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THE DIGITAL DIVIDE:

ICT DEVELOPMENT INDICES 2004

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PREFACE

The digital divide between the information-rich and the information-poor is of increasing concern. A major challenge for policy-makers at the national and international level, therefore, lies in addressing the issue of digital divide between rich and poor countries, rural and urban areas, men and women, skilled and unskilled citizens, and large and small enterprises.

Information and communication technologies (ICTs) offer unique opportunities for developing countries to narrow the development gap with industrialized countries. They have the potential to assist developing countries "leap frog" entire stages of development. However, despite the potential benefits offered by ICTs, significant barriers to their effective use exist in both developed and developing countries. These barriers must be addressed to allow the realization of the full potential of ICTs'. Some barriers may be endemic (e.g. the generation gap, learning processes and gaining experience in ICTs). Developing countries have to deal with problems of telecoms infrastructure, poor computer and general literacy, lack of awareness of the Internet and regulatory inadequacy.

Benchmarking the extent of ICT development is an important tool for policy-makers. It allows comparisons between countries and indicates how well countries are doing compared to others in terms of adaptation, mastery and development. Comparison with better-performing countries helps identify policies for further improvement and progression, which forms part of this report. Cross-country analyses without benchmarking the extent of the digital divide lack the depth of insight required for policy purposes.

The WSIS Plan of Action calls for "realistic international performance evaluation and benchmarking (both qualitative and quantitative) through comparable statistical indicators and research result. A composite Information and Communication Technology (ICT) Development index could show the statistics while the report would present analytical work on policies and their implementation" (p.13). This report presents such analysis and research, and seeks to inform policy-making and enlighten decision-makers in their attempts to promote ICT development, especially in developing countries.

This report updates UNCTAD's ICT Development Indices to benchmark ICT development and review trends in the digital divide. It presents a summary of the policy options that countries can adopt to foster ICT development, and illustrates these by reviewing four country case studies that have successfully promoted growth in ICTs. Importantly, this Report adds depth to its benchmarking analysis by describing examples of innovative grassroots programmes in the field of ICTs in Africa. One of the key findings of the analysis is that it is not merely policy that matters but also what drives the policy and the quality of its implementation. The report contributes to the discussion on how to overcome the digital divide on the basis of examples of ICT policies that are being enacted in practice and to draw guidance as to how implementation might be improved. It represents part of UNCTAD's contribution to the World Summit on the Information Society, to be held in Tunis in November 2005.

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CONTENTS

ABBREVIATIONS AND ACRONYMS

ADSL	Asymmetric Digital Subscriber Line
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
CSTD	Commission on Science and Technology for Development
DSL	Digital Subscriber Line
EU	European Union
GDP	Gross Domestic Product
ICP	Internet Content Provider
ICT(s)	Information and Communication Technology (Technologies)
ISDN	Integrated Services Digital Network
ISP	Internet Services Provider
IT	Information Technology
ITU	International Telecommunication Union
IXP	Internet Exchange Point
MISP	Mobile Internet Service Provider (Republic of Korea)
OECD	Organisation for Economic Cooperation and Development
PC	Personal Computer
P(S)TN	Public (Switched) Telephone Network
PTO	Public Telephone Operator
RCDF	Rural Communications Development Fund
RTDF	Rural Telecommunications Development Fund (Uganda)
SOE	State-owned Enterprise
SSAs	Sub-Saharan African
UAFs	Universal Access Funds
UCC	Ugandan Communications Commission
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Programme
USP	Universal Service Provision
VoIP	Voice over Internet Protocol
WSIS	World Summit on the Information Society
WTDI	World Telecommunication Development Indicators (published by the ITU)
WTO	World Trade Organization

OVERVIEW

The importance of technology to economic development has long been recognized. This may be especially true of Information and Communication Technologies (ICTs), which cut across all economic activities and have a wide range of applications. They offer the potential for increased availability of information, new means of communication, re-organization of productive processes and improved efficiency in many different economic activities.

Despite the potential benefits that can be offered by ICTs, developing countries face significant obstacles to ICT connectivity and access. The underlying causes of low levels of ICT penetration in developing countries includes a lack of awareness of what these technologies can offer; insufficient telecommunications infrastructure and Internet connectivity; expensive ICT access; absence of adequate legal and regulatory frameworks; shortage of requisite human capacity; failure to develop local language content; and a lack of entrepreneurship and business culture open to change, transparency, and social equality.

These problems are reflected in highly uneven growth in the use of ICTs across countries. The so-called digital divide between the information-rich and the information-poor is of increasing concern. A major challenge for policy-makers at the national and international level, therefore, lies in addressing the issue of the digital divide: between rich and poor countries, rural and urban areas, men and women, skilled and unskilled citizens, and large and small enterprises.

From a historical respective, technological gaps, uneven diffusion and possible exclusion from benefits of technologies are not new. Telephony and electricity are still far from being evenly diffused. With ICTs, however, the size and scale of the potential benefits foregone through failure to participate in the new 'digital society' are likely to be much greater. It is essential, therefore, that steps are taken to ensure that developing countries have the ability to participate in the knowledge economy.

The formulation and implementation of national ICT strategies that deal effectively with the preceding challenges must be particularly sensitive to two elements: first, the need for mechanisms to monitor and assess ICT readiness, usage and impact; and second, the need to link ICT policies to other development policies, such as education, trade and health to allow for benefits from synergies between different elements and more broad-based diffusion of ICT.

This report responds to these two needs. It monitors and assesses the international digital divide and its implications. It evaluates ICT development using a range of indicators to benchmark connectivity, access, ICT policy and overall ICT diffusion in a cross-country analysis of a total of 165 countries. The findings are presented in the ICT Development Indices. Further, it extends this benchmarking analysis with a consideration of the policy options open to policy-makers, and how chosen policies can be implemented and linked to a range of other policies. The aim is to make a useful contribution to ICT policy thinking for public and private decision-makers, with a focus on developing countries and, in particular, Africa.

In the benchmarking analysis, countries from the Organisation for Economic Cooperation and Development (OECD) continue to dominate the upper rankings. This lead is partly due to the priority given to ICT policies by OECD countries, with policies across a broad range of fronts (ICT policies are summarized in Chapter 3). South Asian and African countries occupy the lower half of the rankings. Sub-Saharan countries dominate the lower end. This reflects that, as a region, Africa still has a considerable way to go in connectivity and ICT diffusion to hold its own with other regions. Major gains in connectivity have been made by transition economies. Changes in rankings are generally small for Arab and Asian countries. Latin American and Caribbean countries have maintained their levels of ICT diffusion. Intriguingly, a wide variety of countries have made gains in ICT diffusion, while losses are confined to certain regions, notably Africa.

Trends in the digital divide have been analysed. Levels of inequality in access to ICTs remain high still, *around twice average levels of income inequality*. Trends in the digital divide show sharply contrasting trends according to the type of technology. The distributions of Internet hosts and personal computers remain highly uneven. Mainline telephony shows small, but steady reductions in inequality. However, the distributions of mobile telephony and Internet users across different countries suggest strong gains in access to mobiles and the Internet and an expansion of ICT access in developing countries in particular. Mobile telephony and Internet usage suggest that the digital divide measured by inequality in these distributions may be reducing.

The lack of matching gains in more widespread access to personal computers however suggests that gains in Internet usage and access are being achieved mostly through shared access. Policy initiatives such as community telecenters and Public Access Points are thus increasingly important. Promising examples of such initiatives are examined in Chapter 5. The analysis of the digital divide presented in this study provides evidence that marked disparities in ICT access and usage between countries continue to exist, and remain sizeable, although disparities in Internet and mobile usage are reducing rapidly, suggesting more even and widespread access to ICTs.

For further insight, this benchmarking analysis has been extended with a summary of different policy tools that may be used to promote ICT development, and the experiences of some countries that have been successful in promoting access to ICTs are reviewed. Similar policies are relevant to developing countries, although their policy mix differs according to individual countries' needs and circumstances. Policy mixes in developing countries often prioritize resources and seek to increase basic connectivity, expand access and retain skilled labor.

One of the key findings of this report is that it is not just the policy that matters: *who drives the implementation of policy and how it is implemented matter greatly*. How does a leading role by government in encouraging Internet expansion (in the Republic of Korea and Egypt) impact Internet expansion, in contrast to more demand-led expansion driven by consumers (in the People's Republic of China)? Does consumer-led expansion lead to greater consumer awareness, more deeply-rooted skills and faster lifestyle changes? In fact, case studies show that both models seem successful, given the structural characteristics of the market. In order to identify factors that have contributed to the successful uptake of ICTs, the experiences of four countries that have been successful in promoting ICT development are examined.

The report considers the growth of the Internet in China and Egypt, developments in mobile Internet in the Republic of Korea and rapid growth in mobile phones in the Czech Republic to identify key factors underlying progress. Despite different characteristics of the market in each country, it concludes that in each case, a successful compromise was achieved (in some cases, negotiated) between the stakeholders.

In some cases, key players worked together in the common interest. In other countries, particular agents or institutions had particular strength. In the Republic of Korea, the government took the lead in promoting development of the Internet. In China, where the government was more cautious in its approach to ICTs, Internet development has been largely consumer-led with rising incomes leading to an explosion in demand for ICTs. In Egypt, a dynamic Ministry of Communications and Information Technology played a strong role in catalyzing telecommunications development in collaboration with the private sector, emphasizing the importance of public-private partnerships. It is hoped that the experiences of these countries will be instructive in helping policy-makers decide upon priorities for their country.

In view of evidence that Africa is still not keeping up with other countries in ICT diffusion, the report also reviews practical on-the-ground programmes and applications that are being developed in Africa to respond to communities' needs for expanding access to ICTs and telecommunications. It considers the use of Universal Access Funds and the experience of Uganda in establishing a collective fund to build the network infrastructure for telecommunications.

The importance of ICT policies and the market supply-side are often emphasized to the neglect of underlying demand, which is often assumed to exist and to be constrained only by effective purchasing power. Constraints upon demand are often addressed only in passing. The report therefore considers efforts to build demand for ICTs and IT skills through community telecenters. It examines the experience of Egypt in establishing its IT Clubs to extend access and basic IT training to a wider range of customers and communities. The importance of developing relevant content and applications suited to the needs of local populations is discussed for Mali. Local content is essential in order to take ICT applications in new directions, to make them more directly relevant to end-consumers and to build the demand for their uptake. Mali's experience in adapting and using ICTs in a range of fields, including education, telemedicine and the promotion of tourism and arts and crafts illustrates how ICTs can be used to improve people's standards of living.

It is hoped that this report will prove a valuable resource in understanding the importance and relevance of benchmarking ICT development for policy-making. Policy tools and programmes that are being used to promote widespread access to telecommunications, such as Universal Access Funds and Community Access Centres, have been examined and their contribution to the successful uptake of these programmes has been established. The experiences of some countries with promising programmes should prove helpful to others in formulating their policy decisions. Finally, proactive policies are needed to ensure effective utilization of ICTs, focusing on bridging the gaps in opportunities for those with limited access to technology. It is hoped that this report will contribute towards more effective policy decision-making and dissemination of best practice, leading towards more rapid diffusion of ICTs.

This publication complements other work carried out by UNCTAD in the field of ICT for Development. The annual E-Commerce and Development Report provides data and analyses on the impact of ICT on economic growth, enterprise development and trade competitiveness in developing countries, providing policy makers with an analytical and empirical basis for taking the appropriate decisions in the field of ICT and e-business at the national level. The global Partnership on Measuring ICT for Development, which was launched at the occasion of UNCTAD XI in Sao Paulo, Brazil (June 2004), aims to assist developing countries in their production of comparable ICT statistics for monitoring ICT developments and assessing national ICT policies and strategies. The members of the Partnership[1] recently organized a WSIS Thematic Meeting on Measuring the Information Society (Geneva, 7-9 February 2005). The main outcome of this Thematic Meeting was an agreed upon core list of ICT indicators comparable at the international level, which could be collected by all countries. Such internationally agreed indicators and definitions could be used as a basis for data collection to increase comparability between countries.

[1] Members as of February 2005 include the ITU, OECD, UNCTAD, UNESCO Institute for Statistics, UN Regional Commissions (ECA, ECLAC, ESCAP, ESCWA), the UN ICT Task Force, the World Bank and Eurostat,

1. BENCHMARKING ICT DEVELOPMENT

1.1 2002 ICT Development Indices

The ICT Development Indices have been compiled on the basis of measures of connectivity, access and policy. This section analyses ICT diffusion for 2001-2002.

Consistent with analyses by the ITU and World Bank, the top thirty places are dominated by OECD and high-income countries (see Annex Table A.1.) The United States ranks first, with the other top ten countries all European except for Singapore, which has broken into the top ten, rising from 12 to 9. The ITU Internet case study of Singapore (2001) suggests that this is due to a total commitment by the Government to becoming the 'most wired place' on earth. Australia maintains its ranking of 10, while Hong Kong, China, slips marginally from 11 to 12. The Republic of Korea (see 'Some Success Stories' in Chapter 4), the other South East Asian star performer, rockets up the rankings from 22 to 14. Japan now trails the Republic of Korea at 17. The highest-ranking Arab country is the United Arab Emirates at 20, while high-ranking island states are Malta (32nd place) and Barbados (34th place). The highest-ranking transition economy is Slovenia at 23, while the Czech Republic has risen fast up the rankings from 44 to 35 (see Chapter 4).

Table 1: Analysis of ICT Diffusion by income

Index of ICT Diffusion	1995	1999	2000	2001	2002
High income:					
Best	Finland 1	USA 1	USA 1	USA 1	USA 1
Worst	Bahamas 46	Bahamas 57	Bahamas 60	Kuwait 48	Kuwait 42
Average	21	19	20	19	18
Middle income:					
Best	Lithuania 30	Estonia 32	Estonia 32	Malta 31	Estonia 29
Worst	Egypt 154	Micronesia 169	Vanuatu 162	Vanuatu 160	Vanuatu 162
Average	81	82	81	80	80
Low income:					
Best	Vietnam 61	Myanmar 61	Moldova 77	Moldova 84	Moldova 78
Worst	CAR 156	CAR 168	CAR 170	Guinea B166	Guinea B165
Average	120	131	136	131	131

Table 1 confirms the strongly established relationship between the level of telecommunications development and level of incomes. High-income countries dominate the upper ranks of ICT diffusion, ranging from first place (USA) to 42 (Kuwait), with an average ranking of 18 in 2002. Rankings decline with income, as shown by the average rank declines for middle income countries (average ranking 80 in 2002) and for lower income countries (average ranking 131 in 2002). Table 1 suggests increasing polarization over time, with the average ranking of high-income countries improving from 21 in 1995 to 18 in 2002. The average ranking of middle-income countries remains stable at around 80, while the average ranking of lower-income countries remains around 131.

Beyond 35th place, the dominance of Western Europe and the OECD countries ceases to hold sway and a more varied range of countries appears. Between 35th and 55th ranks, Arab states (such as Qatar at 36 and Bahrain at 39), transition economies (Hungary at 37 and Croatia at 38, trailed by Poland at 54) and other Asian states

(Malaysia at 41) enter the rankings. The highest-ranking South Asian state is the Maldives at 50. The highest-ranking Latin American countries also appear, with Suriname at 43 and Chile at 46, followed by Costa Rica at 51 and Argentina at 53. The more developed African countries enter the rankings, with Mauritius at 52 and South Africa at 66.

From 55th to 100th place, there is a mixed mosaic of countries comprising mainly CIS (such as Belarus at 55, Kazakhstan at 71 and Armenia at 81) and Latin American countries (Brazil at 57, Venezuela at 63, Paraguay at 86 and Peru at 88). Russia trails behind its sister states at 94. There are some South Asian states, notably Iran at 84 and Sri Lanka at 97. Other Arab countries also belong to this mid-ranking range, with Oman at 62, Lebanon at 64, Jordan at 75 and Tunisia at 95. Star performers from sub-Saharan Africa appear, such as Botswana in 80th place and Cape Verde at 87.

Beyond Indonesia at 100th place, Sub-Saharan countries begin to dominate the rankings, with Swaziland at 107, Gabon at 108, Guinea at 109, Kenya at 115 and Ghana at 116. The People's Republic of China has rocketed up the rankings 16 places to rank at 118. Other large developing countries include Egypt at 112 and India at 121. One important point to note is that these rankings do not necessarily reflect achievements in specific areas. An important result of using per capita measures is that notable 'islands of achievement' in ICTs are averaged over large populations to yield rankings that are lower than one might otherwise expect. This is one characteristic of aggregate rankings that the current study seeks to address through case studies of some of the more notable success stories, including Egypt and the People's Republic of China (see Chapter 4).

Lower-performing countries in South Asia and Africa dominate the lower half of the rankings. Bolivia and El Salvador trail the rest of Latin America at 141 and 148 respectively. Haiti is the lowest-performing Caribbean country at 164. In the CIS, Georgia lies at 126 and Turkmenistan at 130, while Kyrgyzstan is included in the rankings for the first time at 151. Lower-ranked Arab countries include Yemen at 136, Morocco at 137 and Djibouti at 147. Nepal and Bangladesh trail other South Asian countries in 142 and 145 places respectively. However, Sub-Saharan African countries dominate the lower rankings, including Tanzania at 135, Ethiopia at 146, Senegal at 149, Uganda at 154, Mali at 157 and Nigeria at 161. This presents one aspect to the digital divide that, as a region, Africa still has a considerable way to go in connectivity and ICT diffusion to hold its own with other regions.

One central finding of the 2003 ICT Development Indices Report was the remarkable stability in rankings year on year, reflecting the long-term nature of investments in ICT infrastructure, literacy and access. The 2004 Indices also show that rankings in ICT diffusion for 2002 are stable and closely resemble 2001.

1.2 Comparison with 1995

There is considerable stability in many countries' rankings in a comparison over a longer time period to 1995 (see Annex Table A.2). Many countries' rankings remain roughly the same. However, some countries made radical changes with large jumps up the rankings or declines over this longer time period.

Countries that made only marginal movements in ICT development and remain the same over 1995-2002 include the United States (which progresses from 2nd place to 1st place in the overall rankings) and several other OECD countries in the top thirty rankings (Hong Kong, U.K., Japan, Israel, Italy). This supports the finding that the countries with strong telecommunications development are maintaining their lead and building on their advantages. Other countries showing remarkable stability in rankings over this timescale include: Argentina (around 53); Belarus (unchanged at 55); South Africa (around 66); Columbia (which slips only slightly from 70 to 72); Ecuador (stable at 83); Russia (small progression from 98 to 94); Indonesia (stable at 100); Syria (around 104); Georgia (around 126); Burundi (at 140); and Ethiopia (unchanged at 146). This stability in the index rankings supports the idea that these Indices measure consistent underlying ICT development.

