MONITORING the *Digital Divide* ...and BEYOND

George Sciadas
Editor

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Orbicom
Jointly created in 1994 by UNESCO and Université du Québec à Montréal (UQAM), Orbicom, the Network of UNESCO Chairs in Communications, embodies 28 Chairs and over 250 associate members in 71 countries with representation from communications research, ICT for development, journalism, multi-media, public relations, communications law, and more. The international collaboration of academics, corporate decision makers, policy consultants, and media specialists makes Orbicom a unique network and constitutes a truly multidisciplinary approach to the promotion of communications' development. Since 1996, Orbicom has general consultative status with the Economic and Social Council of the United Nations. Orbicom is engaged in a number of efforts focusing on ICTs, including assessment instruments such as *Digital Review of Asia Pacific* and *Monitoring the Digital Divide ...and beyond*. In 2002, Orbicom received the UNESCO/UNITWIN award for the quality of its projects. To find more about Orbicom, please visit its trilingual website *http://www.orbicom.uqam.ca* or contact *orbicom@uqam.ca*.

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Monitoring the DIGITAL DIVIDE ...and beyond

Scientific Director and Editor: George Sciadas

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infoDev
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Dedicated to the memory of

Tony Zeitoun

Tony, on behalf of the Canadian International Development Agency, supported the project enthusiastically from its inception, followed its every turn, took pride in its accomplishments and was pioneering the planning of its future course.

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ENCOUNTERING DEVELOPMENT:
A NEW MODEL AND METHODOLOGY TO MONITOR THE DIGITAL DIVIDE

by Claude-Yves Charron

Secretary General of Orbicom and Vice-rector of Université du Québec à Montréal

Creating digital opportunities is not something that happens after addressing the "core" development challenges; it is a key component of addressing those challenges in the 21st century.

(G-8 Creating Opportunities for All: Meeting the Challenge, 2001).

Monitoring the Digital Divide ...and beyond is a major initiative of Orbicom. It was launched at the request of network members from the South who, while appreciative of the potential of information communication technologies (ICTs) in supporting sustainable development, were also apprehensive about the dangers of leaving the majority of the people in the South behind with no access to ICTs. An initial concept called *The Digital Divide Index* (DDI) was first designed as an instrument which would track the diffusion and uptake of ICTs over time and across economies and regions.

The DDI was proposed by the Orbicom Research Committee in 2000. The idea was later incorporated into an action plan which was approved by Orbicom's general membership. The research itself started in 2001 under the leadership of the Scientific Director of the project, Dr. George Sciadas of Statistics Canada, with the development of a conceptual framework and a model which was pretested in nine countries. The initiative was then titled *Monitoring the Digital Divide*. The work received funding and encouraging support from the Canadian International Development Agency (CIDA), first and main contributor, and from the *Info*Dev Programme of the World Bank and UNESCO. As the project evolved, it attracted the interest and the co-operation of numerous technical and intellectual partners. The project is one of several Orbicom initiatives addressing issues of access, impact and trust of ICTs. They include the recently published *Digital Review of Asia Pacific 2003-2004* and *Generating Trust in Online Business* published in 2002.

Monitoring the Digital Divide ...and beyond is unique. It goes beyond connectivity and e-readiness issues. Its cohesive conceptual framework and transparent statistical methodology logically incorporate skills into connectivity measurements, and offer intuitive benchmarking and rich analytical perspectives for decision makers. In addition, the work introduces primers on the correlation between ICTs and competitiveness and on the role of knowledge in development, two areas in need of deepening and further study, but which hold much promise.

This initiative is of special relevance to the implementation of the Action Plan of the World Summit on the Information Society, which calls for a realistic international performance evaluation and benchmarking, through comparable statistical indicators and research results. This approach clarifies the magnitude and the transformation of the digital divide, in its domestic and international dimensions over time, and provides an essential methodological framework to monitor progress in the use of ICTs to achieve internationally agreed development goals, including those of the Millennium Declaration. It also allows each stakeholder involved to follow how, with concrete indicators, the transformation from the digital divide to digital opportunities evolves.

With the advent and convergence of ICTs, the world has entered a new era which will witness deep cultural and social changes, and global communication systems which are more interactive and participatory in operation. This new dynamic invites us to cope with still unfamiliar ways of riding the waves in a sea of change. We must learn how to use this new dynamic to ascertain how ICTs are key components in facilitating the achievement of the United Nations' Millennium Development Goals.

FOREWORD

by Dr. Abdul Waheed Khan

Assistant Director-General for Communication and Information / UNESCO

Modern societies are currently undergoing a number of fundamental transformations caused by the growing impact of the new communication and information technologies on all aspects of human life. Some experts go so far as to speak of a revolution comparable to the invention of the alphabet or printing. But this revolution brought about by the new technologies has to confront a major challenge, namely the extreme disparities of access between the industrialized countries and the developing countries and those in transition, as well as within societies themselves. Indeed, the real issue is how to take account of the human dimension of the "digital divide" between and within countries. Despite increased awareness, the rich-poor divide in economic well-being is growing. The challenge now lies in enlisting technology as an ally in the movement for development and social equity. How can we help "maintain, increase and diffuse knowledge," as UNESCO's Charter requires, in this radically new context?

It is increasingly clear that our ability to cope with the "Digital Divide" or the "Knowledge Divide" will become the primary measure of success at both the micro and macro levels. In this sense, information and knowledge are becoming central to development and to attaining the Millennium Development Goals.

This work comes at an opportune time. To measure the Digital Divide most attempts had concentrated on such aspects as connectivity measurements and e-readiness for a restricted number of countries. The Orbicom research breaks new ground with a conceptual framework that goes beyond infrastructure to examine the content and dimension of the Digital Divide through the inclusion of existing and reliable education data. In addition, it has the merit of covering a substantial part of the planet with an emphasis on developing countries. In this sense, *Monitoring the Digital Divide... and beyond* is an essential tool for policymakers, donors and other stakeholders concerned with access to information and the acquisition of knowledge and skills as a means to bridge the Digital Divide.

The fact that education or "skill" data are incorporated in a monitoring instrument of the Digital Divide confirms in my view that education, both in traditional and in new settings, is the key to creating equitable knowledge societies. There are two types of linkages between ICTs and education. The first is the use of education and training, formal and informal, to create IT-literate societies. Enabling all citizens to use ICTs with confidence, in both their personal lives and working environments, is a declared policy in some countries.

The second type of linkage is the use of education and training systems to achieve learning goals that do not necessarily have anything to do with ICTs themselves. After some years of mixed results from technology-driven strategies that focused on equipping educational systems with ICTs, we now need to exchange experiences on approaches where the education or training goals determine the use of ICTs rather than the other way around. I am certain that one conclusion of this exchange will be that age-old methods of education delivery are unable to meet adequately the growing demand for learning and knowledge sharing. Initial signs of this incapacity have already led to several innovations: open learning, distance education, flexible learning, distributed learning and e-learning.

It is also evident that ICTs are excellent tools for facilitating access to scientific journals, libraries, databases and advanced scientific facilities. Another positive aspect is their potential to improve the collection and analysis of complex data. *Monitoring the Digital Divide... and beyond* is a very good example of innovative uses of data and their transformation into an insightful synthesis.

An increased flow of information is, in itself, not enough to lead to holistic and multidimentional development. In building equitable knowledge societies, there is a need for facilitating social, cultural, economical, political and institutional transformation. UNESCO's concept of knowledge societies is based on fostering social development and community participation to ensure that all social groups could equally benefit from the new communication and information technologies. *Monitoring the Digital Divide ...and beyond* could well pave the way for approaches that would address this issue, particularly in the context of developing countries.

PREFACE

by José-Maria Figueres

CEO of the World Economic Forum and
Chairman of the United Nations ICT Task Force

and Bruno Lanvin

*Manager of Info*Dev *at the World Bank and*
Co-editor of the Global Information Technology Report (GITR)

The information revolution differs from previous industrial revolutions in many respects. First, it is not only based on a wave of concurrent technological innovations (in informatics on one hand and in telecommunications on the other), but also underpinned by a number of externalities (network externalities, knowledge-sharing effects) which have never been experienced before in the world economy. Secondly, it challenges many of the 'distances' that have until now separated different players and components of this same world economy. By redefining geographical distances, the information revolution has been the true engine of globalization. By redefining economic distances (between rich and poor) it has the power to become one of the engines of a world free of poverty.

To achieve this goal, however, many obstacles still need to be overcome. Before we can decide on how we should attempt to overcome them, we have to know how high, how far, how deep those obstacles are. Measurements and scorecards will therefore be at the heart of future efforts to address the so-called digital divide and identify the digital opportunities which will increase average income while diminishing income inequalities. This is where Orbicom's work fits so adequately.

While other efforts and entities are concentrating their approach and focus on the ways in which 'e-readiness' relates to overall competitiveness and international development goals (GIT Report, UN ICT Task Force), or on specific implications of the information revolution on employment (ILO), trade (UNCTAD) or education (UNESCO), the Orbicom report is a remarkable attempt to offer a global set of indicators a remarkable attempt to offer a global set of indicators *(infostate)* showing how the availability of ICTs and access to networks can be a misleading indicator if it neglects people's skills, and if ICT networks and skills combined *(infodensity)* are not matched by a measurement of what individuals, business and countries actually **do** with such technologies (*info-use*). It also offers important perspectives into the central role that e-policies and knowledge have started to play in determining how countries will fare in the global competition to benefit from the information revolution and move away from poverty.

As the world prepares for the two parts of the the World Summit on Information Society (Geneva, 2003 and Tunis, 2005), the work produced by Orbicom to describe, measure and monitor the Digital Divide has a very distinct and important role to play. It offers a fresh and broad-ranging perspective of the ways in which 'info-ready' countries differ from 'info-challenged' ones. Governments, international organizations, business, non-governmental organizations, academia and civil society as a whole will be all the more interested in building a development-supportive, open and vibrant information society now that they will have at their disposal a reliable, action-oriented and diversified set of indicators to measure both the intensity of their efforts and the level of their impact. Those of us who are involved in providing such indicators have all the reasons to welcome and salute Orbicom's effort in this domain.

EXECUTIVE SUMMARY

The widely held belief that the proliferation, diffusion and appropriate utilization of ICTs presents enormous opportunities for economic and social development is thwarted by the realization that uneven access and capacity to use them poses serious threats as it could accentuate already existing and sizeable gaps between haves and have-nots.

The Digital Divide is rooted in the heart of Information Society issues. While it has attracted a lot of attention and much has been learned from studies of internal country divides, there has been so far no systematic way to quantify the Digital Divide and monitor its evolution across countries. This work offers the international community such an instrument, the application of which illuminates the issues involved with particular emphasis on developing countries. Unique features are:

- a cohesive conceptual Framework, which goes beyond connectivity measures and logically incorporates skills, as well as offers rich analytical linkages
- explicit measurements both across countries at a given point in time and within countries over-time, in such a way that comparisons are not reduced to changing rankings from year to year
- policy relevant results on a component-by-component basis
- immediate benchmarking against the average of all countries (Hypothetica) and the planet as a whole (Planetia)
- use of existing and reliable data sets with a sound and transparent statistical methodology

The conceptual Framework introduces the notion of a country's "ICT-ization" or Infostate, as the aggregation of Infodensity and Info-use. Infodensity refers to the stocks of ICT capital and labour, including networks and ICT skills, indicative of a country's productive capacity and indispensable to function in an Information Society. Info-use refers to the uptake and consumption flows of ICTs, as well as their intensity of use. It is differences among countries' Infostates that constitute the Digital Divide. Since Infostates are dynamic and ever-evolving, the Digital Divide is a relative concept. Any progress made by developing countries must be examined against the progress made by developed ones.

The empirical application of the model covers a great number of countries. Measurements of networks are offered for 192 countries, covering 99% of the population of the planet; of skills and overall Infodensity for 153 countries, representing 98% of the population; of Info-use 143 countries and overall Infostate 139 countries, both accounting for 95% of the global population. The results are based on 21 variables, reliable, tested and available to all, and extends over the 1996-2001 period.

The findings illuminate the questions of the magnitude and the evolution of the Digital Divide that we set out to answer:

➨ The Digital Divide between developed and developing countries is huge. Western European countries (including all Scandinavian, the Netherlands, Switzerland, Belgium, Luxembourg, the U.K. and Germany), the U.S., Canada, Hong Kong, Singapore, S. Korea, Japan, Australia and New Zealand have achieved very high Infostates, whereas African countries are heavily concentrated at the bottom of the list. In particular, Chad, Ethiopia, the Central African Republic, Eritrea and Malawi, accompanied by Myanmar and Bangladesh, carry the tail. With the average country, Hypothetica, valued at 100, top countries have Infostate values exceeding 200, whereas the bottom is as low as 5! Literally, decades of development separate the haves from the have-nots.

➨ Both Infodensity and Info-use contribute to the Digital Divide, with networks and ICT uptake more than other components. Although century-old wireline telecommunications networks are a cause of the Divide, the gaps are more pronounced in newer technologies - the Internet, computers and cell phones. Skills, as measured by education indicators, also contribute significantly to the Divide, and this is more the case as we move from generic to more specific measurements. If anything, the lack of better measurements in this area underestimates the extent of the Divide.

➨ Over time, Infostates increase across all countries but to varying degrees. In an overall sense, the Digital Divide is closing. This, however, is happening at a very slow pace and is mostly attributed to relative progress by countries in the middle of the distribution. Countries at the bottom continue to lose ground.

➨ The same ICTs that cause much of the Digital Divide are also the ones behind its slow closing. Progress is being made in Internet use, cell phones and Internet networks. Even though such progress is substantial in some countries, the road ahead is very long. If left on its own this dismal situation is unlikely to improve in any significant way within our life times. Concerted action will be required by the international community to alleviate the problem and see that as we move on we do not leave substantial population masses behind, with all the negative consequences that this entails.

➨ A close correlation exists between Infostates and per capita GDP. Initial study reveals that for every point increase in Infodensity, per capita GDP increases anywhere between $136 and $164. There are notable exceptions, though. Countries with similar GDPs can have very different Infostates and vice versa. This speaks to the importance of national e-policies and e-strategies, implying that their design and implementation matter.

As well, a primer on knowledge offers food-for-thought on the complexities associated with its role in development. Knowledge confers the capacity for action and this distinguishes it from information. The significance of tacit knowledge is complemented with the nuances surrounding indigenous knowledge. Case studies are used to place these issues in context. This think-piece offers a critical assessment of the creation and transmission of knowledge but, most importantly, it emphasizes the absorptive capacity of a country as a challenge for development with several policy implications. This refers to the capability to track and assimilate external knowledge and put it to productive uses.

