuals, businesses, and governments to participate in, and benefit more fully from, the global networked world.

Since 2000, however, much has changed in the global political, economic, and technological landscape. International geopolitical tensions have escalated at the same time that the engines of economic growth have slowed in many parts of the world. Meanwhile, the technology sector has undergone massive and widespread consolidation and restructuring, including painful reassessment of investment strategies and product deployment. Only recently have we begun to see the recovery of the global economy and signs of increased activity in the technology sector.

On the occasion of the World Summit for Information Society meetings to be held in Geneva (2003) and the launching of the third edition of the *Global Information Technology Report*, it is fitting to examine what has been accomplished in the last three years. Although a three-year time frame would appear short in most cases, it is a reasonable time frame when viewed in the context of the dynamism of ICT diffusion in the world.

The purpose of this progress report is to evaluate recent performance and ascertain the implications of the work that lies ahead. What is the global picture of the diffusion of ICT? What has been accomplished in the last three years? Which countries are performing well and which are lagging? How much remains to be done? What lessons can we glean?

This progress report is about access to ICT. It focuses on assessing the spread of key information and communication technologies. It examines the pervasiveness of Internet use in the world and traces the diffusion of personal computers, main telephone lines, cellular mobile telephones, television receivers, cable television, and home satellite antennas.

Among the important uses of these technologies is as tools for transmitting information that can be relevant for

development purposes. But beyond the transmission of information, these same tools, when networked, enhance individual, firm, and national productivity, broaden the market access of entrepreneurs and businesses, and improve government service delivery. Significantly, these devices can improve overall individual well-being and transform the interaction between and among various stakeholders in society, transcending geographical and other boundaries.

This progress report analyzes information from the International Telecommunication Union (ITU),[2] which produces the most extensive database on relevant indicators. The database contains several decades' information for more than 200 countries and territories and is an excellent source not just because of the breadth of its scope, but also for the comparability of the data. The current analysis relates to data for 1999–2002 for 200 of the world's economies covering 99.98 percent of the world's population. Seven indicators are included: the number of Internet users (estimated), personal computers, main telephone lines in operation,[3] cellular mobile telephone subscribers[4] and, to a lesser extent, television receivers, cable television subscribers, and home satellite antennas. The data, although ending in 2002, appear to reflect the most current world status of these indicators.

The types of ICT assessed in this chapter were determined primarily by the availability of data. The selection does not, in any way, assert that these devices represent the technologies most relevant for the developmental requirements of countries worldwide. Indeed, beyond the scope of this report are other very important dimensions of the issue of ICT access, such as identifying appropriate technologies and relevant applications and ensuring affordability and ease of use, being particularly mindful of varied linguistic and learning capabilities.

Employing disaggregated data, this analysis is conducted at the global, regional, and country levels. The first part of the analysis focuses on the global picture, defining eight prevailing trends. The second part presents regional profiles that capture those countries that are significantly improving ICT access and those countries that are lagging behind. The third part of the analysis highlights policy considerations that are most relevant to promoting ICT access.

Part I. The Global Picture

Eight key findings sketch the global picture: (1) growth in ICT diffusion has been dramatic, with cellular mobile telephone subscribers exceeding the number of main telephone lines

Table 1. **Increase in Global ICT Diffusion at a Glance, 1999–2002**

	1999	2002	1999–2002 Increase	
	(in millions)	(in millions)	(in millions)	(in percent)
Population	5,962	6,192	229	4
Households	1,484	1,552	68	5
Internet users (estimated)	276	605	329	119
Personal computers	394	550	157	40
Main telephone lines in operation	906	1,098	192	21
Cellular mobile telephone subscribers	493	1,155	662	134
Television receivers	1,573	1,775	202	13
Cable television subscribers	288	359	71	25
Home satellite antennas	78	97	19	24

	% of Total population		% of Total households	
	1999	2002	1999	2002
Internet users (estimated)	5	10	19	39
Personal computers	7	9	27	35
Main telephone lines in operation	15	18	61	71
Cellular mobile telephone subscribers	8	19	33	74
Television receivers	26	29	106	114
Cable television subscribers	5	6	19	23
Home satellite antennas	1	2	5	6

	Ratio to population		Ratio to households	
	1999	2002	1999	2002
Internet users (estimated)	1 in 22	1 in 10	1 in 5	1 in 3
Personal computers	1 in 15	1 in 11	1 in 4	1 in 3
Main telephone lines in operation	1 in 7	1 in 6	1 in 2	1 in 1
Cellular mobile telephone subscribers	1 in 12	1 in 5	1 in 3	1 in 1
Television receivers	1 in 4	1 in 3	1 in 1	1 in 1
Cable television subscribers	1 in 21	1 in 17	1 in 5	1 in 4
Home satellite antennas	1 in 77	1 in 64	1 in 19	1 in 16

Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

and with Internet users exceeding the number of personal computers; (2) the largest increases in ICT diffusion are in the most populous countries; (3) some of the fastest rates of growth and most sizeable increases in diffusion are in developing economies; (4) the best penetration rates are still in advanced economies with relatively small populations; (5) the less developed economies still have the poorest ICT penetration rates; (6) despite the dramatic increases in diffusion of ICT in the most populous countries, it is also in these very same countries where most of the work still needs to be done; and finally, (8) the "divide" in ICT access has narrowed but low income, particularly severely indebted economies in sub-Saharan Africa, still lag considerably.

1. Growth in global ICT diffusion has been dramatic.

While much remains to be done, it is indisputable that the diffusion of ICT access has been nothing less than dramatic over the three years under study. This improvement in ICT access has been achieved despite consolidation in the technology sector and an overall global economic growth slowdown.

The greatest dynamism was exhibited by the growth of cellular mobile telephone subscribers and the increase in the number of Internet users (see Table 1). Of the 6.2 billion people in the world, 1 in every 5 is a cellular mobile telephone subscriber, up from 1 in every 12 three years ago. In this period, the number of cellular mobile telephone subscribers grew 134 percent, outpacing the 21 percent growth of the number of main telephone lines in operation. Since 1999, there have been 662 million additional cellular mobile telephone subscribers, many more than the 192 million main lines added during the same period. As of 2002, the number of cellular mobile telephone subscribers (1.15 billion) exceeded the number of main telephone lines in operation (1.10 billion). Appendix 1 lists by income the 125 economies where the number of cellular mobile telephone subscribers exceeds the number of main telephone lines in operation. As the table highlights, at least 85 of the 125 economies are from middle income and low income countries.[5]

The number of Internet users also multiplied exponentially—119 percent over the last three years. Since 1999, the world has added 329 million more Internet users, bringing the total estimated number of Internet users to 605 million as of 2002. This means that 10 percent or 1 person in every 10 in the world is an Internet user. Significantly, the number of Internet users in the world has exceeded the number of personal computers. There were 550 million personal computers in the world as of 2002, up 40 percent from nearly 400 million in 1999.

Television, however, retains the distinction of being the most pervasive device. There are 1.8 billion television receivers in the world, or 1 for every 3 persons and almost 1 for every household. Coming from a fairly high base, growth in television receivers was 13 percent over the last three years; in numerical terms, that is 202 million more television receivers, a figure higher than the increase in the number of main telephone lines in operation during the same period. But access to cable television and home satellite antennas remains limited. As of 2002, there were about 360 million cable television subscribers in the world, equivalent to 1 subscriber for every 4 households and 1 subscriber in every 17 persons. Meanwhile, home satellite antennas numbered 97 million in 2002, or 1 for every 16 households and 1 for every 64 persons. Both cable television and home satellite antennas grew at a comparable pace, about 25 percent for the three-year period.

2. The largest increases in ICT diffusion came from the most populous countries.

A large proportion of the improvement in ICT diffusion came from some of the most populous countries of the world (see Table 2). For the period 1999–2002, China is the most outstanding performer, posting the highest increase in many of the indicators. The country posted the highest increase in the number of main telephone lines in operation, cellular mobile telephone subscribers, television receivers, and cable

Table 2. **Increases in ICT Diffusion in the 7 Most Populous Countries, 1999–2002**

Increases, 1999–2002* (in millions)						
2002 Population (in millions)	Country	Internet users (estimated)	Personal computers	Main telephone lines	Cellular mobile telephone subscribers	Television receivers
1,285	China	50	10	106	163	40
1,042	India	14	3	15	11	10
288	United States	53	37	6	55	34
212	Indonesia	7	0	2	9	2
174	Brazil	11	7	14	20	4
149	Pakistan	1	0	1	1	5
147	Russian Federation	5	8	5	16	5

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

Box 1. **ICT Diffusion in China and India**

Both China and India have posted remarkable improvements in ICT diffusion over the last decade. A close look at comparative historical data reveals different rates of ICT diffusion: each of the four diffusion rates for China appears to be a multiple of the corresponding rate for India. Differential rates such as these raise the question of what factors affect diffusion rates in countries.[6]

Figure 1. **Main Telephone Lines in Operation, 1992–2002**

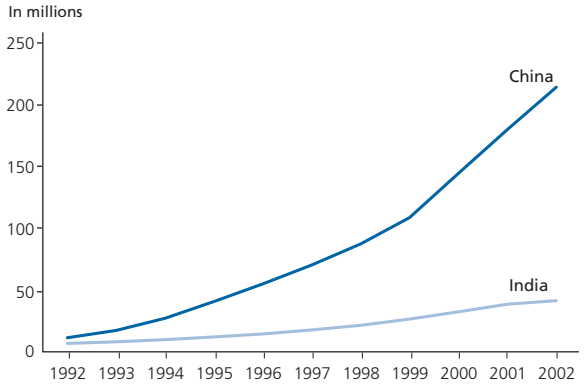


Figure 3. **Personal Computers, 1991–2001**

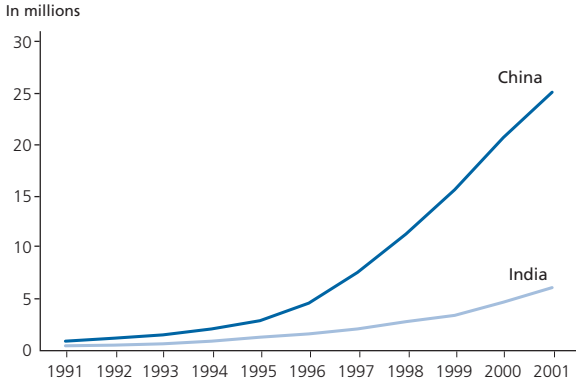


Figure 2. **Cellular Mobile Telephone Subscribers, 1992–2002**

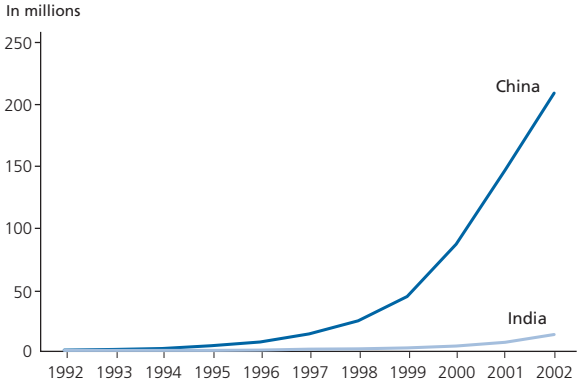
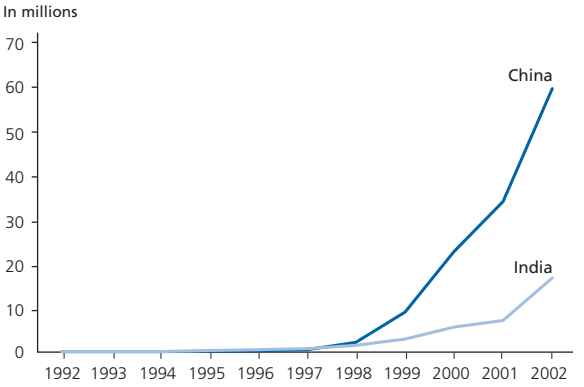


Figure 4. **Internet Users, 1992–2002**



Source: International Telecommunication Union, World Telecommunication Indicators database, accessed July 2003

television subscribers. China also posted the second highest increase in the number of Internet users and the fifth highest increase in the number of personal computers.

Although it is tempting to chalk up the gains in penetration to the scale of China's population, the country's achievements over the last three years is best appreciated when juxtaposed with other populous countries (see Box 1 and Table 2). In terms of main telephone lines, for instance, China added 106 million while India, with the second highest increase, added 15 million. Likewise, China added 163 million cellular mobile telephone subscribers, while the United States, with the second highest increase, added 55 million. Similarly, China had 36 million new cable television subscribers in the three-year period while Japan, with the second highest increase, added 6 million subscribers, a sixth of China's figure.

Of the most populous and developed economies, the United States, Japan, and Germany posted the highest increases. The United States, the third most populous country in the world, added the highest number of Internet users and personal computers at 53 million and 37 million, respectively. The United States is followed by Japan, the ninth most populous country, which posted the third highest increase in the number of Internet users and personal computers. Germany, the 12th most populous country in the world, posted the third highest increase in cellular mobile telephone subscribers, the fourth highest increases in Internet users,

personal computers, cable television subscribers, and home satellite antennas and the fifth highest increase in main telephone lines in operation.

Many of the most populous countries in the developing world also posted the largest increases over the last three years. Next to China and India, Brazil stands out as having added, since 1999, an additional 14 million main telephone lines, 20 million cellular mobile telephone subscribers, 11 million Internet users, and 7 million personal computers. Another notable performer is Russia, which, over the same period, added 8 million personal computers, 5 million main telephone lines, and 5 million television receivers.

Because the figure for main telephone lines in Table 2 includes public pay telephones, more access is being provided than the actual number of lines suggests. During the three-year period, Brazil added 638,100 public pay telephones, China added 488,562 pay phones and India added 442,000. Indonesia also posted a significant increase in pay phones, adding 133,627 over the last three years.

3. Some of the fastest rates of growth and most sizeable increases are in developing economies.

Of the 200 economies included in the study, 180 economies, mostly developing economies, doubled their number of Internet users during this period, growing by as much as 44,400 percent (as in the case of Somalia). During this same period 61 economies doubled their number of personal computers; in the area of telecommunications, 26 economies doubled their number of main telephone lines in operation and at least 69 economies doubled their number of cellular mobile telephone subscribers. Twenty-one economies also doubled their number of television receivers, while 20 economies doubled their number of cable television subscribers and 32 economies doubled their number of home satellite antennas.