Despite this overall stability, there are some countries that made a considerable change from 1995-2002. Table 2 presents countries that have made considerable progress in ICT diffusion over the period 1995-2002.

Table 2: Major gainers in ICT diffusion rankings, 1995-2002

Country	1995	2002	Change
Mongolia	159	89	+70
Uzbekistán	142	92	+50
Sierra Leone	150	103	+47
Mexico	116	73	+43
Egypt *	154	112	+42
Armenia	121	81	+40
Slovak Republic	92	56	+36
Maldives	86	50	+36
China *	147	118	+29
Czech Republic *	60	35	+25
Chile	67	46	+21
Brazil	78	57	+21
Botswana	97	80	+17
Swaziland	122	107	+15
Thailand	79	65	+14
Tunisia	109	95	+14
Republic of Korea *	26	14	+12
Saudi Arabia	72	60	+12
Ghana	128	116	+12
Central African Republic	156	144	+12
Malaysia	51	41	+10

* See Chapter 4. For more information on the success these countries have achieved.
Source: ICT Development Indices, UNCTAD.

Given the importance of promoting ICT development for gains in the knowledge economy and new economic activities, the different experiences of four countries (China, Czech Republic, Egypt and Republic of Korea) that achieved major gains in ICT diffusion are reviewed in Chapter 4 to identify some of the factors that have contributed to their successful uptake of ICTs. Chapter 4 examines the spread of the Internet in China and Egypt, developments in mobile Internet in the Republic of Korea and the rapid growth of mobile phones in the Czech Republic.

Table 3 shows that countries that experienced a considerable decline in ranking in ICT diffusion over 1995-2002 are also mixed, although they mainly comprise African countries:

Table 3: Major declines in ICT diffusion rankings, 1995-2002

Country	1995	2002
El Salvador	49	148
Lesotho	64	117
Tanzania	76	135
Madagascar	80	131
Malawi	88	138
Rwanda	89	134
Paraguay	42	86
Cameroon	81	122
Vietnam	61	99
Bangladesh	107	145
Yemen	102	136
Djibouti	113	147
Sudan	99	129
Angola	114	143
Mali	132	157
Cape Verde	63	87
Cuba	45	69
Albania	104	127
Burkina Faso	140	159
Cote d'Ivoire	141	158
Chad	138	155
Cambodia	105	119
Uganda	144	154

Source: ICT Development Indices, UNCTAD.

It is important to note that while large declines in rankings often represent a deterioration in indicators (e.g. growth in telecommunications infrastructure does not keep pace with rapid growth in population, resulting in a decline in relative per capita measures and a decline in rankings), small declines may not always reflect deterioration in absolute ICT development. Rather, small declines are often attributable to 'neighbourhood effects', whereby neighbouring countries in the rankings improve faster than some others, which are effectively 'running to stand still' in the rankings.

1.3 Regional Performance, 1995 - 2002

170 countries were classified using the UNDP regional groupings into regions of Eastern Europe and CIS, OECD, Arab states, East Asia, South Asia, Latin America and Caribbean, Sub-Saharan Africa and 'others'. The ICT diffusion rankings are:

Table 4: Analysis of ICT Diffusion rankings by regional groupings

Index of ICT Diffusion	1995	1999	2000	2001	2002
1.OECD:					
Best	Finland 1	USA 1	USA 1	USA 1	USA 1
Worst	Mexico 116	Mexico 76	Mexico 79	Mexico 71	Mexico 73
Average	27	23	24	22	23
2.EE&CIS:					
Best	Slovenia 27	Slovenia 25	Slovenia 26	Slovenia 27	Slovenia 23
Worst	Uzbekistan142	Azerbaijan164	Turkmenistan129	Albania 148	Kyrgyz. 151
Average	78	80	84	86	82
3.LAC:					
Best	Guyana 41	Barbados 36	Barbados 39	Barbados 41	Barbados 34
Worst	Bolivia 146	Haiti 165	Haiti 167	Haïti 165	Haïti 164
Average	81	80	77	78	80
4. E.Asia:					
Best	Hong Kong 11	Hong Kong 8	Singapore 10	Hong Kong 11	Singapore 9
Worst	Mongolia 153	Micronesia 169	Vanuatu 162	Vanuatu 160	Vanuatu 162
Average	75	94	95	87	88
5. Arab states:					
Best	Kuwait 31	U.A.E 27	U.A.E 23	U.A.E 26	U.A.E 20
Worst	Egypt 154	Djibouti 141	Djibouti 160	Djibouti 141	Djibouti 147
Average	89	86	90	87	88
6.S. Asia:					
Best	Maldives 86	Maldives 52	Maldives 55	Maldives 56	Maldives 50
Worst	Nepal 137	Banglad. 137	Bhutan 168	Bhutan 167	Bangladesh 145
Average	112	107	120	120	107
7. SSA:					
Best	Mauritius 39	Mauritius 51	Seychelles 38	Seychelles 36	Mauritius 52
Worst	CAR 156	CAR 168	CAR 170	Guinea-B 166	Guinea-B 165
Average	117	132	131	126	130

Average rankings conform to expectations. OECD countries capture the top rankings, with average ranking improving from 27 to 23 from 1995-2002. Eastern Europe and CIS' average ranking declines from 78 to 82 over this period. Latin American and Caribbean countries have a steady average ranking around 80. 'East Asian countries' is a diverse category, including Asian Tigers and Pacific countries such as Micronesia and Asian countries such as Mongolia. East Asia shows some decline in average ranking over 1995-2002 from 75 to 88. Arab countries are also diverse, with countries that are making progress in ICT diffusion (e.g. UAE and Kuwait) and countries that are left behind, such as Djibouti. Overall, Arab countries' average ranking is stable from 1995-2002 at 88. South Asia's average ranking improves from 112 in 1995 to 107 in 2002. Sub-Saharan Africa's average ranking is last and declines from 117 to 130 from 1995-2002. However, Mauritius and Seychelles are highly placed at 52 in 2002 and 36 in 2001, as the region's best performers.

2. THE DIGITAL DIVIDE

Uneven diffusion of technology and inequality in access to technologies are evident in different ways with significant consequences for social, economic and political development. These consequences are reflected in the fact that concern over the digital divide now focuses on resulting 'digital exclusion'. 'Digital exclusion' extends the idea of digital divides based on connectivity and access to emphasize ideas of exclusion or lack of participation and representation in more advanced ICTs.

The digital divide has been analysed using ratios of average per capita penetrations of hardware in developed and developing countries ('Bridging the Digital Divide', ITU 2004). However, this analysis is based on averages in the categories of developed and developing countries, so the ITU's conclusion that the digital divide is shrinking depends upon the classification of countries used. Further, it does not take into account the size of the underlying populations involved and the greater absolute numbers of people with more limited access to ICTs in developing countries, and ignores strong evidence that digital divide is differentiated by the form of technology (UNCTAD, 2003).

Gini coefficients and Lorenz curves (widely used to measure income inequality) are a better way of analysing inequality to measure the digital divide. They assess inequality in the distributions of ICT hardware and Internet users across countries, adopting the country as the base unit of analysis. Gini coefficients compare cumulative shares of Internet users and ICT hardware relative to the cumulative share of the world's population. This is more appropriate, as it uses individual countries as its basis for measurement and also takes into account the size of population in each country in its measurement of inequality. Table 5 presents Gini coefficients of inequality in levels of ICT hardware and users across countries, analysing trends in the evolution of the digital divide over the period 1995 to 2002:

Table 5: Gini coefficients 1995–2002 (*figures in brackets are number of countries*)

Variables	1995	1999	2000	2001	2002
Telephone Mainlines	0.688 (200)	0.614 (202)	0.592 (202)	0.567 (200)	0.551 (188)
Mobile subscribers	0.822 (195)	0.735 (200)	0.703 (198)	0.655 (196)	0.609 (194)
Internet hosts	0.910 (199)	0.913 (201)	0.916 (201)	0.915 (201)	0.913 (204)
PCs	0.791 (110)	0.764 (161)	0.754 (161)	0.747 (162)	0.730 (170)
Internet users	0.871 (136)	0.786 (196)	0.757 (194)	0.735 (194)	0.671 (187)

The results show that Gini coefficients for all ICTs remain high: between 0.55-0.91, around twice the average level of income inequality generally observed. Inequality in access to ICTs across countries remains high and significant. Further, trends in the digital divide are sharply different according to the type of technology. Gini coefficients for Internet technologies (in Internet hosts, PCs and Internet users) show very high concentrations and substantial inequality in their distribution and are

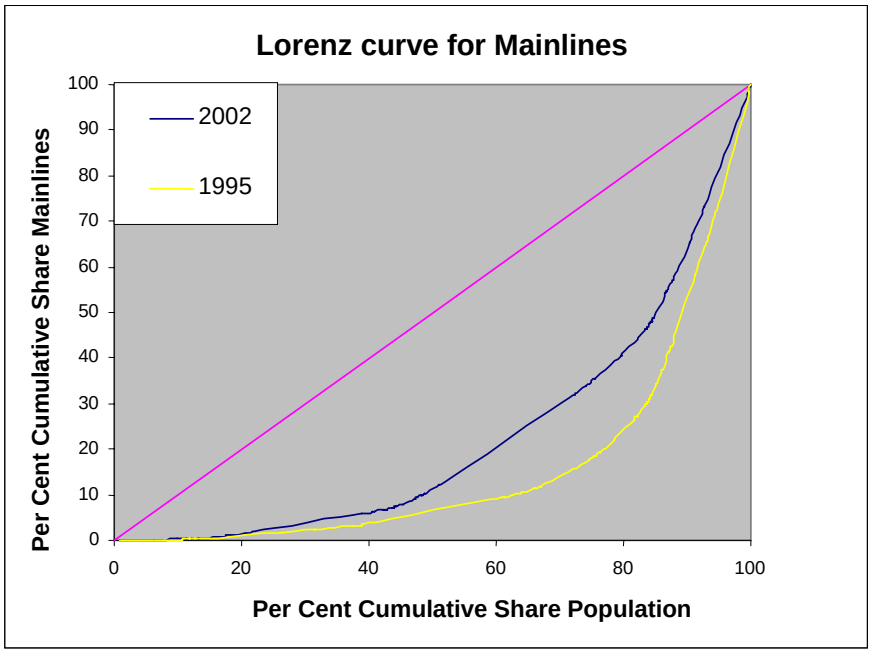
generally only reducing slowly. Mobile telephony shows a sharp reduction in inequality and strong gains in more widespread access worldwide. Mainline telephony, the oldest technology, shows small but steady reductions in inequality. Trends in the digital divide vary according to the type of technology.

2.1 Telephone mainlines

Fixed-line telephones are the most evenly distributed form of communications technology, as the oldest technology analysed here. The ITU notes that since 2000, Africa has gained a larger number of ICT users than the total number of mainlines installed throughout the preceding century (ITU Telecoms Africa 2004 conference). This is at least partly due to policy trends towards privatization and greater private sector participation. Despite 60 per cent of the world's telephone lines being available to 20 per cent of total population in 2002, mainline telephones remain the most evenly diffused form of communications technology. In 1995, fixed line was the only technology with a Gini coefficient under 0.7 (at 0.688; all other ICTs measured have coefficients above 0.79). The Gini coefficient for mainlines of 0.688 reduces slowly but steadily to 0.551 in 2002, as the only technology with a Gini coefficient of under 0.6.

Further, while dial-up remains the most widespread form of Internet access, mainlines remain a common means of accessing the Internet. Rapid gains in mobile technology made by Africa and other developing countries may overcome infrastructural barriers to access to telecommunications, but do not necessarily advantage these countries in more advanced forms of accessing the Internet. Mainline telephones are likely to continue to remain important for the near future.

Figure 1: Trends in the Lorenz curve for mainline telephones, 1995-2002



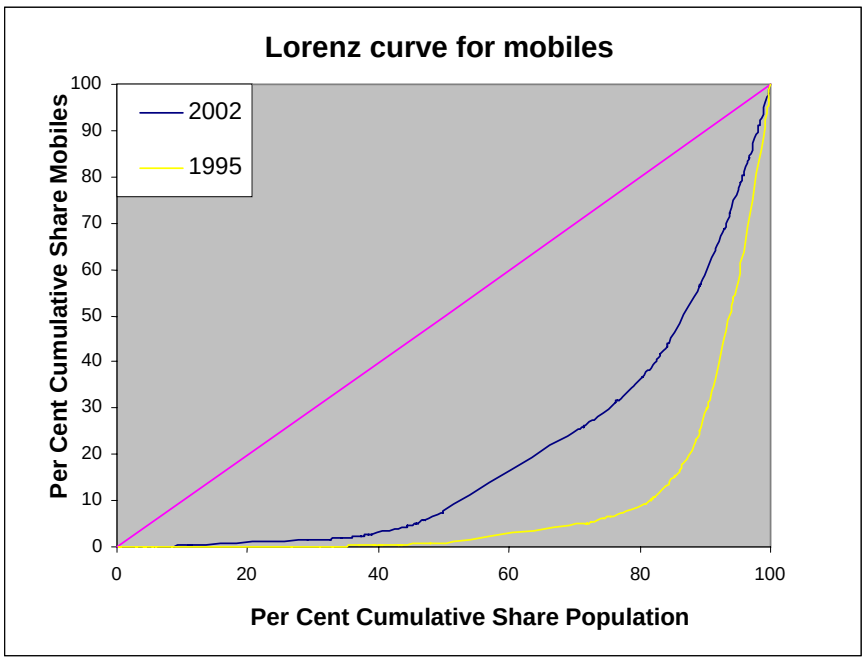
2.2 Mobile subscribers

Mobile telephones show the sharpest reduction in inequality and strongest gains in access. The distribution of mobiles across countries shows considerably more equal

access to mobiles in the 'leap-frogging' and catch-up noted by many observers. The Gini coefficient decreases strongly from 0.822 in 1995 to 0.703 in 2000 and continues to decline strongly to just 0.609 in 2002. The more even distribution of mobile telephones suggests greater access to mobile communications in developing countries. Mobile phones are an important 'leader technology' where challenging geography prevents access with mainline infrastructure to remote regions. Rapid diffusion of mobiles may be partly due to greater private involvement in mobile provision.

However, gains in more even diffusion of mobile phones do not reflect differences in types of usage. In developed countries, mobile handsets are developing into multi-media devices capable of delivering email, photographs and the real-time exchange of information. In developing countries, the reality may be very different, with shared or collective access and widespread use of 'beeping' (to notify recipients of a missed call so they can call back). Users in different countries and cultures are finding their own ways to use new technologies. However, these different types of usage are not reflected in the statistics, which record only the number of mobile phone subscribers.

Figure 2: Trends in the Lorenz curve for mobile phones, 1995-2002

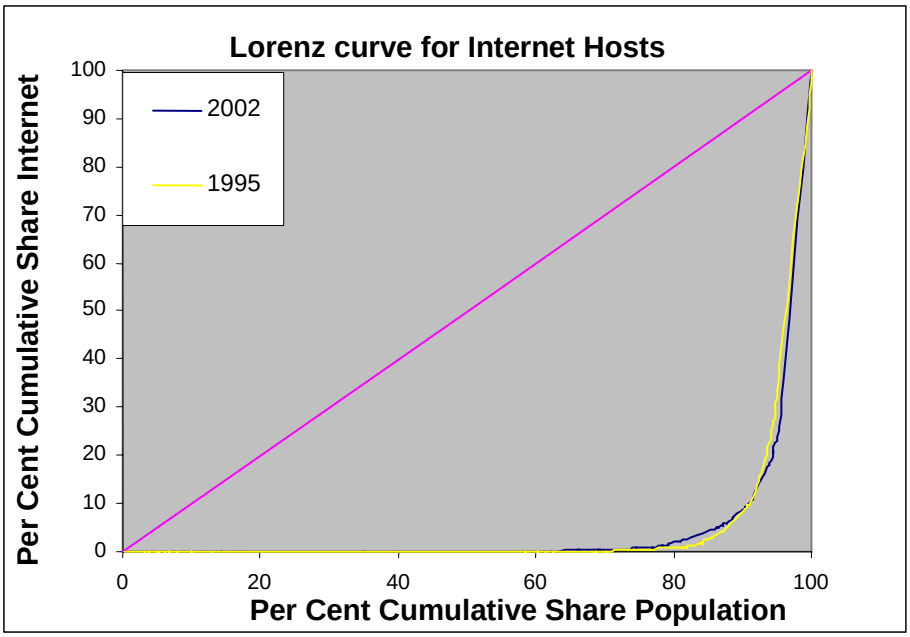


2.3 Internet hosts

Changes in the distribution of Internet hosts across countries indicate that until 2000, this important base technology for Internet access was becoming more unevenly distributed, with a Gini coefficient rising from 0.910 in 1995 to 0.916 in 2000, reflecting growing concentration of Internet hosts in OECD countries and the U.S. in particular. Press (1999) notes that in 1999, OECD nations owned 93 per cent of Internet hosts. In 2002, 10 per cent of the world's population owns over 90 per cent of Internet hosts. Declines in the concentration and inequality of distribution of this essential Internet base technology to 0.913 in 2002 have been negligible. Although the distribution of Internet hosts may not directly affect content (insofar as Internet content is now evolving independently of the physical location of infrastructure) the

location of Internet hosts is still likely to have important consequences for the content and languages used in the Internet.

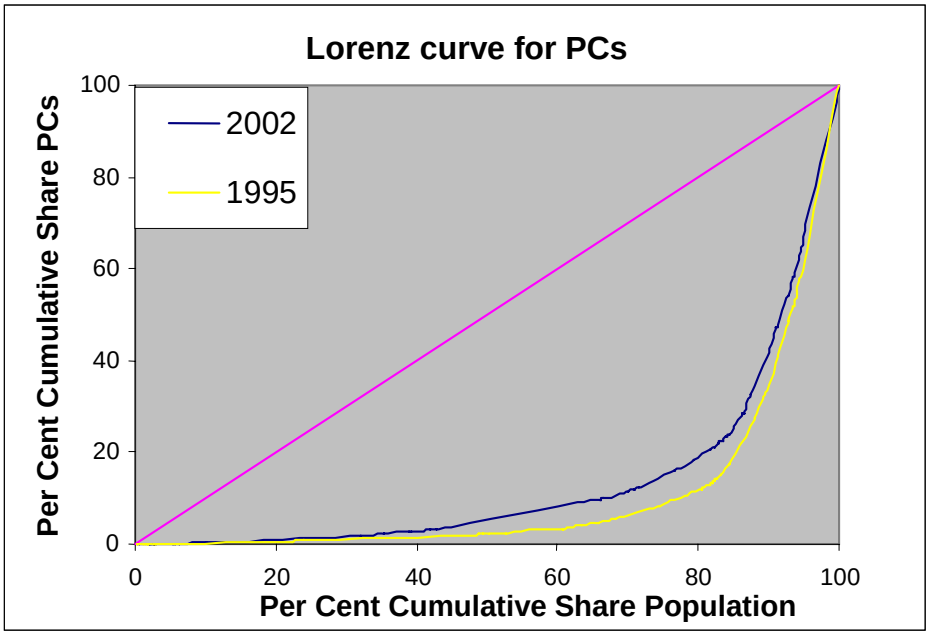
Figure 3: Trends in the Lorenz curve for Internet hosts, 1995-2002



2.4 Personal computers

Similar to Internet hosts, the distribution of PCs remains highly uneven. Around 20 per cent of the world's population had access to 80 per cent of PCs in 2002. Changes in the relative distribution of PCs across countries indicate only slow and small reductions in the inequality of distribution of this important technology, essential for the development of ICT skills and more advanced forms of ICT usage. The Gini coefficient of the distribution of PCs across countries decreases from 0.791 in 1995 to 0.764 in 1999 and 0.730 in 2002. This shows declining inequality, but at a very slow rate. Declines in inequality in the distribution of this essential technology are only marginal and signal important gaps in the development of ICT skills and more advanced forms of ICT usage for the future.