Chapter 1

GENESIS OF THE PROJECT

Significant energy has been expended in recent years to understand the implications of the rapid rise to prominence of Information and Communication Technologies (ICTs), and concerted efforts have been devoted to untangling the linkages between their diffusion, use and economic development. Numerous initiatives have been launched in parallel by national, international and non-governmental organizations, including the upcoming World Summits on the Information Society (WSIS), as if to solidify the instinctive belief that we are witnessing something fundamental with profound consequences, some immediate and others over the longer term. Throughout this creative turmoil, the issue of the Digital Divide emerged to occupy a central position among Information Society issues. Simply understood as the gaps between ICT 'haves' and 'have-nots', it matters enormously to the extent that ICTs represent an historic opportunity for the evolution of our societies and have the potential to accentuate already existing and sizeable imbalances.

This elevated interest is being accompanied by the realization of the importance of measurements. It is in that vein that many voices have been raised in recent times for the need to develop an instrument that would quantify the Digital Divide and systematically monitor its evolution. As an area of investigation, the Digital Divide is multifaceted. It represents the area of overlap between the economic and the social aspects of the Information Society and serves as a prime example of the need for broad, multi-disciplinary approaches. Surely it involves the ever-important issues of deployment of infrastructure and access to it, but it also involves actual uses of ICTs, coupled with their efficacy, intelligence and applications. It extends to include the necessary skills, the evolution of which brings to the forefront issues of training and learning. Moreover, social exclusion and further marginalization of parts of the population, with all their implications, can be dealt with wherever masses of people live. This adds a spatial dimension to the Digital Divide, equally applicable within and across countries. Several other dimensions exist, related to gender, age, family-type and others.

The realization of many of the promises of ICTs, including phenomena like e-commerce and e-government, also relates closely to the Digital Divide. At a minimum, work on this area requires a combination of diverse subject matter expertise and statistical knowledge. Analytical work concerning internal country digital divides has been carried out (e.g. U.S. 1995, 1998, 1999, 2000, 2002, OECD 2001, Sciadas 2002) and much has been learned. Moreover, methodological approaches and statistical techniques have been developed. The impetus behind this project has been the need for the development of an instrument that would quantify the Digital Divide across countries, as well as monitor its evolution. This is indispensable in the formulation of national and international e-strategies, as the emphasis is increasingly placed on ICT-for-development policies. It will help ascertain the relative status of countries and, especially, monitor the relative progress both across countries and components of interest within countries. Such an instrument will provide the international community with a useful mechanism towards:

- the identification of the state of affairs and relative needs among countries;
- the allocation of investments to their most appropriate uses, and;
- the monitoring of performance.

This is where this project aims to contribute.

Objectives and terms of reference

As this is a new area of investigation, it is generally characterized by selective application of concepts and lack of widely understood terminology, definitions and overall nomenclature. This can add to the list of complexities surrounding work in this or related areas. Our focus is on the Digital Divide, which is ICT-centric. While 'divide' is generally understood, the word 'digital' is a misnomer. Digitization is undoubtedly at the center of the recent technological advances, but our domain of interest encompasses more conventional, non-digital ICTs.

Furthermore, the stakeholders established clearly the overall objectives of the project: develop a model, grounded on a sound conceptual framework, the empirical application of which will make possible the systematic measurement of the state and evolution of the Digital Divide internationally. Unlike measurement practices in other areas, where phenomena of interest are measured at a given point in time and the ensuing analyses rely on annual changes in country rankings, the objective was twofold: create a methodology that will make it possible to quantify the Digital Divide and monitor its evolution both

- **across countries at a given point in time, and;**
- **within countries over time.**

Moreover, it was stipulated that the development will be guided by the following terms of reference:

- Place emphasis on developing countries;
- Rely on a modeling approach that yields policy-relevant results;
- Focus on ICTs, but be broader in scope than pure connectivity measures.

Several implications stem from the above, which were addressed during the development of the conceptual framework (Orbicom 2002). A synopsis of this is offered next.

Chapter 2

THE FRAMEWORK AND THE MODEL

The Digital Divide represents the newest addition to already existing, enormous chasms in the stage of development and the standard of living among countries. Like other well-known imbalances, its measurement and analysis require a rigorous framework rather than ad hoc approaches. As the issue immediately invokes comparisons, we must clearly define what is it that divides, as well as establish plausible links between ICTs and economic development. Is it the availability of telecommunications networks that divides and impedes progress? Or is it the existing stocks of computers, cell phones and Internet connections? Or, perhaps, it is the use of such ICTs rather than their stocks that matter more? Could it be that, more than the quantity of ICTs and the intensity of their usage, it is the intelligence of their usage and other intangible qualities that matter? Or all of the above put together? Why? The framework that was developed in Phase I of this project provides the necessary conceptual underpinnings for the systematic quantification and monitoring of the Digital Divide. A synopsis is provided here.

2.1 The concepts

The conceptualization begins with the basics. The overriding issue of a society concerns the quality of life of its people. While this relates to all kinds of intangibles, including matters of social and cultural relationships, development efforts do not set out to improve people's inner happiness, but their economic well-being, current and potential. ICTs are no exception. Consistent with this, while the economy is situated all along within the broader socio-economic, geopolitical and cultural environment of a country, ICTs are treated as an economic and social reality. They are here to stay and the benefits associated with them will necessarily be a function of the way we put them to use.

Next, a distinction is made between consumptive and productive functions. Following economic theory, the standard of living of the people depends largely on their consumption of goods and services. Current consumption is determined by current production, adjusted for foreign trade and society's preferences regarding intertemporal allocation - foregone consumption today (investment) for increased consumption tomorrow. But over time we must confront the problem of expanding the production capabilities of a country in a sustainable way, something that brings us to the whole issue of economic growth and, by extension, to economic development. Therefore, while people's consumption determines their economic well-being today, the country's productive capacity determines economic well-being in the future.

The nature of ICTs is dual; they are both productive assets, as well as consumables. In that setting, the framework developed the notions of a country's ***Infodensity*** and ***Info-use***. Infodensity refers to the slice of a country's overall capital and labour stocks, which are ICT capital and ICT labour stocks and indicative of productive capacity, while info-use refers to the consumption flows of ICTs. Technically, it is possible to aggregate the two and arrive at the degree of a country's 'ICT-ization', or ***Infostate***. The Digital Divide is then defined as the relative difference in infostates among countries. Divides of course can be identified for each constituent component.

Thus,

Infodensity = ***sum of all ICT stocks (capital and labour)***
Info-use = ***consumption flows of ICTs/period***
Infostate = ***aggregation of infodensity and info-use***

Infodensity: The productive capacity of a country is determined by the quantity and quality of its factors of production. At any given point in time, the productive capacity is fixed because the factor stocks and the technology with which they are combined in production are fixed, but over time they are all expandable. Factor growth, technological improvements and productivity gains are instrumental and ICTs affect them all.

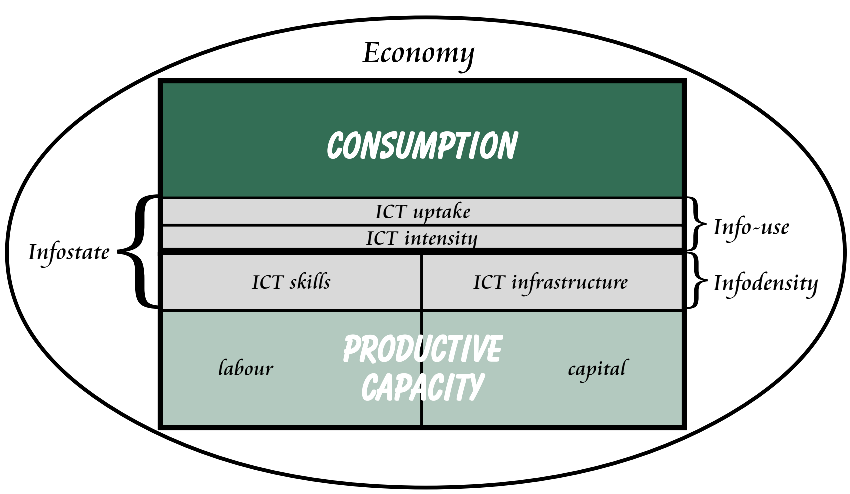
ICT and non-ICT factor inputs are combined to produce ICT and non-ICT goods and services, without a one-to-one correspondence. For instance, computers together with relatively unskilled labour are used to produce telecommunications services, and simple tools are used together with skilled ICT labour in the processing of agricultural output. At the end of the numerous production processes, part of the outputs will be in the form of ICT outputs, which will be absorbed as consumables (final demand) or will be added back to the capital stock (gross investment – replenishing the used-up ICT capital and labour stocks and augmenting them). The same holds true for labour skills, produced and consumed. Attrition, obsolescence, training, movements in and out of the labour force, and brain drain, all affect the skills stock. All these are measurable.

ICT capital comprises ***network*** infrastructure and ICT machinery and ***equipment***. ICT labour can be perceived not so much as a collection of individuals, but as the stock of the ICT ***skills*** of those in the labour force. In this formulation, produced output will be an increasing function of these ICT stocks, as it is for all other forms of capital and labour.

Info-use: Clearly, uptake of ICT goods is indispensable for the consumption of ICT services that would satisfy ultimate needs. In fact, ICT consumption involves the use of both ICT capital and skills, both of which are becoming increasingly complex as consumption expands from staples to complex technological goods and services. Thus, building 'consumptive capacity' is a prerequisite to generating consumption flows. In that vein, a distinction is made between ICT ***uptake*** and ICT ***intensity of use***. (Roughly, uptake corresponds to ICT goods and intensity of use to ICT services). Then the consumption per time period can be measured. In addition to the intensity of use (how much), it matters to know how "smart" use is. This relates to the derived satisfaction, in the case of individuals, and to the issue of productivity in businesses (organizational innovations accompanying technological innovations). Such examinations are outside our purview and can be dealt with more appropriately with case or impact studies. Figure 1 provides a schematic of the framework.

It is evident from the framework that domestic production of ICTs is not crucial. The issues are Infodensity and Info-use. Capitalized and consumed ICT goods and skills can come from imports. Alternatively, a developing country may manufacture ICT goods, which will not be seen in domestic consumption (exports).

Figure 1



Thus, the supply-side ICT sector, although important for all the spillovers entailed, is not prominent. The framework shows that:

domestic production - net exports = household spending + net investment (business and government) + business spending + current government spending

An analogous relationship can be specified for labour skills.

As well, what really matters for development is the utilization of the productive stocks rather than their availability. Having underutilized roads, abandoned factories and rusted telecommunications networks does not increase productive capacity. The same holds true for unemployed or underutilized labour and its skills. The supply-side refers clearly to the productive capacity of the country, but it is differentiated from actual production both because of capacity underutilization and trade.

Considering the intuitive and inextricable link of ICTs with the overall factor stocks and the continuous introduction of new ICTs in consumption, ICTs are clearly not bounded upwards but instead are expandable over time. Even as consumables, achieving complete uptake today means nothing for tomorrow. For instance, if every available ICT had achieved 100% penetration and use rates prior to the arrival of the Internet, the ceiling would have moved upwards immediately after. The same holds true for skills, with obvious implications for productivity. Consequently, there is no pre-set, absolute upper limit of infostate that can be achieved over time.

2.2 An operational model

The building blocks of the model are the notions of Infodensity and Info-use. Each can be measured and examined separately, as can their constituent components: ICT capital, ICT skills, ICT uptake and ICT intensity of use. This structure offers considerable flexibility and can be adapted to detailed examinations. Depending on the application at hand, it is constrained only by data limitations.

Networks: ICT capital comprises all kinds of material goods, from wires and cables, to keyboards, printers, sophisticated routers and switches. They combine to form machinery, equipment and networks. Compared with conventional analyses of goods and services, networks come with their own idiosyncractic nature. One of their major features concerns the well-known externalities. Simply put, the value of a network and the benefits accruing to its users, increase with the number of users. Moreover, major infrastructure build-ups are accompanied by small marginal costs of connections. It is the same networks that are used for consumption and production of many services. Telecommunications networks are used for residential and business use, as well as for a variety of services, such as transmission of voice and data, or long distance and local telephony. An implication of this is that it is practically artificial to apportion networks to categories of use, such as between consumptive and productive capacities - although possible with creative accounting. In the model, ICT networks will be associated with Infodensity.

Skills: The ICT labour stock is really a set of skills, as opposed to ICT versus non-ICT occupations or employment in ICT sector industries. As the use of ICTs becomes more pervasive, such skills are used by people whose primary occupation is a computer programmer, but also a secretary, a waiter or a car mechanic. While the labour stock includes those of labour force age, there are also those below and above the limits who consume ICTs - students and seniors. They obtain skills at school or through some other formal or informal training and consume ICT goods and services, but they are not part of their production. There is substantial overlap between consumption-related skills and skills related to the productive capacity of a country, since a very large number of individuals are involved as both employees and consumers. Such skills are transferable back and forth between productive and consumptive functions, i.e. skills acquired on the job can be used for individual consumption too or the other way around. Work in measuring ICT skills is at an early stage. Until it is further advanced, it is not unreasonable to assume that ICT skills necessary for production and consumption move in parallel. Furthermore, ICT skills cannot be viewed in isolation but they are part of the overall continuum of people's skills, which starts with basic literacy (ETS 2002).

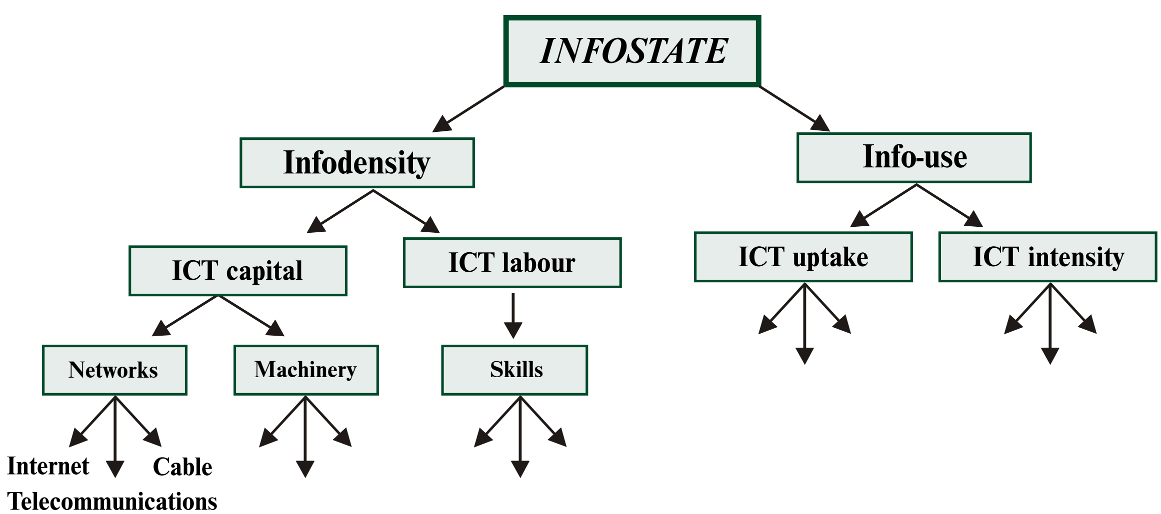
Uptake: Although households are seen as a consumptive sector, transformations of a productive nature involving raw materials and skills do take place for consumption to happen. ICT goods of varying durability are indispensable for the consumption of ICT services and can be considered parts of households' consumptive capacity - which determines current and future consumption flows. (Examples would include the telephone set that makes telephone calls possible, and the computer that allows the consumption of Internet services).