Table 3. **Most Significant Increases in ICT Diffusion, 1999–2002***

Country	(millions)	% of World increase	Country	% change	(thousands)
Internet users (estimated)					
United States	53	16	Somalia	44,400	89
China	50	15	Azerbaijan	3,650	292
Japan	30	9	Uzbekistan	3,567	268
Germany	18	5	Zimbabwe	2,400	480
Korea, Republic of	15	5	Lesotho	2,000	20
India	14	4	Myanmar	1,900	10
France	13	4	Pakistan	1,775	1,420
United Kingdom	12	4	Sao Tome and Principe	1,700	9
Brazil	11	3	Libya	1,686	118
Italy	9	3	Sudan	1,580	79
Personal computers					
United States	37	24	Yemen	383	115
Korea, Republic of	15	10	Zimbabwe	300	450
Japan	12	8	Equatorial Guinea	250	3
Germany	12	7	Bangladesh	246	320
China	10	6	Paraguay	233	140
Russian Federation	8	5	Bhutan	233	7
Brazil	7	4	Togo	200	100
France	5	3	Maldives	167	13
Canada	4	3	Croatia	153	460
Italy	4	3	Saudi Arabia	150	1,803
Main telephone lines in operation					
China	106	55	Somalia	186	65
India	15	8	Sudan	167	420
Brazil	14	7	China	97	105,704
United States	6	3	Mauritania	94	15
Germany	6	3	Ethiopia	89	174
Iran	5	2	Haiti	86	60
Russian Federation	5	2	Guinea-Bissau	84	5
Mexico	4	2	Yemen	79	226
Egypt	3	1	Malawi	77	32
Korea, Republic of	3	1	Lao, PDR	76	27

Table 3. **Most Significant Increases in ICT Diffusion, 1999–2002* (continued)**

In terms of figures			In terms of growth rates		
Country	**(millions)**	**% of World increase**	**Country**	**% change**	**(thousands)**
Cellular mobile telephone subscribers					
China	163	25	Syria	9,900	396
United States	55	8	Cameroon	9,283	557
Germany	36	5	Albania	7,167	789
Japan	24	4	Nigeria	6,432	1,608
United Kingdom	23	3	Burundi	6,400	51
Italy	22	3	Kenya	5,478	1,301
Brazil	20	3	Djibouti	5,257	15
Spain	18	3	Equatorial Guinea	4,400	26
Mexico	18	3	Congo, DR	4,336	217
Television receivers					
China	40	20	Burkina Faso	631	820
United States	34	17	Togo	500	500
Turkey	13	6	Namibia	314	382
India	10	5	Eritrea	233	140
Japan	9	4	Dem. People's Rep. of Korea	195	2,535
Sudan	8	4	Sudan	151	7,572
United Kingdom	7	4	Mali	15	210
Philippines	6	3	Tanzania	117	810
Pakistan	5	3	Albania	115	525
Russian Federation	5	2	Jamaica	98	481
Cable television subscribers					
China	36	57	Spain	466	484
Japan	6	9	Thailand	449	654
United States	5	7	Lebanon	426	81
Germany	3	5	Kyrgyzstan	389	10
India	3	5	Georgia	308	46
Philippines	2	3	Azerbaijan	275	3
Korea, Republic of	1	2	Indonesia	250	50
Australia	1	1	Philippines	145	1,740
United Kingdom	1	1	Australia	143	825
Thailand	1	1	Nigeria	115	32
Home satellite antennas					
United States	5	28	New Zealand	466	247
United Kingdom	2	10	Tunisia	338	1,198
Canada	2	10	Canada	295	1,635
Germany	1	8	Sudan	291	64
Tunisia	1	7	Malta	277	7
Hungary	1	5	Chile	209	85
Syria	1	5	Syria	191	830
Spain	1	5	Sri Lanka	183	0.1
Italy	1	4	Maldives	176	2
Turkey	1	4	Switzerland	157	440

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

Table 3 shows numerous examples of developing economies that are making exemplary progress. Somalia, for instance, posted the largest rate of growth of main telephone lines and Internet users. Syria has the highest rates of growth of cellular mobile telephone subscribers while Yemen posted the highest rates of increase in personal computers. For many of these economies, the dramatic growth rates stem partly from having come from a relatively low base in 1999. But the fact remains that these tremendous growth rates represent huge increases in numbers in many economies. Indeed, over the three-year period and of the 200 economies in the study, 66 economies added at least 1 million cellular mobile telephone subscribers, 43 economies added at least 1 million Internet users, 31 economies added at least 1 million television

receivers, 22 economies added at least 1 million personal computers, and 18 economies added at least 1 million main telephone lines.

In addition to China, India, Russia, and Brazil, several developing economies registered a combination of dramatic growth rates and an equally remarkable increase in the number of users. In South Asia, Pakistan is notable for increasing the number of Internet users despite having a fairly low personal computer base. In 1999 the country had only 80,000 Internet users but over three years 1.4 million users were added, amounting to a growth of 1,775 percent. Pakistan also added 5.4 million television receivers and over 900,000 cellular mobile telephone subscribers; Bangladesh likewise added a similar number of cellular mobile telephone subscribers as Pakistan, as well as 3.2 million new television receivers.

In the Middle East and North Africa region, rapid diffusion occurred in several economies. Iran, Saudi Arabia, and Egypt posted widespread increases. In the last three years, Iran, for instance, added 4.7 million main telephone lines, 2.9 million Internet users, 1.8 million cellular mobile telephone subscribers, 1 million personal computers, and 1 million television receivers. During the same period, Saudi Arabia increased its Internet user base from 100,000 to 1.6 million users. In addition, Saudi Arabia added 4.2 million cellular mobile telephone users, and 1.8 million personal computers. Also remarkable is Egypt's performance over the last three years: an additional 4 million cellular mobile telephone subscribers, 2.7 million main telephone lines, 1.4 million television receivers, and 1.3 million Internet users. Other economies posted spectacular performances for specific indicators: Morocco added 5.8 million cellular mobile telephone subscribers, Tunisia added 1.2 million home satellite antennas, while Syria added half a million more main telephone lines and television receivers.

In South America, Mexico posted impressive additions in the last three years: 18 million cellular mobile telephone subscribers, 4 million main telephone lines, 2.8 million Internet users, 2.6 million personal computers, and 1.8 million television receivers. Similarly, over the same period Chile added 4.2 million cellular mobile telephone subscribers, 3.7 million television receivers, and 3 million Internet users. Argentina, despite its economic difficulties during the last three years, added 2.9 million Internet users, 2.1 million cellular mobile telephone subscribers, and nearly 1 million personal computers. In the Caribbean, Jamaica is notable for doubling the numbers of its television receivers and Internet users while posting an 870 percent increase in the number of cellular phones from about 144,000 in 1999 to 1.4 million by 2002.

While there are fewer economies that posted across-the-board improvements in sub-Saharan Africa, the region nonetheless has many remarkable examples of improvements in ICT diffusion. In the last three years, South Africa added 6.9 million cellular mobile telephone subscribers, 2 million television receivers, and 1.2 million Internet users. Over the same period Nigeria, the region's most populous country, added 4.5 million television receivers and 1.6 million cellular mobile telephone subscribers; the latter figure constitutes a 6,432 percent increase over its 1999 subscriber base of 25,000. Kenya, too, multiplied the number of its cellular mobile telephone subscribers from 24,000 in 1999 to 1.3 million in 2002. Another area where Kenya demonstrated significant improvement is in the number of Internet users, adding 465,000 users over the last three years from a base of only 35,000 users. Similarly, Zimbabwe added 480,000 new Internet users to its 1999 base of only 20,000 while increasing its personal computer base by 450,000. Sudan is outstanding in terms of television receivers, having added 7.5 million in the last three years. Also notable is Burkina Faso, which added 820,000 television receivers over the same period. Several notable improvements can also be found in the increases in the number of cellular mobile telephone subscribers in Cameroon, Senegal, and Côte d'Ivoire, which posted increases of 9,283 percent (557,000 subscribers), 530 percent (465,000 subscribers), and 299 percent (770,000 subscribers), respectively.

In Asia, different economies posted varying magnitudes of increases for different indicators. The largest increase in the number of Internet users was in the Republic of Korea, which added 15 million new users in the three-year period. Indonesia added 7 million Internet users, a 21-fold increase, while Taiwan added nearly 4 million new users, out of its population of about 22 million. Increases in personal computers were most notable in the Republic of Korea, which added 15 million units, and in Malaysia, which increased its number of units by 1.8 million, a doubling of the 1999 level. In terms of main telephone lines, Vietnam and Thailand posted the most remarkable increases: the former added 1.6 million lines while the latter added 1.2 million. Growth of cellular mobile telephone subscribers was most dramatic in Thailand, with nearly 14 million new subscribers added during the three-year period. Taiwan and the Philippines added 12.4 and 11.4 million new subscribers, respectively. Diffusion of television receivers expanded by 195 percent in the Democratic Republic of Korea while the Philippines added 6.3 million units. The latter is also notable for increasing the number of cable television subscribers by 1.7 million, nearly tripling the 1999 figure. Finally, the increase of home satellite antennas was most remarkable in New Zealand, which registered a 466 percent increase.

4. Best penetration rates are still in advanced economies with relatively small populations.

In Internet penetration, Iceland has the highest rate; its number of users is equivalent to 61 percent of its population (see Table 4). Iceland is succeeded by Liechtenstein, Sweden, and Republic

of Korea with Internet penetration rates of 58 percent, 57 percent, and 55 percent of the population, respectively. Singapore, with an Internet penetration of 54 percent of its population, stands out as having the highest household Internet penetration at 227 percent of its households.

For personal computer penetration, the United States takes the lead, with a penetration rate of 62 percent of its population. The United States is followed by Denmark at 58 percent penetration, and both Sweden and Republic of Korea at 56 percent. In addition, there are five other economies with a personal computer penetration of at least 50 percent of their population: Switzerland, Luxembourg, Australia, Norway, and Singapore.

In terms of main telephone lines, Monaco and Bermuda have the highest penetration rates in the world, while Taiwan and Luxembourg have the best penetration rates in terms of cellular phones. For television receivers, Bermuda and the Faroe Islands have the highest penetration rates while Monaco and Liechtenstein have the highest penetration rate of cable television. Faroe Islands and Kuwait have the best penetration rate in the world for home satellite antennas.

Table 4. **Highest Penetration Rates, 2002***

Country	as % of Population
Internet users (estimated)	
Iceland	61
Liechtenstein	58
Sweden	57
Korea, Republic of	55
Singapore	54
United States	54
Netherlands	53
Finland	51
Norway	50
New Zealand	48
Personal computers	
United States	62
Denmark	58
Sweden	56
Korea, Republic of	56
Switzerland	54
Luxembourg	51
Australia	51
Norway	50
Singapore	50
Bermuda	49
Main telephone lines in operation	
Monaco	92
Bermuda	86
Luxembourg	77
Switzerland	73
Norway	73
Sweden	72
Denmark	70
United States	66
Germany	65
Canada	64
Cellular mobile telephone subscribers	
Taiwan	106
Luxembourg	101
Israel	95
Hong Kong SAR	93
Italy	93
Iceland	89
Sweden	89
Czech Republic	85
Greece	85
Finland	85

Country	as % of Population
Television receivers	
Bermuda	108
Faroe Islands	102
United Kingdom	97
Sweden	96
United States	93
Norway	88
Qatar	87
Denmark	86
Latvia	85
Japan	78
Cable television subscribers	
Monaco	59
Liechtenstein	40
Netherlands	40
Belgium	37
Switzerland	37
Luxembourg	31
Germany	26
Virgin Islands (US)	26
United States	25
Canada	25
Home satellite antennas	
Faroe Islands	42
Kuwait	27
Austria	19
Hungary	17
Germany	16
Tunisia	16
Denmark	15
Slovenia	14
Sweden	12
Slovak Republic	12

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

5. The least developed economies still have the poorest ICT penetration rates.

The economies that rank as having among the poorest penetration rates are quite dispersed around the world, with the exception of North America (see Table 5). In the Asia and the Pacific region, Myanmar and Cambodia are most notable: Myanmar has dismal penetration rates in terms of Internet users, personal computers, cellular mobile telephone subscribers, and television, and Cambodia also has low penetration of main telephone lines, television receivers, and personal computers. In the Middle East, Afghanistan has low penetration rates of main telephone lines and cellular mobile telephones while Iraq has a low penetration rate of Internet users and cellular mobile telephones. In Europe, Tajikistan is among the economies with the lowest Internet penetration while Turkmenistan is on the list of those with the lowest penetration rate of cellular mobile telephones. In Latin America and the Caribbean, Haiti ranks among the economies with the world's lowest penetration rates in television receivers while Cuba is among the economies with the poorest cellular mobile telephone penetration. In South Asia, Pakistan and Sri Lanka are among those with the lowest penetration rates of cable television, while Nepal has among the lowest penetration rates for television and cellular phones.

Most of the economies that appear to have the lowest penetration rates are from sub-Saharan Africa. It is notable that with the exception of Kenya, the World Bank has rated as severely indebted nearly all of the sub-Saharan African countries in the list in Table 5.

6. Despite the dramatic increases in diffusion of ICT in the most populous countries, it is also in these very same countries where the greatest number of people can potentially still be connected.

Table 6 lists the 15 most populous countries in the world and displays the numbers of people that are potentially still a market for technologies. The reality is that universal access for individuals is unlikely to be a goal in these countries. In many economies, and for many of these technologies, shared access is not only the norm but is perhaps the optimal and most pragmatic mode. Each country will have to ascertain its own optimal penetration level.

With the two largest populations in the world, China and India face the greatest challenges in ICT diffusion. Both China and India have a combined population of 2 billion people who were not cellular mobile telephone subscribers as of 2002; of the same magnitude are the numbers of main telephone lines in operation, Internet users and personal computers, and television receivers. Next to China and India,

Table 5. **Lowest Penetration Rates, 2002: Priority Countries***

Country	Ratio (per population)
Internet users (estimated)	
Congo, DR	1 per 8,774
Myanmar	1 per 4,899
Liberia	1 per 3,238
Tajikistan	1 per 1,822
Ethiopia	1 per 1,347
Central African Rep.	1 per 1,319
Niger	1 per 979
Iraq	1 per 970
Burundi	1 per 832
Sierra Leone	1 per 707
Personal computers	
Niger	1 per 1,958
Burundi	1 per 1,398
Myanmar	1 per 891
Malawi	1 per 803
Mali	1 per 759
Cambodia	1 per 689
Ethiopia	1 per 673
Chad	1 per 656
Burkina Faso	1 per 629
Benin	1 per 599
Main telephone lines in operation	
Congo, DR	1 per 2,632
Afghanistan	1 per 705
Chad	1 per 665
Niger	1 per 542
Liberia	1 per 476
Uganda	1 per 449
Central African Rep.	1 per 444
Cambodia	1 per 412
Rwanda	1 per 380
Burundi	1 per 316
Cellular mobile telephone subscribers	
Niger	1 per 5,525
Myanmar	1 per 3,555
Afghanistan	1 per 1,941
Liberia	1 per 1,619
Ethiopia	1 per 1,337
Iraq	1 per 1,212
Nepal	1 per 1,060
Cuba	1 per 632
Turkmenistan	1 per 594
Papua New Guinea	1 per 511
Television receivers	
Congo, DR	1 per 526
Chad	1 per 525
Comoros	1 per 282
Malawi	1 per 261
Ethiopia	1 per 182
Central African Rep.	1 per 174
Haiti	1 per 166
Cambodia	1 per 135
Myanmar	1 per 134
Nepal	1 per 120

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

Table 6. **Potential Market for ICT Diffusion, 2002***

Rank according to population	Country	Population that are non-Internet users (in millions)	Population without personal computers (in millions)	Population less the number of main telephone lines (in millions)	Population without cellular phones (in millions)	Population without television receivers (in millions)	Population without cable television subscribers (in millions)
1	China	1,225	1,260	1,070	1,078	875	1,188
2	India	1,025	1,036	1,000	1,029	957	1,002
3	United States	133	110	98	148	21	215
4	Indonesia	204	210	204	200	180	212
5	Brazil	160	161	135	139	114	172
6	Pakistan	147	148	145	148	127	149
7	Russian Federation	141	134	111	129	68	135
8	Bangladesh	133	133	132	132	125	130
9	Japan	70	79	56	46	28	104
10	Nigeria	120	119	119	118	108	120
11	Mexico	97	95	87	76	74	99
12	Germany	48	47	29	23	34	61
13	Vietnam	80	80	78	79	66	n/a
14	Philippines	76	78	77	66	65	77
15	Ethiopia	67	67	67	67	67	n/a

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

significant proportions of the populations of Indonesia, Pakistan, Brazil, and Bangladesh are still unconnected. Significantly, even the United States has considerable work ahead. As of 2002, 147 million people in the country were not cellular mobile telephone subscribers and 133 million people were not Internet users.