Figure 4: Trends in the Lorenz curve for PCs 1995-2002



2.5 Internet Users

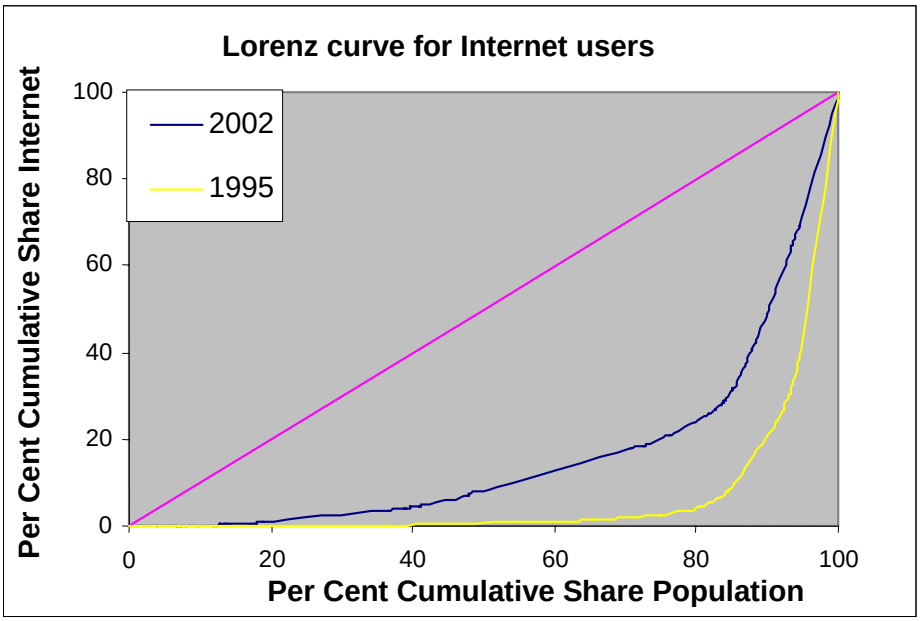
Contrary to the trends in Internet hosts and PCs, the distribution of Internet users suggests strong gains in access to the Internet across countries. The Gini coefficient decreases from 0.871 in 1995 to 0.671 in 2002, with an especially strong reduction from 2001-2002. In 2002, around 80 per cent of Internet users were still accounted for by 20 per cent of world population. More widespread distribution of Internet users offers hope of an expansion of Internet access outside advanced countries and in developing countries in particular. In the absence of significant gains in inequality of distribution of physical hardware, this suggests that gains in Internet access are mostly through forms of shared access. This makes policy initiatives such as community telecenters and shared public points of access even more important.

However, numbers of Internet users are estimates. The number of Internet subscribers for a country is multiplied by an estimated ratio to estimate the number of Internet users. In Arab countries, there are an estimated 2.5-3 Internet users per subscriber account except for Jordan (6 users per account), Egypt (8 users per account) and Iraq (25 users per account) (Nua surveys, Insight research, 2000, quoted in American Chamber of Commerce 'IT in Egypt' Report, 2003). These assumed estimation ratios reflect different types of access, with Internet access more personal and individualized in the Gulf states, in contrast to more widespread forms of shared access, for example through IT Clubs in Egypt (Chapter 5) or Publinets, publicly supported Internet access points, in Tunisia.

Most of the gains in Internet usage derive from more populous developing countries in the middle of the distribution. China increased its share of Internet users from just 3.7 per cent in 1999 to nearly 10 per cent of the world's population of Internet users in 2002. This accounts for the upwards shift of the Lorenz curve in the middle of the distribution in Figure 5 and strongly contributes to the reduction in the Gini coefficient. However, the distribution of Internet users does not indicate how the

Internet is being used, which is an important added dimension to the digital divide not captured here.

Figure 5: Trends in the Lorenz curve for Internet users, 1995-2002



3. ICT POLICIES

Following the benchmarking of ICT development in the first chapter, which policies can be used to promote ICT development? The OECD has conducted a survey of member countries using an IT policy questionnaire with a comprehensive summary of policies and programmes among members. The OECD divides policies into:

(i) IT policies to encourage the development, diffusion and use of ICTs (with a positive emphasis on spreading ICTs among the population); and
(ii) Policies to address the digital divide (with an emphasis on addressing any remaining inequality or deficiencies in access to ICTs between different communities, cultures, ethnicities).

This chapter summarizes policies identified by the OECD.[2]
These policies are useful and relevant to developing countries as they provide a preview of examples of leading policies that are currently being implemented in advanced countries, with which developing countries will ultimately have to contend with if they are to remain competitive in the global markets for ICTs. OECD countries are taking the initiative on a range of ICT policies across several categories, including:

a) General policy vision, and policies on the ICT environment;
b) Network infrastructure;
c) Technology development;
d) Technology diffusion;
e) Diffusion to businesses;
f) IT skills, education and training initiatives;
g) Globalization and international cooperation.

These different policies for ICTs show how promoting ICT development needs action across a range of policy domains. Coordinated policy initiatives are needed across different areas to build the local capabilities to master and adapt these fast-changing technologies. Becoming competitive in ICTs needs effort to develop a range of local capabilities in infrastructure, skills, research and the diffusion and the development of business services. A central body may be needed to coordinate and oversee all policy issues driving competitiveness centrally, to ensure policy coherence across different policy domains and to make sure that efforts in some fields are not held up by bottlenecks in other areas.

For this reason, several countries have established high-level task forces charged with monitoring and overseeing the implementation of policies for ICTs, such as the ICT taskforce in Australia and the National Information Technology Council in Malaysia. These Task Forces often build on principles of public-private partnership and collaboration between government and the private sector, to ensure that policy-making can respond quickly to firms' needs and concerns. These central bodies focus attention on ICTs, analyse trends in ICT development, identify gaps and/or priorities for action and make recommendations for urgent action to boost and maintain countries' performance in ICTs and their international competitiveness. They are often supposed to be independent (although the ITU notes that in practice, this is difficult to achieve, as these bodies are the products of the political, social, legal and

[2] Abridged from the OECD Information Technology Outlook, 2002.

economic conditions in each country). The nature of these bodies as private or public partnerships may impact on the compromise policy mix reached, although research in this area is relatively limited to date.

In fact, the policy mix is more likely to differ between industrialized and OECD countries and developing countries. It is noticeable that OECD policies emphasize innovation, Research and Development (R&D) and access for specific groups with special needs. Many OECD countries (Sweden, Norway, Canada and the US) make use of applied industry solutions with the collaboration of the private sector in R&D, training and apprenticeship programmes and adapting school curricula, as well as policies on the immigration of skilled labour.

Most of these policies are relevant to developing countries, but their policy mix differs according to their priorities. For example, developing countries may prioritize resources and funding solutions with a focus on increasing connectivity, expanding ICT access across the general population, training and retaining skilled labour. To illustrate the range of policies and the policy mix for developing countries, policies are illustrated with reference to developing countries in Table 6 (based on the Internet case studies from the ITU). This is to show that developing countries can, and are, addressing a range of ICT policies on different fronts, and are experimenting with best practice to find their own working model and policy mix. They need to find a policy mix that suits their needs, which will not be the same as OECD priorities.

In fact, there is some indication that demand-oriented policies to raise awareness of ICTs and their usefulness are especially relevant in developing countries. Often, the general assumption is made that demand exists, and is constrained only by purchasing power. In fact, given limited resources of consumers in these countries, policies to publicize and demonstrate the practical usefulness of ICT services take on added importance to encourage consumers to use ICTs. Public access and 'Computer for Every Home' initiatives are vital in raising awareness and encouraging the take-up of ICTs.

The impact of ICT policies will be maximized if policies are implemented in a coordinated way across a range of categories, rather than over-emphasizing any one of these areas to the neglect of others. This has implications for sequencing, and allows synergies to develop: for example, training up skilled labour improves the capacity of these staff to carry out R&D, which in turn develops their skills and enables them to train others. Virtuous, self-reinforcing cycles are established between different policy areas. Some developing countries (such as Egypt) have been successful in this respect, taking action on a range of different issues in conjunction to successfully promote their ICT development with tangible results (see 'success stories' in Chapter 4). Table 6 gives examples of different ICT policies in some OECD countries and some developing countries.

Table 6: Policies to promote ICT development, with OECD examples (OECD 2002, abridged).	**Examples in developing countries**
A) General policy vision and policies on the ICT environment	
1. Government policy and vision for ICTs, including: citizenship and citizens' rights; universal access; education; business and the ICT sector; e-commerce; ICT skills and training; proprietary rights; censorship; latest developments in the knowledge economy and IT policy environment; broadband access and policies for software sector (Norway, Canada, Mexico, Korea, Singapore)	National ICT Plan (Egypt, Philippines); ICT Policy (Uganda); National IT Agenda (Malaysia, 1996); National IT Policy Committee (Nepal).
2. Electronic transactions: measures for electronic settlement, authentication, e-signature (Czech Rep; Rep. of Korea); security, privacy protection, consumer protection; 'soft trust' issues (the Internet Watch Foundation in the UK).	E-Signature Law (Egypt); E-Commerce Act (Philippines) E-Commerce Committee and Digital Signature Act (Malaysia); Bolivia lacking in 2000.
3. Intellectual property rights: to create clear and enforceable mechanisms for IP, licensing and dissemination by owners of technology; use of authorized software and services (US, UK, Japan).	Intellectual Property Rights Laws (Egypt, 2002).
4. Standards and IT certification (e.g. Finland, Canada).	National Institute (Egypt); lack of standards (Nepal).
B) Network infrastructure	
1. To create a strong, vibrant telecoms sector: empowerment of the regulator and regulatory incentives; measures to enhance competition within the telecommunications sector; privatization, licensing, franchising (Thailand); national ownership limits (Republic of Korea allowed 49 per cent FDI)	Independent regulatory agencies (Egypt, Bolivia). Connectivity in Multimedia Super Corridor (Malaysia); IT Smart Village (Egypt); IT ecozones (Philippines).
2. Basic infrastructure development: extending network coverage; increasing capacity (quantity); digitizing the network, unbundling the local loop (quality); increasing range of services.	Masterplans (Egypt); National Plan (2001/5) gives 5 per cent budget to ICTs (Malaysia).
3. Further support for broadband infrastructure development as an advanced technology and important facilitator of further access (Rep. of Korea, Singapore).	Broadband Strategy (Egypt, 2004); Multimedia Super Corridor (Malaysia).
C) Technology development	
1. R&D Programmes: increase R&D budget allocated to ICTs (France); strengthen links of public research institutions with industry (France, Sweden); high-speed backbone for research institutions (Poland and Portugal); focus on ICTs: telecoms (Slovak Rep), e-health (Greece); e-teaching (Italy), home appliances (Japan), software (Switzerland), ICT Centre of Excellence (Australia).	Intentions to support IT-related R&D and create an IT Park (Nepal, 2000); IT Smart Village (Egypt); Multimedia Super Corridor (Malaysia).
2. ICTs for government use: inter-departmental technical standards to ensure compatibility, development of central infrastructure (central platform, portal and servers), electronic identity; electronic security (Singapore); integrating state databases; set up government portal (Czech Rep).	E-Government Programme (Egypt, Malaysia), Government Info Systems Plan (Philippines).
3. Government procurement of ICT goods: to develop ICT supply capabilities in certain industries and to procure ICT goods at lower prices and promote e-procurement (Czech Rep., Italy).	Egypt: E-government programme with Microsoft and other providers.
4. Venture finance for high-tech start-ups and SMEs. IT Venture Investment (Korea), ICT SMEs	Industry Development Fund (Egypt).

(Australia), risk capital funds for SMEs (Mexico); contacts for ICT firms and risk capital (Belgium).	
D) Technology diffusion	
1. Diffusion to individuals and households: measures for connectivity (Hungary); price limits (Spain); grants and subsidies (UK); market mechanisms and private sector plans (Finland, Sweden).	Abolition of subscription charges (Egypt, 2002); "*Ordinateur Familial*" programme in Tunisia.
2. Diffusion to businesses, to provide information and promote e-commerce; public-private partnerships (Czech State Information Policy); financial and fiscal incentives to promote ICT use.	Public-private working groups (Egypt); Multimedia Super Corridor (Malaysia); Computer Association Nepal
3. ICTs in education and access to schools: 'Internet into Schools' programme (Czech Rep.); 'School on the Web' (Switzerland); Singapore and Republic of Korea.	PCs for Schools (Philippines); Smart Schools (Egypt) lack of plans (Uganda, Bolivia, Laos, Nepal, Vietnam).
4. Online government services: government as a model user, procurer, provider of online information and services (Singapore, Czech Rep., UK); e-citizen programmes.	e-government programmes deliver online services to the public in Egypt, Malaysia, Philippines.
5. Access through other public institutions (e.g. libraries, universities) and public-private collaboration (e.g. community centres and IT Clubs).	IT Club programme (Egypt).
6. Access for rural/low income areas, as separate programmes, or incorporated within plan for and measures to promote universal access by the regulator (Uganda, Nepal, Malaysia, Peru).	Fund for telecentres (Uganda, Chile); Universal Service Fund (Uganda, Egypt); rural licences (Philippines).
7. IT for special needs groups: overall, including women (Norway); disabilities (Portugal, Sweden, Spain); young people (Norway); senior citizens (Belgium, Norway); unemployed (Italy, Sweden); civil servants (Portugal, Italy, Austria); rural areas (Spain); community learning centres (Hungary).	IT Clubs programme (Egypt); delivery to rural areas (regulator in Bolivia); underprivileged children (NGOs in India); mobile ICT buses (Malaysia).
8. Measures to promote access for SMEs and content for their needs (Norway, Sweden).	
9. Measures to create content to stimulate use of ICTs and the Internet.	IT clubs offer training courses (Egypt).
10. Measures to lower the costs of IT.	Ministries negotiate for bulk capacity rates (in Egypt).
11. Demonstration programmes: programmes to increase demand for ICTs; programmes to demonstrate new applications and use of e-marketplaces; awareness-raising programmes (sharing of success stories and experiences).	Computer for Every Home to stimulate demand and strengthen domestic manufacture (Egypt); Multimedia Super Corridor (Malaysia); IT ecozones (Philippines).
12. Financing and subsidies of IT equipment and/or services.	
E) Diffusion to businesses	
1. Support and training for SMEs: - IT competence programme for small firms (Sweden); Small firm training loans (UK); website for SMEs for every stage of lifecycle (Switzerland); programme focusing on SMEs and e-commerce (Norway); Information for IT skills for SMEs (Sweden).	SMEPol at the Ministry of Trade (Egypt); SME support programmes (Mali, Uganda, Tanzania, Nepal).
2. Information, market research and other business development services, e.g. trade databases, portals for matchmaking buyers and suppliers (Czech Rep., UK); exchange of information, contacts; Knowledge carrier programme (Netherlands).	Industrial Product Information System and Trade Information Network (Egypt). Multimedia Super Corridor (Malaysia).
3. Assistance for regions and rural areas: Networking the Nation initiatives (Australia, Canada);	Regulator's plans for universal access to remote areas;

regulatory plans for universal access (Czech Rep.), universal access funds, financed out of licence fees (Malaysia); telecottages programme to connect remote villages (Hungary); Regional Development Agencies (UK); Rural Telecommunications Funds (Uganda, Rwanda).	Governorates Administrative Project (Egypt).
F) IT skills, education and training initiatives	
1. Coordinating mechanisms for IT skills: surveys using standard skill definitions, skills audits to measure skills shortages; coordinating mechanisms (IT Skills Hub, ICT Taskforce in Australia; Software Human Resource Council in Canada); Information portals (Australian IT Skills Hub). Schemes for employment assistance and labour market information (Belgium, Australia, Canada).	Egypt: Labour monitored by the Ministry of Labour and Manpower: 18,000 ICT professionals trained to date; ICT workforce 33,000 in 2003.
2. IT education in schools: low-cost access to schools; training teachers in methods & technologies; work experience in IT firms (US); IT certification for teachers (Competency Standards in Australia); increasing content of IT in curricula (U.S.); relevant content (UK, Australia, Czech Rep).	Smart Schools Network (Egypt); "Training of Trainers" for IT Clubs (Egypt); 'Enlaces' connected 6,000 schools (Chile); WorLD project (Brazil, Chile, Peru, Paraguay).
3. Programmes targeting students: financial support to students and schools specializing in IT (Republic of Korea); programmes to increase numbers of students in IT (Sweden, Finland and IT4U in Austria); programmes to establish stronger links between industry and education (Science Lectureship Initiative in Australia; e-commerce research centres at universities); IT internships (Canada, U.S.); adapting curricula to industry needs (Spain); E-business degrees (Ireland); IT University (Sweden).	Smart Schools Network, IT Clubs, Basic Training Programme (Egypt); University courses in technology (Egypt, Nepal, India, China); partnerships between universities and ISPs to set up Internet cafes on campus (Philippines).
4. Vocational training for current & potential workers: training for ICT professionals (from payroll taxes - Spain, Belgium, Italy; also Sweden, Finland, UK, Austria); programmes for retraining, skills and lifelong learning (Italy, Poland, Norway, Austria, Greece); E-business management accreditation scheme (Belgium), SME IT-skills programme (Sweden); apprenticeship programme with industry partners (Canada); internship programme (U.S.); 'on-the-job' training (Greece).	PPP training in the Professional Training Program; Vocational Education Program (Egypt); IT training centres (Philippines); Networking Academies set up with Cisco (Philippines); National Institute of IT offers training (India).
4. IT certification: National Council of Accreditation in Informatics and Computers (Mexico); IT Engineers Exam & IT Coordinator certification (Japan); Public Employment Service (Austria); programmes to define specific sets of ICT skills (Employability Skills 2000+ in Australia, Poland and Canada; Skill standard in Japan); International Computer Driving Licence in OECD Countries	Basic Training Programme to obtain International Computer Driving Licence (Egypt).
5. Funds for training: scholarships and student loans (e.g. career development loans in UK); training incentives, tax credits, loan subsidies and direct grants (US).	Training programmes carry bursaries (e.g. Egypt's Basic Training Programme).
G) Globalization and international cooperation	
International cooperation (WSIS); Multilateral cooperation (e.g. eEurope+ in EU, UN); bilateral programmes; measures to promote trade in technology-intensive goods; Licensing and import of foreign technology and capital goods.	International, Arab, African organizations, WSIS; trade treaties, aid programmes. IPA reforms; IT Parks to attract FDI in ICTs.