According to the framework, what matters in a society is overall consumption, not just consumption of ICTs. As more ICTs are consumed, substitutions take place. They can come either in the form of opportunity costs (spending on a cell phone by prolonging the life of clothing) or displacement (substituting a broadband Internet connection for dial-up service). In the very least, there will be substitutions in consumption due to the inescapable 24-hour-day constraint. Using the Internet will lead to reduced time of watching television or playing with the kids. When a new ICT enters the consumption basket, the relative proportions of ICT and non-ICT consumables will change. Although continuously higher relative proportions of ICTs in consumption is not the objective, these substitutions do not represent force-feeding. They will be regarded as reflecting consumer choices and therefore positive. What balance will be found over time, cannot be known a priori.

In principle, ICT uptake and intensity of usage also permit any level of desired detailed disaggregation. For instance, sectoral measurements and analyses can be accommodated. Businesses can be split by size or industry sector, and governments by level (national, regional, local) and type of institution (public administration, education, health). Furthermore, groups of households/individuals can be differentiated by gender, urban and rural locations, income, level of education and other characteristics important for the understanding of digital divides internal to a country.

In applying the model, we must be cognizant of its tree-like structure (see Figure 2), something that can be exploited and provide both latitude and depth in actual investigations. However, the main components provide robustness in comparability, substitutions at the bottom notwithstanding.

Figure 2



Empirical considerations

For measurement purposes, the framework serves as a guide for an operational model which approximates pragmatically the purity of concepts. Such an exercise involves several nuances, including the constraints of existing indicators and their lopsided availability among countries. Statistical manipulation must be combined with, and guided by, subject matter considerations and the project's terms of reference.

An indicators' model: While alternative empirical applications are admissible under the framework, the modeling approach relies on indicators. Practically, each component of the model is populated by suitable indicators (see Text Box, p. 15). These are converted to indexes, a method that makes possible their aggregation across different units of measurement. The exercise is carried out from the bottom up, as explained in the technical specifications, in order to be able to trace analytically the explanations of the findings back to their origin.

Nature of ICTs: ICTs are 'general-purpose technologies' and permeate production and consumption activities. At times, the boundaries between them get blurred and judgment is needed in the absence of detailed sectoral data, such as availability of computers at homes vs. businesses. As well, ICT skills can only be imperfectly approximated at present, with general indicators from the skills' continuum. Moreover, ICTs are the product of technological convergence between new and older networks and technologies. The newer ones are mainly associated with two-way interactivity rather than one-way provision of information. Frequently, in work involving developed countries, the information component of ICTs is either ignored or downplayed. This is so because the older technologies have achieved such a widespread penetration in these countries that it makes them uninteresting in comparative analyses. A prime example is television. While this may make sense in that context, inclusion of the information component of ICTs is indispensable when the emphasis is on developing countries. Therefore, although the comparison among developed countries will be largely neutralized with respect to those components, they will be included in the application here. That it is possible for such media to turn interactive, upon digitization, is even more fitting.

A relativistic approach: Consistent with the need for policy relevance of the model, as opposed to its business usefulness, Infostates are expressed in relative terms. Thus, a small country like Luxembourg can have a higher level of Infostate than a much larger one, say, India. In absolute terms, this is unlikely to happen. The available stocks of ICTs and their utilization matter for businesses with an eye on market size.

Reference country and period: Considering the relative nature of the Digital Divide due to the constant evolution of infostates everywhere, the model calls for a reference country and a reference year to be used. The reference country facilitates comparisons and the reference year makes possible the monitoring of the evolution of each country's Infostate components over time. The empirical application extends over the 1996-2001 period, with time series data sufficient to capture the recent evolution of ICTs. 2001 was chosen as the reference (base) year due to the availability of additional indicators - which are expected to continue to exist. Appropriate linkage factors were used to compare with prior years – explained fully in the methodology section. Rather than choose a specific country as a reference, Hypothetica was created, a country that represents the average values of all countries examined. This offers immediate and intuitive initial benchmarking. As an alternative benchmark, Planetia is created and included in the calculations. In this case, the values are those of the planet as a whole, if viewed as one country and, in this setting, each country could be seen as a region of the planet. The methodology and its technical specifications, together with explanatory notes are contained in detail in Chapter 8.

While adhering to the use of existing data from credible sources, in total 192 countries are included in the measurements of networks, covering 99% of the population of the planet, 153 countries in skills and therefore Infodensity, covering 98% of the population, 143 countries in Info-use and 139 in overall Infostate, covering more than 95% of the global population.

Data gaps

In the course of the research, the following limitations were identified:

- lack of an adequate number of indicators,
- insufficient quality of some indicators.

Clearly, there is ample room for a concerted international effort to develop ongoing statistical information concerning matters of information and knowledge-based societies with a development angle. If the present framework, in conjunction with its information requirements and identification of data gaps, proves helpful towards such a mission, it will have made a modest contribution.

2.3 Distinguishing features

Work in this area is full of challenges. While no major attempts have been made in measuring the Digital Divide across countries per se (hence the need for this project), several attempts have been made in somewhat related areas. The approach here contributes to the overall research agenda and offers the following:

- A cohesive framework which provides a perspective, as well as makes possible analytical linkages, economic or otherwise.
- A realistic depiction of the Digital Divide and its decomposition to constituent parts, all of which are unbounded upwards, both in the context of developed and developing countries.
- Time-series data that make possible the quantification of evolutions and comparisons. Therefore, benchmarking and comparisons of evolutions do not have to be constrained to comparing changed rankings from one period to the next.
- The best existing data, reliable and available to all.
- A methodology which makes the empirical application rubust, in a transparent, reproducible and defensible way within the context of the study.

INDICATORS

Indicators are extremely useful to focus the discussions of complex issues on their important components, and to illustrate the direction of their movement and the order of magnitude of change. Indicators come in any kind, shape or form. They can be simple or complex, quantitative or qualitative, and can be expressed in various units of measurement. Invariably, the value of individual indicators depends on the context within which they are used.

Indicators, useful as they are, are not substitutes for detailed analyses of specific issues. The messages conveyed by their use must not be confused with detailed findings from case studies. Indicators are generally more useful for highlighting differences of some scale. Not only the context but the specific intended use of indicators is also of paramount significance. Knowing the penetration of computers equipped with modems may be useful in formulating policies on access, but inadequate for a bank that contemplates the offering of Internet banking.

In conjunction with all the above, one must have knowledge of what indicators purport to indicate. This requires knowledge of the subject matter around them, including as much 'metadata' information related to their compilation as possible. When penetration rates change, for instance, one must know that likely both the numerators and the denominators have changed. Thus, growth rates can be computed meaningfully only on the basis of the absolute figures used in their construction.

In short, every indicator has its strengths and limitations. The quest for perfection will be futile and can only lead to inactivity and paralysis. Simplicity is a virtue in this case. Indicators are practically selected through a combination of reasonableness and availability. Over the longer term, areas of interest and statistical gaps can be identified for investment in the production of more and better indicators. In principle, we do not gain by merely adding indicators. It is more productive to find more suitable ones to substitute.

Choosing indicators is thus somewhat of an art. However, it does require broad knowledge and experience, in conjunction with practical considerations concerning data availability. Ideally, chosen indicators should be 'well-behaved', that is, the direction of their movement should be unambiguously linked to whether or not we are moving towards, or away from, a desired state. In addition, they should be unbiased and in the case of ICTs 'technology-neutral'. This is meant to neutralize different technological platforms among countries, so that comparisons will be fairer.

INFOSTATE

Infodensity

Networks

Main telephone lines per 100 inhabitants
Waiting lines/mainlines
Digital lines/mainlines
Cell phones per 100 inhabitants
Cable TV subscription per 100 households
Internet hosts per 1,000 inhabitants
Secure servers/Internet hosts
International bandwidth (Kbs per inhabitant)

Skills

Adult literacy rates
Gross enrollment ratios
- Primary education
- Secondary education
- Tertiary education

Info-use

Uptake

TV equipped households per 100 households
Residential phone lines per 100 households
PCs per 100 inhabitants
Internet users per 100 inhabitants

Intensity

Broadband users/Internet users
International outgoing telephone traffic minutes per capita
International incoming telephone traffic minutes per capita

Chapter 3

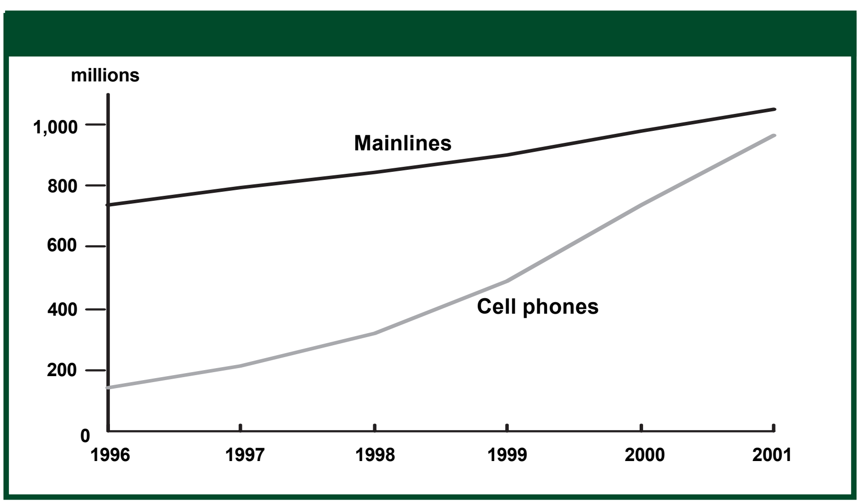
OVERVIEW OF RECENT TRENDS

Before the empirical application of the model, it is fitting to have a brief overview of developments that would be useful in establishing the perspective against which to interpret the findings.

The era of Information Societies is characterized by substantial movement, and a great deal of parallel developments are ongoing for some time now. A substantial part of these is related to ICTs, an area which has generated much excitement and considerable hope. Certainly, substantial progress has been made over the last few years. This progress, however, has been uneven – both across countries and technologies.

One of the most spectacular advances of our times has come from the cell phone. While, overall, wireline telecommunications networks continue to expand, over the last 15 years or so mobile networks and handheld sets have expanded to such an extent as to rival these networks, long-time part of the planet's landscape (Chart 1).

Chart 1. **Cell phones versus mainlines**



Just within the period of examination, from 1996 to 2001, the number of cell phone subscriptions on a global scale increased from 20 per 100 mainlines to 92 (Table 1). (By 2002, cell phone subscriptions had already overtaken mainlines - ITU 2002).

Table 1**. Ratios of cell phones over mainlines**

	1996	1997	1998	1999	2000	2001
Mainlines	738,024,874	792,364,485	845,747,660	904,405,000	980,857,493	1,050,289,871
Cell phones	144,984,882	214,744,940	318,382,755	492,581,789	739,036,475	962,512,345
Ratio	***0.20***	***0.27***	***0.38***	***0.54***	***0.75***	***0.92***

This is more impressive considering that wireline telecommunications networks have been around since the 19th century, and that they are still growing at a healthy rate. Over the 1996-2001 period, they expanded at an average annual compounded rate of growth of 7.3% to exceed one billion mainlines in 2001. At the same time, waiting lists declined substantially and, on a planetary scale, the networks achieved average digitization of 90%, something that makes possible the offering of value-added services. Even such growth, though, pales in comparison to the 46% annual average of cell phone subscriptions[1].

Perhaps more indicative of the impressive diffusion of cell phones is the fact that in many countries the number of cell phone subscriptions already exceeds fixed telephone lines. While this was the case for a couple of countries earlier on (i.e. Cambodia and Finland in 1997 - the former with practically non-existing wireline network, the latter with a highly advanced one), this was the case in 101 countries (of the 192 examined) in 2001, 41 of which over the last year alone. This phenomenon that exemplifies leapfrogging is particularly visible in Africa, where in several instances cell phones outweigh mainlines by a factor of seven or more. Table 2 shows the top countries with a ratio of cell phones to mainlines of two or more. There are several others that have certainly already crossed that threshold by now. In many cases, the jumps have been spectacular.

In parallel, our times have been witnessing the phenomenal introduction and diffusion of the Internet, a technology even younger than the cell phone with less than a decade of life - at least in its commercial incarnation. While the penetration of PCs continues to increase noticeably, as does that of TV sets, cable and other ICTs, the path followed by the Internet is only comparable to that of the cell phone.

[1] *Subscriptions is a lower number than users, as every line may be used by multiple users.*

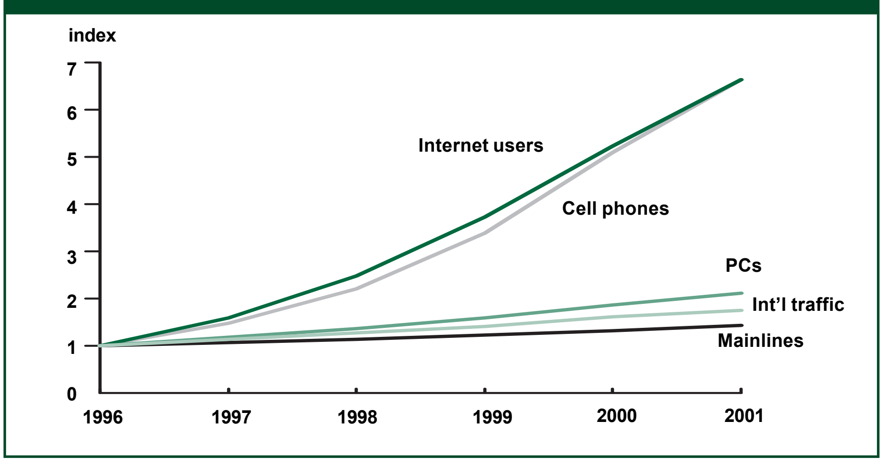
Their trajectories are comparable and they are set apart, both exceeding by far the growth of other ICTs. In 2001, the number of Internet users was already half that of cell phone subscribers. These movements are shown for selected indicators, in index form, in Chart 2.