7. The largest markets for ICT applications and content are now a mixture of developed and developing economies.

When assessing which among the economies in the world now have the largest number ICT users and devices, it is significant to find that China, Republic of Korea, India, Brazil, and Russia have risen to the top leagues of economies with the largest ICT base. Table 7 depicts the top 10 economies in terms of the number of users for each ICT indicator, along with the proportion of the world market represented by the country. Even for these economies, however, there remains the challenge of creating relevant applications for the different markets.

8. The "divide" in ICT access has narrowed, but low income economies still lag considerably, particularly in sub-Saharan Africa.

Table 8 demonstrates that middle and low income economies have posted faster growth rates than high income economies for most of the technologies included in this study. Faster growth rates for middle and low income economies are certainly evident in the increases in the number of Internet users and cellular mobile telephone subscribers.

With the exception of the Internet and personal computers, middle and low income economies posted larger increases than high income economies. In terms of the number of main telephone lines in operation, the increase in the number of lines in middle and low income economies was seven times higher than the increase in high income economies. In the case of television receivers, the increase in middle and low income economies was twice the increase in high income economies. Even in terms of cellular mobile telephone subscribers, low and middle income economies added 1.4 times the number added by high income economies.

Other signs of a narrowing divide in ICT access are evident when examining how much the low and middle income economies account for the overall global penetration of ICT. Low and middle income economies are inhabited by 84 percent of world population. It is notable that as of 2002, this category accounted for 61 percent of all television receivers, 52 percent of all cable television subscribers, 48 percent of all main telephone lines, 45 percent of cellular mobile telephone subscribers, 30 percent of Internet users and home satellite antennas, and 22 percent of personal computers. These figures are particularly striking when compared to those of 1999, when low and middle income economies accounted for only 15 percent of the world's Internet users and 26 percent of cellular mobile telephone subscribers.

Table 7. **Largest Markets for ICT Applications and Content, 2002**

	(in millions)	% of World total
Internet users (estimated)		
United States	155	26
China	59	10
Japan	57	9
Germany	35	6
Korea	26	4
United Kingdom	24	4
France	19	3
Italy	17	3
India	17	3
Canada	15	3
Main telephone lines in operation		
China	214	15
United States	190	19
Japan	71	8
Germany	54	5
India	41	3
Brazil	39	3
Russian Federation	36	3
United Kingdom	35	4
France	34	3
Italy	27	3
Television receivers		
China	410	24
United States	267	14
Japan	100	6
India	85	5
Russian Federation	79	5
Brazil	60	4
United Kingdom	57	3
Germany	48	3
France	38	2
Indonesia	32	2
Home satellite antennas		
United States	18	19
Germany	13	15
Japan	12	13
United Kingdom	7	6
Indonesia	4	5
Algeria	4	4
France	3	3
Italy	3	3
Poland	3	3
Canada	2	1

	(in millions)	% of World total
Personal computers		
United States	178	35
Japan	49	9
Germany	36	6
Korea, Republic of	26	4
China	25	4
United Kingdom	22	4
France	21	4
Canada	15	3
Italy	13	2
Brazil	13	2
Cellular mobile telephone subscribers		
China	207	12
United States	141	15
Japan	81	9
Germany	59	7
Italy	52	6
United Kingdom	50	6
France	39	4
Brazil	35	3
Spain	33	3
Korea, Republic of	32	4
Cable television subscribers		
China	96	25
United States	73	22
India	40	12
Japan	23	6
Germany	22	6
Russian Federation	11	4
Korea, Republic of	8	3
Canada	8	2
Netherlands	7	2
Argentina	6	2

Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

It is of great concern, however, that the low income economies still lag considerably behind in terms of penetration rates of their population. Of the 2.5 billion total population of low income economies (41 percent of the world's population), only 2 percent are cellular mobile telephone subscribers, and only 1 percent are Internet users and have access to cellular mobile telephones.

Part II. Regional Profiles

When the global picture is disaggregated into different regions, the results present an interesting mix, as shown in Table 9. Of all the regions, the United States and Canada combined ("North America") has the highest number of personal computers, equivalent to 35 percent of the world's

Table 8. **The "Divide"in ICT Diffusion (According to Income Level), 1999–2002***

	1999 (in millions)	2002 (in millions)	1999–2002 Increase (in percent)	(in millions)	% of Total population 1999	2002
Internet users (estimated)						
High income	235	423	80	187	25	44
Upper middle income	16	51	213	34	3	10
Lower middle income	20	99	398	79	1	5
Low income	5	32	575	28	0	1
World	276	605	119	329	5	10
Personal computers						
High income	321	429	34	108	34	45
Upper middle income	25	43	75	19	5	9
Lower middle income	38	63	64	25	2	3
Low income	10	15	56	5	0	1
World	394	550	40	156	7	9
Main telephone lines in operation						
High income	542	567	4	23	58	59
Upper middle income	85	107	25	22	17	21
Lower middle income	221	345	57	125	10	16
Low income	58	80	38	22	2	3
World	906	1,098	21	192	15	18
Cellular mobile telephone subscribers						
High income	363	637	76	274	39	66
Upper middle income	49	138	181	89	10	27
Lower middle income	73	335	357	262	3	15
Low income	7	44	532	37	0	2
World	493	1,155	134	662	8	19
Television receivers						
High income	629	695	11	66	66	71
Upper middle income	154	167	9	14	31	33
Lower middle income	583	663	14	80	27	30
Low income	207	250	21	43	9	10
World	1,573	1,775	13	202	26	29
Cable television subscribers						
High income	153	172	12	19	16	18
Upper middle income	19	21	11	2	4	4
Lower middle income	79	119	50	39	4	5
Low income	37	47	8	3	2	2
World	288	359	22	64	5	6
Home satellite antennas						
High income	57	68	18	10	6	7
Upper middle income	9	12	29	3	2	2
Lower middle income	8	13	42	3	0	1
Low income	4	5	12	0	0	0
World	78	97	22	17	1	2

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

Table 9. **The "Divide"in ICT Diffusion (Geographic Perspective), 1999–2002***

	1999 (in millions)	2002 (in millions)	1999–2002 Increase (in percent)	(in millions)	% of Total population 1999	2002
Internet users (estimated)						
Asia and the Pacific	67.1	192.5	187	125.5	3	9
Canada and the United States	113.0	170.2	51	57.2	37	53
Europe	77.6	168.5	117	90.8	9	19
Latin America and the Caribbean	10.5	36.2	245	26.2	2	7
North Africa and the Middle East	2.6	12.8	383	9.6	1	4
South Asia	3.0	18.6	512	15.5	0	1
Sub-Saharan Africa	2.3	6.0	156	3.6	0	1
World	276.2	604.8	119	328.5	5	10
Personal computers						
Asia and the Pacific	90.3	137.3	52	47.0	4	7
Canada and the United States	152.1	193.3	27	41.2	49	60
Europe	114.7	159.4	39	44.7	13	18
Latin America and the Caribbean	19.1	32.6	71	13.5	4	6
North Africa and the Middle East	8.7	13.6	51	4.4	3	4
South Asia	4.2	7.4	77	3.2	0	1
Sub-Saharan Africa	4.7	6.8	42	2.0	1	1
World	393.9	550.5	40	156.1	7	9
Main telephone lines in operation						
Asia and the Pacific	251.7	368.0	46	116.3	12	18
Canada and the United States	203.6	210.0	3	6.4	66	66
Europe	314.3	334.5	6	20.2	36	38
Latin America and the Caribbean	67.4	89.4	33	22.1	13	17
North Africa and the Middle East	29.0	38.9	34	9.9	10	12
South Asia	30.9	47.1	52	16.2	2	3
Sub-Saharan Africa	9.2	10.2	11	1.0	1	2
Cellular mobile telephone subscribers						
World	492.7	1,154.8	134	662.1	8	19
Asia and the Pacific	160.0	423.7	165	263.6	8	20
Canada and the United States	93.0	152.6	64	59.7	30	48
Europe	182.2	404.9	122	222.7	21	46
Latin America and the Caribbean	40.9	101.5	148	60.6	8	19
North Africa and the Middle East	7.6	33.4	340	25.8	3	10
South Asia	2.6	16.0	520	13.4	0	1
Sub-Saharan Africa	6.5	22.8	253	16.3	1	3
World	906.1	1,098.0	21	191.9	15	18
Television receivers						
Asia and the Pacific	583.5	648.5	11	65.0	29	31
Canada and the United States	253.3	288.5	14	35.2	82	90
Europe	414.5	460.8	11	46.3	48	53
Latin America and the Caribbean	136.5	150.1	10	13.5	27	28
North Africa and the Middle East	57.6	63.0	8	4.9	19	20
South Asia	98.1	117.0	19	18.9	7	8
Sub-Saharan Africa	29.4	47.3	61	17.9	5	7
World	1,572.8	1,775.1	13	201.8	26	29
Cable television subscribers						
Asia and the Pacific	91.8	139.0	51	47.1	5	7
Canada and the United States	76.6	81.0	6	4.4	25	25
Europe	67.9	78.4	10	6.9	8	9
Latin America and the Caribbean	13.3	15.5	14	1.9	3	3
North Africa and the Middle East	1.3	1.4	12	0.1	0	0
South Asia	37.1	43.7	8	3.0	3	3
Sub-Saharan Africa	0.1	0.2	38	0.1	0	0
World	288.1	359.2	22	63.6	5	6
Home satellite antennas						
Asia and the Pacific	19.5	17.5	-11	-2.1	1	1
Canada and the United States	13.7	20.1	47	6.4	4	6
Europe	33.8	43.6	26	8.7	4	5
Latin America and the Caribbean	1.6	2.7	62	1.0	0	1
North Africa and the Middle East	8.9	11.9	29	2.6	3	4
South Asia	0.0	0.0	177	0.0	0	0
Sub-Saharan Africa	0.4	1.2	83	0.3	0	0
World	77.9	96.8	22	16.8	1	2

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

Table 10. **Regional Profiles in ICT Diffusion, 1999–2002***

	1999 (in millions)	2002 (in millions)	1999–2002 Increase (in percent)	1999–2002 Increase (in millions)	% of Total population 1999	% of Total population 2002
Asia						
Population	2,031.7	2,080.3	2	48.6		
Internet users (estimated)	67.1	192.5	187	125.5	3	9
Personal computers	90.3	137.3	52	47.0	4	7
Main telephone lines in operation	251.7	368.0	46	116.3	12	18
Cellular mobile telephone subscribers	160.0	423.7	165	263.6	8	20
Television receivers	583.5	648.5	11	65.0	29	31
Cable television receivers	91.8	139.0	51	47.1	5	7
Home satellite antennas	17.1	17.5	2	0.4	1	1
Europe						
Population	868.1	874.0	1	5.8		
Internet users (estimated)	77.6	168.5	117	90.9	9	19
Personal computers	114.7	159.4	39	44.7	13	18
Main telephone lines in operation	314.3	334.5	6	20.2	36	38
Cellular mobile telephone subscribers	182.2	404.9	122	222.7	21	46
Television receivers	414.5	460.8	11	46.3	48	53
Cable television receivers	67.9	78.4	15	10.4	8	9
Home satellite antennas	33.8	43.6	29	9.7	4	5
Latin America						
Population	509.8	530.8	4	21.0		
Internet users (estimated)	10.5	36.2	245	25.7	2	7
Personal computers	19.1	32.6	71	13.5	4	6
Main telephone lines in operation	67.4	89.4	33	22.1	13	17
Cellular mobile telephone subscribers	40.9	101.5	148	60.6	8	19
Television receivers	136.5	150.1	10	13.5	27	28
Cable television receivers	13.3	15.5	17	2.2	3	3
Home satellite antennas	1.6	2.7	66	1.1	0	1
North Africa and the Middle East						
Population	300.9	320.3	6	19.4		
Internet users (estimated)	2.6	12.8	388	10.2	1	4
Personal computers	8.7	13.6	56	4.9	3	4
Main telephone lines in operation	29.0	38.9	34	9.9	10	12
Cellular mobile telephone subscribers	7.6	33.4	340	25.8	3	10
Television receivers	57.6	63.0	9	5.4	19	20
Cable television receivers	1.3	1.4	12	0.1	0	0
Home satellite antennas	8.9	11.9	34	3.0	3	4
South Asia						
Population	1,322.9	1,390.2	5	67.3		
Internet users (estimated)	3.0	18.6	512	15.5	0	1
Personal computers	4.2	7.4	77	3.2	0	0
Main telephone lines in operation	30.9	47.1	52	16.2	2	2
Cellular mobile telephone subscribers	2.6	16.0	520	13.4	0	1
Television receivers	98.1	117.0	19	18.9	5	6
Cable television receivers	37.1	43.7	18	6.6	2	2
Home satellite antennas	0.0	0.0	192	0.0	0	0
Sub-Saharan Africa						
Population	621.5	676.2	9	54.7		
Internet users (estimated)	2.3	6.0	156	3.6	0	1
Personal computers	4.7	6.8	43	2.0	1	1
Main telephone lines in operation	9.2	10.2	11	1.0	1	2
Cellular mobile telephone subscribers	6.5	22.8	253	16.3	1	3
Television receivers	29.4	47.3	61	17.9	5	7
Cable television receivers	0.1	0.2	38	0.1	0	0
Home satellite antennas	0.4	1.2	228	0.8	0	0

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

personal computers. In 1999, North America also had the highest number of Internet users and cellular mobile telephone subscribers but by 2002, this was no longer the case. By 2002, because of dynamic growth in overall ICT diffusion, the Asia-Pacific region had the highest number not only of Internet users and cellular mobile telephone subscribers but also of main telephone lines, television receivers, and cable television subscribers. Europe takes the lead in terms of the number of home satellite antennas. These three regions—North America, Asia and the Pacific, and Europe—account for at least 60 percent of the global penetration for each device.

In terms of penetration rates, Europe is a distant second to North America with the exception of cellular mobile telephone subscribers where Europe, with a 46 percent rate, nearly matches North America's 48 percent rate. The Asia and the Pacific region, despite its dynamism, actually has a penetration rate below the world average in terms of numbers of Internet users and personal computers. The remaining regions, Latin America and the Caribbean, North Africa and the Middle East, South Asia, and sub-Saharan Africa, have single digit penetration rates for both Internet users and personal computers. A particularly distressing figure is the main telephone line penetration rate in sub-Saharan Africa, which barely improved since 1999 and remains low at 2 percent of its total population and 8 percent of total households.