4. SOME SUCCESS STORIES

4.1 Overview

The previous chapters have reviewed trends in ICT development and diffusion from 1995 to 2002 and summarized a set of policies to promote ICT development. This chapter examines four 'success stories' in ICT development and Internet take-up in different regions and countries to identify some of the factors underlying progress in:

- Asia – the development of mobile Internet in the Republic of Korea and the growth of the Internet in the Republic of China;
- The Middle East – expansion in ICTs in Egypt; and
- Europe – rapid growth of mobile telephony in the Czech Republic.

In each country, a successful compromise was achieved (in some cases, negotiated) between the stakeholders the consumers, the government and the market operators, all endowed with different strength, power, institutional roles and expectations. In some cases, these key players were able to work towards a common goal. In other countries, particular agents or institutions have particular strength. For example, in China, the government was quite cautious in its approach to ICTs and rising consumer incomes led to an explosion in demand and the demand-led development of ICTs. In Egypt, a dynamic ministry played a strong role in catalysing ICT development.

This suggests that it is not just the *policies* that count towards ICT development, but *who* is implementing these policies that drives and enforces their implementation. Rapid progress in telecommunications development is achieved where each country achieves a compromise that works well for the characteristics of their market. It is hoped that the experiences of other countries will be instructive in helping policy-makers decide upon priorities for their country.

4.2 Expansion of ICTs in the People's Republic of China[3]

The expansion of ICTs and the Internet depends on achieving a good compromise in the triangle of market demand, government policy and market operators. This triangle is not always built on equal partnerships, however. China has made strong gains in ICT infrastructure and access from very low levels of telecommunications development to per capita penetration levels that are now average among middle-income countries. In ICT diffusion, China rose from 147th in 1995 to 134th in 2001 to 118th in 2002, mainly due to gains in connectivity. In China, ICT development has been driven largely by rising incomes and growing market demand.

In 2002, China's mainline and mobile networks were the first-largest in the world, with 214 million mainline and 206 million subscribers. However, on a per capita basis relative to population, China's telecommunication networks remain average among low and middle-income countries. In 2002, China had 17.1 mainlines per 100 inhabitants; 16.0 mobile subscribers per 100 inhabitants; and 2.7 PCs per 1,000 inhabitants - rates which lagged behind several other East Asian countries including Singapore and Malaysia. Less than 2 per cent of the population are online.

[3] Main source: 'China and the knowledge economy: Seizing the 21st century', World Bank.

However, China has very high growth rates in information infrastructure over recent years, over three times as high as overall economic growth. In 2002, China had among the highest growth rates in mainlines (19 per cent) and PCs (42 per cent) in East Asia. Internet connectivity is growing especially fast, albeit from a low base. The China Internet Network Information Center estimates that there were 22.5m Internet users in January 2001, five times the number one year and a half earlier. This explosive growth in Internet use makes China the leading Internet market in Asia (excluding Japan). Total telecom estimates that there are around 520 Internet Service Providers (ISPs) and 600 Internet Content Providers (ICPs) in China.

Although the government recognizes the importance of the ICT industry, the World Bank Institute finds that 'the telecom legal and regulatory environment has not kept up with major changes in ICT sectors since the current telecommunications law was enacted in 1987… Telecommunications regulation has been based on fragmented administrative decrees dealing mainly with technical standards and service tariffs'. It notes that this has tended to create uncertainty for investors and market entrants.

In 2000, the State Council passed regulations defining basic and value-added services. Responsibilities, including universal access obligations, were set out in regulations for service providers. Restricting usage to select providers, using unreasonable cross subsidies or charging below-cost prices to drive out competition are illegal. Infrastructure construction and network access are still planned and regulated by central and local government. One feature of Internet access in China is the high degree of state control over content: it is not permitted to disseminate content that conflicts with constitutional principles; harms national security, interests and unity; damages religious policy; promotes superstition; destructs social discipline and stability; or impairs the lawful rights of others.

In market structure, the World Bank Institute notes that state-owned China Telecom retains its mainline monopoly and is the dominant player in the Internet market. There is a duopoly in the mobile market between China Mobile (70 per cent market share) and its state-designated competitor (30 per cent). The World Bank concludes that 'Chinese telecom markets have yet to be liberalized and deregulated'.

4.3 Expansion of ICTs in the Arab Republic of Egypt[4]

The experience of Egypt offers a contrasting picture. Egypt rose strongly up the ICT diffusion rankings from 154th in 1995 to 112th in 2002. Egypt has strong traditions of central government and reliance on government to provide services and policy leadership. Its economy has suffered a slowdown and deterioration in economic conditions since 2000, which has led to reductions in real wages and consumer purchasing power. As a result, the demand-led model of ICT development that China is currently experiencing does not apply to the same extent in Egypt.

The Egyptian Ministry of Communications and Information Technology (MCIT) is widely recognized to be a forward-looking and dynamic Ministry and is leading the way in promoting and encouraging the use of ICTs. It is doing this by encouraging investment and investing heavily in infrastructure, building public-private

[4] Main source: Egypt's Telecommunications Master Plan II Overview 2004, MCIT, 2004.

collaboration through its weekly meetings with the private sector and experimenting with models of shared public access in the IT Clubs.

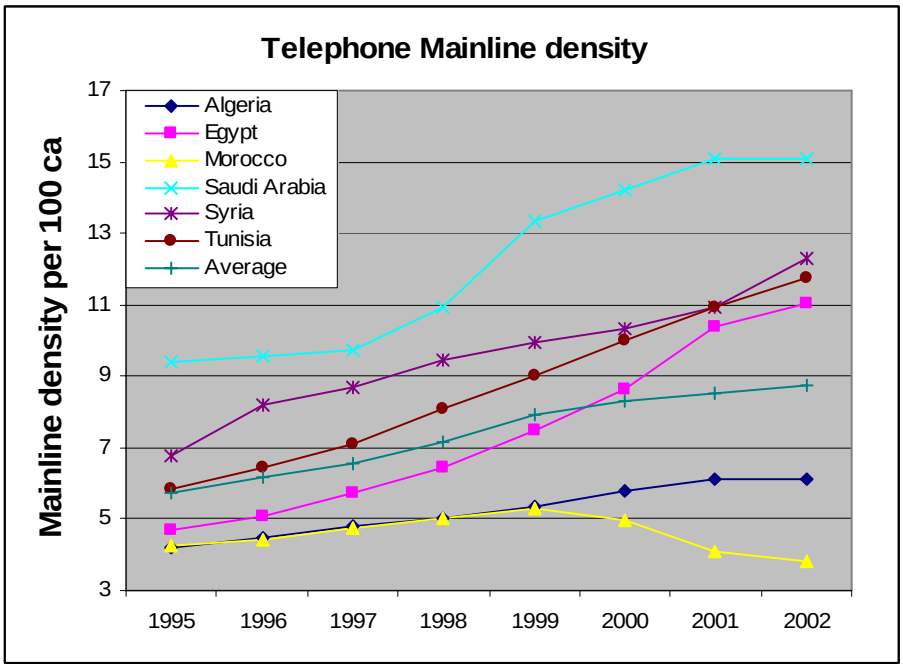
The Egyptian MCIT was established in October 1999 but has already taken considerable action and made real progress in expanding ICTs access in Egypt. It set the long-term goal of creating an export-driven, private-sector led ICT market.

Infrastructure is being expanded and upgraded under Masterplans I (2000-2004) and II (2004-2007), which aim to provide nationwide connectivity in an integrated telecoms network and backbone. Objectives for infrastructure include:

- Implementing modem pooling to divert Internet traffic to the data network and relieve switches from traffic pressure;
- Digital Subscriber Loop deployment by Telecom Egypt and service providers;
- Introducing other access technologies e.g. fixed wireless and fibre optic links;
- Building reliable Multi-Service Backbone based on ATM and IP routing;
- Establishing Internet Exchange Points as hubs for Middle East traffic;
- Upgrading circuit-switching technology to more efficient packet-switching.

Under Masterplan I, fixed mainlines increased to 11.5m subscribers in 2004 (Figure 6 below). Under Masterplan II, wireless and wire-line technologies will be combined and access services liberalized to attract private investment. There are now over 6m mobile subscribers in Egypt, bringing total teledensity to 13.2 per 100 people.

Figure 6: Telephone Mainline Density in Egypt, 1995-2002



Most significantly, the Ministry abolished Internet subscription charges in January 2002, so Internet prices now cost the same as a local call, making Internet prices in Egypt among the lowest in the world at Egyptian Pounds 1.25 or US18 cents per hour. Charges are shared between Telecom Egypt and consumers' ISPs in a joint venture

that became profitable in July 2003. A MCIT/World Bank e-readiness evaluation found the abolition of subscription charges had a direct impact on Internet usage, with 68 per cent of Egyptian Internet users having started to use the Internet after the Subscription Free Internet initiative was introduced. Some 3m people in Egypt are now Internet users, with ISP density at 474,727 inhabitants per ISP in 2004. This is an example of a working compromise between market and consumer interests that has had a direct and measurable impact on Internet usage.

The Ministry is encouraging informal interactions between the private and public sectors and there are weekly meetings between the Ministry and MNCs in the sector to share strategic ideas for building the IT and telecoms market. This provides an informal means of sharing concerns and ideas as to how to go about promoting the development of the sector. As a result, the Ministry has launched several programmes for skills development to meet the needs of the IT sector. The Professional Training Programme was launched in 2000 in collaboration with Cisco systems to train 25,000 IT professionals and 5,000 engineers. Training academies have been established for skilled IT professionals. 11 MNCs are now participating in this programme: training is provided by companies benefiting from training under the scheme (including Cisco, Nortel, Ericsson, Lucent, Huawei and Alcatel). The programme is announced in the press and universities and provided free of charge, subsidized by MCIT and private firms.

As a region, the Middle East has been estimated to be 3-4 years behind the U.S. in terms of IT development and 2 years behind Europe (Middle East Economic Digest, 2001). Internet penetration in the Gulf States (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE) is more than 15 times higher than in the rest of the Arab world (Insight Research, 2000). Although these countries account for less than 12 per cent of the Arab world's population, they claim more than 60 pert cent of the region's Internet users (Nua surveys, Insight research, 2000). Studies estimate that there are 2.5-3 Internet users per subscriber account in most Arab countries, except for Jordan (with 6 users per account), Egypt (8 users per account) and Iraq (25 users per account). However, there is evidence that governments are giving greater recognition to ICTs, with good results.

4.4 Expansion of mobile Internet in the Republic of Korea[5]

Finding the optimal market structure is not always easily achieved. In some cases, it may be necessary for the Government to intervene and take early action where market players may be displaying anti-competitive tendencies. This was the case in the Republic of Korea, where the government stepped in and encouraged companies towards competitive conduct, in the interests of consumers and the market as a whole.

The Republic of Korea has risen up the ICT diffusion rankings by 12 places, from 26th rank in 1995 to 14th rank in 2002. This is due to significant gains in connectivity (which outweigh a small decline in access scores). All the evidence suggests the Government of Korea has consistently prioritized telecommunications and ICT development. Moreover, the government has not been afraid to intervene impartially in the interests of the overall development of the market.

[5] Source: Korea Internet White Paper (2002), National Computerization Agency and Ministry of Information and Communication, Republic of Korea.

The government of the Republic of Korea has taken decisive action on ICTs and the Internet from early on. The Korea Information Infrastructure project was launched in 1995 and by 2000, high-speed high-capacity optical transmission networks had been established in 144 regions. The Government specifically sought to provide high-speed Internet and multimedia services at low cost, including discounted rates for Internet access for 10,000 primary, middle and high schools. These efforts have been rewarded: at the end of 2001, 7.8m people subscribed to high-speed Internet services and 56.6 per cent of the population used the Internet, one of the highest rates of Internet usage in the world.

However, when it came to developing the mobile Internet network market for wider consumer access, the Government faced new challenges. Mobile Internet has attracted attention as a next-generation communication market with the convergence of mobile and wired Internet technology. In wired Internet access networks, one network is linked to many ISPs. In the mobile Internet market, mobile carriers limit the content providers and ISP service options available to subscribers in a monopoly stranglehold over the service. Korean mobile carriers in control of mobile Internet networks locked out competing carriers and prevented them from tapping into their networks to maintain market share and gain more subscribers.

The Government, therefore, concluded that the mobile Internet market was not as robust as it could be, to the detriment of consumers' interests and the market as a whole. It may be considered as an inefficient allocation of resources that does not follow the convergence of mobile and wired services.

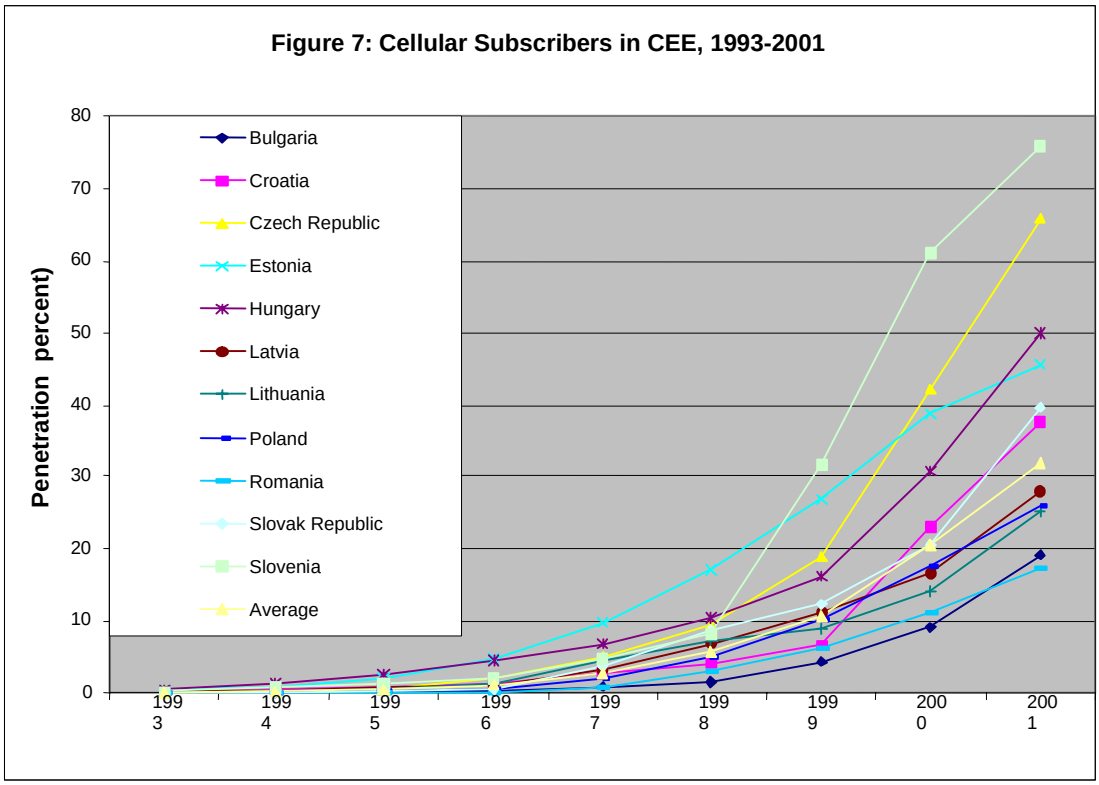
The Ministry of Information and Communication of the Republic of Korea stated that, in principle, mobile carriers must open their proprietary mobile Internet networks to other mobile carriers, content providers and all Mobile Internet Service Provider (MISP). Without forming a partnership with wired Internet services, mobile carriers must invest more to build a proprietary mobile Internet network. The MIC further guided content providers and mobile carriers to share openly the evaluation standards and registration guidelines for content providers. The three mobile carriers agreed to list openly the registration standards for companies wishing to become content providers, as well as revealing their hidden menus on their web portals. In addition, the government also pushed mobile carriers to share their gateways and open their Inter Working Function when the domestic mobile Internet standard platform was agreed in late 2002. This should ultimately ensure that content providers can produce content more conveniently and mobile devices should have fewer compatibility problems.

4.5 Expansion of mobile telephony in the Czech Republic

The remarkable expansion of mobile telephony in the Czech Republic illustrates some of the factors underlying rapid expansion in mobiles. The Czech Republic has risen nine places up the ICT diffusion rankings from 60th in 1995 to 35th in 2002, due to improvements in connectivity and access. In the Czech mobile market, a duopoly was established that allowed an optimum compromise to be achieved between investments in infrastructure and the prices consumers were prepared to pay. This supports the finding of the ITU (World Telecommunications Development Report, 2002) that a competitive market structure is generally better than a market structure with no competitive elements.

After the change in regime, the Czech Republic experienced challenges typical of many transition markets: the country inherited an outdated infrastructure operated by a state-owned monopoly following years of under-investment. The opening up of the economy to foreign investment and market forces and moves towards European accession led to rapid growth and modernization of telecom infrastructure, a vibrant mobile sector and flourishing Internet market. In 2002, the European Information Technology Observatory concluded "the Czech Republic remains the most dynamic ICT market in Central and Eastern Europe". This is especially true of mobile telephony. In 1993, the Czech Republic had a very low average level of mobile phone penetration for CEE. In 2001, vigorous growth meant that it had one of the highest mobile penetrations in CEE in Figure 7:

Figure 7: Cellular Subscribers in CEE, 1993-2001



There are three main reasons why the mobile sector grew so rapidly. The main players, Eurotel and RadioMobil, benefited from underdeveloped infrastructure and long waiting lists in the mid-1990s. There was 'enough, but not too much' competition in their duopoly, which allowed operators to achieve a good compromise between price and investment, without undercutting margins too heavily. A change in consumer lifestyle made mobile phones an essential convenience. Introduction of prepaid services fuelled mobile growth. A third operator, Český Mobil, entered the market in March 2000. Mobile penetration surpassed mainline penetration in 2000 and there are now over 7.5 million subscribers in a population of 10m.

As the mobile market nears saturation, operators are diversifying products and services: for example, promoting one SIM-card for work and another for personal use. Price-conscious Czechs may own two phones to take advantage of cheaper prices from other providers on messages, as well as voice. Operators are marketing 'm-commerce' and mobile games, and following international strategies promoting new technologies or targeted consumer segment-specific strategies. The question is now

whether operators can capitalize on their early experience gained from the Czech mobile expansion to market new and innovative strategies for m-commerce and games in the Czech Republic and elsewhere.