Even more recently, we see interest of some scale in the deployment of technologies for broadband access, expected to help materialize many of the Internet promises. Indeed, broadband matters and has started to take hold. So far, though, this is happening quite asymmetrically. The data reveal that in 2001 only 45 countries had broadband users[2] and several among them had already achieved sizeable penetration among their Internet users.

Table 2. **High-ratio countries, 2001**

cell phones/mainlines	
Congo D.R.	7.5
Gabon	6.9
Congo	6.8
Cambodia	6.7
Uganda	4.9
Mauritania	4.5
Morocco	4.0
Paraguay	4.0
Philippines	3.5
Cameroon	3.1
Rwanda	3.0
Tanzania	2.9
Lesotho	2.6
Madagascar	2.5
Côte d'Ivoire	2.5
Togo	2.5
Venezuela	2.4
Botswana	2.2
South Africa	2.2
Guinea	2.2
Benin	2.1
Seychelles	2.1
Chad	2.0

Chart 2. **Growth of selected ICTs**



[2] *Broadband is defined here to include DSL and cable modems.*

In 2001, the number of broadband users just exceeded 31 million, 35% of which were in the United States. However, in terms of penetration among Internet users, South Korea topped the list with 32%, followed by Hong Kong (24%) and Canada (21%).

A related issue concerns a country's international bandwidth. This is shared by everyone and determines the capacity to handle data flows in and out of the country and, consequently, their speed of transmission. Again, the situation here is characterized by enormous gaps between haves and have-nots. Considering the existing architecture on the planet, the distribution of bandwidth is extremely uneven. Over recent years, in particular, several countries are experiencing a bandwidth glut, having built over-capacity, while others are in dire straits. Obviously, prices are central to the issue of deployment, but some progress is being made. Among other things, international bandwidth and its architecture impact on the pattern of traffic among countries. In terms of Kbs per capita, the list is dominated by European countries, namely the Netherlands, Denmark, Belgium, Sweden, Switzerland, Norway, the United Kingdom, France and Luxembourg. Several African countries barely register on that scale - after many decimals. At the same time, as ICTs increasingly penetrate governments, businesses and people's lives everywhere, their usage is naturally increasing. Just one indication is provided by the amount of time spent on the phone. Never in history have humans been so talkative! Average combined incoming and outgoing traffic nearly doubled from 1996 to 2001. On average, each person on the planet talked for 20 minutes, up from 12 in 1996. Once again, the differences among countries are huge. Table 3 contains the most and the least talkative countries.

Table 3. **Time spent on the phone, 2001**

(average minutes per capita)			
Top		**Bottom**	
Luxembourg	908		
Gibraltar	796	Burkina Faso	1.8
Bermuda	698	Indonesia	1.7
Ireland	442	Nepal	1.7
Hongkong	431	India	1.7
Singapore	409	Kenya	1.6
United Arab Emirates	384	Mozambique	1.6
Switzerland	349	Nigeria	1.4
Macau	326	Central African Rep.	1.4
Bahrain	307	Madagascar	1.2
Cyprus	301	Bangladesh	1.1
Canada	289	Myanmar	0.7
St. Vincent and the Grenadines	258	Tanzania	0.7
Qatar	256	Chad	0.6
Barbados	253	Uganda	0.5
New Zealand	223	Ethiopia	0.5

Outgoing and incoming international traffic are basically the mirror image of one another. Some countries are known to originate many more calls than they help terminate and vice versa, while others have a very balanced traffic pattern. Table 4 shows countries in each group.

Therefore, we have ample evidence for extremely uneven ICT deployment and use among countries, even before we measure the Digital Divide.

Table 4. **Ratios of outgoing over incoming telephone traffic, 2001**

high		around 1		low	
United Arab Emirates	4.1	Brunei Darussalam	1.1	Nigeria	0.3
Bermuda	3.0	Sweden	1.1	Romania	0.3
United States	2.5	Samoa	1.1	Mali	0.3
Saudi Arabia	2.2	Spain	1.1	Djibouti	0.2
Botswana	2.0	Belgium	1.0	Jamaica	0.2
Norway	2.0	United Kingdom	1.0	Cape Verde	0.2
Hongkong	1.9	Netherlands	1.0	Albania	0.2
Iran	1.8	Central African Rep.	1.0	Cameroon	0.2
Singapore	1.6	Kuwait	1.0	Peru	0.2
Japan	1.6	Chad	1.0	Mongolia	0.2
Luxembourg	1.6	Thailand	1.0	Gambia	0.2
Israel	1.5	Austria	1.0	India	0.2
Guinea	1.5	Argentina	1.0	El Salvador	0.2
Qatar	1.5	Denmark	0.9	Sri Lanka	0.2
Barbados	1.5	Bahrain	0.9	Bangladesh	0.2
		Greece	0.9	Sudan	0.2
		Ireland	0.9	Myanmar	0.2
		Canada	0.9	Honduras	0.2
		Costa Rica	0.9	Pakistan	0.2
				Eritrea	0.2
				Cuba	0.1
				Ecuador	0.1
				Viet Nam	0.1
				Philippines	0.1

Chapter 4

EMPIRICAL APPLICATION

What follows represents the first large-scale application of the model across a great number of countries. These countries represent up to 99% of the population of the planet. The sole criterion for not including the remaining countries, either in their entirety or in specific components of the model, has been data availability. Research efforts are already underway to improve the coverage even more in subsequent applications.

4.1 Magnitude of the Digital Divide

The results of the empirical application are illuminating, conducive to rich analysis, and address directly the questions we set out to answer. One of the first key questions for which answers are sought is: **How big is the Digital Divide?** The following results quantify its magnitude through the measurement of countries' Infostates. As well, analytical insights are derived, starting from Infostate levels and zeroing-in on specific components of interest.

Infostates

The model was run and the Infostate figures obtained for 2001 are shown in Chart 3. The results make it immediately clear that the gaps are huge. Top countries achieve index values of 230, while countries at the bottom assume values as low as 5. Literally, many decades of development separate the haves and the have-nots.

Countries with the highest Infostates are from Western Europe (including all Scandinavian countries, the Netherlands, Switzerland, Belgium, Luxembourg, the U.K. and Germany), the U.S. and Canada from North America, Hong Kong, Singapore, S. Korea and Japan from Asia, as well as Australia and New Zealand. Countries at the bottom of the Infostate list are concentrated heavily in Africa, with Chad, Ethiopia, the Central African Republic, Eritrea and Malawi at the very bottom, accompanied by Myanmar and Bangladesh.

Chart 3. **Infostates, 2001**

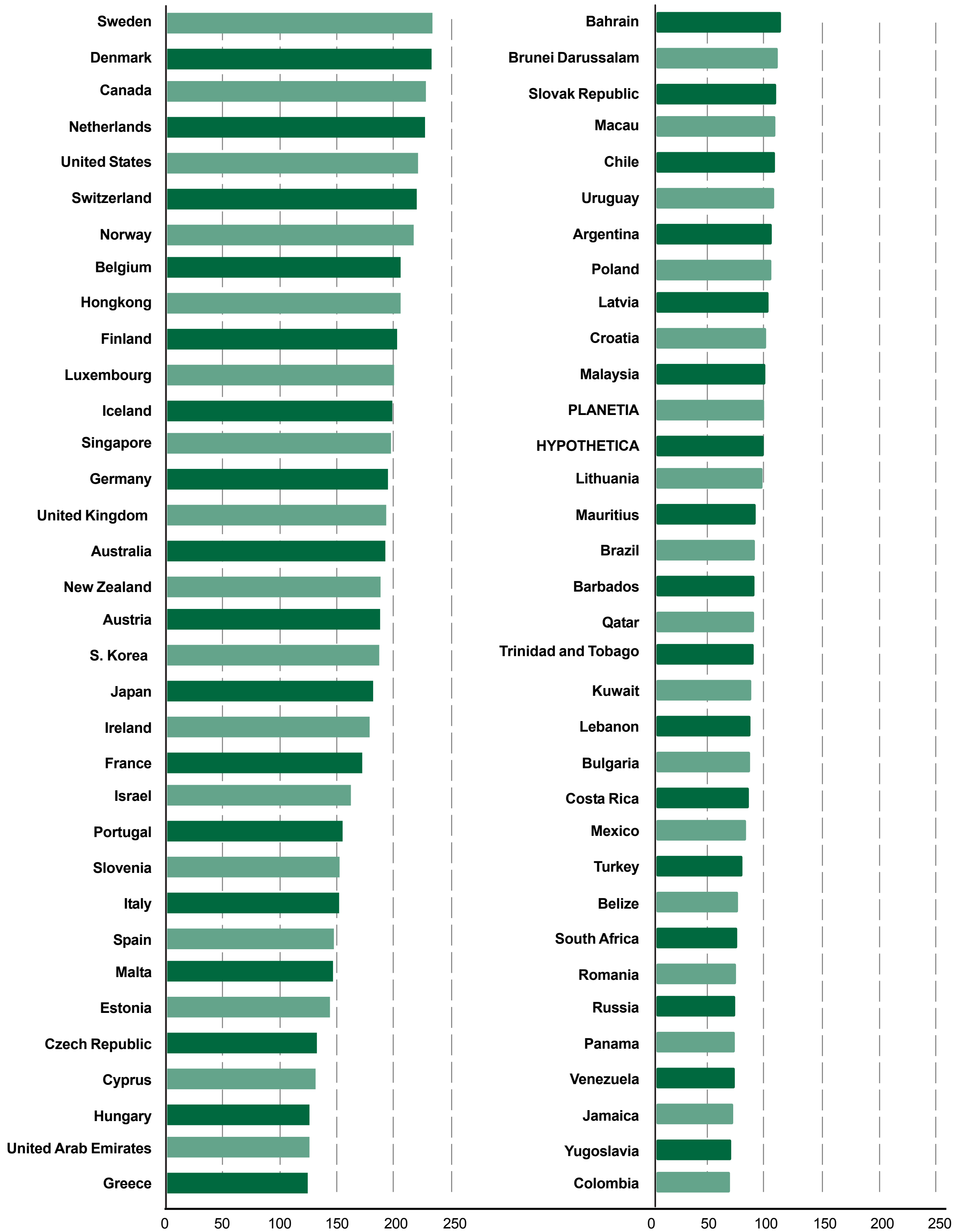
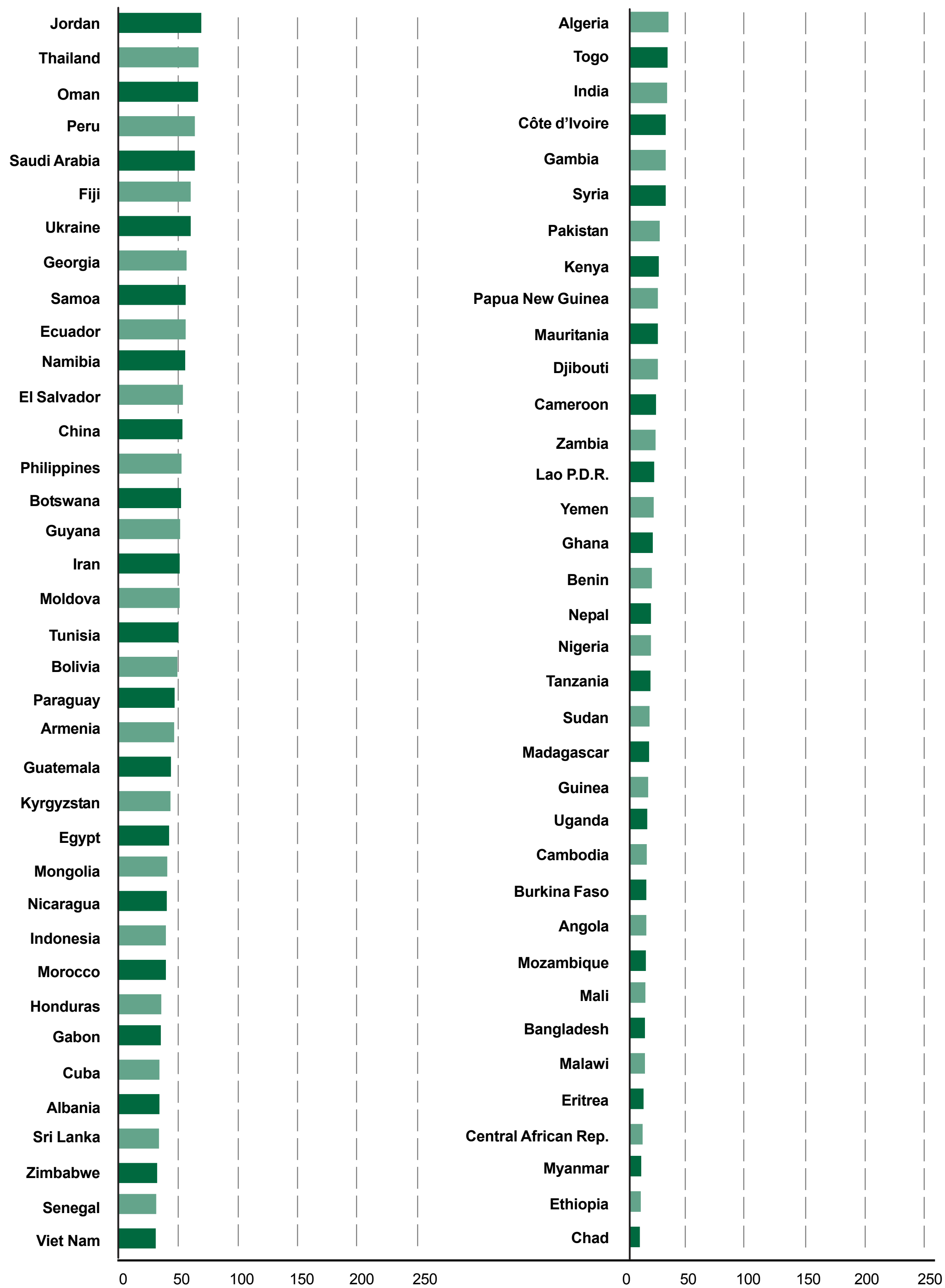


Chart 3. **Infostates, 2001** *(cont'd)*



A Profile of Hypothetica

Hypothetica is a country with values equal to the average of all countries used in the empirical application of the model. Consequently, it is based on a different number of countries for each component measured. That is: for indicators related to networks, Hypothetica represents the average of 192 countries, accounting for 99% of the planet's population in 2001; for indicators related to skills and overall Infodensity it is based on the average of 153 countries, representing 98% of the population, for Info-use it is based on 143 countries, while for the overall Infostate it is based on 139 countries, both accounting for 95% of the global population. In that sense, it is the best average country that can be derived from the existing data, and not the average of each and every country in existence.