North America—Canada and the United States

Canada and the United States, with a combined population of 320 million people, have an estimated 170.2 million Internet users. This is equivalent to a 53 percent penetration rate of the population and 28 percent of the world's Internet users. About a third of the estimated number of Internet users were added in the last three years alone, when the number of Internet users in the region increased by 57.2 million, a 51 percent increase.

Compared to the growth in the number of Internet users, the growth in personal computers was slower although these two economies combined still have the largest number compared to any other region in the world. As of 2002, these two economies together had 193 million personal computers, of which 41.2 million were added in the last three years, equivalent to a 27 percent increase. The current individual penetration rate is 60 percent.

With already high penetration rates in the number of main telephone lines in operation, the United States and Canada posted a 3 percent increase in the number of telephone lines, adding 6.4 million lines in the last three years. By 2002, the number of main telephone lines reached 210 million, equivalent to a 66 percent individual penetration rate.

Cellular mobile telephone penetration is lower at 48 percent but the growth rate in the diffusion of this device has been much higher. In the last three years, the number of cellular mobile telephone subscribers increased by 64 percent, or 59.7 million. As of 2002, Canada and the United States had 153 million cellular mobile telephone subscribers, a figure that exceeds the number of cellular mobile telephone subscribers in Latin America and the Caribbean.

Despite an already high television penetration rate at 82 percent of its individual population as of 1999, Canada and the United States added a combined 35.2 million television receivers in the three-year period, a 14 percent increase. As of 2002, these two economies had a total of 288.5 television receivers, significantly more than 3.5 times the number of cable television subscribers, and 14.4 times the number of home satellite antennas. In the last three years, cable television subscribers increased by 4.4 million, a relatively lackluster growth of 6 percent when compared to the growth of home satellite antennas which increased by 47 percent or 6.4 million.

Europe

Looking at the 52 economies of the region with a combined population of 874 million, Europe, as of 2002, had 461 million television receivers, 405 million cellular mobile telephone subscribers, 335 million main telephone lines, and 168 million Internet users (see Table 10). In addition, the region had 159 million personal computers, 78 million cable television subscribers, and 44 million home satellite antennas.

Over the last three years, the most dramatic growth rates in the region are the number of cellular mobile telephone subscribers, up 122 percent, and the number of Internet users, up 117 percent. Diffusion of other devices was more moderate, with growth of television receivers at 11 percent and main telephone lines at 6 percent over the three-year period. The relatively mild growth in the diffusion of these two technologies is largely because of the fairly high 1999 penetration rates: television receivers at 48 percent of total population and main telephone lines at 36 percent of the population.

In Europe, Germany, as of 2002, had the largest number of Internet users and personal computers, as well as main telephone lines, cellular mobile telephone subscribers, cable television subscribers, and home satellite antennas. Over the last three years, Germany also posted the largest increases in nearly all the devices under study except for television receivers and home satellite antennas. In actual numbers, Germany added nearly 18 million new Internet users, an increase of 105 percent and nearly 12 million personal computers, a growth of 47 percent. During the same period, the country added 5.5 million main telephone lines and nearly six times that number, or 36 million, new cellular mobile telephone subscribers, equivalent to a 152 percent

Table 11. **Regional Highlights: Leading Countries in Growth and Penetration, Europe**

	Change (units), 1999–2002			Change (%), 1999–2002			Penetration rate (% of Population), 2002	
Internet users (estimated)								
1	Germany	17,900,000	1	Azerbaijan	3,650	1	Iceland	61
2	France	13,346,000	2	Uzbekistan	3,567	2	Liechtenstein	58
3	United Kingdom	11,500,000	3	Belarus	1,517	3	Sweden	57
4	Italy	8,800,000	4	Kyrgyzstan	1,420	4	Netherlands	53
5	Spain	5,026,000	5	Bosnia and Herzegovina	1,329	5	Finland	51
6	Russian Federation	4,500,000	6	Serbia	700	6	Norway	50
7	Turkey	3,400,000	7	Lithuania	385	7	Denmark	47
8	Netherlands	2,390,000	8	Russian Federation	300	8	Monaco	46
9	Portugal	2,200,000	9	Albania	300	9	Germany	42
10	Belgium	2,000,000	10	Turkmenistan	300	10	Estonia	41
Personal computers								
1	Germany	11,520,940	1	Croatia	153	1	Denmark	58
2	Russian Federation	7,500,000	2	Russian Federation	136	2	Sweden	56
3	France	5,020,000	3	Latvia	100	3	Switzerland	54
4	Italy	4,025,000	4	Moldova	100	4	Luxembourg	51
5	United Kingdom	4,000,000	5	Bulgaria	84	5	Norway	50
6	Spain	2,000,000	6	Armenia	75	6	Iceland	45
7	Netherlands	1,200,000	7	Lithuania	73	7	Finland	44
8	Sweden	1,000,000	8	Slovak Republic	64	8	Germany	43
9	Austria	913,000	9	Georgia	56	9	Netherlands	43
10	Poland	900,000	10	Albania	50	10	Ireland	38
Main telephone lines in operation								
1	Germany	5,510,000	1	Albania	57	1	Monaco	92
2	Russian Federation	4,551,000	2	Azerbaijan	36	2	Luxembourg	77
3	Spain	2,225,170	3	Bosnia and Herzegovina	33	3	Switzerland	73
4	Poland	1,224,800	4	Kazakhstan	18	4	Norway	73
5	United Kingdom	1,124,000	5	Moldova	15	5	Sweden	72
6	Italy	949,950	6	Croatia	15	6	Denmark	70
7	Turkey	860,810	7	Russian Federation	15	7	Germany	65
8	Ukraine	595,600	8	Macedonia, FYR	14	8	Iceland	63
9	Netherlands	387,000	9	Ireland	14	9	Netherlands	62
10	Romania	376,000	10	Spain	14	10	Cyprus	61
Cellular mobile telephone subscribers								
1	Germany	35,754,000	1	Albania	7,167	1	Luxembourg	101
2	United Kingdom	22,736,000	2	Tajikistan	2,012	2	Italy	93
3	Italy	22,020,000	3	Kazakhstan	1,975	3	Iceland	89
4	Spain	18,471,290	4	Kyrgyzstan	1,962	4	Sweden	89
5	France	17,151,800	5	Belarus	1,883	5	Czech Republic	85
6	Russian Federation	16,297,500	6	Bosnia and Herzegovina	1,323	6	Greece	85
7	Turkey	15,252,843	7	Russian Federation	1,189	7	Finland	85
8	Poland	10,043,500	8	Moldova	1,150	8	United Kingdom	84
9	Czech Republic	6,665,624	9	Ukraine	927	9	Norway	84
10	Greece	5,410,260	10	Croatia	672	10	Slovenia	84
Television receivers								
1	Turkey	12,725,620	1	Albania	115	1	Faroe Islands	102
2	United Kingdom	7,400,000	2	Turkey	81	2	United Kingdom	97
3	Russian Federation	5,000,000	3	Sweden	76	3	Sweden	96
4	Sweden	3,700,000	4	Georgia	74	4	Norway	88
5	Netherlands	2,000,000	5	Kazakhstan	39	5	Denmark	86
6	Kazakhstan	1,540,110	6	Norway	38	6	Latvia	85
7	Romania	1,500,000	7	Azerbaijan	36	7	Monaco	76
8	Poland	1,298,000	8	Netherlands	24	8	Finland	68
9	Norway	1,100,000	9	Romania	21	9	Luxembourg	66
10	France	1,000,000	10	Austria	21	10	Netherlands	65

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

growth. Germany also added 3.2 million cable television subscribers and 1.3 million home satellite antennas during the three-year period.

The United Kingdom is second in Europe in the number of Internet users, personal computers, television receivers, and home satellite antennas. It is the third in the region in the number of main telephone lines in operation and cellular mobile telephone subscribers, and fourth in the region in terms of cable television subscribers. Over the last three years, the United Kingdom has added nearly 12 million Internet users, 4 million personal computers, 1 million main telephone lines, 23 million cellular mobile telephone subscribers, more than 7 million television receivers, 760,000 cable television subscribers, and nearly 1.8 million home satellite antennas.

France is third in the region in the number of Internet users, personal computers, and home satellite antennas while ranking fourth in the region in terms of main telephone lines in operation, cellular mobile telephone subscribers, and television receivers. In the three-year period, France added more than 13 million Internet users, a growth of nearly five times the 1999 figure, bringing the total number of Internet users in the country to more than 18.7 million.

In the region, Italy has the fourth largest number of Internet users and personal computers, at 17 million and 13 million, respectively. Italy is fifth in the region in terms of the number of main telephone lines but is second in the number of cellular mobile telephone subscribers. Italy is sixth in the number of television receivers and fourth in home satellite antennas. In the last three years, Italy has added 8.8 million Internet users, 4 million personal computers and, notably, 22 million cellular mobile telephone subscribers.

Russia stands out in Europe as having the largest number of television receivers and the second largest number of main telephone lines and cable television subscribers in the region. Russia has also demonstrated tremendous increases over the last three years: a 300 percent increase in the number of Internet users, 136 percent increase in the number of personal computers and, notably, a 1,189 percent increase in the number of cellular mobile telephone subscribers.

In terms of population penetration rates, six economies in the region have over 50 percent of their population using the Internet: Iceland, Liechtenstein, Sweden, the Netherlands, Finland, and Norway, in descending order. For personal computers, five economies have over 50 percent penetration rates: Denmark, Sweden, Switzerland, Luxembourg, and Norway, also in descending order. Regarding main telephone line penetration rates, 19 economies have over 50 percent penetration rates; in the lead are Monaco, Luxembourg, Switzerland, Norway, and Sweden. In terms of cellular mobile telephone subscribers, at least 27 economies in the region have a penetration rate greater than 50 percent; Luxembourg, Italy, Iceland, Sweden, and the Czech Republic have the highest penetration rates in the region. For television receivers, 24 economies in the region have over 50 percent penetration, led by the Faroe Islands, the United Kingdom, Sweden, and Norway; among the middle income economies in this list are Latvia, Malta, the Czech Republic, Russia, and Estonia. For cable television, only Monaco has more than 50 percent penetration; the other leading economies in this regard are Liechtenstein, the Netherlands, Belgium, and Switzerland. For home satellite antennas, Faroe Island has the highest penetration rate at 42 percent of its population, followed by Austria at 19 percent penetration, Hungary at 17 percent, and Germany at 16 percent.

As of 2002, there were 20 economies in the region that had Internet penetration rates lower than 10 percent, which is the world average. The three raising the most concern are Tajikistan, where 1 person in every 1,822 is an Internet user; Turkmenistan, which has a ratio of 1 user for every 606 persons; and Albania, which has a ratio of 1 Internet user for every 403 persons. In terms of personal computers, data were missing for 12 economies in the region, but among those that had available data, Albania had the lowest penetration rate with 1 computer for every 134 persons, and Armenia followed with 1 personal computer for every 109 persons. In terms of main telephone lines, only five economies in the region had less than 10 percent penetration rate: Turkmenistan, Kyrgyzstan, Uzbekistan, Albania, and Tajikistan. The last in the list, Tajikistan, had a 4 percent penetration rate. For cellular mobile telephone subscribers, nine economies in the region had a less than 10 percent penetration rate; Turkmenistan and Tajikistan have among the lowest penetration rates, both with less than 1 percent. In terms of television penetration, only one country in the region has less than a 10 percent penetration—Kyrgyzstan, with a 5 percent rate.

One of the economies in the region with among the lowest penetration rates but that has made considerable progress over the last three years is Albania. Between 1999 and 2002, Albania increased its number of Internet users by 300 percent, personal computers by 50 percent, main telephone lines by 57 percent, television receivers by 115 percent and, notably, the number of cellular mobile telephone subscribers by 7,167 percent.

Asia and the Pacific

Asia and the Pacific, a region comprising 33 economies, has a combined population of 2.1 billion, of which 193 million, or 9 percent, are Internet users and 137 million, or 7 percent, have personal computers (see Table 10). There are more cellular mobile telephone subscribers in the region than there are main telephone lines: about 424 million cellular

mobile telephone subscribers compared to 368 million main telephone lines. In terms of television, the region has 648 million television receivers, 139 million cable television subscribers, and 17 million home satellite antennas.

Over the period 1999–2002, the number of Internet users in the region surged by 187 percent while the number of cellular mobile telephone subscribers jumped by 165 percent. The growth in cellular mobile telephone subscribers has increased the penetration rate from 8 percent to 20 percent in three years, the latter rate being higher than the main line penetration rate of 18 percent. Slowest growth rates in the region were in television receivers, up 11 percent, and home satellite antennas, which only increased by 2 percent. Television, however, is the most pervasive device in the region, with a 31 percent penetration rate.

In terms of actual numbers, China leads the region in Internet users, main telephone lines, cellular mobile telephone subscribers, television receivers, and cable television subscribers. China also leads the region in terms of growth rates in many of these technologies. In the 1999–2002 period, China increased its number of main telephone lines by 97 percent, cellular mobile telephone subscribers by 377 percent, and the number of Internet users by 564 percent. Overall penetration rates, however, still have much room for improvement: main telephone and cellular mobile telephone penetration rates are below 20 percent while Internet user and personal computer penetration rates are in the low single digits.

Japan leads the region in the number of personal computers and home satellite antennas. It is second to China in the number of Internet users, the number of main telephone lines in operation, cellular mobile telephone subscribers, television receivers and cable television subscribers. Despite relatively high levels of penetration, Japan continued to post significant increases. Over the period 1999–2002, Japan added 30 million new Internet users, 12 million personal computers, 24 million cellular mobile telephone subscribers, 9 million television receivers, and more than 5 million cable television subscribers. In terms of penetration rates, Japan leads the region in television receivers and home satellite antennas.

In actual numbers, as of 2002, the Republic of Korea is second in the region in terms of personal computers, with more than 26 million units. The country is third in the region in the number of Internet users, the number of main telephone lines, cellular mobile telephone subscribers, and cable television subscribers.

Next to China, Japan, and the Republic of Korea is Taiwan, which is fourth in terms of total number of Internet users, main telephone lines, cellular mobile telephone subscribers and cable television subscribers, and fifth in the penetration of personal computers. Australia is fourth in terms of numbers of personal computers and home satellite antennas but fifth in numbers of Internet users and main telephone lines. Indonesia is third in the region for numbers of television receivers and second for home satellite antennas, and Thailand is fourth in the region in terms of television receivers and fifth in terms of cellular mobile telephone subscribers and home satellite antennas. Malaysia is third in numbers of home satellite antennas while the Philippines is fifth in the region in terms of the number of cable television subscribers.