5. ICT DEVELOPMENT IN AFRICA

5.1 Overview

The previous chapters have reviewed policies for ICT development and illustrated these with reference to several countries that successfully boosted their ICT development. This chapter looks specifically at ICT development in Africa, and some of the policies and programmes that are being undertaken to encourage and promote the diffusion of ICTs.

ICT development in Africa is changing rapidly in infrastructure development, usage and institutional set-up. There has been rapid progress in certain sectors, notably mobile telephony, with greater emphasis on regulation, competition policy and universal access to ICTs using means such as Universal Access Funds (UAFs) and Community Access Centres. Analysis of the ICT diffusion index showed that African countries had generally poor performance in overall ICT development (see Table 7 below). However, the analysis of the digital divide in this report showed that is evolving in different ways, and at different rates, according to the technology. Nowhere is this truer than for African telecommunications development.

Table 7: ICT diffusion rankings of selected African countries

Country	1995*	1999	2000	2001	2002
Botswana	97	84	82	82	80
Cameroon	139	130	136	143	122
Cape Verde	63	93	90	89	87
Cote d'Ivoire	141	133	141	139	158
Ethiopia	145	139	146	152	146
Ghana	128	119	119	118	116
Kenya	119	111	114	114	115
Lesotho	64	106	109	158	117
Mauritius	39	51	53	51	52
Nigeria	..	159	165	164	161
Rwanda	89	131	139	133	134
South Africa	65	59	65	61	66
Tanzania	76	120	125	121	135
Uganda	144	136	144	136	154
Zambia	125	114	118	116	123
Zimbabwe	100	140	106	104	..

* Rankings are smaller, due to the smaller number of countries in the 1995 sample.

Barriers to the installation of infrastructure in geography, large rural and often remote populations and limited fixed-line networks have encouraged the rapid take-up of mobiles. Africa has the world's fastest growing mobile network (ITU, 2004) at around 75 per cent per annum (partly due to the low subscriber base). This rapid growth in mobile telephony offers prospects for extending basic telecommunications to a broader user base and for overcoming some aspects of the digital divide. In 2003, African mobile users surpassed 50 million or 6.0 mobile users per 100 inhabitants, so there are now twice as many mobile users as fixed lines with a mainline density of 2.9 per 100 inhabitants for Africa.

Furthermore, there were estimated to be over 12 million Internet users in the same year. The ITU (2004) identifies the means of fostering Internet development as: the liberalization of international gateways; the development of low-cost fixed Wireless Technologies for broadband access; and the establishment of national Internet Exchange Points or IXPs (to avoid the so-called 'Hotmail problem' whereby emails between two users in the same country are exchanged via a foreign server abroad, using valuable international bandwidth). There are currently only nine IXPs in Africa as a whole.

The ITU notes that in 2003, 16 African countries had ICT policies, while 21 were in the process of preparing an ICT policy. However, 16 countries had not yet begun the process of developing an ICT policy (ITU, 2004). The ITU also identifies promising trends in competition and the regulatory environment for African telecommunication markets. Since 1994, 41 African countries have opened their mobile markets up to competition, with more than one mobile operator. 40 countries have now established independent regulators, setting the foundations for further expansion in telecoms services. However, generic policy recommendations of greater competition and independent regulation are usually specific to each market and must be tailored to their individual needs and characteristics. As the case study on the Czech Republic shows, successful expansion of the mobile market in a duopoly market structure depended on a balance being achieved between prices sufficiently low to encourage demand in local purchasing power markets, but high enough to sustain reinvestment by operators.

Perhaps the most interesting developments in African telecoms are the innovative programmes and new institutional mechanisms being tried out to provide wider access to more affordable ICTs and to find practical ways of bridging gaps in access to telecommunications.

5.2 Key programmes for promoting ICT development

This section examines some of the mechanisms and programmes currently being used to promote ICT development and diffusion in Africa. It tries to draw out some of the critical success factors determining the success of these programmes and key policy lessons that may be applied and used successfully elsewhere. It examines the use of Universal Access Funds (section 5.2.1), Community Access Centres (section 5.2.2) and some of the applications and content being generated, adapted and used (section 5.2.3) in some countries, citing the experience of Mali in particular.

5.2.1 Universal Access Funds (UAFs)[6]

Universal Access Funds are currently being promoted as one way to encourage competing operators to extend telecommunications access into less profitable areas, including remote rural areas with poorer populations. In the past, monopoly operators were responsible for universal service, typically through state support and/or cross subsidies. Intelecon (2001) notes that while cross-subsidies served their purpose in monopoly environments, they may distort market signals and place an 'unfair' burden on certain operators in newly liberalized telecom sectors following a shift to private sector provision. They observe that in order to finance access objectives in a

[6] Principal source for this section: "Africa 04 Daily", ITP (2004); Intelecon (2001).

'competitively neutral and transparent manner', a growing number of countries are now turning to UAFs and the use of 'smart' subsidies.

The idea is that the Fund can be used to introduce incentives and 'smart subsidies' (upfront short-term subsidies) to cover the heavy initial costs of extending networks to less profitable areas. According to the ITU's 'Trends in Telecommunication Reform 2003 study', 60 countries worldwide have a fund or are in the process of establishing one, including Uganda, South Africa, Egypt, Nigeria, Burkina Faso and Madagascar. In theory, funds can enable the private sector to provide nationwide universal service from its own resources. A UAF collects funding from service providers, which is then used to subsidize the provision of access to areas where it is not otherwise economically viable to provide services. In most cases, funds are resourced from licence fees, spectrum charges or a levy (usually 1-2 per cent) on operator revenues to assist specific operators willing to serve high cost rural areas. Operators then compete for licences to deliver services, often in an auction. One main advantage is that private operators are not obligated to enter areas where they would not otherwise operate, but are given the incentives to do so. Subsidizing those operators with the motivation and willingness to invest is the main argument often made for UAFs.

'Smart' subsidies or incentives are given to encourage commercial suppliers to enter the market and establish new networks, but without creating long-term dependence on subsidies. An initial subsidy is given to cover start-up roll-out costs (capital and operating) to move the heavy upfront investments to the point of financial viability and an acceptable rate of return. This ensures that projects that are viable in the long-term begin and that networks are established, despite their heavy initial investment costs. Such subsidies should be given only once, to avoid creating dependence. In return, the operator is expected to meet roll-out and service obligations (including quality of service) specified in the bidding documents and to develop the services in a long-term self-sustaining manner, free from further subsidies. The operator is usually not given exclusive rights to service provision, but rather 'first in' advantages to areas otherwise unlikely to attract entrants.

In practice, Universal Access Funds raise several issues. It is essential to define:

- How resources are awarded, e.g. by tender, minimum-subsidy auction, etc;
- How the specific purposes for which funds can be used, the beneficiary areas and services and costs qualifying for subsidization;
- Who should contribute to the Fund: for example in Morocco, "the incumbent Maroc Telecom is charged with providing universal service together with other operators. The cost of universal service is shared amongst all telecom operators" (ITU Morocco case study). Countries have different requirements as to who should contribute to the UAF: fixed operators, fixed and mobile, ISPs or the postal sector. In principle, all those who are likely to benefit from the activities of the fund should contribute, in proportion to their revenues.
- Who are the eligible beneficiaries and recipients of funding;
- The level of contributions: this is typically set at between 1-4 per cent. The Ugandan fund charges a 1 per cent levy; the levy in South Africa was so low at 0.25 per cent as to be ineffective; but Morocco's levy was comparatively high at 4 per cent.

- Sources for contributions: national budgets, levies on subscribers and operators' revenues. Some regulators have put forward proposals to extend levies to equipment manufacturers, ISPs and computer makers.
- How contributions should be calculated. In Morocco, total costs are calculated from line costs, subscription costs, telephone booths installed on public roads, cost of information services and directory publishing costs.

Intelecon (2001) examines funds used for promoting universal access in developing countries and emerging markets in sources of funding, parties managing the Fund and the type of services offered. Table 8 presents a summary of the characteristics of different UAFs that Intelecon has identified for some countries.

Table 8: Characteristics of funds in different countries

Country	Fund status	Funding Sources	Fund administrator	Disbursement of Funds
Argentina	Planned	1 per cent operators' gross revenues	Operators (virtual fund)	Government sets teledensity targets
Brazil	Operational	1 per cent operators' gross revenues on telecom	Regulatory agency	-
Chile	Operational	State budget	Regulatory agency	Competitive bids
Colombia	Operational	5 per cent of national and long-distance revenues + funds from licences	Ministry of Communications	Subsidies awarded by competitive bids (lowest bid wins)
Ghana	Planned	1 per cent operators' net revenues	-	-
India	Planned	-	Regulatory agency	-
Malaysia	Operational	6 per cent weighted revenues Fixed, mobile operators	Regulatory agency	Subsidies awarded by competitive bids
Mexico	Planned	-	-	-
Nepal	Operational	2 per cent levy on revenues of incumbent, ISPs, mobile operators.	Regulatory agency	Subsidies awarded by competitive bids
Peru	Operational	1 per cent of all operators gross revenues	Regulatory agency	Subsidies go to lowest bidder
Philippines	Planned	-	Dept. of Transport & Communications	-
South Africa	Operational	0.16 per cent of all operators' revenues	Fund manager unit	Telecentre projects & areas of greatest need
Uganda	Operational	1 per cent levy on all operators, post, ISPs.	Regulatory agency	Competitive bids

Source: Adapted from Intelecon research (2001).

There are thus different models that can be used in setting up a UAF. Governments and regulatory agencies must determine the model that is most appropriate, given the structure and characteristics of the market and the policy goals that they wish to achieve.

Perceived inequities in any of these factors can result in Funds being politicized and coming under the influence of incumbent telecom operators in newly liberalized markets with growing competition. Some Funds are managed by government ministries; others are the responsibility of regulatory or independent authorities. The World Bank notes that Funds can become well-endowed parts of the state apparatus in developing countries and hence subject to more meddling (Telecommunications Reform study series by the World Bank). To mitigate this, UAFs should be managed by an independent board, often under the auspices of the regulator, with a separate manager, board of trustees, bank account and reporting procedures. Independent boards are perceived as less likely to be influenced by government or political interest, although this is not always the case (especially since newly established regulators are often less powerful than long-established incumbent operators).

5.2.1.1 Uganda's Rural Communications Development Fund (RCDF) [7]

In Uganda, more than 80% of the population of 25 million lives in rural areas. The RCDF was therefore introduced as a key policy instrument to promote universal access under the authority of the regulator, the Uganda Communications Commission (UCC). The UCC sets general policy objectives for universal access to ensure:

- The provision of basic communications services to all people in Uganda within a reasonable distance;
- the effective utilisation of the RCDF to leverage investment in rural communication development;
- the promotion of ICT usage in Uganda.

Following stakeholder consultations and a study of demand, these policy objectives were defined in more specific targets as:

- Public-access voice telephony in all 926 sub-counties with a long-term target of 1 public access telephone per 5000 inhabitants in every sub-county by 2005;
- A local Internet Point of Presence (POP) in each of the 56 Districts;
- Increasing the use of ICTs by supporting private or public institutions to create at least one vanguard telecentre or ICT project in every district;
- Ensuring effective utilization of the RCDF to leverage investment in rural communication development as a viable business through competitive access to 'smart' subsidies;
- To use special interconnection rates as a means of enhancing rural communication sustainability and minimizing subsidy requirements.

In 2002, UCC asked the two licensed national operators, UTL and MTN Uganda, to declare in which counties they would be able to provide service with at least one public access telephone per sub-county. The telecom operators effectively gave up their right of exclusivity in other sub-counties not included in their declared service areas. The UCC then offered these 'unprotected' areas as open to competitive entry and eligible for RCDF subsidies in order to achieve minimum levels of universal

[7] Principal sources for this section: 'Uganda's Approach to Universal Access and Communications Development Funding', Uganda Communications Commission; ITU Internet case study on Uganda (2001); and 'Telecommunications Reform in Uganda', World Bank (2002).

access. UCC has so far focused on basic telephony and Internet access (it is planned to review postal services at a later date).

In Uganda, the RCDF is funded by a 1 per cent levy on revenues of all operators in the communications sector (including telecoms, post and courier markets) and a US$ 5 m 'seed finance' grant received from the World Bank under the Rural Electrification programme. In expenditures, the maximum one-off subsidies operators are eligible to receive are calculated by submitting telephone revenues and costs to a 'viability test' for areas to be subsidized through the RCDF. Telephony license subsidization is projected at 60 per cent of RCDF expenditures, with further budgets allowed for pilot projects, Internet POPs, an Internet Exchange Point, several school ICT projects, as well as ICT training, ICT Awareness and ICT Content creation projects.

A study of demand was carried out to establish the viable need for services in the sub-counties, which were then categorized into different 'license packages' to distribute capital costs and risks of service fairly across each package. Bidders were required to accept universal access responsibility for some higher cost areas in each package, but were also able to obtain the higher subsidies associated with those areas. A more complex tender strategy was adopted to award subsidies for the District Internet POPs, in which no ISP should be awarded more than 10 POPs (excluding Districts that were not bid for). This strategy seeks to limit the impact of Fund subsidies on competition in the ISP market and tries to avoid helping any one ISP to a position of dominance to preserve neutrality in the market.

UCC is also one of the first regulators in Africa that plans to introduce an asymmetric 'special interconnection' regime for rural areas, with a rural termination surcharge on calls terminating at public access phones. UCC considers that the justification for asymmetric termination rates is that rural networks cost more to establish and operate than urban networks and that, in Uganda, urban users are willing to pay additional tariff rates to cover added costs to call rural areas.

Uganda has thus gone a considerable way towards experimenting with a range of different incentives and techniques to promote clearly defined universal access objectives. It has established the Ugandan Fund aiming to promote telecommunications service and access to ICTs across the country under the direction of the regulator. Based on a detailed study of demand, Uganda has developed its own tender strategies to standardize incentives between operators. The Ugandan Fund also addresses access to ICTs through ICT projects and telecenters. The next section goes on to discuss Community Access Centres as another means of promoting collective access to ICTs.

5.2.2 Collective Access Centres

Collective Access Centres or Public Access Points (PAPs) take several different forms, depending on the services they provide and the needs of their customers and surrounding area. PAPs all have in common the provision of services to the public at large or to specific groups. These services range from the provision of basic communications services, including voice telephony and fax, to more advanced applications such as computer processing, Internet and computer skills training.

In its review "IT Clubs in Africa" (2004), the Egyptian Ministry of Communications and Information Technology defines IT Clubs as centers that use IT to provide a range of services on a shared access basis. The Ministry distinguishes between four different types of collective telecenters:

- ***Public call offices*** providing access to public telephone(s), fax, photocopying and/or receipt of incoming calls or faxes. These centers often work well in densely populated urban areas with low purchasing power, where consumers are not able to afford individual access to telecommunications. Senegal is the country with the most public call offices in Africa, and has 9,000 offices spread throughout the country, (ITU case study, 2001).

- ***Community Telecenters*** use ICTs to support specific activities needed by certain communities in urban or rural areas. They may be based on a needs assessment of the local community and aim to provide information-based services for sustainable development, with a focus on training and education. An example is the Telecenters Communautaires Polyvalents in Mali.

- ***Multipurpose Community Telecenters*** extend basic Community Telecenters by offering more advanced ICT services such as tele-education, telehealthcare, government and community online services. Examples include the Asante Akim MCT in Ghana, the Songhai network of telecenters in Benin and telecenter programmes in Uganda and Mozambique.

- ***Mobile Internet Units*** bring the benefits of ICTs and the Internet to rural and underdeveloped areas. These units reduce risks in establishing permanent centres with uncertain long-term financial viability and have the advantage of reaching potentially larger numbers of consumers (for more limited times). Although their impact on local communities is more limited, they can be important 'leader programmes' to introduce ICTs and raise awareness among rural populations and explore the market potential for ICTs at reduced risk. Examples include the Mobile Internet Units in Malaysia.

For collective access centres to be sustainable in the long-term, they must appeal to, attract and keep a broad base of customers who can see the benefits in using them and are willing to pay for access to ICTs. Among the main factors determining telecenter sustainability, Roman and Colle (2002) identify: participation by the community; national commitment; partnerships between government and NGOs; networking between centres to share experiences and research; viable long-term planning and a business plan; and a focus on information, rather than just connectivity. This focus on developing relevant content of interest and suited to the needs of the local community is essential for the success of the centre, in attracting and keeping customers. It also signifies the real 'bridging' of the digital divide at the community level, in developing applications and content of genuine relevance to different communities. Some key lessons emerging from the use of community access centres are highlighted by the experience of Egypt with its IT Clubs, and by the experience of Mali in developing local content.

5.2.2.1 Egypt: Pioneering IT Clubs (ITCs)[8]

Egypt has tried several models of shared access to ICTs since the mid-1990s and has already drawn some valuable conclusions which the Ministry of Communications and Information Technology has published to benefit others. Early pilot projects in 1997 with Century Kids Clubs and Technology Access Community Centers attracted mainly select groups of users (children under 15 and local professionals) and did not achieve the broad coverage and usage the Ministry wished to promote.

The Ministry launched the bold IT Club initiative, designed to promote awareness and affordable access to ICTs to all Egyptian citizens including those in underprivileged areas. The main aim is to make Internet accessible and affordable (at around 15 cents per hour) to people with little or no prior experience of ICTs. In December 2003, there were 618 clubs with another 300 planned soon, each with an instructor available to train users in basic computer skills, software applications and web design. So far, about 100,000 users have made use of the ITCs.

Under the initiative, MCIT selects and supports hosting organizations. Host organizations can apply to become an IT Club by preparing a detailed business plan outlining the services it will offer and a budget to demonstrate its financial sustainability. Criteria for selecting a host organization are:

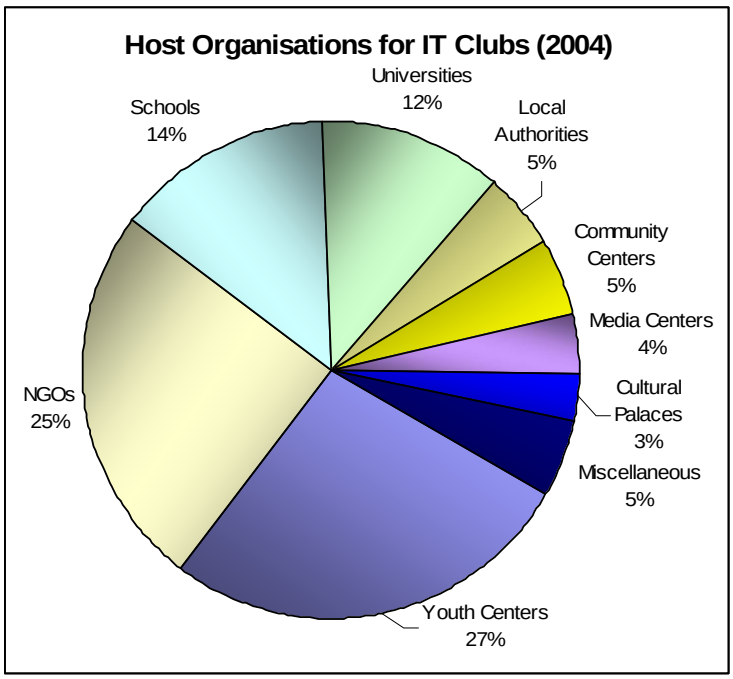
- Lack of suitable access to ICTs in the vicinity;
- The organization is in a suitable location accessible to a wide range of society;
- The IT Club will be accessible during suitable working hours;
- The organization focuses, or is accessible to, youth from 10-25 years of age;
- The hosting organization has qualified staff to manage the IT Club;
- The hosting organization has been successful as a business organization.