In this context, every country carries effectively the same weight regardless of its population. To a large extent, this describes well everyday comparisons on our planet today, as country-states are the main units of reference. When policies are contemplated, implemented or monitored, it is not customary to benchmark the results against planetary averages. It is, however, instructive to compare the situation of such a country with that of the planet as a whole (Planetia). Several differences emerge, with their own analytical usefulness.

			GROWTH		INFOSTATE INDICATORS		
	1996	2001	96-01	avg. annual		1996	2001
					mainlines/100 inhabitants	19.8	23.3
population	24,491,984	31,590,591	*7.1*	*1.4*	waiting lists/mainlines	23.6	13.5
households	7,318,065	8,012,021	*9.5*	*1.8*	digital lines/100 mainlines	75.6	90.0
avg. family size	4.6	4.5	-	-	cell phones/100 inhabitants	3.2	23.9
mainlines	3,843,869	5,470,249	*42.3*	*7.3*	cable/100 households	10.2	14.4
waiting lists	217,186	140,017	*-35.5*	*-8.4*	Internet hosts/1000 inhabitants	2.7	16.6
digital lines	3,030,239	5,111,652	*68.7*	*11.0*	secure servers/1000 Internet hosts	-	3.0
cell phones	755,130	5,013,085	*563.9*	*46.0*	bandwidth (Kbs/capita)	-	0.4
cable	1,208,715	1,838,475	*52.1*	*8.7*	literacy rate (%)	79.4	81.8
Internet hosts	84,669	738,320	*772.0*	*54.2*	gross enrollment in primary ed. (%)	95.2	99.5
secure servers	-	721	-	-	gross enrollment in secondary ed. (%)	62.8	68.5
bandwidth (Kbs)	-	8,391,398	-	-	gross enrollment in tertiary ed. (%)	19.8	24.3
television households	6,345,,654	7,645,778	*20.5*	*3.8*	television households/100 households	60.0	66.0
residential mainlines	3,510,202	5,205,437	*48.3*	*8.2*	residential mainlines/100 households	43.5	49.4
PCs	1,652,974	3,476,224	*110.3*	*16.0*	PCs/100 inhabitants	6.0	11.9
Internet users	495,758	3,291,702	*564.0*	*46.0*	Internet users/100 inhabitants	1.4	11.5
broadband users	-	242,370	-	-	broadband users/100 Internet users	-	1.3
avg. int'l traffic (min.)	918,983,387	1,610,152,248	*75.2*	*11.9*	avg. int'l traffic (min/capita)	15.6	25.5

A Profile of Planetia

Planetia represents the planet at large, if it was viewed as one country. Consequently, its values are the sums of all countries covered in the empirical application. In skills, where literacy rates and gross enrollment ratios are measured in percentages rather than absolute figures, Hypothetica and Planetia are assumed to be the same and are assigned the same values.

Often times the values assumed by individual indicators of Planetia fall short of Hypothetica's, whereas other times they exceed them. This is so because of the sizeable difference among countries with respect to both their levels of "connectivity", as well as their population bases. When large countries fall substantially below average, Planetia's indicators trail those of Hypothetica. Many small countries may have sizeable penetration rates and, in the average sense, they are weighted as much as a large country. Examples would be the average family size, where the average country has values higher than the planet, as well as telephone mainlines, waiting lists and PCs. Conversely, when countries with substantial combined populations have penetration rates higher than others, Planetia's indicators exhibit values higher than Hypothetica's. Examples would be cable and Internet hosts.

In effect, Planetia is the weighted average of all countries, the weights being the populations. Realizing, for instance, that China and India together account for one-third of the planet's population helps establish the perspective.

			GROWTH	
	1996	**2001**	**96-01**	**avg. annual**
population	5,662,460,963	6,065,393,554	*7.1*	*1.4*
households	1,405,068,386	1,538,308,119	*9.5*	*1.8*
avg. family size	4.0	3.9	-	-
mainlines	738,022,878	1,050,287,870	*42.3*	*7.3*
waiting lists	41,699,801	26,883,289	*-35.5*	*-8.4*
digital lines	581,805,970	981,437,198	*68.7*	*11.0*
cell phones	144,984,906	962,512,347	*563.9*	*46.0*
cable	232,073,274	352,987,126	*52.1*	*8.7*
Internet hosts	16,256,512	141,757,527	*772.0*	*54.2*
secure servers	-	138,451	-	-
bandwidth (Kbs)	-	1,611,148,326	-	-
television households	945,502,372	1,139,220,901	*20.5*	*3.8*
residential mainlines	523,020,105	775,610,119	*48.3*	*8.2*
PCs	246,293,088	517,957,445	*110.3*	*16.0*
Internet users	73,868,010	490,463,619	*564.0*	*46.0*
broadband users	-	36,113,180	-	-
avg. int'l traffic (min.)	68,464,264,327	119,956,344,502	*75.2*	*11.9*

INFOSTATE INDICATORS	**1996**	**2001**
mainlines/100 inhabitants	13.0	17.3
waiting lists/mainlines	5.7	2.6
digital lines/100 mainlines	78.8	93.4
cell phones/100 inhabitants	2.6	15.9
cable/100 households	16.5	22.9
Internet hosts/1000 inhabitants	2.9	23.4
secure servers/1000 Internet hosts	-	1.0
bandwidth (Kbs/capita)	-	0.3
literacy rate (%)	79.4	81.8
gross enrollment in primary ed. (%)	95.2	99.5
gross enrollment in secondary ed. (%)	62.8	68.5
gross enrollment in tertiary ed. (%)	19.8	24.3
television households/100 households	67.3	74.1
residential mainlines/100 households	37.2	50.4
PCs/100 inhabitants	4.3	8.5
Internet users/100 inhabitants	1.3	8.1
broadband users/100 Internet users	-	7.4
avg. int'l traffic (min/capita)	12.1	19.8

It is also immediately evident that the majority of countries are below the average country, Hypothetica. Specifically, from the 139 included in Infostate measurements, 94 countries accounting for 82% of the population are performing below average, while only 45 countries accounting for 18% of the population have Infostate values above the average. The location of the mean value of the index is strongly influenced by the very high values of the Infostate index at the top end of the distribution (which is unbounded) relative to the very low values at the bottom end (which are obviously bounded at 0).

Being the difference between Infostates, the Digital Divide needs a point of reference. One way to establish its magnitude is to use Hypothetica as the benchmark against which each country is compared. Practically, the differences between countries' Infostate values from Hypothetica would be computed. A positive number would indicate above-average performance and a negative number below average performance; the more positive or negative the number, the more so. The end result would be identical to Chart 1, except that the 100 would shift to 0 - and is not shown. (Alternative approaches could involve bilateral, regional or similar comparisons).

Based on these results, the 139 countries were split into five groups for analytical purposes. The top, group A, contains 22 countries with highly-advanced Infostates, 10 of which have values more than twice the average (or close to it). They account for 13% of the global population and are all from Western Europe (including all Scandinavian) and North America, with the addition of Australia, New Zealand, as well as Hong, Kong, Singapore, S. Korea and Japan from Asia. Their exact positions should not be emphasized. Values and rankings among the top ten in particular can easily change depending on the exact methodological treatment. The model set out to quantify the differences between these countries and others, and not within this group of countries.

The second group (B) contains countries with sufficiently advanced Infostates to be above the average (with the addition of Lithuania, which is only marginally below). These 24 countries collectively account for less than 5% of the world's population, as some are small. Here we find South European countries (Portugal, Italy, Spain, Malta, Cyprus and Greece), countries from the former Eastern block (Slovenia, Estonia, the Czech Republic, Hungary, the Slovak Republic, Poland, Latvia, Croatia and Lithuania), together with Chile, Uruguay and Argentina from Latin America, UAE and Bahrain from the Arab states and only Macau and Malaysia from Asia. Groups A and B with above-average Infostates combined, account for less than 18% of the global population. Group C contains 25 countries with Infostate values ranging from 60% to more than 90% of the average. This group accounts for about

13% of the population and represents a geographically diverse group with Latin American countries (Brazil, Costa Rica, Panama, Venezuela, Colombia and Peru), Arab countries (Qatar, Kuwait, Jordan, Oman and Saudi Arabia), a couple of African countries (South Africa and Mauritius) and only Thailand from Asia.

Group D, is a group of 38 countries that accounts for more than half the population of the planet. Their Infostates are between one-quarter and 60% of the average. This group is indicative of that huge population masses live in countries substantially below the average. This is so because this group contains China and other countries with sizeable populations, such as the Philippines and Indonesia. Many Latin American countries are here (Ecuador, El Salvador, Guyana, Bolivia, Paraguay, Nicaragua, Honduras etc.), as well as Asian countries (Iran, Armenia, Kyrgyzstan, Mongolia and Vietnam). We also find North African countries (Tunisia, Egypt, Algeria) and several others from sub-Saharan Africa, with above-average performance for the continent (Botswana, Zimbabwe, Senegal, Togo, Côte d'Ivoire and Gambia).

Finally, group E contains 30 countries with about 14% of the global population, and is for the most part populated by African countries. Non-African countries in this group are Pakistan, Lao, Yemen, Nepal, Bangladesh and Myanmar. Their Infostates range from only 5% to just over 20% of the average. These groups, together with the proportions of the population they represent, are shown in Table 5.

Table 5. **Country groups**

Group	Number of countries	% of population world	% of population Infostate
A	22	13.0	13.6
B	24	4.7	4.9
C	25	12.6	13.3
D	38	51.1	53.6
E	30	13.9	14.6
Total	**139**	**95.4**	**100.0**

4.2 Causes of the Digital Divide

Infodensity and Info-use

The huge Digital Divide identified above comes from a multitude of sources. To begin with, both main aggregates of Infodensity and Info-use contribute to the Divide. The orders of magnitude involved in either of them are not substantially different. We do observe, however, that the range between haves and have-nots in Info-use is somewhat greater than that of Infodensity. Both the top values of the index are higher and the bottom are lower. At the same time, there is slightly more concentration in the middle, and while 43 countries are above the average in Infodensity, this is the case for 52 countries in Info-use.

Generally, there is a high degree of consistency in countries' rankings between Infodensity, Info-use and overall Infostate. If a country is high in one, it is high in both of the others. Similar findings apply to countries with low or intermediate Infostates. Although the exact ranking changes, the countries within the groups remain largely the same (see Table 6, as well as Annex Charts 2 and 3). More specifically, 21 of the 22 countries classified in group A according to their Infostate values are in the top 22 of both Infodensity and Info-use. The only exception is S. Korea, which is not in the top 22 of Infodensity, but drops slightly to 25th. Moreover, 20 of the top 22 countries in Infostate are in the top 22 of the individual components of both Networks and Uptake.

Similarly, those moving up from the bottom to the top half in Infodensity and Info-use moved from the very high end of the bottom half to the very low end of the top half. All of the bottom 30 countries in Infostate (Group E) are in the bottom 30 of Info-use, and only one (Kenya) is not also in the bottom 30 for Infodensity. So, the differences across the two main aggregates are quite small.

Overall, the gaps between the top and bottom countries in either aggregate are not very different. Among the top group, the Netherlands and Scandinavian countries dominate Infodensity, whereas in Info-use Canada, Hong Kong, Singapore, S. Korea and the U.S. are doing comparatively better. Small differences exist at the bottom, with most African countries being present. Countries with higher values in Infodensity than Info-use are, among Eastern Europeans, the Czech Republic, Slovenia, Estonia, Hungary, Poland, Slovak Republic, Latvia, Lithuania and Croatia, and among Latin American countries, Uruguay, Argentina and Chile. The reverse is the case for Macau, Bahrain and Malaysia with above-average Info-use values but below average Infodensities.