In terms of Internet users, two economies in the region have greater than 50 percent penetration rates: Republic of Korea and Singapore. These two economies are followed by New Zealand, Japan, Hong Kong, and Australia, all of which have penetration rates higher than 40 percent. For personal computers, three economies, Republic of Korea, Australia, and Singapore have penetration rates above 50 percent, followed by Taiwan at a 40 percent penetration rate. In terms of main telephone line penetration, Taiwan, Hong Kong, Japan, Australia, and Guam have the highest rates, all exceeding 50 percent. Similarly, Taiwan also leads in the region in terms of cellular mobile telephone penetration, but this time followed by Hong Kong, Singapore, and Republic of Korea. Significantly, 9 out of 33 economies in the region have cellular mobile telephone penetration rates greater than 60 percent. Television penetration rates are also significantly high in the region, with Japan at 78 percent, Australia at 72 percent, Guam at 71 percent and Brunei at 61 percent. For cable television, Taiwan, followed by Guam and Japan, has the highest penetration rates while for home satellite antennas, Japan leads, followed by New Zealand.

As of 2002, 19 of the 33 economies have Internet penetration rates below 10 percent, including China, Indonesia, the Philippines, Thailand, and Vietnam. Of the 19 economies with single-digit Internet penetration rates, four have penetration rates below 1 percent: Solomon Islands, Laos, Cambodia, and Myanmar (there is no figure for the Democratic People's Republic of Korea). The latter three economies also have personal computer penetration rates below 1 percent. In terms of main telephone line penetration, 15 economies have a less than 10 percent penetration rate, with Cambodia having the lowest rate of less than 1 percent. For cellular mobile telephone penetration rates, 13 economies have less than a 10 percent penetration rate (data are missing for two economies). Television penetration rates tend to be higher, with 11 economies having penetration rates of less than 10 percent.

Of concern is Myanmar, which ranks among those with the lowest penetration rates in the region across various indicators. The country has 1 television for every 134 persons, 1 main telephone line for every 166 persons, 1 personal computer for every 891 persons, 1 cellular mobile

Table 12. **Regional Highlights: Leading Countries in Growth and Penetration, Asia and the Pacific**

	Change (units), 1999–2002			Change (%), 1999–2002			Penetration rate (% of Population), 2002	
Internet users (estimated)								
1	China	50,200,000	1	Myanmar	1,900	1	Korea, Republic of	55
2	Japan	30,140,000	2	Reunion	1,400	2	Singapore	54
3	Korea, Republic of	15,410,000	3	Vietnam	1,400	3	New Zealand	48
4	Indonesia	7,100,000	4	Indonesia	789	4	Japan	45
5	Malaysia	4,700,000	5	Samoa	700	5	Hong Kong SAR	43
6	Taiwan	3,790,000	6	Lao, PDR	650	6	Australia	43
7	Thailand	3,500,000	7	Cambodia	650	7	Taiwan	38
8	Australia	2,800,000	8	Vanuatu	600	8	Malaysia	31
9	Philippines	2,410,000	9	China	564	9	Guam	30
10	Hong Kong SAR	1,518,800	10	French Polynesia	338	10	Macau	26
Personal computers								
1	Korea, Republic of	14,928,000	1	Korea, Republic of	129	1	Korea, Republic of	56
2	Japan	12,400,000	2	Mongolia	108	2	Australia	51
3	China	9,500,000	3	Malaysia	100	3	Singapore	50
4	Taiwan	2,226,100	4	Marshall Islands	100	4	Taiwan	40
5	Australia	2,000,000	5	Thailand	78	5	Hong Kong SAR	38
6	Malaysia	1,800,000	6	Philippines	75	6	Japan	38
7	Thailand	1,079,000	7	China	61	7	New Zealand	38
8	Philippines	940,000	8	Vietnam	60	8	French Polynesia	28
9	Hong Kong SAR	600,000	9	Cambodia	54	9	Macau	21
10	Singapore	400,000	10	Macau	53	10	Malaysia	15
Main telephone lines in operation								
1	China	105,704,200	1	China	97	1	Taiwan	58
2	Korea, Republic of	2,738,910	2	Lao, PDR	76	2	Hong Kong SAR	57
3	Indonesia	1,669,842	3	Vietnam	74	3	Japan	56
4	Vietnam	1,558,861	4	Indonesia	27	4	Australia	54
5	Thailand	1,284,206	5	Thailand	25	5	Guam	50
6	Taiwan	1,055,660	6	Mongolia	24	6	Korea, Republic of	49
7	Australia	830,000	7	Tonga	23	7	Singapore	46
8	Japan	619,000	8	Cambodia	21	8	New Zealand	45
9	Philippines	446,491	9	Samoa	21	9	Reunion	40
10	Malaysia	239,201	10	Vanuatu	20	10	Macau	40
Cellular mobile telephone subscribers								
1	China	163,324,000	1	Tonga	2,296	1	Taiwan	106
2	Japan	24,272,410	2	Vanuatu	1,533	2	Hong Kong SAR	93
3	Thailand	13,777,599	3	Thailand	589	3	Singapore	79
4	Taiwan	12,364,270	4	Mongolia	525	4	Korea, Republic of	68
5	Philippines	11,366,250	5	Vietnam	479	5	Reunion	66
6	Indonesia	9,479,031	6	Indonesia	427	6	Australia	64
7	Korea, Republic of	8,899,280	7	Philippines	399	7	Japan	64
8	Australia	6,264,000	8	China	377	8	Macau	63
9	Malaysia	6,255,000	9	Lao, PDR	357	9	New Zealand	62
10	Hong Kong SAR	2,022,493	10	Reunion	341	10	Brunei Darussalam	39
Television receivers								
1	China	40,000,000	1	Dem. People's Rep. of Korea	195	1	Japan	78
2	Japan	9,000,000	2	Papua New Guinea	83	2	Australia	72
3	Philippines	6,300,000	3	Philippines	77	3	Guam	71
4	Dem. People's Rep. of Korea	2,535,000	4	Solomon Islands	71	4	Brunei Darussalam	61
5	Indonesia	2,000,000	5	Kiribati	35	5	New Zealand	54
6	Thailand	1,700,000	6	Tonga	27	6	Hong Kong SAR	50
7	Australia	768,000	7	Malaysia	13	7	New Caledonia	50
8	Taiwan	760,000	8	Myanmar	13	8	Taiwan	44
9	Vietnam	609,000	9	China	11	9	Korea, Republic of	36
10	Malaysia	555,000	10	Thailand	10	10	China	32

Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

telephone subscriber in every 3,555 persons, and 1 Internet user in every 4,899 persons.

Latin America and the Caribbean

Of the 531 million people in the 38 economies in the Latin America and the Caribbean region, 36 million (7 percent of the population) are Internet users and a slightly lower figure, 33 million (6 percent of the population), have personal computers (see Table 10). As in Europe and Asia, the region has more cellular mobile telephone subscribers (102 million) than the number of main telephone lines (89 million). The region has 150 million television receivers, 15 million cable television subscribers, and 2.7 million home satellite antennas.

From 1999–2002, the region has experienced a 245 percent increase in the number of Internet users and a 148 percent increase in the number of cellular mobile telephone subscribers. Personal computers grew by 71 percent while home satellite antennas increased by 66 percent. Growth of television receivers was relatively mild at 10 percent, and brought the television penetration rate to 28 percent of total population. The region's cellular mobile telephone penetration rate of 19 percent exceeds the main telephone line penetration rate of 17 percent. Internet and personal computer penetration in the region, at 7 percent and 6 percent respectively, is below the world average of 10 percent and 9 percent, respectively.

In terms of actual numbers, Brazil leads the region in the number of Internet users, personal computers, main telephone lines in operation, cellular mobile telephone subscribers, television receivers, and home satellite antennas. Brazil is succeeded by Mexico, which holds the second highest number for all the indicators. Argentina is first for the number of cable television subscribers and third for Internet users, personal computers, main telephone lines, cellular mobile telephones, and home satellite antennas. Chile is fourth in the number of Internet users and home satellite antennas, and fifth for numbers of personal computers, main telephone lines, cellular mobile telephone subscribers, television receivers, and cable television subscribers. Colombia is fourth in terms of personal computers and number of main telephone lines in operation and fifth in terms of numbers of home satellite antennas. Venezuela is fourth in numbers of cellular mobile telephone subscribers and cable television subscribers.

For both Internet users and personal computers, no economy in the region has a penetration rate higher than 50 percent. Twenty-seven economies in the region, including Brazil, Mexico, Colombia, Venezuela, and Peru have less than a 10 percent penetration rate for Internet and personal computers. In terms of main telephone lines, the region has two economies, Bermuda and the Virgin Islands, with penetration rates above 50 percent, while nine economies have main telephone line penetration rates below 10 percent. Cuba, Honduras, Paraguay, Nicaragua, and Haiti have among the lowest main telephone penetration rates. For cellular mobile telephones, three economies have penetration rates above 50 percent—Martinique, Guadeloupe, and Jamaica—while seven economies have penetration rates below 10 percent. Honduras, Nicaragua, Haiti, and Cuba have among the lowest cellular mobile telephone penetration rates. In terms of television receivers, five economies in the region, including Chile and Uruguay, have penetration rates above 50 percent, and only two economies have penetration rates below 10 percent.

Of the economies in the region, Cuba has one of the lowest penetration rates for some indicators. The country has a 1 percent Internet penetration rate, with 1 Internet user in every 94 persons. In terms of telephone lines, Cuba has a 5 percent penetration rate, with 1 main telephone line for every 20 persons. Perhaps the most striking statistic is the number of cellular mobile telephone subscribers, which, at 17,851, is equivalent to 1 subscriber in every 632 persons.

South Asia

South Asia, a region of eight economies and a combined population of 1.4 billion, has 18.6 million Internet users and 7.4 million personal computers (see Table 10). The region has 47 million main telephone lines and 16 million cellular mobile telephone subscribers. Television receivers are more prevalent than any other device—there are 117 million television receivers in the region and 44 million cable television subscribers but less than 4,000 home satellite antennas.

In the last three years, the region added nearly 19 million television receivers and more than 16 million main telephone lines. In the same period there were 15 million new Internet users, a growth of 512 percent. The region also increased the number of cellular mobile telephone subscribers by 13.4 million, equivalent to a growth of 520 percent, and added 3.2 million personal computers and 6.6 million cable television subscribers during the three-year period.

Overall, regional penetration rates have been quite low, the highest being the television penetration rate at 6 percent of total population. Penetration rates of main telephone lines and cable television subscribers are in the 2 percent range, while the region's cellular mobile telephone penetration is at 1 percent. The penetration rate of personal computers is less than 1 percent.

As the largest economy in the region in terms of weight and population, India also has the highest numbers for the various devices and user indicators. The scale in which India has been improving in the last three years is quite remarkable—the country added nearly 15 million main telephone lines, nearly 14 million Internet users, 10.8 million cellular mobile telephone subscribers, 10 million television receivers, 3 million cable television subscribers, and 2.7 million personal computers.

Table 13. **Regional Highlights: Leading Countries in Growth and Penetration, Latin America and the Caribbean**

	Change (units), 1999–2002			Change (%), 1999–2002			Penetration rate (% of Population), 2002	
Internet users (estimated)								
1	Brazil	10,800,000	1	Haiti	1,233	1	Bermuda	46
2	Chile	2,950,000	2	Martinique	700	2	Chile	24
3	Argentina	2,900,000	3	Dominica	525	3	Aruba	22
4	Mexico	2,841,166	4	Guatemala	515	4	Dominica	16
5	Peru	1,500,000	5	Aruba	500	5	Puerto Rico	16
6	Colombia	1,318,000	6	El Salvador	500	6	Virgin Islands (US)	15
7	Venezuela	594,429	7	Chile	472	7	Uruguay	12
8	Ecuador	403,315	8	Honduras	471	8	Argentina	11
9	Puerto Rico	400,000	9	Ecuador	403	9	Guyana	11
10	Guatemala	335,000	10	Paraguay	400	10	Trinidad and Tobago	11
Personal computers								
1	Brazil	6,900,000	1	Paraguay	233	1	Bermuda	49
2	Mexico	2,600,000	2	Brazil	113	2	Guadeloupe	22
3	Argentina	900,000	3	Cuba	100	3	Costa Rica	17
4	Colombia	733,000	4	Bolivia	90	4	Belize	14
5	Chile	641,814	5	Costa Rica	75	5	Martinique	13
6	Peru	350,000	6	Ecuador	61	6	Grenada	12
7	Costa Rica	300,000	7	Mexico	60	7	St. Vincent and the Grenadines	12
8	Venezuela	300,000	8	Chile	56	8	Chile	12
9	Ecuador	152,652	9	Colombia	52	9	Uruguay	11
10	Paraguay	140,000	10	Nicaragua	50	10	Barbados	9
Main telephone lines in operation								
1	Brazil	13,825,000	1	Haiti	86	1	Bermuda	86
2	Mexico	4,014,240	2	Brazil	55	2	Virgin Islands (US)	63
3	Colombia	1,100,578	3	Guatemala	39	3	Barbados	48
4	Argentina	652,672	4	Mexico	37	4	Antigua and Barbuda	48
5	Chile	358,403	5	El Salvador	35	5	Guadeloupe	45
6	Peru	334,265	6	Cuba	32	6	Martinique	42
7	Ecuador	296,660	7	Costa Rica	29	7	Bahamas	41
8	Venezuela	290,982	8	Ecuador	26	8	Netherlands Antilles	37
9	Costa Rica	235,389	9	Guyana	26	9	Puerto Rico	34
10	Guatemala	235,267	10	Peru	20	10	Aruba	34
Cellular mobile telephone subscribers								
1	Brazil	19,848,300	1	Guyana	3,001	1	Martinique	79
2	Mexico	18,196,625	2	Dominica	1,070	2	Guadeloupe	70
3	Chile	4,185,011	3	Jamaica	870	3	Jamaica	53
4	Venezuela	2,678,826	4	Trinidad and Tobago	836	4	Aruba	48
5	Colombia	2,630,465	5	Belize	697	5	Chile	43
6	Argentina	2,066,000	6	Bahamas	665	6	Bahamas	39
7	Peru	1,286,686	7	St. Vincent and the Grenadines	603	7	Virgin Islands (US)	37
8	Jamaica	1,255,612	8	Haiti	460	8	Antigua and Barbuda	32
9	Guatemala	1,239,285	9	Nicaragua	442	9	Puerto Rico	31
10	Paraguay	1,231,407	10	Suriname	397	10	Paraguay	29
Television receivers								
1	Brazil	4,000,000	1	Jamaica	98	1	Bermuda	108
2	Chile	3,668,711	2	Chile	87	2	Virgin Islands (US)	65
3	Mexico	1,800,000	3	Guyana	42	3	Uruguay	52
4	Colombia	1,499,020	4	Haiti	19	4	Chile	52
5	Jamaica	481,000	5	Honduras	18	5	Antigua and Barbuda	45
6	Ecuador	424,633	6	Ecuador	16	6	Jamaica	37
7	Argentina	400,000	7	Suriname	15	7	Grenada	35
8	Venezuela	214,258	8	Guatemala	13	8	Brazil	35
9	Peru	200,000	9	Colombia	13	9	Trinidad and Tobago	34
10	Guatemala	200,000	10	Barbados	13	10	Puerto Rico	34

Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

Table 14. **Regional Highlights: Leading Countries in Growth and Penetration, South Asia**