MCIT provides the necessary equipment (computers, printers, LAN, Internet access, a server, as well as ten networked PCs, etc.) on a three year lease programme. Private sector partners provide space, infrastructure, utilities, furniture and security. If the IT Club is successful, it retains ownership of the equipment on lease maturity. If it is unsuccessful, the equipment returns to the Ministry for use elsewhere. A minimum performance of 50 per cent utilization is required from the host organization. If it is not successful in maintaining this utilization rate, it is either downsized or closed.

A key finding is that Clubs should build on existing foundations in existing clubs, community centres and organizations. At least 40 per cent of ITCs have been established in youth centres, sport clubs, cultural centres, schools, mosques, churches and NGOs in every governorate. This allows benefits from an established customer base and existing demand and reduces start-up costs, especially premises, an important barrier in communities with limited resources. The profile of host organizations in Egypt to date is shown in Figure 8.

[8] Principal source for this section: 'Egypt: IT Clubs for Africa', MCIT (2004).

Figure 8: Profile of host organizations



Perhaps the best indication of the success of Egypt's programme is the significant rate of expansion of IT Clubs. By December 2003, 618 IT Clubs had been established, 191 of them were established in 2003 alone, with the Ministry planning to achieve one thousand clubs by 2005. Other benefits include the development of ICT skills and the creation of jobs by ITCs for university graduates who can join the "Training of Trainers" programme to become instructors. The evidence suggests broader benefits to industry and the community from developing a pool of ICT-enabled workers, as well as ICT awareness in the wider community at large.

5.2.3 The importance of relevant content:[9] the case of Mali

The importance of developing relevant content suited to the needs of the local community has already been emphasized. Relevant content realizes the full potential of ICTs; it helps new applications to be developed; and importantly, it also creates the consumer demand that promotes further take-up of ICTs. The experience of Mali in developing local content illustrates how ICTs can be used in different ways to 'bridge' the digital divide and shows what access to telecommunications can come to mean to different communities.

Mali is a landlocked country in West Africa with 11.6m inhabitants and average per capita income of $300 in 2003 (Ministry of Communications and New Technologies, 2004). It comprises 8 regions and 11,234 villages, many of which are rural. From relatively low penetration rates in telecommunications, ICTs are now being used for several different and innovative purposes. For example, they are helping meet the strong demand for higher education. ICTs and an Intranet were introduced at the University of Mali in 2003, although difficulties remain in lack of equipment and connections, inadequate documentary resources and insufficient teaching staff.

[9] Main source for this section: Presentation to ITU Telecoms Africa 2004; Mali MCNT (2004).

ICTs are also being used in telemedicine to overcome some of the challenges in a country where 35 per cent of the population does not have access to basic healthcare. The Keneya Blown medical network (website www.keneya.net) was set up in 2001 by a group of researchers at the University of Mali to cover five hospitals. A pilot centre for research and training has been established in conjunction with partner universities and other institutions linked for real-time access to the electronic resources of libraries, laboratories and online journals. The first attempts at medical teleteaching have been initiated between North-South, South-North and South-South. Monthly teleteaching lessons were broadcast from Geneva and Bamako in August 2002, and followed in Segou, Timbuktu, Nouakchott, and N'Djamena and by different organizations in France and Geneva. The Ministry cites the examples of exchange of expertise in neurosurgical operations, with an expert in Geneva and patient in Bamako, and for a leprology consultation, with an expert in Bamako and patient in Geneva.

In e-commerce, the Ministry is working on the promotion of tourism and publicity and sale of artisanal arts and crafts over the Internet. Websites have been established for tourism and handicrafts by the Ministry of Tourism and Artisan Crafts to provide information, publicize cultural events and establish contacts and communication with new and existing partners. Mali has strong traditions in artisanal crafts, which employ 5.4 per cent of the workforce, the majority of whom are below the poverty threshold. These crafts are still oriented towards local markets. The Ministry of Tourism and Artisan Crafts and the National Centre for the Promotion of Artisanal Crafts have been working with craftsmen and women to establish and promote small businesses, improve their marketing, seek out new distribution channels and help with training.

ICTs also have an important role to play in the preservation and restoration of artistic heritage. The National Museum of Mali has an online presence and digital techniques are being used to record and document ancient manuscripts in conjunction with the French Cultural Centre. The Internet is being used to exchange information on the latest restoration and conservation methods, as well as in the fight against the pillage and illegal exportation of artefacts. Cultural news and events are relayed over the web through the website of the Ministry of Culture. Intranets have been established in government and administration.

Mali has embarked on a telecenter programme including Telecenters Communautaires Polyvalents in rural regions, as well as Community Multimedia Centres (CMCs) at the community level. These are used as a tool for development in relaying weather and hydrological information, financial news (local market and foreign market news) and other information over the Internet. The Ministry highlights the importance of visual and audio information that can be used to reach overwhelmingly illiterate rural populations. It is now focusing its efforts on big awareness and training efforts to build human capital and reach wider audiences through its community centres. Mali has been able to take advantage of membership of the larger online Francophone community with initiatives such as Le Campus Numérique Francophone (which has given ICT training to 2,407 graduates). The Université Virtuelle Africaine gives short-term training in partnership with American and Canadian universities. 'Internet a l'école' projects are offered in conjunction with Swisscom-UIT-Mali in Timbuktu.

Examples such as these show how ICTs are being used with real achievement in a variety of different fields. Special efforts are being made to reach poorer and rural communities, in addition to the cosmopolitan urban classes and the civil service, where ICTs may be adopted more readily. The Ministry concludes that ICTs are precious tools for development and a growing reality in Mali. A range of efforts are underway on a variety of fronts to find meaningful and valuable uses for ICTs in serving more remote rural communities. Efforts to find workable ICT applications for poorer and rural communities are commendable and represent the real meaning of ICTs in enabling the population to take a more active role in improving their lives.

5.3 Conclusions

This section presented an overview and comparison of ICT access in Africa, before reviewing some of the practical on-the-ground programmes and applications that are being developed in Africa to respond to needs of communities in expanding access to ICTs and telecommunications. It considered the growing use of UAF and the experience of Uganda in establishing a collective fund to build the network infrastructure for telecommunications. It identified the issues that can arise in setting up a collective fund and establishing smart incentives among competing operators and highlighted the lessons from the experience of the Ugandan Communications Commission in setting out clear guidelines.

Whilst essential, basic network infrastructure is not enough. This section also considered grassroots efforts to build IT skills and capabilities through the use of community telecenters. It examined the experience of Egypt in establishing its IT Clubs to extend access and basic IT training to a wider range of customers and communities than would otherwise have access. It concluded that, where possible, such telecenters should be grafted onto existing infrastructure and existing customer bases to reduce start-up costs and to take advantage of existing infrastructure and connections. It is also necessary to motivate these clubs in some way, through use of lease-transfer incentives on the equipment and infrastructure.

The importance of developing relevant content and applications suited to the needs of local populations was emphasized to take ICT applications in new directions; to make them more directly relevant to end-consumers; and to build the demand for their take-up. All too often, the importance of ICT policies and the market supply-side is considered to the neglect of underlying demand (presumed to exist and constrained only through effective purchasing power). In this respect, the role of ‘leader technologies’ such as mobile phones and community telecenters in familiarizing consumers with basic ICTs and what ICTs can do for them is essential. The experience of Mali in adapting and using ICTs in a range of fields including education, telemedicine and the promotion of tourism and arts and crafts gives useful examples of how ICTs can be used to improve people’s standards of living. Ultimately, this represents the true meaning of what ICTs should be used for: to enable communities to find out more and to make choices and take decisions to improve their standard of living.

6. APPENDICES

Appendix 1. Methodology

The Index of ICT Diffusion is designed to evaluate ICT development using indicators of ICT diffusion across countries. It measures the average achievements in a country in three dimensions:

- *Connectivity* as measured by Internet hosts per capita, number of PCs per capita, the number of telephone mainlines per capita and the number of mobile subscribers per capita. As such, it gives a measure of the infrastructure development.

- *Access*, as measured by the number of estimated Internet users, the adult literacy rate, the cost of a local call and GDP per capita (PPP US$). This component aims at describing the opportunity to take advantage of being connected.

- *Policy*, as measured by the presence of Internet exchanges, the levels of competition in local loop telecom and the domestic long distance, the level of competition in the Internet service provider market.

An index score is calculated for each of these indicators by applying the following formula: Value achieved / Maximum reference value. Connectivity, Access and Policy indices are then calculated as an average of index scores of their respective components and Index of ICT Diffusion is itself an average of these three dimensions.

Appendix 1-a. Index methodology

Edgeworth (1925) defines an index number as "a number [that] shows by its variations the changes in a magnitude which is not susceptible either [to] accurate measurement itself or [to] direct valuation in practice". Press (1999) observes that "in tracking diffusion of the Internet, one must choose a balance between breadth and depth" and concludes that “an index may be more robust than a [*single*] indicator in measuring a qualitative concept”. This view of a cluster of technologies is consistent with that of the Mosaic Group, which suggests that individual technologies need to be evaluated, since countries seldom exhibit uniform capabilities across the broad spectrum of ICTs. Measures of breadth and depth are needed — a dilemma which the Mosaic Group resolves by the use of Kiriat or “wheel and spoke” diagrams (Press, 1999) to reflect technology as a “multi-faceted concept”. UNCTAD has reflected this balance between breadth and depth through use of an aggregate index with component sub-indices.

However, there are dangers inherent in the use of a disaggregated index. The Mosaic Group observes in its “Framework Analysis” paper (1997) that “while it is tempting to derive a single index to reflect a country's IT capability, such an approach is unlikely to provide the depth of understanding needed for policy decision-making”. Press (1997) explicitly warns against the dangers of averaging, or "reducing a [*multi-faceted*] capability diagram down to a single number" (i.e. area), since capability diagrams with the same total area may have very different shapes, that is countries

exhibit different profiles across the spectrum of ICT technological capabilities. Press (1999) notes further challenges for Internet indices: "should be orthogonal, each measuring an independent aspect of the state of the Internet in a nation, but it is difficult to define indices that are both comprehensive and uncorrelated". Simple averaging of indicators in an index implicitly assumes equal weighting of indicators and the possibility of offset of one indicator by another (i.e. connectivity is assumed to be equivalent to access and policy). GIT (2000) notes that an "additive model implies that strength on any one of these dimensions could compensate for weakness on another".

Whether inputs into the process of technology development are considered sequential, as with UNDP (2001), or synergistic, as in the “cluster” approach of McConnell International (2001), determines the form of index adopted. A sequential concept of technological inputs implies an additive model in which factors with implied equivalence may offset each other. In other words, strength on one aspect can compensate for weakness on another, as above. This is also the perspective within which the idea of “leapfrogging” fits. For instance, Cambodia's lack of fixed mainlines may not matter, as its high mobile penetration rate is likely to offset this, implying “leapfrogging” by “skipping a step” in the sequence. In fact, determinants do not have the same or equivalent influence over IT capability. Connectivity is a limiting factor, while government policy impacts upon IT capability and may result in lower IT capability for a well-connected nation (e.g. in comparing Pakistan with India, the positive impact of early liberalization of telecoms licenses is seen on Internet growth in Pakistan, compared with slower growth under public monopoly, private monopoly and finally liberal privatization in India).

Conversely, a synergistic view of a critical mass of associated technologies essential for a country's advancement in technology implies a multiplicative model in which weakness in any one input may hinder and impede effective development on the basis of non-equivalent inputs. This is the view put forward by McConnell International (2001) in the context of the Internet, stating that a multitude of factors must be in place in order to take full advantage of the economic potential of the Internet, and that weakness in one area can seriously obstruct the realization of potential benefits. GIT (2000) also describes a synergistic view of technological development by highlighting the fact that all four dimensions in its model, namely national orientation, socio-economic infrastructure, technological infrastructure and productive capacity, have to be strengthened for a nation to enhance its technology-based export competitiveness.

Despite these two differing views and methodologies, indices have usually followed simple additive averaging models. UNCTAD also opts for such a model mainly for two reasons. First, our review of work to date indicated that results calculated using both methodologies do not differ significantly from each other. Second, the additive model is more widely used because of its relative simplicity. UNCTAD uses the aggregated index approach, with component indices (similar to UNDP's Human Development Index). Countries' overall scores may be disaggregated into component indices of interest, permitting finer discernment between nations with different profiles across the spectrum of ICT capabilities. Attention should not focus on final index scores, but on scores across country profiles.

Relative or absolute indices

The ITU notes in its 2002 *World Telecommunications Development Report* that "over the last few decades, virtually every country has succeeded in improving its telecommunications sector. Thus, every country can show that its particular blend of policies has been successful". In absolute scores, therefore, nearly all countries will show increases in telecommunications connectivity. The ITU concludes "it is only by making *international comparisons* that it is possible to show which policies have been more successful than others…For this reason, an approach based on *comparative rankings* may be more meaningful than one that uses absolute growth rates" [italics added]. The ITU argues that relative growth rates are more insightful for policy analysis than absolute growth rates. UNCTAD therefore uses a methodology based on relative rankings, rather than absolute scores. Using relative rankings, countries' index scores are calculated as a proportion of the maximum score achieved by any country in any one year. This method has the advantage that reference points derive from real-world achievements realized by any country. However, it has the drawback that reference countries change year on year, thus reducing inter-year comparability. Only country rankings can be compared between years, consistent with the ITU's recommendations, rather than direct comparisons of countries' scores (since the reference points are changing). In this report, UNCTAD adopts a comparative approach based on comparisons of relative country rankings between years to identify countries that are making progress in ICT uptake, and those that are being left behind in the digital divide.

Evidence from other studies illustrates some issues that may arise using relative indices. GIT (2000) notes that relative indexing "is a relative scaling so that an apparent 'decline' over time or low score is only relative to other countries". GIT's HTI "are *relative* indicators. Hence, a 'decline' on an indicator does not imply an actual drop, just that competing countries have advanced faster". Thus, "Germany is considerably closer to other leading nations than to the U.S. and Japan…this distancing is not due to any decline in Germany, but rather to the remarkable gains by the U.S" (GIT 2000). UNIDO (2002) also notes that "movements in rankings are relative, not absolute. Many [countries] like Kenya are not particularly technology-intensive exporters – they move up the scale because their exports are more complex than their other measures relative to other countries in their vicinity".

These observations support the idea that, in general, it is more meaningful to talk about countries' rankings than about a country's index score. Countries tend to group or "bunch" together (particularly around the centre of the index distribution), where a score interval of 0.1 may be equivalent to several places in the rankings. Conversely, countries that stand out in the lead or fall behind in the tails of the distribution may have relatively large gaps between country scores, such that a significant improvement in index score is necessary in order to catch up leaders, or for those behind to catch other countries up. In general, it will thus be more meaningful to talk about countries' rankings than about their absolute index scores.

Reference points

The question of approach in using relative versus absolute indices is closely connected with the issue of reference points. Indices with absolute scores are calculated as a proportion of fixed reference points. This has the advantage of permitting direct year-on-year comparability of scores (although, for the reasons cited above, the significance of a country's score depends upon its place in the index distribution), but it is unclear what these reference points should be for ICT achievements. With some indicators, maximum achievements are relatively straightforward: for example, 100 per cent literacy rate, 100 per cent Internet user rate. For other indicators, maximum achievements are less obvious. Mobile penetration may reach over 100 per cent (e.g. for subscribers with more than one phone, or two Subscriber Identification Module cards per phone). There are no established a priori ceiling limits for Internet host penetration.

The problem of an outlying "star performer" is also illustrated in GIT's work, where the country with the maximum reference value forges ahead. "The U.S. increased [its electronics production] by $71billion from 1996 to 1999. The U.S. position is so strong that even China's remarkable doubling of electronics production from $33billion to $65billion increases its score only from 12 to 19" (out of 100).

Indicator scores methodology

Scores are derived as an index relative to the maximum and minimum achieved by countries in any indicator:

Index score = (Value – Minimum)/(Maximum – Minimum)

Since the minimum value achieved is zero[10] for most indicators, scores amount to a percentage of maximum values:

Index score: = (Value – 0)/(Maximum – 0) = Value / Maximum

Annex table A.1 presents the Index of ICT Diffusion calculated on the basis of the Connectivity and Access Indices for 2002 and 1999.

Additive model and averaging

There is no a priori logic for weighting indicators in their aggregation into the index. Simple averaging of indicators in an index implicitly assumes equal weighting of indicators and the possibility of offset of one indicator by another (i.e. mobiles are assumed to have equal importance to telephones, PCs and Internet hosts; connectivity is assumed to be equivalent to access and policy). GIT (2000) notes that an "additive model implies that strength on any one of these dimensions could compensate for weakness on another". This is consistent with a sequential view of ICTs, rather than a

[10] The statistically desirable property of "reversibility" that the index calculated forwards and backwards should be reciprocals of each other (Fisher, 1922), namely, it is not fulfilled owing to the use of arithmetic averages in the indices. Use of "zero" minimum values means that this "reversible property" yields mathematically undefined answers (reciprocals of zero). However, that does not have significant consequences for this index.

synergistic one (where any weakness in the cluster reduces overall technological capabilities, i.e. a multiplicative model as discussed previously).
Furthermore, use of simple averages across scores results in averaging effects. GIT (2000) recognizes that "a given indicator combines several scores [so] typically no country will score 100 on the resulting indicators". In general, distributions are averaged into the centre of the scoring range. Averaging effects are noted by UNIDO (2002), which recognizes the possibility of "offset…at least for some countries [where] use of two benchmarks together biases the results against them in that their average capabilities appear lower".