Table 6. **Infostates and rankings, 2001**

	Infostate Index	Infostate Rank	Infodensity Index	Infodensity Rank	Info-use Index	Info-use Rank
Sweden	230.5	1	228.2	2	232.8	6
Denmark	230.0	2	222.9	4	237.4	5
Canada	224.8	3	194.6	10	259.8	1
Netherlands	224.2	4	232.6	1	216.1	9
United States	217.9	5	199.5	8	237.9	4
Switzerland	216.8	6	210.6	6	223.1	8
Norway	214.4	7	223.8	3	205.4	12
Belgium	202.6	8	201.7	7	203.6	13
Hongkong	202.6	8	161.9	20	253.4	2
Finland	199.5	10	215.9	5	184.4	19
Luxembourg	197.1	11	183.1	12	212.1	10
Iceland	195.6	12	180.5	14	211.9	11
Singapore	194.3	13	155.8	21	242.3	3
Germany	191.8	14	181.8	13	202.3	14
United Kingdom	190.2	15	196.2	9	184.4	19
Australia	189.5	16	186.5	11	192.5	18
New Zealand	185.2	17	174.8	15	196.1	15
Austria	184.7	18	174.3	16	195.8	17
S. Korea	183.8	19	145.6	25	232.0	7
Japan	178.7	20	162.9	19	196.1	15
Ireland	175.6	21	172.6	17	178.7	21
France	168.9	22	163.2	18	174.8	22
Israel	159.0	23	153.5	23	164.6	23
Portugal	151.7	24	155.5	22	148.0	28
Slovenia	149.1	25	144.3	26	154.1	26
Italy	148.5	26	140.4	28	157.2	25
Spain	144.3	27	142.3	27	146.3	29
Malta	143.4	28	137.1	29	150.0	27
Estonia	140.5	29	136.3	30	144.9	30
Czech Republic	129.0	30	146.0	24	113.9	37
Cyprus	128.0	31	103.9	42	157.6	24
Hungary	122.6	32	133.0	31	113.1	38
United Arab Emirates	122.6	32	104.6	40	143.8	31
Greece	121.2	34	132.7	32	110.7	39
Bahrain	116.3	35	94.2	46	143.6	32
Brunei Darussalam	113.4	36	124.1	33	103.7	45
Slovak Republic	111.7	37	116.1	34	107.5	40
Macau	111.2	38	87.2	48	141.8	33
Chile	110.8	39	104.5	41	117.3	35
Uruguay	109.9	40	114.8	37	105.3	42
Argentina	107.9	41	114.3	38	101.8	47
Poland	107.2	42	116.1	34	99.0	49
Latvia	104.8	43	115.9	36	94.7	50
Croatia	102.3	44	100.4	43	104.3	43
Malaysia	101.5	45	86.0	50	119.7	34
PLANETIA	**100.6**	**-**	**98.5**	**-**	**102.7**	**-**
HYPOTHETICA	**100.0**	**-**	**100.0**	**-**	**100.0**	**-**
Lithuania	98.7	46	111.6	39	87.3	53
Mauritius	92.5	47	79.7	55	107.4	41
Brazil	91.6	48	96.9	44	86.6	54
Barbados	91.2	49	82.1	52	101.4	48
Qatar	90.8	50	70.9	62	116.2	36
Trinidad and Tobago	90.6	50	86.8	49	94.5	51
Kuwait	88.1	52	75.5	59	102.9	46
Lebanon	87.4	53	83.4	51	91.6	52
Bulgaria	86.8	54	94.4	45	79.9	57
Costa Rica	86.0	55	71.1	61	103.9	44
Mexico	83.0	56	90.2	47	76.3	58
Turkey	79.9	57	76.8	58	83.1	55
Belize	75.5	58	70.6	63	80.7	56
South Africa	74.5	59	81.8	53	67.9	64
Romania	73.4	60	79.7	55	67.6	65
Russia	72.9	61	77.6	57	68.6	63
Panama	72.6	62	81.4	54	64.7	70
Venezuela	72.3	63	69.5	65	75.3	59
Jamaica	70.8	64	71.2	60	70.3	60
Yugoslavia	69.1	65	70.3	64	67.9	64
Colombia	67.8	66	68.1	66	67.5	67
Jordan	66.9	67	64.4	70	69.5	61
Thailand	64.7	68	68.0	69	61.6	72
Oman	64.3	69	59.6	73	69.4	62
Peru	61.8	70	57.3	77	66.6	68
Saudi Arabia	61.5	71	57.7	76	65.5	69
Fiji	58.4	72	61.1	71	55.9	75
Ukraine	58.2	73	68.1	66	49.6	80
Georgia	54.7	74	58.7	74	50.9	79
Samoa	54.1	75	68.1	66	42.9	86
Ecuador	53.9	76	52.6	81	55.2	76
Namibia	53.7	77	58.1	75	49.6	80
El Salvador	51.9	78	48.8	83	55.2	76
China	51.4	79	48.5	84	54.5	78
Philippines	50.4	80	57.1	78	44.5	84
Botswana	50.3	81	60.7	72	41.8	88
Guyana	49.4	82	40.4	92	60.4	74
Iran	49.0	83	38.4	94	62.4	71
Moldova	48.9	84	53.4	80	44.7	83
Tunisia	48.0	85	37.7	96	61.0	73
Bolivia	47.0	86	52.5	82	42.0	87
Paraguay	45.0	87	56.3	79	35.9	96
Armenia	44.5	88	43.9	88	45.2	82
Guatemala	41.9	89	48.3	85	36.4	94
Kyrgyzstan	41.3	90	46.0	86	37.1	92
Egypt	40.4	91	37.6	97	43.5	85
Mongolia	38.6	92	43.7	89	34.1	98
Nicaragua	38.4	93	38.3	95	38.4	90
Indonesia	37.6	94	40.9	91	34.5	98
Morocco	37.5	95	36.4	98	38.8	89
Honduras	33.7	96	32.8	100	34.7	97
Gabon	33.5	97	44.8	87	25.0	107
Cuba	32.4	98	28.2	103	37.2	91
Albania	32.2	99	42.1	90	24.6	109
Sri Lanka	31.7	100	39.6	93	25.3	106
Zimbabwe	30.2	101	35.5	99	25.6	105
Senegal	29.4	102	23.7	109	36.3	95
Viet Nam	29.2	103	26.9	104	31.7	102
Algeria	29.0	104	25.6	107	32.9	100
Togo	28.4	105	25.2	108	31.9	101
India	27.9	106	28.5	102	27.4	104
Côte d'Ivoire	26.9	107	29.2	101	24.8	108
Gambia	26.8	108	26.1	105	27.7	103
Syria	26.6	109	19.1	119	37.1	92
Pakistan	21.9	110	21.0	114	23.0	111
Kenya	21.0	111	26.0	106	17.0	115
Papua New Guinea	20.2	112	19.5	117	20.9	112
Mauritania	20.2	112	21.4	111	19.0	114
Djibouti	20.1	114	16.9	125	23.9	110
Cameroon	18.7	115	21.4	111	16.3	117
Zambia	18.6	116	23.6	110	14.6	118
Lao P.D.R.	17.3	117	21.3	113	14.1	119
Yemen	17.0	118	17.2	124	16.8	116
Ghana	16.2	119	19.4	118	13.5	121
Benin	15.4	120	20.8	115	11.5	123
Nepal	14.5	121	17.3	123	12.1	122
Nigeria	14.4	122	14.9	126	14.0	120
Tanzania	14.3	123	18.2	120	11.2	124
Sudan	13.5	124	9.4	134	19.4	113
Madagascar	12.9	125	17.4	122	9.6	129
Guinea	12.1	126	14.9	126	9.9	128
Uganda	11.5	127	17.9	121	7.4	133
Cambodia	11.2	128	19.7	116	6.4	134
Burkina Faso	10.7	129	12.8	129	8.9	131
Angola	10.6	130	10.5	132	10.8	126
Mozambique	10.5	131	11.6	130	9.5	130
Mali	9.9	132	11.4	131	8.6	132
Bangladesh	9.5	133	8.5	135	10.6	127
Malawi	9.5	133	14.9	126	6.1	135
Eritrea	8.5	135	6.6	139	10.9	125
Central African Rep.	7.8	136	10.2	133	6.0	136
Myanmar	6.5	137	8.1	136	5.2	137
Ethiopia	6.1	138	7.4	137	5.1	138
Chad	5.2	139	7.3	138	3.7	139

It is noteworthy that Planetia is below Hypothetica in Infodensity, but above it in Info-use - albeit marginally. This indicates that larger countries with lower levels of Infodensity do use what they have. For instance, China's Info-use index (54.5) is six points higher than its Infodensity (48.5) and Mexico's much more so (90.2 vs. 76.3). This is not always the case, though (for instance, see India).

Component analysis

Looking beneath the aggregates of Infodensity and Info-use we can identify specific causes of the Digital Divide which, inevitably, are associated with individual components of measurement. It should be noted from the outset that each and every constituent component of Infostate is partially responsible. This includes networks, skills, ICT uptake and intensity of use. However, the extent to which each of these – and indeed each area measured by specific indicators – contributes, differs widely both across indicators and across countries. In the process of this type of analysis, relative strengths and weaknesses are revealed.

Networks: Networks are a major contributor to the overall Digital Divide between haves and have-nots. The first thing to observe is that the gap between top and bottom values, as measured by the Networks index, is much greater than it has been in any of the aggregates examined so far. While both the top end is moving higher and the bottom end lower, the top increases by more than 150 points whereas the bottom is only falling by a few points - as it is bounded at zero. The usual culprits dominate, with the Netherlands, Scandinavian countries and Switzerland occupying the very top, and African countries with the addition of Myanmar, Bangladesh and Haiti, carrying the tail. The very bottom represents values for networks less than 1% of the average and more than 400 times lower than the top. These gaps are very telling and clearly indicate the distances involved in the deployment of networks in these countries. Hypothetica has a value higher than Planetia, indicating that some of the countries lagging behind are large ones. The values for the Networks index, together with selected indicators, are shown in Table 7 (see also Annex Chart 1).

From the 192 countries contained in the computations, only 49 countries are above the average. This represents a proportion much lower than that of the higher aggregates of Infodensity and Info-use and is consistent with the larger divide when networks are concerned. The increased gaps are also present within each of the five groups examined previously, unveiling an additional dimension to the divide. The differences between the top and bottom within each group are much larger in Networks, denoting a greater variability than the overall indexes.

Analysis at the level of the individual indicators for telephone mainlines, cell phone subscriptions and the Internet reveals that the gaps are relatively more pronounced in the newer technologies, particularly the Internet. While penetration of mainlines and cell phone subscriptions varies widely among countries, variability is even larger in Internet hosts. (Here, unlike the case in overall networks, Planetia has a value significantly higher than Hypothetica, indicative of the large number of countries with penetration next to nothing). By and large, these findings hold true when the indicators for wireline and mobile networks and the Internet are computed and analyzed, reinforcing the correlation between newness, variability and contribution to the Digital Divide. They are shown in Annex Table 1. (Bear in mind that the indexes for wireline networks and the Internet are based on more indicators than contained in Table 7).

Ranking countries with the wireline telecommunications index yields a range from more than 400 to practically zero. In wireline, several smaller countries have quite dense networks, denser than more advanced countries overall. These include Gibraltar, Bermuda, the Cayman islands and the channel islands of Guernsey and Jersey. At the very bottom we meet Congo, Liberia, Chad, Niger and Rwanda from Africa, and Cambodia from Asia. 75 countries are above average, though, indicating the age of such networks. Discrepancies among countries related to fixed telecommunications networks are well-documented over the years (ITU 2001). Some progress in developing countries notwithstanding, progress has been steady in developed countries too. This is so due to the explosion of demand for new lines, including multiple lines – for Internet connections, fax lines – or accommodation of expanded usage. Overall, waiting lines have decreased and digitization is proceeding quickly.

At the same time, a newer part of network gaps is created by the cell phone technology and the Internet. While many developing countries have entered lately in the fray and expanded significantly their wireless infrastructure and subscription base, developed countries have again done better. However, many developing countries have leapfrogged to mobile networks. Although the gaps remain at the same scale when ranked by mobile networks, differences start to emerge. Taiwan tops this list, while countries such as Luxembourg, Israel, Italy and Austria are close to the top and fare comparatively much better than in other indicators. At the bottom, in addition to the countries mentioned earlier, we also encounter Bhutan, Tajikistan and Cuba with underdeveloped networks. In total, 69 of 192 countries are above average.

Table 7. **Networks, 2001**

	Networks index	Fixed /100	Mobile /100	Internet /1000
Netherlands	378.9	62.1	76.7	163.4
Norway	344.5	73.2	81.5	100.5
Denmark	343.5	72.2	74.0	104.8
Switzerland	340.8	73.2	72.8	72.8
Sweden	335.2	73.9	79.0	82.5
Finland	310.8	54.8	80.4	170.7
Luxembourg	301.0	78.0	92.0	31.4
United States	282.2	66.7	45.1	372.9
Canada	275.3	67.6	36.2	96.3
Belgium	272.5	49.8	74.7	34.1
Liechtenstein	262.6	60.0	46.2	106.4
United Kingdom	253.2	58.7	77.0	37.1
Taiwan, China	252.5	57.3	96.6	76.4
Germany	251.7	63.4	68.2	29.4
Iceland	241.4	66.4	86.5	190.5
Hongkong	241.0	58.0	85.9	57.6
Australia	224.5	54.1	57.4	118.0
Austria	222.9	46.8	81.7	40.1
Ireland	217.4	48.5	77.4	33.4
New Zealand	211.8	47.7	59.9	106.9
Singapore	207.6	47.1	72.4	47.9
Japan	200.3	58.6	58.8	55.9
France	194.1	57.3	60.5	13.3
Gibraltar	185.1	89.2	35.6	46.1
Israel	179.6	46.6	90.7	22.1
Portugal	179.1	42.5	77.4	23.9
Bermuda	178.6	86.9	20.6	79.9
Czech Republic	174.0	37.8	67.9	21.1
Malta	166.7	53.0	61.1	22.3
Jersey	160.1	84.8	70.4	18.1
Guernsey	159.5	87.5	50.2	24.2
Faroe Islands	156.4	55.6	59.4	35.8
Slovenia	153.6	40.2	73.7	14.8
Virgin Islands (U.S.)	153.5	63.5	37.5	22.6
Italy	150.3	47.1	88.3	11.7
S. Korea	149.3	48.6	62.1	14.8
Greenland	147.4	46.7	29.9	46.1
Spain	143.7	43.4	73.4	13.3
Estonia	138.1	35.4	45.5	35.7
Hungary	137.9	37.5	49.8	16.8
Andorra	135.9	43.8	33.7	40.1
Greece	134.2	52.9	75.1	13.5
Brunei Darussalam	132.6	25.9	40.1	25.5
Cayman Islands	122.7	84.9	38.0	11.9
Aruba	120.3	35.0	50.0	8.7
United Arab Emirates	117.6	34.0	61.6	15.4
Slovak Republic	112.2	28.9	39.9	13.5
Uruguay	104.4	28.3	15.5	21.1
New Caledonia	102.6	23.1	31.0	21.5
HYPOTHETICA	**100.0**	**17.3**	**15.9**	**23.4**
Poland	99.2	29.5	25.9	12.7
Argentina	98.7	22.4	19.3	12.8
Latvia	98.6	30.7	27.9	10.6
PLANETIA	**97.0**	**17.3**	**15.9**	**23.4**
Cyprus	94.0	63.1	45.6	3.0
Lithuania	93.7	31.3	27.7	9.6
Chile	92.8	23.3	34.2	8.0
Croatia	87.3	38.3	37.7	4.7
French Polynesia	84.8	22.3	28.5	7.3
Seychelles	80.8	26.1	53.9	3.2
Brazil	77.2	21.8	16.7	9.6
Bahrain	77.2	26.7	46.0	2.6
Mexico	75.0	13.7	21.7	9.1
Guadeloupe	72.6	45.7	63.6	1.0
Trinidad and Tobago	72.1	24.0	19.7	5.3
Guam	71.7	50.9	20.7	0.9
Martinique	71.2	43.0	71.5	0.9
Bulgaria	70.3	35.9	19.1	3.3
Malaysia	69.7	19.8	31.4	3.1
Mauritius	63.6	25.6	22.7	2.6
South Africa	63.2	11.1	24.2	5.4
Turkey	62.8	28.5	29.5	1.6
Kuwait	62.0	20.8	38.6	1.5
Lebanon	61.3	18.7	22.9	2.1
Macau	60.2	39.4	43.4	0.4
Panama	58.4	13.0	16.4	2.7
Dominican Rep.	56.9	11.0	14.6	4.8
Puerto Rico	55.1	34.6	31.6	0.4
Romania	54.9	18.4	17.2	2.1
French Guiana	54.1	26.8	39.6	0.6
Barbados	52.0	48.1	19.8	0.5
Yugoslavia	49.8	22.9	18.7	1.5
Costa Rica	49.6	23.0	7.6	2.1
Belize	49.1	14.3	15.9	1.4
Jamaica	48.5	20.5	24.4	0.6
Qatar	46.9	27.5	29.3	0.2
T.F.Y.R. Macedonia	46.5	26.3	10.9	1.3
Bahamas	46.1	40.0	19.7	0.1
Venezuela	45.6	10.9	26.3	0.9
Tonga	45.4	10.9	0.2	208.1
Russia	44.0	24.3	5.3	2.4
Samoa	43.9	5.4	1.8	30.0
Oman	43.2	9.0	12.4	1.8
Colombia	42.9	17.2	7.6	1.3
Thailand	39.4	9.9	12.3	1.2
Botswana	37.8	8.5	18.8	0.8
Namibia	37.2	6.4	5.5	2.5
Saudi Arabia	36.8	14.5	11.3	0.5