	Change (units), 1999–2002			Change (%), 1999–2002			Penetration rate (% of Population), 2002		
Internet users (estimated)									
1	Maldives	12,000	1	Maldives	400	1	Maldives	5	
2	India	13,780,000	2	India	492	2	India	2	
3	Bhutan	9,250	3	Bhutan	1,233	3	Bhutan	1	
4	Sri Lanka	135,000	4	Sri Lanka	208	4	Sri Lanka	1	
5	Pakistan	1,420,000	5	Pakistan	1,775	5	Pakistan	1	
6	Nepal	25,000	6	Nepal	71	6	Nepal	0	
7	Bangladesh	154,000	7	Bangladesh	308	7	Bangladesh	0	
8	Afghanistan	n/a	8	Afghanistan	n/a	8	Afghanistan	n/a	
Personal computers									
1	Maldives	12,500	1	Maldives	167	1	Maldives	7	
2	Bhutan	7,000	2	Bhutan	233	2	Bhutan	1	
3	Sri Lanka	145,000	3	Sri Lanka	138	3	Sri Lanka	1	
4	India	2,700,000	4	India	82	4	India	1	
5	Pakistan	20,000	5	Pakistan	3	5	Pakistan	0	
6	Nepal	20,000	6	Nepal	33	6	Nepal	0	
7	Bangladesh	320,000	7	Bangladesh	246	7	Bangladesh	0	
8	Afghanistan	n/a	8	Afghanistan	n/a	8	Afghanistan	n/a	
Main telephone lines in operation									
1	India	14,908,660	1	Bhutan	64	1	Maldives	10	
2	Pakistan	703,893	2	Bangladesh	58	2	Sri Lanka	5	
3	Bangladesh	249,032	3	India	56	3	India	4	
4	Sri Lanka	211,192	4	Sri Lanka	31	4	Bhutan	3	
5	Nepal	74,638	5	Nepal	29	5	Pakistan	2	
6	Bhutan	7,625	6	Maldives	29	6	Nepal	1	
7	Maldives	6,472	7	Pakistan	24	7	Bangladesh	1	
8	Afghanistan	4,050	8	Afghanistan	14	8	Afghanistan	0	
Cellular mobile telephone subscribers									
1	India	10,803,329	1	Maldives	1,332	1	Maldives	15	
2	Pakistan	940,170	2	Bangladesh	621	2	Sri Lanka	5	
3	Bangladesh	926,000	3	India	573	3	India	1	
4	Sri Lanka	674,925	4	Pakistan	337	4	Pakistan	1	
5	Maldives	38,973	5	Nepal	298	5	Bangladesh	1	
6	Nepal	16,381	6	Sri Lanka	263	6	Nepal	0	
7	Afghanistan	12,000	7	Afghanistan	n/a	7	Afghanistan	0	
8	Bhutan	0	8	Bhutan	n/a	8	Bhutan	0	
Television receivers									
1	India	10,000,000	1	Bangladesh	68	1	Pakistan	14	
2	Pakistan	5,390,000	2	Maldives	41	2	Maldives	13	
3	Bangladesh	3,171,102	3	Bhutan	38	3	Sri Lanka	12	
4	Sri Lanka	300,000	4	Pakistan	34	4	India	8	
5	Nepal	43,000	5	Nepal	29	5	Bangladesh	6	
6	Afghanistan	20,000	6	Sri Lanka	16	6	Bhutan	3	
7	Maldives	10,700	7	India	13	7	Afghanistan	1	
8	Bhutan	5,000	8	Afghanistan	7	8	Nepal	1	

Note: *or latest available data
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

None of the economies in the region has a penetration rate of more than 20 percent for any of the indicators. The penetration rates are notably high for television receivers, where Pakistan at 14 percent has the highest rate percent, followed by Maldives at 13 percent and Sri Lanka at 12 percent; the rest of the economies have single-digit penetration rates. In terms of main telephone lines only the Maldives reaches the 10 percent mark, with India at a 4 percent penetration rate, Pakistan at 2 percent, and Bangladesh at 1 percent. In terms of cellular mobile telephone penetration, Maldives has a 15 percent penetration rate followed by Sri Lanka at 5 percent while India, Pakistan, and Bangladesh post a 1 percent penetration rate.

In this region, penetration rates for Bangladesh, Nepal, and Afghanistan are cause for concern. In Bangladesh, only 1 person in every 653 is an Internet user; there is 1 personal computer for every 296 persons and 1 main telephone line for every 195 persons. Similarly, Nepal has 1 television for every 120 persons, 1 personal computer for every 290 persons, 1 Internet user in every 387 persons, and 1 cellular mobile telephone subscriber in every 1,060 persons. Finally, Afghanistan has 1 main telephone line for every 705 persons and 1 cellular mobile telephone subscriber in every 1,941 persons.

Middle East and North Africa

The Middle East and North Africa, a region of 20 economies, has a combined population of 320 million, roughly equivalent to the combined population of the United States and Canada (see Table 10). Of the region's 320 million people, about 13 million, or 4 percent, are Internet users and about 14 million have personal computers. The Middle East and North Africa region is one of the few regions where the number of personal computers exceeds the estimated number of Internet users. In terms of telecommunications, the region has 39 million main telephone lines (12 percent individual penetration) and 33 million cellular mobile telephone subscribers (10 percent individual penetration). The region also has 63 million television receivers, and a far higher number of home satellite antennas, nearly 12 million, than cable television subscribers, which number 1.4 million.

Between 1999 and 2002 the region posted a 388 percent increase in the number of Internet users, equivalent to 10.2 million new users, and a 340 percent increase in cellular mobile telephone subscribers, equivalent to 25.8 million new subscribers. Personal computers increased by 56 percent while main telephone lines and home satellite antennas both grew by 34 percent. At a slower pace were increases in cable television at 12 percent and television receivers at 9 percent.

Television penetration rate in the region is 20 percent. Main telephone lines and cellular mobile telephone subscriber penetration rates are slightly lower at 12 percent and 10 percent, respectively. Penetration rates of both Internet users and personal computers are both at 4 percent, leaving much room for improvement.

In the region, Iran has the highest number of Internet users, personal computers, and main telephone lines. Over the last three years Iran has added 2.9 million Internet users, a 1,167 percent increase. During the same period, Iran also increased the number of personal computers by 1 million, main telephone lines by 4.7 million, and cellular mobile telephone subscribers by 1.8 million.

Israel has the highest number of cellular mobile telephone subscribers and cable television subscribers, and the second highest number of Internet users. In the last three years, Israel added 1.2 million Internet users, a 150 percent increase. During the same period, Israel also added 3.4 million cellular mobile telephone subscribers, a 120 percent increase.

Saudi Arabia is second in the region in terms of the number of personal computers and home satellite antennas. It ranks third in the region in the number of Internet users, main telephone lines in operation, television receivers and cable television subscribers. Notably, during the period 1999–2002 the number of Internet users in Saudi Arabia rose by 1.5 million, an increase of 1,500 percent. Similarly, the country increased its number of personal computers by 150 percent or 1.8 million. Saudi Arabia also posted a notable increase in the number of cellular mobile telephone subscribers, adding 4 million over the last three years, which is equivalent to a growth of 499 percent.

Egypt has the second highest number of telephone lines in the region, and the fourth highest number of cellular mobile telephone subscribers, Internet users, and personal computers. Over the last three years, Egypt expanded its number of Internet users by 650 percent, adding 1.3 million new users. The country also added more than 2.7 million main telephone lines and more than 4 million new cellular mobile telephone subscribers.

In terms of Internet penetration rates, at 37 percent the United Arab Emirates has the highest in the region. The United Arab Emirates is followed by Israel at 30 percent penetration, Bahrain at 25 percent, and Lebanon at 12 percent. In terms of personal computers, Israel has the highest penetration rate at 24 percent, followed by Qatar at 18 percent and Bahrain at 16 percent. In terms of main telephone lines, Israel has the highest penetration rate at 47 percent, followed by the United Arab Emirates at 34 percent and Qatar at 29 percent. Similarly, Israel has the highest cellular mobile telephone penetration at 95 percent followed by the United Arab Emirates with a 76 percent penetration rate and Bahrain at 58 percent. In terms of television penetration, Qatar has the highest rate at 87 percent, followed by Oman at 55 percent and Bahrain at 43 percent. For cable television, Israel has the highest penetration rate at 18 percent, and for home satellite antennas Kuwait has the highest penetration rate of 27 percent.

Table 15. **Regional Highlights: Leading Countries in Growth and Penetration, Middle East and North Africa**

	Change (units), 1999–2002			Change (%), 1999–2002			Penetration rate (% of Population), 2002	
Internet users (estimated)								
1	Iran	2,918,000	1	Libya	1,686	1	United Arab Emirates	37
2	Saudi Arabia	1,500,000	2	Saudi Arabia	1,500	2	Israel	30
3	Egypt	1,300,000	3	Iran	1,167	3	Bahrain	25
4	Israel	1,200,000	4	Syria	1,000	4	Lebanon	12
5	United Arab Emirates	717,615	5	Morocco	900	5	Qatar	11
6	Morocco	450,000	6	Algeria	733	6	Kuwait	11
7	Algeria	440,000	7	Egypt	650	7	Saudi Arabia	7
8	Tunisia	355,500	8	Djibouti	500	8	Oman	7
9	Lebanon	200,000	9	Bahrain	450	9	Jordan	6
10	Syria	200,000	10	Yemen	300	10	Tunisia	5
Personal computers								
1	Saudi Arabia	1,803,000	1	Yemen	383	1	Israel	24
2	Iran	1,000,000	2	Saudi Arabia	150	2	Qatar	18
3	Egypt	370,000	3	Jordan	122	3	Bahrain	16
4	Israel	240,000	4	Tunisia	107	4	United Arab Emirates	14
5	Tunisia	155,000	5	Lebanon	83	5	Saudi Arabia	13
6	United Arab Emirates	150,000	6	Djibouti	67	6	Kuwait	12
7	Lebanon	125,000	7	United Arab Emirates	50	7	Lebanon	8
8	Yemen	115,000	8	Egypt	49	8	Iran	7
9	Jordan	110,000	9	Oman	46	9	Jordan	4
10	Syria	100,000	10	Syria	43	10	Oman	4
Main telephone lines in operation								
1	Iran	4,703,833	1	Yemen	79	1	Israel	47
2	Egypt	2,743,639	2	Egypt	59	2	United Arab Emirates	34
3	Saudi Arabia	611,361	3	Iran	56	3	Qatar	29
4	Syria	498,955	4	Tunisia	35	4	Bahrain	26
5	Algeria	308,000	5	West Bank and Gaza	34	5	Kuwait	20
6	Tunisia	297,619	6	Syria	31	6	Iran	20
7	Yemen	225,704	7	Saudi Arabia	23	7	Lebanon	20
8	Israel	222,000	8	Jordan	22	8	Saudi Arabia	14
9	Jordan	122,325	9	Libya	20	9	Jordan	13
10	United Arab Emirates	118,476	10	Algeria	19	10	Syria	12
Cellular mobile telephone subscribers								
1	Morocco	5,829,496	1	Syria	9,900	1	Israel	95
2	Saudi Arabia	4,171,337	2	Djibouti	5,257	2	United Arab Emirates	76
3	Egypt	4,013,726	3	Yemen	1,707	3	Bahrain	58
4	Israel	3,454,000	4	Morocco	1,579	4	Kuwait	52
5	Iran	1,829,082	5	Jordan	930	5	Qatar	44
6	United Arab Emirates	1,595,804	6	Egypt	834	6	Jordan	23
7	Jordan	1,101,180	7	Tunisia	812	7	Lebanon	23
8	Kuwait	927,000	8	Saudi Arabia	499	8	Saudi Arabia	22
9	Yemen	472,323	9	Algeria	456	9	Morocco	21
10	Tunisia	448,653	10	Iran	373	10	Oman	17
Television receivers								
1	Egypt	1,400,000	1	Syria	28	1	Qatar	87
2	Iran	1,000,000	2	Jordan	11	2	Oman	55
3	Syria	674,300	3	Tunisia	11	3	Bahrain	43
4	Saudi Arabia	407,000	4	Egypt	10	4	Kuwait	40
5	Yemen	310,000	5	Iran	10	5	Lebanon	35
6	Morocco	293,381	6	Israel	8	6	Israel	32
7	Tunisia	200,000	7	Saudi Arabia	7	7	Yemen	27
8	Israel	150,000	8	Morocco	6	8	Saudi Arabia	26
9	Jordan	95,000	9	Yemen	6	9	United Arab Emirates	24
10	Oman	85,000	10	Oman	6	10	Egypt	23

Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

For television, only two economies, Iraq and Djibouti, have penetration rates below 10 percent. For main telephone lines, seven economies have single-digit penetration rates, including Algeria and Morocco. For cellular mobile telephone subscribers, 10 economies have less than 10 percent penetration rates, including Egypt, Tunisia, Iran, Yemen, and Syria. In terms of Internet users, Saudi Arabia, Jordan, and Tunisia are among the 14 economies in the region with penetration rates that are lower than the world average of 10 percent. In the region, Yemen has the lowest Internet penetration, with 1 Internet user for every 485 persons. In terms of personal computers, Morocco, Iraq, Yemen, and Algeria have penetration rates of about 1 percent of population.

Sub-Saharan Africa

Sub-Saharan Africa, a region with 47 economies and a combined population of 676 million, has about 6 million Internet users and nearly 7 million personal computers (see Table 10). There are nearly 23 million cellular mobile telephone subscribers, which is more than twice the 10.2 million main telephone lines in operation. Like other regions, television is the most prevalent of the ICT devices included in the study. There are 47 million television receivers in the region, and about 1.2 million home satellite antennas and 188,000 cable television subscribers.

Over the last three years, cellular mobile telephones increased by 253 percent in the region, an addition of 16.3 million. During the same period, only 1 million lines were added, an 11 percent increase. Consequently, in 20 economies of the region, the number of cellular mobile telephone subscribers exceeds the number of main telephone lines.

Regional Internet growth, although it was an increase of 156 percent, amounted to only 3.6 million new users. This means that in the last three years, the region added slightly fewer users than what Taiwan, an economy with about 22 million people, added during the same period. Personal computers in the region also rose by only 2 million during the three-year period, an increase of 43 percent. While the increase is certainly welcome, it is disappointing when one takes into account that it is slightly less than the increase in the number of personal computers in Taiwan.

South Africa has the highest number of Internet users, personal computers, main telephone lines in operation, cellular mobile telephone subscribers, and home satellite antennas in the region. The country added nearly 1.3 million Internet users over the last three years, a 70 percent increase. In terms of the number of cellular mobile telephone subscribers, the country added 6.9 million, an increase of 133 percent.

Other economies in the region with notable ICT bases are Nigeria, Kenya, Zimbabwe, and Sudan. Nigeria has the highest number of cable television subscribers in the region, and the second highest number of personal computers, main telephone lines in operation, and cellular mobile telephone subscribers. Kenya has the second highest number of Internet users (tied with Zimbabwe) and the third highest number of cellular mobile telephone subscribers. Zimbabwe has the second highest number of Internet users, the third highest number of personal computers, and the third highest number of cable television subscribers. Sudan has the largest number of television receivers in the region, the third largest number of main telephone lines, and the fifth largest number of personal computers.