Unit of analysis

Our units of analysis are nation States, countries or territories defined by national boundaries. Technological hubs, or "centres of excellence" with extensive hinterlands (Telegeography, quoted in UNDP's HDR, 2001) are aggregated into national-level statistics and it is important to be aware of the significant averaging effect this has on our results. Adoption of nations and territories as our unit of analysis gives added pre-eminence to Singapore, as both a nation state and a "large city" (ITU, 2000), compared with, for example, a lower ranking for India, comprising Bangalore as a technological hub. Were New York or Bangalore to be separated out from their hinterlands, very different results would emerge. New York has more Internet hosts available to it than the whole of sub-Saharan Africa, which means that a city ranking, or ranking of nations by cities, would yield different results. The survey by Telegeography (2001) gives some indication of what a ranking by cities looks like.

Bridges.org (2001) observes that *international digital divides* have been assessed by comparisons of connectivity hardware between countries (PCs, hosts, servers, telephones), whereas *domestic digital divides* are assessed by measures of access by different groups (ethnicity, gender, age, income). The concept of disparities in access to ICTs is the same in both cases, but the unit of analysis as the nation state determines the choice of variables and method. The Mosaic Group (1996) measured the 'indigenization' of IT capability, or "involvement by nationals…in installation, use, operation, maintenance, management and adaptation of technology…performed by indigenous personnel". Its later (1998) theoretical framework assesses absorption of ICT technologies as independent, stand-alone technologies. The national origin of technology is not considered. Analysis of technology along national lines measures "national differences" in the adoption and absorption of IT. However, whether such differences are national or cultural may be indeterminate (boundaries of nation States and culture may coincide, but this is not always the case). Expatriate communities are often important in promoting technological adoption in their homelands (e.g. communication needs of overseas Vietnamese, the accumulated human capital of Indian software specialists in United States).

National size effects

GIT (2000) notes that the Innovation Index of Porter and Stern (1999) "is normalized (per capita measures), whereas [GIT's] is not (most of the statistical components reflect national totals). HTI address national technological competitiveness without particular concern for an economy's size". However, it does not explore the consequences of this for its results. In fact, this may introduce bias into results.

UNIDO (2002) notes that "the use of a population deflator works against large countries, but remains a good way to adjust for country size". This may be particularly true for infrastructure, where a certain minimum threshold infrastructure in the network may be required, irrespective of the size of the country. Further expansion of the network may result in economies of scale in larger countries, resulting in proportionately reduced levels of infrastructure per capita. Population dispersion and geographical dispersion of the network are intimately related to country size. It is unlikely that these effects can be corrected for; however, it is important to remain aware of their existence and the fact that averaging measures across per capita population may implicitly work against larger countries, lowering their relative rankings.

In fact, the most important consequences of using normalized per capita measures in our indices arise for developing countries. Where countries have high rates of population growth, indices based on per capita indicators of telecommunications development mean that any growth in telecommunications infrastructure must outstrip population growth to result in an improved indicator value and index score.

Data omission effects

The treatment of data omissions is central in determining the results of an index. In calculating the indices, final scores must be adjusted for the number of data observations and weighted, so as to eliminate the impact of data omissions. Failure to do so effectively “dilutes” the final index score by the number of omissions. However, data omissions are more likely for poorer countries. This poses a problem for our results, the extent of which is unclear. For some indicators (e.g. telephone mainlines and mobiles, in the connectivity index), about 200 countries have been covered to a reasonable extent. However, some indicators (e.g. local call costs, in the Access Index) have more limited data availability that varies from year to year. Rodriguez and Wilson (2000) note that their "results almost surely err on the side of optimism, as countries with poor or no available data are most likely to be the same countries that are being left behind by the information revolution". This caution also applies to our study. The omission of primarily poorer countries with low data availability means that absent or negligible observations are omitted. Our sample essentially comprises those countries with a degree of connectivity infrastructure in the first instance. This introduces bias from sample truncation into our findings, but it is difficult to establish the extent of this bias or how to correct it.

Appendix 1-b. Definition of components

Indicators:

Connectivity

Connectivity is narrowly defined as the physical infrastructure available to a country, as distinct from broader factors determining access (e.g. literacy, cost). It represents the basic “limiting factor” regarding access to ‘and use of’ ICTs – without the essential physical hardware, ICT use is not possible. UNCTAD defined narrow “connectivity” as the minimum set of measures necessary for ICT access, comprising Internet hosts per capita, PCs per capita, telephone mainlines per capita, and mobile subscribers per capita. This excludes supporting infrastructure (such as electricity

supply and transport), affordability and broadband access (which may be currently more relevant to developed countries, but is expected to become increasingly important to all countries in the future). McConnell International notes that "a multitude of factors must be in place…a weakness in any one can degrade a country's ability to take advantage of the economic potential of the Internet". This view sees connectivity as a cluster of technologies with synergies, rather than precedence, between different types of infrastructure. This is in contrast to UNDP's sequential logic of "old" (telephony and electricity) as opposed to "new" innovations (hosts, PCs) and "leapfrogging" between stages with an underlying sequential order.

Internet hosts per capita

The number of Internet hosts has been adopted as a measure of the Internet penetration of a country and the degree of national "connectivity". Network Wizards define a host as follows: "A domain name that has an IP address (A) record associated with it. This would be any computer system connected to the Internet (via full or part-time, direct or dial-up connections) i.e. nw.com, www.nw.com". OECD (2002) considers that "host count is the most precise available data on the presence of Internet in a country". Cross-country regression work has mainly used this variable as the most representative variable of Internet diffusion, for example Hargittai (1999), Kiiski and Pohjola (2001), and Robinson and Crenshaw (1999).

- An increasing number of Internet hosts implies increased ability to handle, service and store large amounts of data. However, difficulties include:

- Ambiguity and overlap with Internet server functions: hosts may include name servers, mail servers and file servers; Measurement methods and difficulties in allocating hosts to nations.

Hosts are assumed to be in the country shown by their country code (e.g. .nl for Netherlands). However, "there is not necessarily any correlation between a host's domain name and its location. A host with a .nl domain name could easily be located in the U.S. or any other country. Hosts under domains EDU/ORG/NET/COM/INT could be located anywhere. There is no way to determine where a host is without asking its administrator" (Network Wizards).

A single computer may host several domain names and a single domain name might be hosted by a group of computers (ITU, 2001). Figures have been adjusted for the physical location of the hosts. Data are subject to revision and there are often discrepancies between different surveys. In July 1999, OECD nations owned 93 per cent of hosts (Press, 1999).

PCs per capita

Telephone lines and *personal computers* are key components for Internet access before 3G and WAP mobile access become widely available, with significant implications for ICT adoption. Current access methods include dial-up access, using a telephone line, PC and modem. PCs therefore represent an upper limit for Internet access. Caselli and Coleman (2001) use the number of computer imports as a measure of "computer technology adoption".

PC estimates are available for developed countries, but measurement may be unreliable. Most ITU data are estimates of PC stocks from sales or import data. This is inaccurate for developing countries, where shipment data are scarce and significant channels for PC imports are omitted (e.g. smuggling, grey market, local assembly). Increased PC penetration rates should increase ICT connectivity. This is purely a numerical count and gives no indication of the power or quality of PCs, the use made of them or by which access method (e.g. shared Internet access, with multiple users for single PC).

Telephone mainlines per capita

This is a relatively reliable, basic "limiting factor" of connectivity and representative of potential, if not actual, levels of "dial-up" access. ITU statistics include telephone subscribers plus the number of payphones (data from telecom authorities or operators). Increased availability of telephone mainlines should increase Internet connectivity, assuming that dial-up access is available. However, this does not give an indication of the speed, reliability or cost of the connection, which are important considerations.

It is also important to be aware of the proxy variables that may be implicit in this measure. Telephone networks typically require large investments, and so average national income and the public resources available play a significant role in determining connectivity on a national basis. Population distribution, urban/rural dispersion and underlying geographical factors are important determinants of the extent of telephone networks; for example, Nepal and Cambodia have geographically limited mainline networks, while Turkey's is widely distributed.

Mobile subscribers per capita

Mobile connectivity and this measure will become increasingly important in the future. Current methods of Internet access emphasize PC-based applications, with 3G and WAP less widely adopted. Inclusion of mobiles allows leapfrogging in, for example, Cambodia (ITU case study, 2002) to be counted. However, the ITU notes that the Cambodian Government has neglected fixed lines, which are "more important for Internet access at this time". Inclusion of both fixed and mobile telephones reflects forms of ICT access that are important now and will remain so in the future.

Access

Jensen (2000) considers Internet connectivity from a more technical telecommunications perspective, noting that it "requires more than simply installing phone cables…the Internet is dependent on the telephone network ([comprising] cost of the line and cost of local and long-distance charges), availability and affordability of access equipment…and pervasiveness of telematics (mix of hard/software with human/organizational skills and knowledge transfer)". This introduces a broader definition of access and the factors determining use of ICTs, beyond narrowly defined connectivity.

Number of Internet users

This is an *ex-post* measure of the level of Internet use achieved by a nation in realized access to the Internet. However, Nua surveys and ITU (2001) point out different survey methods and definitions of Internet 'users':

Inhabitants > awareness > ICT access > users > subscribers

The number of *subscribers* paying for Internet access is more precise than the number of users and implies a certain degree of usage in terms of realized actual users. It is also more measurable, but may not reflect full usage as it omits free or shared access. For developing countries, subscribers may constitute "elite" consumers and fail to include common types of usage (e.g. shared access and cybercafes).

Nua collects its data from national surveys that do not use consistent methodology, thus reducing their comparability. For consistency, UNCTAD used ITU estimates of Internet users, weighted by population to yield Internet users per capita. The estimates in ITU surveys are consistently lower than those in SangoNet surveys (Nua). However, to test how representative ITU estimates are, countries were ranked and compared using Nua and ITU user estimates. Comparison of rankings revealed similar country profiles across both sources so, irrespective of actual indicator values, we can have confidence in the country rankings.

Literacy

In the absence of widely available voice protocols, text-based protocols remain the most widely used Internet applications. Language barriers and illiteracy have been identified as common obstacles to Internet access. Language has been modelled using dummy variables for English-speaking former colonies (Robinson and Crenshaw, 1999). However, the rapid growth of other languages on the Internet means that the importance of this obstacle to access is diminishing all the time. According to GlobalReach, 43 per cent of on-line users and 68.4 per cent Web content use English, down from 80 per cent of Web-pages in English in the late 1990s. Literacy remains a pervasive barrier to access, particularly for developing countries. Basic literacy represents an important *ex-ante* capability for Internet access, of which only a small subset may be realized as the proportion of Internet users. "Depth" measures of human capital, such as tertiary education, are considered less relevant for basic Internet access. We therefore included basic literacy in our index as an important determinant of access.

Cost of a local call

Prices are an important measure and determinant of access, since people will not use the Internet if they cannot afford it. In Europe, the practice of per minute billing has been considered a major obstacle to Internet adoption (Center for Democracy and Technology, 2002). Some countries may have high Internet connectivity (e.g. high telephone and PC penetration) but relatively low user levels. The most widely used Internet access method is dial-up (U.S. Internet Council, 2000), with the following main charges:

1. Telephone charges (line rental and/or call charges paid to the PTO);

2. Internet access charges (paid to the ISP).

Internet pricing comparisons are complex (depending upon method of access, time and frequency of use), change rapidly and are often available only for developed countries.

Given data constraints for developing countries, we adopted the cost of a local call as the most representative indicator of cost of access. However, telephone charges issues include the following:

- Local call charges: some telephone operators do not charge directly for local calls (including operators in North America and New Zealand). This has been considered an integral factor key to the expansion of ICTs in North America (Information Society, quoted in Center for Democracy and Technology, 2002);

- Operators may include a proportion of "free" local calls in subscription charges;

- Charges may be fixed regardless of call duration;

- Local call charges may differ depending on the time of day or the day of week, or whether the call is for Internet access; and

- Operators may provide discounted calls to user-specified numbers.

The reduced cost of calls should facilitate the expansion of access to ICTs.

GDP per capita

Income is another key determinant of access and people's ability to afford hardware investment and ongoing call costs (that are often a significant proportion of the cost in accessing the Internet). $1 an hour charged by a cybercafe is unaffordable for people whose average income is $2 per day. Average national income is also a proxy variable for a country's level of development, often implicitly related to a country's level of investment and thus its connectivity and infrastructure. Kedzie (1997) notes that "economic development is a leading candidate for a compounding factor that affects both democracy and electronic communication networks simultaneously". However, in his study of democracy and interconnectivity based on simultaneous equations analysis growth in Internet nodes, "statistical test results do not support…economic development as a confounding third variable… neither democracy nor GDP proves to influence interconnectivity strongly".

Policy

The Policy Index relates to 2001–2002, as these data are current and ITU gives “real-time” data. Retrospective comparison is made with the other indices for 1995–2000. However, the stability of the rankings emerging gives us confidence that these are valid comparisons to make.

Presence of Internet exchanges

Abramson (2000) defines Internet exchange (IX) points – also called network access points (NAPs) or metropolitan area exchanges (MAEs) – as physical installations created by third parties to facilitate traffic exchange between ISPs. Telegeography defines IX as "services created to facilitate on-site interconnections between independent or third-party Internet networks". This definition can be ambiguous: ITU considers that Egypt has access to the functions of an IX (ITU, 2001), but Egypt is not listed as having an IX (Telegeography).

Internet exchanges are important for permitting domestic exchange of within-country traffic, without using valuable international bandwidth. Abramson (2000) notes that IX "provide focal points for local traffic exchange, enhancing local Internet infrastructure and reducing dependence on international links". Establishing an Internet exchange is an important policy decision in the allocation of resources for developing countries, keeping domestic Internet traffic within the country and saving international bandwidth for other uses.

For the majority of developing countries, Internet exchanges are nationally based, that is one per country (e.g. Kenya IX, Indonesia IX). Some countries have multiple exchanges serving major urban centres (e.g. Capetown IX, Johannesburg IX). In the United States, IX operate primarily at the State level or serve major urban centres, where MAE may be a more appropriate name.

Our policy variable is a dichotomous variable (1 for an IX, 0 for its absence) since, for the majority of developing countries, the establishment of an IX is a major step. The additional benefits arising from further exchanges at the urban level may be considered marginal. The establishment of an IX may also be indicative of a proactive ICT policy outlook.

Competition in the local loop/domestic long distance

Competition in a country's telecoms sector is an important policy choice. Current thinking holds that monopolies may hinder rapid development and advocates liberalization of the telecoms sector in promoting new entry and competition, lowering prices and expanding access. The OECD (2001) concludes that “countries that moved early to liberalise telecoms have much lower telecoms costs and a wider diffusion of ICTs than countries that were late to take action” (p. 9). It recommends that countries “facilitate the diffusion of ICT, by increasing competition in telecoms and technology (p. 22)…[with] policies to unbundle the local loop and improve interconnection frameworks” (p. 24). The structure and policy developments in the telecoms market affect the diffusion and absorption of ICTs within a country. Gorman and Malecki (2000) observe that “regulation and lack of telecommunication competition make it more expensive to operate through Asian and European providers (Gorman and Malecki, 2000; Cukier, 1998a). The high cost of infrastructure and connections in Europe makes a circuit from Washington DC to Paris, London or Stockholm cost less than direct lines (Paltridge, 1999). Although prices are dropping as competition increases, leasing capacity on many intra-European leased lines remains more expensive than trans-Atlantic routes (Paltridge, 1999)”.

However, evidence from the cross-country regresision studies is conflicting. Kiiski and Pohjola (2001) found that Internet access cost best explained growth in computer hosts per capita; however, competition (lack of monopoly) in telecoms markets proved insignificant. This is in sharp contrast to Hargittai (1999), who found that monopoly in the telecoms sector had a considerable negative impact on Internet connectivity in OECD countries (but not via reduced prices in access costs, which proved statistically insignificant).

Competition in the local loop describes a country's telecoms market structure and government policy towards telecoms, irrespective of whether competition actually

results in reduced prices. Based on data from ITU T-Reg Unit, our index scores competition in the local loop as 1, partial competition as 0.5, duopoly as 0.25 and monopoly as 0. It is important to be aware of the implicit value judgements inherent in this scoring system. The “monopoly” score of 0 does not recognize the potentially beneficial effects conferred by a "benign monopoly". SingTel is widely recognized to have been an efficient, proactive incumbent in Singapore's telecoms sector, with important benefits for the adoption of ICTs in Singapore (ITU, 2001). This contrasts with the Nepal Telecommunications Company in Nepal, which "was not customer-orientated in pricing, bandwidth or service" (ITU, 2000). In future work, the clear-cut monopoly/competition distinction could be replaced by analysis of actual country practice.

Competition in the ISP market

The ITU defines web servers as installations that provide end-user access to the Internet, disseminate information and sell products and services (ITU, 2001). However, Cukier (1998) identifies four different types of ISP — backbone, downstream, webhosting and online service providers. Competition in a country's ISP market is important for the domestic diffusion of ICTs. Competition in Internet service provision may reduce prices and installation time, and improve quality and availability of different services and customer care, thereby enhancing access. The beneficial effects of a vibrant ISP market are illustrated by Indonesia and Egypt, each with in excess of 60 ISPs, as opposed to Cambodia and Viet Nam, where a limited number of ISPs and higher market concentration arguably result in higher prices and reduced customer service (ITU case studies).

The number of ISPs in a country has been used as an indicator of market liberalization. However, as there are at least four different types of ISP (Cukier, 1998), the number of ISPs may be difficult to define and establish. Furthermore, markets may be fast-changing and there may be no legal requirement for ISPs to register. Also, it is necessary to distinguish between licensed ISPs and operational ISPs. This makes ISP counts inaccurate in large, liberalized markets. The number of ISPs has not been used in our index. UNCTAD uses ITU's T-Reg unit data to define this variable as a simple dichotomous variable (competitive scored as 1, monopoly as 0), rather than a continuous scale based on the number of ISPs.

Appendix 1-c. Data sources

- Internet hosts, Personal computers, Cellular mobile telephone subscribers, Main telephone lines in operation, number of estimated Users, Cost of local calls: International Telecommunication Union (ITU), World Telecommunication Indicators (2003).
- Gross Domestic Product: World Bank, World Development Indicator Online.
- Adult Literacy rate: United Nations Educational, Scientific and Cultural Organization, Institute for Statistics.
- Internet Exchanges, Telegeography, Internet Exchange Points Directory.
- Level of competition in local loop telecom/domestic long distance and Internet Service Provider markets: ITU, T-REG, Online Country Profiles.
- Population: United Nations Statistical Division, World Population Prospects: the 2002 Revision.