Table 7. **Networks, 2001** ***(cont'd)***

	Networks index	Fixed /100	Mobile /100	Internet /1000
Jordan	36.5	12.9	16.7	0.4
Ukraine	36.2	21.2	4.4	1.2
Fiji	36.1	11.2	9.9	0.8
Northern Marianas Islands	35.1	42.9	6.2	0.3
Grenada	32.3	32.8	6.4	0.1
Paraguay	32.2	5.1	20.4	0.5
Guatemala	31.4	6.5	9.7	0.6
Georgia	29.6	17.4	6.1	0.4
Peru	28.4	7.8	5.9	0.5
Philippines	28.0	4.2	15.0	0.4
Suriname	27.8	17.6	19.8	0.1
Ecuador	27.3	10.4	6.7	0.3
Kazakhstan	26.1	12.1	3.6	0.7
Moldova	25.9	14.6	5.1	0.4
El Salvador	25.9	10.2	13.4	0.1
China	25.3	13.7	11.0	0.1
Swaziland	24.7	3.1	5.4	1.1
St. Vincent and the Grenadines	24.5	22.7	6.5	0.0
Bolivia	24.2	6.3	9.4	0.2
Azerbaijan	23.8	12.0	9.4	0.2
Belarus	23.4	28.8	1.4	0.3
Saint Lucia	23.3	31.7	1.7	0.1
Cape Verde	22.2	14.3	7.2	0.1
Morocco	20.9	4.1	16.4	0.1
Gabon	19.0	3.0	20.5	0.1
Reunion	18.7	41.0	57.6	0.0
Armenia	18.3	14.0	0.7	0.6
Nicaragua	18.2	2.9	3.0	0.4
Indonesia	17.4	3.5	3.1	0.2
Albania	17.4	5.0	9.9	0.0
Kyrgyzstan	17.2	7.8	0.5	0.9
Mongolia	17.1	5.2	8.1	0.1
Iran	16.2	16.9	3.2	0.0
Sri Lanka	16.0	4.4	3.6	0.1
Côte d'Ivoire	15.8	1.8	4.5	0.2
Egypt	15.2	10.4	4.3	0.0
Zimbabwe	15.2	2.2	2.9	0.3
Guyana	15.1	9.2	8.7	0.0
Tunisia	14.5	10.9	4.0	0.0
Gambia	13.9	2.6	4.1	0.1
Kiribati	13.5	4.2	0.6	0.3
Honduras	13.5	4.7	3.6	0.0
Senegal	13.1	2.5	3.1	0.1
Marshall Islands	12.1	7.7	0.9	0.1
Solomon Islands	11.9	1.7	0.2	0.9
Maldives	11.2	9.9	6.9	0.0
India	11.2	3.8	0.6	0.1
Turkmenistan	11.0	8.0	0.2	0.3

	Networks index	Fixed /100	Mobile /100	Internet /1000
Mauritania	9.8	1.0	4.3	0.0
Kenya	9.2	1.0	1.9	0.1
Pakistan	9.1	2.3	0.6	0.1
Libya	9.1	10.9	0.9	0.0
Togo	9.1	1.0	2.6	0.0
Benin	9.0	0.9	1.9	0.1
Zambia	8.7	0.8	1.1	0.1
Congo	8.0	0.7	4.8	0.0
Lesotho	7.9	1.0	2.6	0.0
Algeria	7.4	6.1	0.3	0.0
Viet Nam	7.3	3.8	1.5	0.0
Cuba	6.9	5.1	0.1	0.1
Tanzania	6.9	0.4	1.3	0.0
Rwanda	6.9	0.3	0.8	0.1
Cameroon	6.7	0.7	2.0	0.0
Djibouti	6.6	1.5	0.5	0.0
Papua New Guinea	6.5	1.2	0.2	0.1
Burkina Faso	6.4	0.5	0.6	0.1
Lao P.D.R.	6.3	1.0	0.5	0.0
Cambodia	6.0	0.2	1.7	0.0
Uzbekistan	5.7	6.7	0.3	0.0
Guinea	5.5	0.3	0.7	0.0
Ghana	5.5	1.2	0.9	0.0
Sierra Leone	5.5	0.5	0.5	0.1
Madagascar	5.0	0.4	1.0	0.0
Nepal	4.8	1.3	0.1	0.1
Yemen	4.7	2.2	0.8	0.0
Syria	4.6	10.3	1.2	0.0
Uganda	4.6	0.2	1.2	0.0
Tajikistan	4.4	3.6	0.0	0.0
Mali	4.1	0.5	0.4	0.0
Nigeria	3.5	0.5	0.3	0.0
Bhutan	3.4	2.6	0.0	1.7
Malawi	3.1	0.5	0.5	0.0
Mozambique	2.9	0.5	0.9	0.0
Angola	2.6	0.6	0.6	0.0
Central African Rep.	2.4	0.2	0.3	0.0
Haiti	2.3	1.0	1.1	0.0
Niger	2.0	0.2	0.0	0.0
Liberia	1.7	0.2	0.1	0.0
Congo D. R.	1.6	0.0	0.3	0.0
Burundi	1.6	0.3	0.4	0.0
Sudan	1.6	1.4	0.3	0.0
Ethiopia	1.3	0.4	0.0	0.0
Chad	1.3	0.1	0.3	0.0
Bangladesh	1.2	0.4	0.4	0.0
Eritrea	0.8	0.8	0.0	0.1
Myanmar	0.8	0.6	0.0	0.0

By far, the largest divide comes from Internet hosts, where the range becomes really extreme. Top countries (U.S., Iceland, Finland etc.) have values that could exceed 1,000, whereas a good number of countries barely register anything above zero. In these cases, Internet networks are practically non-existent. In addition to African countries, here we also find Syria and Vietnam. An additional indicator of how the Internet contributes more to the Digital Divide, comes from the fact that only 44 of the 192 countries are above average – and many of those that are have very high values. Therefore, the Internet has emerged not only as a revolutionary new technology but also as a major source of the Digital Divide. Many countries, especially in Africa, did not have any measurable access until fairly recently. It is expanding, though.

Related to that is the issue of international bandwidth, which is extremely skewed – even within the context of developed countries. While this deteriorates the Digital Divide, it is not reflected much in the actual index for reasons explained in the methodology section. Secure servers do not reveal a great deal, but many island states are disproportionately represented. However, these technologies that relate to e-commerce, are not widespread anywhere yet. Cable is an additional network that contributes to a lesser extent to the Divide. However, many countries do not have such networks at all.

Skills: ICT skills are also a cause of the Digital Divide. However, considering that work on measurements in this area is at a very early stage, sufficient information for a good assessment does not exist. For this reason, in the computations of the indices, ICT skills moderate somewhat the severe gaps caused by networks. While skills are not analysed in detail, clearly the indicators used are such that they underestimate the gaps, to the extent that ICT skills move in parallel with the pervasiveness of ICTs. This is reinforced by the fact that clearly gaps increase as we move to more advanced levels of education, especially tertiary. This is particularly true among developed countries, where not much differentiation is offered by more generic indicators.

In the overall index, Sweden, Australia, the U.K., Finland and Germany come on top, while at the bottom we find exclusively African countries. Differentiation is comparatively low, ranging from a high value of 155 to a low of 18.5, with 85 of 153 countries above the average. There are differences in the rankings compared to networks. One observation concerns the rise of Eastern European countries, Russia, Latvia, Slovenia, Estonia, Lithuania, Belarus, Ukraine and Bulgaria to occupy higher positions than they did in networks. The skills index, together with the indicators for literacy rates and gross enrollment in primary, secondary and tertiary education are shown in Table 8. (For individual indices see Annex Table 2).

Table 8. **Skills, 2001**

	Skills index	Literacy (%)	Enrollment (%)		
			Primary	Secondary	Tertiary
Sweden	155.4	99.0	109.9	148.8	70.0
Australia	154.9	99.0	102.1	160.8	63.3
United Kingdom	151.9	99.0	98.9	156.4	59.5
Finland	150.0	99.0	101.6	126.0	73.9
Belgium	149.3	99.0	105.0	147.1	57.0
Norway	145.4	99.0	101.4	114.6	70.0
Denmark	144.6	99.0	101.9	128.2	58.9
New Zealand	144.3	99.0	99.9	112.4	69.2
Netherlands	142.8	99.0	107.5	124.5	55.0
S. Korea	142.1	97.9	101.1	94.1	77.6
United States	141.1	99.0	101.0	95.2	72.6
Spain	140.9	97.7	105.1	115.6	59.4
Canada	137.6	99.0	98.6	102.6	60.0
France	137.2	99.0	104.9	107.8	53.6
Ireland	137.0	99.0	119.4	109.1	47.5
Russia	136.8	99.6	116.7	83.3	64.1
Latvia	136.3	99.8	100.3	90.9	63.1
Austria	136.3	99.0	103.7	99.0	57.7
Poland	135.9	99.7	99.6	101.4	55.5
Slovenia	135.5	99.6	100.2	92.2	60.5
Portugal	135.1	92.5	121.2	113.6	50.2
Iceland	135.0	99.0	102.3	108.7	48.7
Estonia	134.5	99.8	103.0	91.7	57.5
Lithuania	132.9	99.6	101.3	95.2	52.5
Japan	132.5	99.0	100.8	102.5	47.7
Belarus	132.4	99.7	108.6	84.4	56.0
Argentina	132.3	96.9	120.1	96.7	48.0
Germany	131.3	99.0	103.8	99.0	46.3
Israel	131.2	95.1	113.9	93.3	52.7
Italy	131.2	98.5	100.9	95.9	49.9
Greece	131.1	97.3	99.3	98.4	50.5
Switzerland	130.1	99.0	107.3	99.6	42.1
Barbados	129.8	99.7	110.1	101.6	38.2
Ukraine	128.3	99.6	78.0	105.2	43.3
Hungary	128.3	99.3	102.0	98.6	40.0
Bulgaria	126.9	98.5	103.2	94.2	40.8
Uruguay	126.3	97.6	109.4	98.1	36.1
Macau	126.2	94.1	103.8	84.3	52.1
Kyrgyzstan	123.2	97.0	101.4	85.6	41.1
Czech Republic	122.4	99.0	104.3	94.6	29.8
Brazil	121.6	87.3	162.3	108.5	16.5
Kazakhstan	120.3	99.4	98.8	88.5	30.9
Slovak Republic	120.1	99.0	103.0	87.3	30.3
Libya	118.6	80.8	115.6	89.5	48.8
Chile	117.8	95.9	102.7	75.4	37.5
Thailand	117.4	95.7	94.8	81.9	35.3
Singapore	116.9	92.5	94.3	74.1	43.8
Philippines	116.5	95.1	112.6	77.3	31.2
Georgia	116.1	99.0	95.5	72.9	34.5
Brunei Darussalam	116.1	91.6	104.2	112.6	14.4
Romania	115.8	98.2	98.8	82.3	27.3
Peru	115.7	90.2	127.6	80.8	28.8
Croatia	115.4	98.4	91.3	82.1	29.0
Bahrain	115.1	87.9	103.2	101.3	25.2
Cyprus	114.9	97.2	96.6	93.4	20.0
Cuba	114.6	96.8	101.9	84.5	24.2
Bolivia	113.9	86.0	115.9	79.6	35.7
Jordan	113.7	90.3	100.8	87.7	28.6
Panama	113.6	92.1	111.6	69.2	34.9
Lebanon	113.5	86.5	98.9	75.7	42.3
Malta	112.7	92.3	106.3	88.9	21.5
Bahamas	112.0	95.5	90.6	83.9	24.8
Mongolia	111.7	98.5	98.8	61.1	33.3
Luxembourg	111.4	99.0	100.9	94.4	9.3
Moldova	110.1	99.0	83.8	71.2	27.9
Tajikistan	109.1	99.3	104.3	78.5	14.0
Hongkong	108.8	93.5	94.3	71.9	27.4
Mexico	108.5	91.4	113.2	75.3	20.7
Guyana	108.3	98.6	119.7	73.4	11.6
Colombia	108.1	91.9	112.4	69.8	23.3
Qatar	107.2	81.7	104.6	89.0	24.6
Malaysia	106.0	87.9	98.7	70.3	28.2
South Africa	105.9	85.6	111.4	87.3	15.2
Venezuela	105.9	92.8	101.9	59.3	28.5
Gabon	105.9	99.0	143.8	59.6	8.0
Samoa	105.7	98.7	102.9	75.5	10.9
Armenia	105.4	98.5	78.2	73.3	20.2
Trinidad and Tobago	104.6	98.4	100.4	80.8	6.5
Jamaica	104.3	87.3	99.6	83.3	16.4
Fiji	103.5	93.2	110.4	70.0	13.5
Albania	102.0	85.3	107.0	78.3	15.1
Costa Rica	102.0	95.7	106.8	60.2	16.0
Dominican Republic	101.8	84.0	124.0	59.5	23.1
Belize	101.5	93.4	128.1	74.0	0.9
Ecuador	101.3	91.8	115.0	57.4	17.6