In terms of penetration rates, Mauritius and the Seychelles interchange for the top 2 slots for most of the technologies. Mauritius has the highest Internet penetration rate at 15 percent of its population, followed by the Seychelles at 11 percent and South Africa at 7 percent. For personal computers, the Seychelles has the highest penetration rate at 14 percent of the population, Mauritius is second with 11 percent penetration and Cape Verde is third, with 8 percent penetration. In terms of the number of cellular mobile telephone subscribers, the Seychelles registered a 53 percent penetration rate, followed by Mauritius at 29 percent and South Africa at 27 percent. For television receivers, Sudan has the highest penetration rate at 39 percent, followed by Gabon and Mauritius at 30 percent

The penetration rates for the majority of the economies in the region are cause for concern. Forty-three economies in the region have a less than 5 percent penetration rate for Internet users. Of the 43 economies, 30 of them have penetration rates below 1 percent. The Central African Republic, Ethiopia, Liberia, and the Democratic Republic of Congo have among the worst Internet penetration rates. In the latter, for example, only 1 in every 8,774 persons is an Internet user, a far cry from the world average of 1 in every 10 persons.

Personal computers present a similar picture. Only two economies, the Seychelles and Mauritius, post penetration rates higher than 10 percent. The rest of the region either has less than 10 percent, or no data are available. Of those where data are available, at least 17 have penetration rates below 1 percent. Among those with the lowest penetration rates for personal computers is Niger, with 1 personal computer for every 1,958 persons.

In terms of main telephone lines, 41 out of 47 economies in sub-Saharan Africa have a penetration rate below 5 percent. At least 31 of these economies have penetration rates of 1 percent or less. Some of the worst rates are in the Democratic Republic of the Congo, where there is an estimated 1 main telephone line for every 2,632 persons.

For cellular mobile telephone subscribers, 33 economies have a penetration rate below 5 percent. Of these 33 economies,

Table 16. **Regional Highlights: Leading Countries in Growth and Penetration, Sub-Saharan Africa**

	Change (units), 1999–2002			Change (%), 1999–2002			Penetration rate (% of Population), 2002	
Internet users (estimated)								
1	South Africa	1,280,000	1	Somalia	44,400	1	Mauritius	15
2	Zimbabwe	480,000	2	Zimbabwe	2,400	2	Seychelles	11
3	Kenya	465,000	3	Lesotho	2,000	3	South Africa	7
4	Togo	170,000	4	Sao Tome and Principe	1,700	4	Sao Tome and Principe	6
5	Nigeria	150,000	5	Sudan	1,580	5	Zimbabwe	4
6	Mauritius	125,000	6	Chad	1,400	6	Togo	4
7	Somalia	88,800	7	Kenya	1,329	7	Cape Verde	4
8	Sudan	79,000	8	Congo, DR	1,100	8	Botswana	3
9	Senegal	75,000	9	Eritrea	900	9	Namibia	2
10	Tanzania	75,000	10	Congo, DR	900	10	Swaziland	2
Personal computers								
1	South Africa	700,000	1	Zimbabwe	300	1	Seychelles	14
2	Zimbabwe	450,000	2	Equatorial Guinea	250	2	Mauritius	11
3	Sudan	115,000	3	Togo	200	3	Cape Verde	8
4	Togo	100,000	4	Sudan	135	4	South Africa	7
5	Nigeria	100,000	5	Gabon	127	5	Namibia	5
6	Senegal	60,000	6	Angola	125	6	Zimbabwe	5
7	Ethiopia	55,000	7	Ethiopia	122	7	Botswana	4
8	Namibia	50,000	8	Comoros	110	8	Togo	3
9	Kenya	50,000	9	Namibia	100	9	Senegal	2
10	Tanzania	40,000	10	Eritrea	79	10	Gabon	2
Main telephone lines in operation								
1	Sudan	420,422	1	Somalia	186	1	Mauritius	27
2	Nigeria	251,828	2	Sudan	167	2	Seychelles	26
3	Ethiopia	173,705	3	Mauritania	94	3	Cape Verde	16
4	Côte d'Ivoire	116,846	4	Ethiopia	89	4	South Africa	11
5	Ghana	83,567	5	Guinea-Bissau	84	5	Botswana	8
6	Mauritius	70,126	6	Malawi	77	6	Namibia	6
7	Somalia	65,000	7	Rwanda	70	7	Sao Tome and Principe	4
8	Senegal	58,749	8	Lesotho	58	8	Swaziland	3
9	Zimbabwe	48,898	9	Comoros	57	9	Gambia	3
10	Malawi	31,738	10	Nigeria	56	10	Zimbabwe	2
Cellular mobile telephone subscribers								
1	South Africa	6,893,000	1	Cameroon	9,283	1	Seychelles	53
2	Nigeria	1,608,060	2	Nigeria	6,432	2	Mauritius	29
3	Kenya	1,301,465	3	Burundi	6,400	3	South Africa	27
4	Côte d'Ivoire	769,924	4	Kenya	5,478	4	Botswana	24
5	Cameroon	557,000	5	Equatorial Guinea	4,400	5	Gabon	22
6	Senegal	465,548	6	Congo, DR	4,336	6	Cape Verde	10
7	Tanzania	376,014	7	Gabon	3,057	7	Mauritania	9
8	Uganda	336,952	8	Mozambique	2,326	8	Namibia	8
9	Ghana	334,974	9	Gambia	1,784	9	Gambia	7
10	Botswana	323,000	10	Burkina Faso	1,685	10	Congo, DR	7
Television receivers								
1	Sudan	7,571,630	1	Burkina Faso	631	1	Sudan	39
2	Nigeria	4,500,000	2	Togo	500	2	Gabon	31
3	South Africa	2,053,000	3	Namibia	314	3	Mauritius	30
4	Burkina Faso	820,000	4	Eritrea	233	4	Namibia	27
5	Tanzania	810,000	5	Sudan	151	5	Seychelles	20
6	Togo	500,000	6	Mali	150	6	South Africa	18
7	Namibia	382,480	7	Tanzania	117	7	Togo	13
8	Mali	210,000	8	Burundi	83	8	Cape Verde	10
9	Kenya	152,928	9	Mozambique	79	9	Nigeria	10
10	Eritrea	140,000	10	Nigeria	60	10	Mauritania	10

Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003

24 economies have a penetration rate of 1 percent or lower. Niger's penetration rate is particularly worrisome, with 1 cellular mobile telephone subscriber in every 5,525 persons.

Television penetration rates are, on the whole, higher than that for the other technologies. Ten of the 47 economies have television penetration rates higher than 10 percent. Only four economies have penetration rates below 1 percent. Chad and the Democratic Republic of the Congo are among those with the lowest television penetration rates. Chad has 1 television for every 525 persons while the Democratic Republic of the Congo has 1 television for every 526 persons.

Breaking down the aggregate figures according to levels of indebtedness, the picture reveals the tendency that the greater the level of indebtedness, the lower the penetration rates. In the region, 64 percent of the population live in what are classified as severely indebted economies, 24 percent of the population belong to economies classified as moderately indebted economies, while 12 percent belong to less indebted economies. In sub-Saharan Africa, less indebted economies have on average 1 Internet user in every 22 persons. This is in stark contrast to severely indebted economies that have, on average, 1 Internet user in every 471 persons. Similarly, less indebted economies have on average 1 personal computer for every 20 persons, while severely indebted economies have 1 personal computer for every 277 persons. Less indebted economies also have 1 main telephone line for every 13 persons, while severely indebted economies have 1 main telephone line for every 149 persons. In terms of cellular mobile telephones there is 1 cellular mobile telephone subscriber in every 6 persons in less indebted economies while in severely indebted economies there is 1 subscriber in every 87.

Box 2. **Crafting the Right Framework**

It is more important than ever for each economy to determine what types of policies are needed to create an environment and network infrastructure that would facilitate greater ICT access and overall networked readiness. Setting the "right" framework is difficult because it requires policy coherence among various areas.

The framework below outlines the elements that should be considered in crafting an environment for networked readiness:

PART I. MARKET ENVIRONMENT

HUMAN RESOURCES

Education
- Infrastructure-related: computerization and networking of schools and libraries
- Content-related: training of educators and integration of ICT in the curriculum
- Government expenditures in education

Labor
- Certification and accreditation of ICT literacy levels
- Skills development
- Skills matching through appropriate recruitment tools and centers
- Reversing the brain drain

CAPITAL
- Early-stage financing: access to venture capital
- Later-stage financing: access to capital markets

TECHNOLOGY

Technological Diffusion
- Role of trade in technology transfer
- Role of foreign direct investment in technology transfer

Technological Innovation
- Financing: grants, subsidies, tax concessions, loans
- Academia-business collaboration
- Industry clusters
- Ease of patent registration

PART II. LEGAL AND REGULATORY FRAMEWORK

LEGAL FRAMEWORK
- Basic legal framework: property rights, contract law
- Revising and creating relevant legislation: e-commerce
- Harmonization with international law

REGULATORY FRAMEWORK
- Regulatory capacity: establishing an independent and effective regulatory agency
- Degree of regulation: choosing an appropriate level of regulation
- Regulatory process: licensing/auctions, standards setting, dispute resolution: interconnection

PART III. INFRASTRUCTURE
- Market Structure: privatization, liberalization
- Pricing: choice or regulatory pricing regime, metered vs. non-metered, subsidies vs. no subsidies, Internet telephony
- Universal Service/Access
- Content: local content, content regulation, taxation, privacy, and consumer data protection
- Network quality: network service and support, quality of service monitoring, security
- Supporting infrastructure: electricity, postal systems, customs, transport logistics
- Financial: payment gateway, identification, authentication

Source: Figueres-Olsen, J-M and F. Paua. 2003. "Crafting the Environment for Networked Readiness." In *Global Information Technology Report 2002–2003*. New York: Oxford University Press for the World Economic Forum.

Box 3. **Promoting ICT Diffusion Through e-Government: Presence and Services**

ICT diffusion flourishes best when governments make it a priority to promote the use of technologies. One of the ways governments can do this is through e-government, such as increasing government presence on the web and providing relevant information and services online.

To benchmark the presence of national governments on the web and to assess the quality and sophistication of online government services, the World Economic Forum conducted a survey of national government websites from June to July 2003. Significantly, many developing economies are making inroads in e-government. Low income economies such as Tanzania and Nicaragua have remarkable online government presence. Moreover, several middle income economies, including Argentina, China, Estonia, Mexico, Philippines, South Africa, Guatemala, and Malta are increasing the level of sophistication of their e-government services websites (Figure E).

The result of the survey is captured in two e-government indicators that have been incorporated this year in the Networked Readiness Index Rankings. The first measure (Data table II.3.03) pertains to the presence of national governments on the web and this includes assessment of the websites of the chief executive, the judiciary, the main legislative body, ministries, embassies, and finally, the main government online portal, if available. The second measure (Data table III.3.02) evaluates the sophistication of online government service delivery. For each country, the availability and quality of five e-government services were assessed: filing of personal taxes, application for car registration, application for passports, application for business permits and, finally, electronic public procurement.

Of the five e-government services assessed, application for business permits and electronic public procurement cater mostly to business while the other three services cater to individual citizens.

In terms of online government presence, it is remarkable that all 102 economies have at least one branch of government online. Of the 102 economies, 101 economies have at least one ministry website, 94 economies have a website for the national parliament and 89 economies have a website for the judiciary. Of the 94 economies with a website for the national parliament, 79 economies have old bills and the constitution online. Of the 89 economies with a website for the judiciary, 66 economies post information on bills and pending cases online. Finally, of the 102 economies covered in the survey, 83 economies have a central site for the government, and of this number, 25 economies have single-entry portals to electronic services for citizens.

In terms of the sophistication of online government services, many countries, including developing countries, are making significant inroads. For business permits, only 14 economies can conduct electronic payments, but at least 90 economies had procedure details online, of which 52 economies allow downloading of forms. For electronic procurement, only 10 economies can do the entire transaction online but at least 78 economies have a related website with procedure details. For passport applications, at least 70 economies have simple contact information and procedure details while for car registration, at least 49 economies provide procedure details, of which 31 allow downloading of forms. Finally, for filing personal taxes, 72 economies have relevant web pages with downloadable forms while 17 countries, including developing countries like Guatemala, allow electronic payment.

Figure 5. **Matrix of Sophistication of Online Government Service Delivery vs Country Income Classification**

	Stage 1	Stage 2	Stage 3
HIGH INCOME		Greece	Australia
		Luxembourg	Austria
		Slovenia	Canada
			Denmark
			Finland
			France
			Germany
			Hong Kong SAR
			Ireland
			Israel
			Japan
			Korea, Republic of
			New Zealand
			Singapore
			Spain
			Sweden
			Taiwan
			United Kingdom
			United States
MIDDLE INCOME	Bolivia	Algeria	Argentina
	Botswana	Brazil	China
	Honduras	Bulgaria	Estonia
	Macedonia	Chile	Guatemala
	Namibia	Colombia	Malta
	Trinidad and Tobago	Costa Rica	Mexico
		Croatia	Philippines
		Czech Republic	South Africa
		Dominican Republic	
		Ecuador	
		Egypt	
		El Salvador	
		Hungary	
		Jamaica	
		Jordan	
		Latvia	
		Lithuania	
		Malaysia	
		Mauritius	
		Morocco	
		Panama	
		Paraguay	
		Peru	
		Poland	
		Romania	
		Russian Federation	
		Serbia	
		Slovak Republic	
		Sri Lanka	
		Thailand	
		Tunisia	
		Turkey	
		Uruguay	
		Venezuela	
LOW INCOME	Chad	Angola	
	Ethiopia	Bangladesh	
	Gambia	Cameroon	
	Ghana	India	
	Haiti	Indonesia	
	Madagascar	Kenya	
	Malawi	Mozambique	
	Mali	Nigeria	
	Nicaragua	Pakistan	
	Senegal	Tanzania	
	Vietnam	Uganda	
	Zimbabwe	Ukraine	
		Zambia	

Stage 1. Information stage: e-government services websites, where available, provide basic information

Stage 2. Interactive stage: e-government services websites allow submitting and downloading forms

Stage 3. Transaction stage: at least one e-government service enables electronic payment for the transaction

Source: World Economic Forum, Survey of National Government Websites, accessed June–July 2003

Nonetheless, the gains are apparent across the board, particularly in the area of Internet users and cellular mobile telephone subscribers. In 1999, 1 in every 266 persons was an Internet user in sub-Saharan Africa; by 2002, this ratio improved to 1 in every 113 persons. For the severely indebted economies, this ratio moved from 1 Internet user in every 1,996 persons to 1 in every 471 persons. In terms of cellular mobile telephone subscribers, the region improved its 1999 ratio of 1 subscriber in every 96 persons to 1 in 30 by 2002. At the same time, the penetration rate of cellular mobile telephone subscribers in severely indebted economies dramatically improved from 1 subscriber in every 797 persons to 1 subscriber in 87.

Policy Imperatives and Market Implications

The analysis above has painted the global picture of ICT diffusion as well as presented the profiles of ICT penetration in the different regions of the world. Evaluating the progress of ICT diffusion over the last three years, the analysis clearly shows that much has been achieved in improving access to information and communication technologies in the world, particularly in many developing economies.

That much of this remarkable growth in ICT diffusion has been achieved in a difficult environment makes it even more extraordinary. The last three years marked the peaking of the Internet bubble and consolidation in the technology industry. It was also a period marked by a synchronized downturn in the global economy.