Annex Table A.1. 2002 Index of ICT diffusion by ranking

RANKING	COUNTRY	DIFFUSION	CONNECTIVITY	ACCESS	POLICY
1	United States	0.8056	0.7459	0.8653	1.0000
2	Iceland	0.7547	0.6824	0.8269	1.0000
3	Sweden	0.7247	0.6708	0.7786	1.0000
4	Luxembourg	0.7236	0.6748	0.7723	1.0000
5	Denmark	0.7200	0.6663	0.7738	1.0000
6	Finland	0.6908	0.6347	0.7469	1.0000
7	Norway	0.6859	0.6039	0.7679	1.0000
8	Netherlands	0.6802	0.6166	0.7438	0.7500
9	Singapore	0.6630	0.5619	0.7640	1.0000
10	Australia	0.6511	0.5629	0.7394	1.0000
11	Switzerland	0.6507	0.6285	0.6728	1.0000
12	Hong Kong (China)	0.6445	0.5292	0.7599	1.0000
13	Canada	0.6216	0.4768	0.7664	1.0000
14	Korea (Rep. of)	0.6160	0.4777	0.7543	0.8750
15	Germany	0.6114	0.5028	0.7200	1.0000
16	United Kingdom	0.6085	0.5155	0.7014	1.0000
17	Japan	0.6063	0.4663	0.7464	1.0000
18	New Zealand	0.5940	0.4800	0.7080	0.8750
19	Israel	0.5764	0.4624	0.6905	0.5000
20	United Arab Emirates	0.5724	0.3524	0.7923	0.2500
21	Ireland	0.5706	0.4731	0.6681	1.0000
22	Austria	0.5699	0.4648	0.6750	1.0000
23	Slovenia	0.5610	0.4402	0.6818	0.2500
24	Italy	0.5496	0.4210	0.6781	1.0000
25	France	0.5453	0.4273	0.6633	1.0000
26	Belgium	0.5389	0.4152	0.6626	0.8750
27	Cyprus	0.5250	0.3655	0.6846	0.5000
28	Spain	0.5005	0.3955	0.6054	1.0000
29	Estonia	0.4867	0.3469	0.6264	0.7500
30	Macao (China)	0.4838	0.3065	0.6611	0.0000
31	Greece	0.4767	0.3631	0.5903	1.0000
32	Malta	0.4763	0.3991	0.5536	0.5000
33	Portugal	0.4696	0.3675	0.5717	1.0000
34	Barbados	0.4695	0.2162	0.7227	0.0000
35	Czech Republic	0.4524	0.3622	0.5427	1.0000
36	Qatar	0.4389	0.2142	0.6637	0.0000
37	Hungary	0.4248	0.3069	0.5427	0.5000
38	Croatia	0.4240	0.2908	0.5571	0.5000
39	Bahrain	0.4229	0.2440	0.6017	0.0000
40	Brunei Darussalam	0.4159	0.1434	0.6883	0.0000
41	Malaysia	0.4042	0.1931	0.6153	0.6250
42	Kuwait	0.3906	0.2084	0.5728	0.1667
43	Suriname	0.3864	0.1213	0.6516	0.5000
44	Saint Kitts and Nevis	0.3820	0.2444	0.5197	0.0000
45	Latvia	0.3816	0.2369	0.5263	0.5000
46	Chile	0.3787	0.1979	0.5595	1.0000
47	Lithuania	0.3724	0.2276	0.5173	0.2500
48	Bulgaria	0.3671	0.1889	0.5453	0.5000
49	Trinidad and Tobago	0.3577	0.1600	0.5554	0.2500
50	Maldives	0.3565	0.0773	0.6358	0.0000

Annex Table A.1. 2002 Index of ICT diffusion by ranking (continued)

RANKING	COUNTRY	DIFFUSION	CONNECTIVITY	ACCESS	POLICY
51	Costa Rica	0.3560	0.1593	0.5526	0.0000
52	Mauritius	0.3495	0.1783	0.5207	0.0000
53	Argentina	0.3460	0.1291	0.5629	1.0000
54	Poland	0.3424	0.1747	0.5101	0.8750
55	Belarus	0.3329	0.1175	0.5483	0.3333
56	Slovak Republic	0.3299	0.2659	0.3939	0.5000
57	Brazil	0.3256	0.1358	0.5154	0.7500
58	Guyana	0.3199	0.0645	0.5753	0.0000
59	New Caledonia	0.3195	0.2137	0.4252	0.0000
60	Saudi Arabia	0.3148	0.1293	0.5003	0.5000
61	Uruguay	0.3134	0.1680	0.4588	0.1250
62	Oman	0.3104	0.0722	0.5485	0.0000
63	Venezuela	0.3053	0.1101	0.5005	0.7500
64	Lebanon	0.3050	0.1260	0.4841	0.0000
65	Thailand	0.3049	0.1020	0.5078	0.6250
66	South Africa	0.3038	0.1277	0.4798	0.3333
67	Romania	0.3034	0.1166	0.4902	0.5000
68	Turkey	0.3033	0.1630	0.4437	0.2500
69	Cuba	0.3007	0.0147	0.5867	0.2500
70	Belice	0.2994	0.1309	0.4679	0.0000
71	Kazakhstan	0.2972	0.0679	0.5264	0.6667
72	Colombia	0.2972	0.0879	0.5064	1.0000
73	Mexico	0.2969	0.1316	0.4622	0.7500
74	Guatemala	0.2955	0.0542	0.5367	0.5000
75	Jordan	0.2948	0.0993	0.4903	0.2500
76	Philippines	0.2940	0.0659	0.5221	1.0000
77	Grenada	0.2938	0.1874	0.4002	0.0000
78	Moldova	0.2874	0.0676	0.5072	0.2500
79	Dominican Rep.	0.2842	0.1025	0.4659	0.7500
80	Botswana	0.2830	0.0907	0.4753	0.2500
81	Armenia	0.2813	0.0581	0.5044	0.2500
82	Marshall Islands	0.2811	0.0432	0.5191	0.0000
83	Ecuador	0.2805	0.0679	0.4931	0.1250
84	Iran (Islamic Rep. of)	0.2801	0.0777	0.4825	0.0000
85	Fiji	0.2762	0.0723	0.4800	0.0000
86	Paraguay	0.2755	0.0926	0.4585	0.2500
87	Cape Verde	0.2727	0.0878	0.4577	0.2500
88	Peru	0.2710	0.0562	0.4859	1.0000
89	Mongolia	0.2704	0.0417	0.4992	0.5000
90	Azerbaijan	0.2704	0.0712	0.4695	0.1667
91	T.F.Y.R. Macedonia	0.2699	0.1513	0.3886	0.2500
92	Uzbekistán	0.2654	0.0247	0.5061	0.1667
93	Namibia	0.2653	0.0577	0.4729	0.2500
94	Russia	0.2620	0.1240	0.4000	0.5000
95	Tunisia	0.2589	0.0529	0.4649	0.2500
96	Tajikistan	0.2545	0.0139	0.4951	0.0000
97	Sri Lanka	0.2545	0.0281	0.4809	0.5000
98	Jamaica	0.2543	0.1869	0.3217	0.2500
99	Viet Nam	0.2531	0.0215	0.4846	0.2500
100	Indonesia	0.2528	0.0259	0.4797	0.5000
101	Tonga	0.2526	0.1622	0.3431	..

Annex Table A.1. 2002 Index of ICT diffusion by ranking (continued)

RANKING	COUNTRY	DIFFUSION	CONNECTIVITY	ACCESS	POLICY
102	Dominica	0.2525	0.1395	0.3656	0.0000
103	Sierra Leone	0.2457	0.0061	0.4853	0.5000
104	Syrian Arab Republic	0.2456	0.0428	0.4484	0.0000
105	Saint Lucia	0.2455	0.1658	0.3251	0.0000
106	Bosnia and Herzegovina	0.2441	0.1331	0.3551	0.2500
107	Swaziland	0.2424	0.0309	0.4540	0.2500
108	Gabon	0.2366	0.0630	0.4103	0.3750
109	Guinea	0.2345	0.0050	0.4641	0.2500
110	Algeria	0.2309	0.0213	0.4406	0.0000
111	Ukraine	0.2269	0.0846	0.3692	0.0833
112	Egypt	0.2254	0.0474	0.4033	0.2500
113	Panama	0.2235	0.0885	0.3585	0.5000
114	Honduras	0.2234	0.0280	0.4188	0.0000
115	Kenya	0.2193	0.0148	0.4238	0.6250
116	Ghana	0.2183	0.0100	0.4266	0.5000
117	Lesotho	0.2153	0.0215	0.4091	0.0000
118	China	0.2115	0.0893	0.3338	0.8750
119	Cambodia	0.2093	0.0078	0.4107	0.3750
120	Lao P.D.R.	0.2090	0.0063	0.4117	0.0000
121	India	0.2081	0.0154	0.4009	1.0000
122	Cameroon	0.2079	0.0134	0.4024	0.0000
123	Zambia	0.2029	0.0078	0.3981	0.2500
124	Pakistan	0.2024	0.0459	0.3590	0.8750
125	Papua New Guinea	0.2012	0.0228	0.3796	0.1250
126	Georgia	0.1989	0.0655	0.3324	0.7500
127	Albania	0.1966	0.0855	0.3077	0.5000
128	Samoa	0.1963	0.0413	0.3514	0.0000
129	Sudan	0.1962	0.0087	0.3837	0.7500
130	Turkmenistan	0.1946	0.0277	0.3615	0.3333
131	Madagascar	0.1911	0.0041	0.3782	0.7500
132	Eritrea	0.1905	0.0033	0.3777	0.2500
133	Togo	0.1888	0.0215	0.3561	0.2500
134	Rwanda	0.1887	0.0053	0.3722	0.0000
135	Tanzania (United Rep. Of)	0.1886	0.0068	0.3704	0.2500
136	Yemen	0.1881	0.0147	0.3615	0.2500
137	Morocco	0.1877	0.0632	0.3121	0.2500
138	Malawi	0.1866	0.0037	0.3696	0.7500
139	Gambia	0.1842	0.0289	0.3396	0.2500
140	Burundi	0.1818	0.0030	0.3607	0.6667
141	Bolivia	0.1813	0.0479	0.3146	0.2500
142	Nepal	0.1794	0.0048	0.3539	0.2500
143	Angora	0.1758	0.0047	0.3470	0.6250
144	Central African Rep.	0.1712	0.0021	0.3404	0.0000
145	Bangladesh	0.1711	0.0040	0.3381	0.0833
146	Etiopía	0.1708	0.0020	0.3396	0.0000
147	Djibouti	0.1613	0.0141	0.3085	0.0000
148	El Salvador	0.1604	0.0678	0.2529	0.7500
149	Senegal	0.1604	0.0259	0.2949	0.2500
150	Comoros	0.1603	0.0054	0.3152	0.0000
151	Kyrgyzstan	0.1577	0.0275	0.2879	0.3750
152	Mauritania	0.1562	0.0270	0.2854	0.3333

Annex Table A.1. 2002 Index of ICT diffusion by ranking

RANKING	COUNTRY	DIFFUSION	CONNECTIVITY	ACCESS	POLICY
153	Solomon Islands	0.1548	0.0178	0.2919	0.0000
154	Uganda	0.1546	0.0054	0.3037	0.5000
155	Chad	0.1505	0.0018	0.2991	0.0000
156	Congo	0.1452	0.0171	0.2733	0.6667
157	Mali	0.1404	0.0025	0.2782	0.5000
158	Côte d'Ivoire	0.1378	0.0233	0.2523	0.2500
159	Burkina Faso	0.1296	0.0035	0.2558	0.2500
160	Níger	0.1176	0.0007	0.2344	0.6667
161	Nigeria	0.1136	0.0070	0.2201	0.7500
162	Vanuatu	0.1102	0.0203	0.2001	0.0000
163	Benin	0.0984	0.0110	0.1858	0.0000
164	Haiti	0.0955	0.0108	0.1803	0.0000
165	Guinea-Bissau	0.0685	0.0027	0.1344	0.7500

Annex Table A.2. ICT diffusion rankings, 1995-2002

	1995	1999	2000	2001	2002
Afghanistan	198	..	..	..	..
Albania	104	102	103	148	127
Algeria	108	109	113	113	110
Angola	114	151	149	149	143
Antigua and Barbuda	50	64	..	..	..
Argentina	54	53	52	55	53
Armenia	121	92	96	92	81
Australia	7	13	13	10	10
Austria	18	18	16	19	22
Azerbaijan	91	164	127	102	90
Bahamas	46	57	60	..	..
Bahrain	40	38	41	40	39
Bangladesh	107	137	145	150	145
Barbados	52	36	39	41	34
Belarus	55	55	58	59	55
Belgium	21	22	24	23	26
Belize	75	63	111	68	70
Benin	129	152	158	157	163
Bhutan	163	..	168	167	..
Bolivia	146	104	105	147	141
Bosnia and Herzegovina		122	124	126	106
Botswana	97	84	82	82	80
Brazil	78	66	62	62	57
Brunei Darussalam	36	43	35	37	40
Bulgaria	47	48	85	52	48
Burkina Faso	140	157	163	162	159
Burundi*	139	130	136	143	140
Cambodia	105	138	148	122	119
Cameroon	139	130	136	143	122
Canada	10	11	12	16	13
Cape Verde	63	93	90	89	87
Central African Rep.	156	168	170	140	144
Chad	138	155	156	156	155
Chile	67	50	46	47	46
China	147	135	134	134	118
Colombia	70	68	70	74	72
Comoros	118	142	151	146	150
Congo	152	160	159	161	156
Congo (Democratic Republic of the)	..	162	..	..	..
Costa Rica	59	46	49	54	51
Cote d'Ivoire	141	133	141	139	158
Croatia	43	70	61	42	38
Cuba	45	60	64	60	69
Czech Republic	60	58	54	44	35
Denmark	6	6	4	3	5
Djibouti	113	141	160	141	147
Dominica	..	58		125	102
Dominican Rep.	133	147	121	73	79

Annex Table A.2. ICT diffusion rankings, 1995-2002 (continued)

	1995	1999	2000	2001	2002
Ecuador	83	80	86	86	83
Egypt	154	115	117	115	112
El Salvador	49	91	92	94	148
Equatorial Guinea	..	..	..	..	..
Eritrea	130	124	133	137	132
Estonia	38	32	32	34	29
Ethiopia	145	139	146	152	146
Fiji	..	79	80	80	85
Finland	1	5	8	7	6
France	20	23	25	25	25
Gabon	..	153	132	90	108
Gambia	155	161	166	144	139
Georgia	127	..	128	127	126
Germany	17	20	14	13	15
Ghana	128	119	119	118	116
Greece	29	31	33	33	31
Grenada	90	71	67	..	77
Guatemala	111	112	115	110	74
Guinea	151	154	152	106	109
Guinea-Bissau	123	167	169	166	165
Guyana	41	73	68	67	58
Haiti	..	165	167	165	164
Honduras	112	110	116	112	114
Hong Kong	11	8	11	11	12
Hungary	44	41	40	38	37
Iceland	4	2	2	2	2
India	157	118	123	124	121
Indonesia	100	97	102	100	100
Iran (Islamic Rep. of)	101	87	87	88	84
Iraq	..	..	..	..	..
Ireland	22	17	20	20	21
Italy	25	24	22	24	24
Jamaica	84	75	69	69	98
Japan	16	15	18	15	17
Jordan	87	85	81	77	75
Kazakhstan	74	117	73	76	71
Kenya	119	111	114	114	115
Korea (Rep. of)	26	21	21	22	14
Kuwait	31	39	43	48	42
Kyrgyzstan	..	..	..	..	151
Lao P.D.R.	177	125	122	123	120
Latvia	35	47	47	49	45
Lebanon	69	56	59	66	64
Lesotho*	64	106	109	158	117
Liberia*	..	..	..	..	..
Libya	..	140	..		
Lithuania	30	44	50	50	47
Luxembourg	12	7	6	8	4
Madagascar	80	123	135	130	131
Malawi	88	134	142	138	138

Annex Table A.2. ICT diffusion rankings, 1995-2002 (continued)

	1995	1999	2000	2001	2002
Malaysia	51	42	44	35	41
Maldives	86	52	55	56	50
Mali	132	149	154	159	157
Marshall Islands	120	118	..	43	41
Mauritania	124	143	150	154	152
Mauritius	39	51	53	51	52
Mexico	116	77	79	71	73
Moldova	77	81	77	84	78
Mongolia	159	113	97	87	89
Morocco	131	127	130	129	137
Mozambique	110	144	153	151	..
Myanmar	180	62	112	111	89
Namibia	95	95	91	93	93
Nepal	137	132	143	145	142
Netherlands	14	9	5	6	8
New Zealand	8	14	17	17	18
Nicaragua	117	88	..	..	..
Niger	149	158	164	163	160
Nigeria		159	165	164	161
Norway	3	3	3	4	7
Oman	..	89	95	64	62
Pakistan	152	126	138	142	124
Panama	71	78	78	81	113
Papua New Guinea		163	161	119	125
Paraguay	42	83	84	85	86
Peru	94	86	88	83	88
Philippines	126	76	76	79	76
Poland	58	45	48		54
Portugal	34	29	31	30	33
Qatar	..	33	37	39	36
Romania	66	105	75	105	67
Russia	98	61	110	108	94
Rwanda*	89	131	139	133	134
Saint Kitts and Nevis	..	..	57	57	44
Saint Lucia	143	..	..	..	105
Samoa	135	101	131	128	128
Sao Tome and Principe	..	..	94	..	..
Saudi Arabia	72	72	74	78	60
Senegal	148	150	155	153	149
Seychelles	..	..	38	36	..
Sierra Leone	150	146	147	101	103
Singapore	15	12	10	12	9
Slovak Republic	92	40	64	58	56
Slovenia	27	25	26	27	23
Solomon Islands	150	145	157	155	153
Somalia	..	..	..	..	60
South Africa	65	59	65	61	66
Spain	32	30	29	29	28
Sri Lanka	153	96	98	98	97
St Vincent	134	..	..	..	..

Annex Table A.2. ICT diffusion rankings, 1995-2002 (continued)

	1995	1999	2000	2001	2002
Sudan	99	121	126	132	129
Suriname	..	168	45	46	43
Swaziland	122	108	107	103	107
Sweden	5	4	7	5	3
Switzerland	9	10	9	9	11
Syria	103	103	104	109	104
T.F.Y.R. Macedonia	106	99	99	97	91
Tajikistan	..	90	93	96	96
Tanzania	76	120	125	121	135
Thailand	79	82	83	75	65
Togo	136	129	140	131	133
Tonga					101
Trinidad and Tobago	62	54	51	53	49
Tunisia	109	98	101	95	95
Turkey	73	67	67	65	68
Turkmenistan	..	..	129	135	130
Uganda	144	136	144	136	154
Ukraine	115	69	..	117	111
United Arab Emirates	33	27	23	26	20
United Kingdom	13	16	15	14	16
United States	2	1	1	1	1
Uruguay	53	49	56	72	61
Uzbekistan	142	94	89	91	92
Vanuatu	140	156	162	160	162
Venezuela	68	65	71	70	63
Viet Nam	61	107	100	99	99
Yemen	102	128	137	..	136
Zambia	125	114	118	116	123
Zimbabwe	100	140	106	104	..

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