Today, the technology industry is increasingly showing signs of a pick-up in activity. The information and communication technology sector in general is also benefiting from the consolidation that has occurred during the last three years: debt levels have been reduced, operations have been streamlined, and much of the excess has been minimized. Research and development activities are accelerating and more innovations are coming to market. All these positive developments in the sector augur very well for continued dramatic improvements in ICT diffusion.

These positive developments come at an opportune time because, as the above analysis also shows, much still needs to be done to improve global ICT diffusion. Many members of the global community have yet to gain access to some of the most basic information and communication technologies. Even in the context of shared access in developing economies, the disparities of ICT access remain glaring. The lingering gap will continue to exist unless international and national policymakers as well as business leaders and other stakeholders exert concerted efforts to close it.

The task before us all is twofold: apply the lessons we have learned, particularly in the last three years, and seize the opportunities of improved economic prospects in order to reduce the gaps in access to ICT. As the world gears up for economic recovery and the technology sector stands poised for a rebound, there are four policy considerations and another four market implications for policymakers, business leaders, and civil society to bear in mind.

Four Policy Imperatives

The first policy imperative is that it is more important than ever to craft the right framework. As the variations in country performance in ICT diffusion reveals there is no simple blueprint for crafting the right environment for fostering increased ICT access. A particular policy and regulatory framework that is most suitable for one country may not be applicable to another due to a myriad of variations, ranging from geographic terrains to differing economic, political, social, and institutional contexts.

Yet the fact remains that the most appropriate framework for an economy must be in place to enable it to fully capture the benefits of ICT (see Box 2). On the policy side, this means assessing several aspects of the framework: market structure, pricing, universal service/access, content, network quality, and supporting infrastructure. With so many aspects involved in the framework, it is important to ensure policy coherence as well as flexibility in adapting to rapidly changing technologies and shifting global trade and investment patterns. Moreover, there must be in place a clear and up-to-date legal framework that is consistent with international law. It is also important to ensure that an independent regulator who is empowered and equipped to implement regulatory policy, allocate scarce resources, adjudicate disputes, and balance goals of efficiency, equity, and innovation oversees a country's regulatory regime.

The second important policy imperative is that the issue of ICT access is ultimately about developing human capacity. The willingness to acquire technological devices depends on the expected utility of these devices, which in turn depends on an individual's capacity to use these devices. For policymakers, this means that attention must be placed on education and labor policies. A country's educational system and policies must provide the relevant knowledge and skills needed by individuals in the knowledge economy. Likewise, labor policies must ensure timely upgrading of the knowledge and skill base of the workforce. Significantly, both education and labor policies must entail the allocation of sufficient resources and investment from governments.

It is important, however, that efforts to enhance human capacity be pursued concurrently with efforts to ensure that appropriate technologies are being developed. Policymakers and business leaders must continually assess whether existing technologies are relevant to the needs and abilities of the intended users.

The third important policy imperative is that ICT diffusion flourishes best when governments make it a priority to promote the use of technologies. When one looks at economies with low penetration rates, one of the questions that immediately come to mind is: what, if anything, are the governments doing to promote ICT access? There are many reasons that developing country governments may be unable to focus on ICT promotion. Some governments are unfortunately caught in wars and various forms of political instability. There are others that simply do not have the resources to address the issue of ICT access because of pressing requirements in the area of food, security, or healthcare; these cases clearly provide opportunities for donor economies and international and nongovernmental organizations to offer assistance. In yet other cases the problem is lack of attention to policy and resource allocation; policymakers are then called upon to adopt a longer-term perspective and to look at effective ICT promotion as an investment in the future.

Beyond establishing policy and regulatory frameworks conducive to creating a network infrastructure, governments must also promote the use of these technologies, either by example through e-government (see Box 3), or through proactive policies to promote local content. Production of local content and relevant applications are important elements when encouraging individuals to acquire and use ICT. In advanced economies, there are cases where it is lack of interest, rather than lack of affordability, that deters a potential Internet user.

Equally as important as producing local content, government also must foster the creation of an environment that allows information exchanges, that is, freedom of communication and expression. Freedom of the press is curtailed in many countries, and this constraint often extends into Internet content regulation.

The fourth policy imperative is that international trade plays a very important role in ICT diffusion. International trade allows domestic producers and consumers to have access to a greater variety of ICT products and services at prices lower than would otherwise be possible. To facilitate ICT diffusion, policymakers must liberalize trade by lowering tariff and non-tariff barriers to ICT.

Four Market Implications

In addition to policy considerations, this progress report on global ICT diffusion indicates important market implications. The first is that there is a significantly large market that is yet to be connected. Ninety percent of the world's 6.2 billion population are not Internet users. There are 1.5 billion households in the world but there are only half a billion personal computers. Moreover, despite the rapid adoption of cellular mobile telephones, more than 5.5 billion people in the world are not cellular mobile telephone subscribers.

The second implication is that there is a potentially large market for technologies and applications other than what is available today. One of the caveats noted in the introduction of this study is that indicators monitored in this analysis may not be the most relevant or the most affordable technologies, particularly for developing economies. For instance, is a desktop personal computer practical for a farmer who works in the field all day? Or can more appropriate technologies be developed? Beyond the question of relevance, more user-friendly technologies must also be developed to cater to the varying educational, linguistic, and ability levels of people. Technologies must also be developed that are affordable for the intended users. There are clearly unmet needs and opportunities to innovate upon existing technologies.

The third implication revealed by the analysis of global ICT diffusion is that it is important to study demand and take-up patterns. In the face of rapidly shifting technologies, companies and governments are often faced with the difficult task of choosing technology platforms. As policymakers strive towards promoting ICT access and providing information and relevant online services, it is important that they choose a platform that is broadly used by their constituency and that can be best used to connect to the networked economy. For companies, this task has the added component of having to ascertain the projected demand for these technologies.

Three years ago, it would have been difficult to predict that cellular mobile telephone subscribers would exceed the number of main telephones lines in 125 economies (Appendix 1). There are many reasons for the rapid take-up of cellular mobile telephone subscribers; among these reasons is the waiting time in many developing economies to get a telephone line connected. Two other very important reasons are the introduction of pre-paid cards, which dramatically reduced the cost of access, and the popularity and affordability of short messaging service, which allows the sending of text messages through a mobile telephone. Indeed, determining which technologies are spreading rapidly and assessing what is driving the spread can provide important lessons that may be applicable to existing and emerging technologies.

Beyond examining where growth is coming from, it is equally important to examine the varying take-up patterns of technologies. What does this mean for developing economies seeking the easiest, most affordable way to connect to the Internet? It is also interesting to see that amidst the emergence of various new devices, television remains among the most pervasive ICT in the world. What implication does this have for delivering time-sensitive information? Worldwide over the last three years, purchases of personal

computers grew by 40 percent, which pales in comparison to the 119 percent growth in the number of Internet users. What does this say about the price structure and appeal of the current design of personal computers? What impact would Wi-Fi, and other new technologies, have on improving Internet access?

The fourth market implication is that we have barely begun to tap the possibilities of the current network. In the world today, for example, there are at least 1.5 billion cellular mobile telephone subscribers. What kind of applications can be created for this subscriber base? What opportunities do a network of more than 600 million Internet users present? Moreover, what implications would convergence have on the current network and array of applications? The rate of growth of ICT diffusion and the rapid take-up of newer technologies certainly provide us with strong reasons to be optimistic about tapping the potential of an increasingly networked world.

Conclusion

As a progress report on the global diffusion of ICT, the analysis of the empirical data clearly shows that globally, access to ICT has increased dramatically, particularly in terms of cellular mobile telephones and the Internet. That a significant proportion of the growth came from emerging market economies is remarkable. What makes the overriding high rate and diffusion of ICT even more extraordinary is that it occurred at a time that was marked by a synchronized downturn in the global economy and deep consolidation in the technology sector.

Yet analysis at the regional and country level, particularly when disaggregated according to income levels, reveals the persistence of a significant gap between the penetration rates in high income economies and low income economies, particularly those economies in sub-Saharan Africa that are severely indebted. Even in the context of shared access in developing economies, the disparities of ICT access still remain glaring. The lingering gap will continue to exist unless international and national policymakers as well as business leaders and other stakeholders exert a concerted effort to apply the lessons that have been learned, particularly over the last three years. It is equally important to seize the opportunities of improved economic prospects in order to reduce the gaps in access to ICT.

The analysis of the global diffusion of ICT leads us to four policy imperatives and four market implications for policymakers, business leaders, and civil society. To promote greater diffusion of ICT it is important, first, to craft the right framework in terms of policy and regulatory environments. The second policy consideration is to develop human capacity in order to encourage individuals to use ICT and enable them to maximize the benefits of having access to ICT. The third is for governments to promote the use of ICT through a national ICT strategy, e-government initiatives, promotion of local content, and the creation of an environment where freedom of communication and expression can prevail. The fourth policy imperative is that international trade plays a very important role in ICT diffusion, and governments must reduce tariff and non-tariff barriers to ICT imports.

As the world gears up for economic recovery and the technology sector stands poised for a rebound, the analysis highlights four market implications. The first is that a large proportion of the world is yet to be connected and this represents a tremendous market opportunity. The second implication is that since most of those yet to be connected are in the developing world, there is a potentially large market for new and more affordable technology as well as applications that are more relevant and user friendly. Clearly there are opportunities to innovate and improve upon existing technologies. Related to the second implication is the third, which highlights the importance of studying demand and take-up patterns in order to anticipate future requirements. And the final implication is that the world has barely begun to tap the possibilities of the current network, which has more than 600 million Internet users, and more than 2 billion main telephone lines and cellular mobile telephone subscribers. The rate of growth of ICT diffusion and the rapid take-up of newer technologies certainly provide strong reasons for optimism as we continue to tap the potential of an increasingly networked world.

Endnotes

1 The first *Global Information Technology Report* was a collaboration between the World Economic Forum, the Center for International Development at Harvard University, and *info*Dev of the World Bank.

2 Data are primarily from the International Telecommunication Union (ITU) World Telecommunication Indicators Database, accessed July 2003. Public information is available at the ITU website:http://www.itu.int/ITU-D/ict/

3 "Main telephone lines" is defined by the ITU as "telephone lines connecting a customer's equipment (e.g., telephone set, facsimile machine) to the Public Switched Telephone Network (PSTN) and which have a dedicated port on a telephone exchange." ITU also notes that, "for most countries, main lines also include public payphones." More information can be found on the Technical Notes page of the ITU website: http://www.itu.int/ITU-D/ict/statistics/at_glance/main02.pdf

4 "Cellular mobile telephone subscribers" is defined by the ITU as "users of portable telephones subscribing to an automatic public mobile telephone service using cellular technology that provides access to the PSTN." More information can be found on the Technical Notes page of the ITU website: http://www.itu.int/ITU-D/ict/statistics/at_glance/main02.pdf

5 Classification of economies according to income is based on the World Bank's Country Classification whereby economies are divided according to 2002 GNI per capita, calculated using the World Bank Atlas method. The groups are: low income, USD 735 or less; lower middle income, USD 736 to 2,935; upper middle income, USD 2,936 to 9,075; and high income, USD 9,076 or more. For the purposes of Appendix 1, "lower middle income" and "upper middle income" were merged into one "middle income" category. More information on the World Bank Country Classification can be found on the World Bank website: http://www.worldbank.org/data/countryclass/countryclass.html

6 The historical perspective on the China and India experiences in ICT diffusion was first explored in Paua, F., E. J. Lee, A. Padmanabhan, et al. 2001. "Information Infrastructure Development in China and India: Comparative Analysis, 1986–2000." Unpublished paper, Harvard University.

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Appendix 1. **Countries Where the Number of Cellular Mobile Telephones Subscribers Exceeds the Number of Main Telephones Lines in Operation, 2002***

High income economies	
	Difference**
Italy	24,864,050
United Kingdom	14,776,000
Spain	14,769,400
Taiwan	10,805,990
Japan	9,969,000
Korea, Republic of	9,085,000
Germany	5,480,000
France	4,656,560
Portugal	4,167,900
Greece	3,706,534
Israel	3,234,000
Belgium	3,003,085
Hong Kong SAR	2,454,598
Austria	2,427,000
Netherlands	2,100,000
Australia	1,989,000
Finland	1,550,000
Sweden	1,474,000
Singapore	1,364,900
United Arab Emirates	1,334,417
Ireland	994,000
Slovenia	855,565
Kuwait	745,109
Denmark	738,898
New Zealand	671,000
Norway	517,000
Switzerland	399,000
Bahrain	213,544
Reunion	189,800
Martinique	147,900
Guadeloupe	113,500
Luxembourg	108,237
Macau	100,032
Qatar	90,184
Iceland	75,310
Brunei Darussalam	48,560
French Polynesia	37,480
New Caledonia	29,291
Aruba	15,868
Liechtenstein	2,077

Middle income economies	
	Difference**
Mexico	10,986,630
Philippines	10,877,304
Thailand	9,617,158
South Africa	7,186,000
Morocco	5,071,223
Czech Republic	4,749,334
Malaysia	4,575,000
Turkey	4,459,500
Venezuela	3,621,790
Chile	2,978,496
Hungary	2,895,555
Poland	2,600,000
Saudi Arabia	1,690,422
Slovak Republic	1,520,658
Paraguay	1,393,800
Jamaica	950,000
Guatemala	731,117
Lithuania	695,674
Albania	580,000
Jordan	531,999
Estonia	406,000
Croatia	399,000
Dominican Republic	314,937
Bolivia	308,735
Peru	277,735
Botswana	272,400
Bosnia and Herzegovina	258,555
Serbia	257,434
Gabon	248,584
El Salvador	221,119
Oman	218,000
Latvia	215,985
Ecuador	134,673
Panama	98,855
Lebanon	96,264
Malta	69,590
Sri Lanka	48,472
Trinidad and Tobago	36,857
Namibia	32,602
Swaziland	27,940
Mauritius	22,775
Seychelles	22,734
West Bank and Gaza	21,500
Belize	20,860
Maldives	13,248
Suriname	9,634
Guyana	6,859
Djibouti	4,875
Honduras	4,011

Low income economies	
	Difference**
Indonesia	3,949,965
Kenya	997,118
Nigeria	931,060
Côte d'Ivoire	690,929
Cameroon	461,558
Bangladesh	393,000
Cambodia	346,506
Uganda	338,334
Senegal	328,804
Tanzania	278,500
Mauritania	213,733
Mozambique	207,512
Congo	199,800
Ghana	162,878
Congo, DR	130,000
Togo	108,844
Madagascar	103,569
Mongolia	88,000
Rwanda	68,500
Nicaragua	68,295
Benin	65,702
Zimbabwe	65,146
Guinea	64,783
Gambia	61,650
Lesotho	57,964
Zambia	50,617
Angola	45,000
Sierra Leone	43,505
Burundi	29,916
Burkina Faso	27,992
Chad	22,365
Equatorial Guinea	18,200
Malawi	12,947
Haiti	10,000
Mali	2,909
Central African Republic	2,083

Note: *or latest available data
** indicates the difference between the number of cellular mobile telephone subscribers and the number of telephone main lines in operation.
Source: Author's calculations based on data from the International Telecommunication Union, World Telecommunication Indicators Database, accessed July 2003