Table 8. **Skills, 2001** ***(cont'd)***

	Skills index	Literacy (%)	Enrollment (%) Primary	Secondary	Tertiary
PLANETIA	100.0	81.8	99.5	68.5	24.3
HYPOTHETICA	100.0	81.8	99.5	68.5	24.3
Mauritius	99.8	84.8	108.6	77.1	11.4
Yugoslavia	99.4	94.0	69.3	62.1	24.2
Viet Nam	99.2	92.7	105.6	67.1	9.7
Sri Lanka	98.3	91.9	105.9	72.1	5.3
Tunisia	98.3	72.1	117.3	78.3	21.7
Paraguay	98.2	93.5	111.2	59.8	10.1
Botswana	97.5	78.1	108.3	93.1	4.6
Indonesia	96.1	87.3	110.0	57.0	14.6
Turkey	93.9	85.5	100.6	57.7	15.0
United Arab Emirates	93.0	76.7	99.1	75.1	12.1
China	92.8	85.8	106.4	62.8	7.5
Egypt	92.7	56.1	99.6	85.7	39.0
El Salvador	91.9	79.2	109.3	54.2	17.5
Kuwait	91.9	82.4	84.8	55.6	21.1
Iran	91.1	77.1	86.4	78.1	9.9
Namibia	91.0	82.7	112.2	61.7	5.9
Swaziland	90.8	80.3	124.6	59.9	5.2
Saudi Arabia	90.7	77.1	67.5	67.8	22.4
Algeria	89.4	67.8	112.0	70.8	15.0
Zimbabwe	83.1	89.3	95.0	44.5	3.9
Oman	82.2	73.0	72.3	68.2	8.5
Myanmar	82.1	85.0	89.0	38.6	11.5
Nicaragua	80.8	66.8	103.5	54.0	11.8
Honduras	80.0	75.6	106.0	32.0	14.7
Syria	79.8	75.3	109.1	43.3	6.1
Congo	79.5	81.8	96.9	41.9	5.0
Lesotho	79.0	83.9	115.0	32.8	2.6
Guatemala	74.2	69.2	102.2	37.0	8.4
Kenya	73.5	83.3	94.0	30.6	3.0
India	72.7	58.0	101.6	48.7	10.5
Lao P.D.R.	71.7	65.6	113.1	37.6	3.3
Malawi	71.0	61.0	136.9	35.7	0.3
Togo	70.2	58.4	124.2	39.1	3.7
Uganda	69.9	68.0	135.8	18.6	3.0
Ghana	68.3	72.7	80.2	36.2	3.3
Cameroon	68.0	72.4	107.8	19.6	4.9
Liberia	66.3	54.8	118.0	38.2	2.9
Cambodia	65.1	68.7	110.1	18.7	2.8
Zambia	64.4	79.0	78.2	23.5	2.5
Morocco	63.3	49.8	94.4	39.3	10.3
Nigeria	63.2	65.4	81.9	30.3	4.0
Rwanda	63.0	68.0	118.6	12.1	1.7
Nepal	62.9	42.9	118.2	50.6	4.6
Yemen	62.4	47.7	79.2	47.6	10.8
Madagascar	60.6	67.3	103.1	14.3	2.2
Haiti	58.9	50.8	110.4	29.3	1.2
Papua New Guinea	58.3	64.6	83.8	21.1	2.3
Bangladesh	58.2	40.6	100.2	45.7	6.6
Sudan	55.6	58.8	55.0	28.8	6.9
Côte d'Ivoire	54.0	49.7	81.3	23.2	7.0
Eritrea	52.1	56.7	59.5	28.3	1.7
Gambia	48.9	37.8	82.3	36.2	1.9
Pakistan	48.2	44.0	74.4	24.1	3.5
Tanzania	48.0	76.0	63.0	5.8	0.7
Benin	47.8	38.6	95.5	21.8	3.6
Mauritania	46.8	40.7	83.0	21.0	3.7
Congo D. R.	46.7	62.7	46.8	18.4	1.4
Mozambique	45.7	45.2	91.5	11.9	0.6
Central African Republic	43.6	48.2	75.0	9.6	1.9
Djibouti	43.3	65.5	40.3	14.7	0.9
Senegal	42.9	38.3	74.8	17.8	3.7
Angola	42.0	42.0	73.6	15.5	0.7
Chad	41.6	44.2	73.2	11.5	0.9
Ethiopia	40.9	40.3	64.4	18.0	1.6
Guinea	39.9	41.0	67.0	13.8	1.3
Mali	31.8	26.4	61.2	15.0	1.9
Burkina Faso	25.7	24.8	44.3	10.2	0.9
Niger	18.5	16.5	35.5	6.2	1.5

The more modest contribution of skills to the Digital Divide is, to a good extent, accounted for by the smaller differences in literacy rates, combined with the fact that developed countries have already achieved near-complete literacy, whereas less developed countries continue to improve. The same, more or less, holds true for gross enrollment ratios in primary education. In a sense, the gap is smaller as the top goes up to 163 while the bottom increases to 35.7, denoting a narrower spread. Interestingly, when ranked by primary education, less developed countries are on top. Brazil tops the list followed by Gabon, Malawi, Uganda, Belize, Peru, Swaziland, Togo and the Dominican Republic. However, Congo, Burundi, Burkina Faso and Niger carry the tail and developed countries are in the middle.

Larger gaps start to open up as we move to higher and more specialized levels of education. In secondary education, for example, the gap increases substantially (top value 235 and bottom 8). Developed countries are on top, while Tanzania and Niger are at the bottom. The spread becomes even more pronounced in tertiary education, where the index assumes a top value of 318.8 (S. Korea) and a low one of 1.8 (Malawi). Thus, the gaps are not far off the big ones we encountered in networks.

Considering the movements unveiled by the preceding analysis, it is fair to say that as we move towards more specific indicators of ICT skills, the gaps widen. Consequently, the index numbers presented underestimate the extent of the Digital Divide.

ICT Uptake: Gaps in ICT uptake between the top and bottom in the list of countries measured are significantly larger than in overall Info-use. Thus, although gaps here are not as huge as those in networks, uptake in general is also a major source of the Digital Divide. The top value (U.S.) is 288.7 and the bottom (Chad) just 0.8. Noticeable among the change in the rankings is that S. Korea is positioned significantly higher than it was in networks, while Planetia is more than ten points below Hypothetica. The latter denotes that large countries are lower in uptake than in other components. The same African countries we have seen before, together with Myanmar and Cambodia, are at the bottom of the list. In total, 53 of the 149 countries are above the average.

The main sources of gaps in uptake are again the newer technologies of PCs and the Internet. Gaps are bigger in PCs, followed by Internet users, while they are more contained in residential phones and much lower in television households. Among measured indicators, the gaps in PCs are higher than those in cell phones and Internet usage, and second only to Internet networks overall. Only 45 countries are above

Table 9. **ICT Uptake, 2001**

	Uptake index	TV households	Residential mainlines /100	PCs	Internet users
United States	288.7	98.6	120.1	62.5	50.1
Sweden	274.4	94.4	92.1	56.1	51.6
Iceland	271.9	97.0	142.0	41.8	59.9
S. Korea	269.7	94.0	116.2	48.1	52.1
Denmark	266.8	96.9	119.6	54.2	42.9
Canada	264.9	99.2	107.7	47.3	46.7
Bermuda	264.7	95.0	127.6	49.5	46.4
Norway	262.9	90.2	113.0	50.8	46.4
Luxembourg	254.0	99.5	131.2	51.7	36.0
Australia	253.8	96.3	106.4	51.6	37.1
Netherlands	252.2	95.7	89.5	42.8	49.1
New Zealand	251.2	97.8	100.6	39.3	46.1
Singapore	251.0	84.5	118.0	50.8	41.2
Switzerland	246.7	99.7	119.4	53.8	30.7
Hongkong	240.2	99.0	103.6	38.7	38.7
Japan	235.2	99.0	117.7	35.8	38.4
Germany	234.5	94.2	104.7	38.2	37.4
Finland	233.1	91.0	79.3	42.3	43.0
Taiwan, China	229.9	97.8	141.5	36.4	34.9
United Kingdom	226.8	97.5	102.1	36.6	33.0
Gibraltar	218.0	81.9	121.0	54.6	22.5
Austria	212.8	96.9	72.5	33.5	38.7
Ireland	209.4	93.9	104.0	39.1	23.3
Slovenia	206.8	98.2	100.2	27.6	30.1
France	205.6	94.7	96.9	32.9	26.4
Belgium	196.2	95.0	96.0	23.3	31.0
Israel	191.1	87.3	115.0	24.6	27.7
Malta	186.6	92.9	120.2	23.0	25.3
Cyprus	185.0	97.2	146.7	24.7	21.8
Italy	184.0	97.5	101.0	19.5	26.9
Estonia	167.4	91.4	72.7	17.5	30.0
Portugal	164.7	99.8	99.3	11.7	28.1
Spain	161.7	98.9	108.1	16.8	18.3
Bahrain	161.5	96.8	115.2	15.4	20.3
United Arab Emirates	161.1	70.2	102.2	13.5	31.5
Macau	156.0	78.0	84.0	17.9	22.5
Malaysia	145.6	84.7	68.5	12.6	27.3
Czech Republic	130.7	87.9	68.7	14.7	14.7
Chile	129.6	95.3	61.3	10.6	20.1
Slovak Republic	124.6	96.2	59.9	14.9	12.5
Hungary	124.6	96.6	78.5	9.5	14.8
Greece	123.8	97.5	101.3	8.1	13.2
Mauritius	123.2	89.6	80.2	10.8	13.2
Seychelles	121.8	75.4	80.6	14.7	11.0
Uruguay	120.5	93.0	77.0	11.0	11.9
Qatar	120.0	85.8	139.9	16.4	6.6
Costa Rica	118.2	83.7	65.2	17.0	9.3
Brunei Darussalam	113.4	98.3	104.7	7.3	10.2
Croatia	113.3	71.4	69.2	13.3	11.1
Kuwait	111.9	98.0	67.7	12.0	8.8
Poland	108.2	98.3	73.8	8.5	9.8
Argentina	104.0	97.0	66.4	8.0	10.1
Latvia	102.2	74.4	58.9	15.3	7.2
HYPOTHETICA	**100.0**	**75.9**	**51.7**	**8.8**	**8.4**
Trinidad & Tobago	97.6	85.3	74.0	6.9	9.2
Barbados	96.9	82.5	91.3	9.3	5.6
Lebanon	94.4	92.6	65.9	7.5	7.8
St. Vincent and the Grenadines	93.9	83.9	76.2	11.3	4.8
Lithuania	92.0	92.4	71.9	7.1	6.8
PLANETIA	**89.8**	**75.9**	**51.7**	**8.8**	**8.4**
Turkey	85.4	97.7	98.8	4.1	6.0
Bulgaria	80.5	92.0	84.7	3.2	7.5
Brazil	77.8	90.9	61.2	6.3	4.7
Belize	77.3	35.2	46.3	13.4	7.3
Mexico	68.6	85.8	46.2	6.9	3.6
Venezuela	64.8	79.8	39.8	5.3	4.7
Russia	64.2	95.6	54.3	5.0	2.9
Jordan	64.0	86.6	58.3	3.3	4.5
South Africa	63.7	64.6	25.1	7.0	6.5
Oman	63.2	98.0	48.8	3.2	4.6
Colombia	63.2	94.2	66.4	4.2	2.7
Romania	62.8	86.6	50.0	3.6	4.5
Suriname	62.4	65.6	68.8	4.5	3.3
Jamaica	61.9	65.0	52.3	5.0	3.8
Peru	61.9	64.9	27.4	4.8	7.7
Yugoslavia	61.9	79.4	62.4	2.3	5.6
Panama	58.2	76.6	42.5	3.8	4.1
Saudi Arabia	58.1	96.5	62.3	6.3	1.3
Iran	56.8	67.4	63.2	7.0	1.6

Table 9. **ICT Uptake, 2001** ***(cont'd)***

	Uptake index	TV households	Residential mainlines	PCs	Internet users
		/100			
Cape Verde	56.5	40.0	60.1	6.9	2.7
Thailand	55.3	97.9	26.6	2.8	5.8
Tunisia	53.3	88.4	37.5	2.6	4.1
Guyana	51.4	37.2	28.8	2.6	10.9
Fiji	46.2	62.9	38.0	4.6	1.8
Ecuador	46.0	84.9	39.0	2.3	2.6
Maldives	45.8	61.2	40.1	2.2	3.6
China	44.7	87.3	41.5	1.9	2.6
El Salvador	43.9	84.5	38.1	2.2	2.3
Georgia	41.2	85.7	55.7	2.9	0.9
Ukraine	40.1	97.0	54.1	1.8	1.2
Namibia	39.1	37.9	20.2	5.5	2.5
Armenia	34.5	65.7	56.9	0.9	1.8
Moldova	33.8	63.4	41.9	1.6	1.4
Egypt	32.8	89.9	39.7	1.5	0.9
Philippines	32.7	61.5	14.9	2.2	2.6
Bolivia	31.1	47.2	19.8	2.1	2.2
Botswana	30.3	15.3	21.1	3.9	3.0
Samoa	30.1	96.6	36.5	0.6	1.7
Morocco	27.3	76.6	17.1	1.4	1.4
Nicaragua	27.0	59.8	11.0	2.5	1.4
Kyrgyzstan	25.9	18.5	28.1	1.3	3.0
Cuba	25.8	76.1	12.3	2.0	1.1
Syria	25.6	75.6	43.3	1.6	0.4
Senegal	24.9	60.8	14.6	1.9	1.0
Paraguay	24.6	69.1	15.6	1.4	1.1
Guatemala	24.6	40.4	18.3	1.3	1.7
Honduras	23.0	48.0	15.3	1.2	1.4
Mongolia	22.9	28.4	17.7	1.5	1.7
Indonesia	22.8	54.5	10.5	1.1	1.9
Algeria	21.6	66.0	31.6	0.7	0.6
Togo	20.7	19.7	5.0	2.6	3.2
Viet Nam	20.6	79.6	9.3	0.9	1.2
Kiribati	20.4	21.4	14.9	1.0	2.3
Gambia	16.5	11.1	17.4	1.3	1.3
India	15.8	42.9	16.2	0.6	0.7
Zimbabwe	14.9	22.2	6.5	1.7	0.9
Sri Lanka	14.6	20.6	13.1	0.9	0.8
Côte d'Ivoire	14.2	46.5	12.6	0.7	0.4
Gabon	14.1	9.0	12.1	1.2	1.3
Albania	13.3	40.5	18.3	0.8	0.3
Djibouti	13.3	39.7	6.2	1.1	0.5
Pakistan	12.7	74.8	10.7	0.4	0.3
Papua New Guinea	11.0	8.1	1.5	5.7	0.9
Solomon Islands	10.6	4.3	7.3	3.9	0.5
Sudan	9.8	83.5	7.8	0.4	0.2
Mauritania	9.5	47.3	2.8	1.0	0.3
Kenya	8.1	10.3	2.1	0.6	1.6
Yemen	7.9	93.6	10.6	0.2	0.1
Cameroon	7.5	39.8	3.2	0.4	0.3
Zambia	6.4	21.9	2.1	0.7	0.2
Lao P.D.R.	6.1	29.9	3.8	0.3	0.2
Nigeria	6.0	46.0	1.9	0.7	0.1
Ghana	5.7	21.3	3.4	0.3	0.2
Nepal	4.9	3.8	7.0	0.4	0.3
Benin	4.5	6.6	4.0	0.2	0.4
Tanzania	4.3	10.3	1.4	0.4	0.3
Eritrea	4.1	19.1	2.3	0.2	0.2
Angola	4.1	24.1	2.8	0.1	0.1
Bangladesh	4.0	23.7	1.8	0.2	0.1
Guinea	3.6	8.4	1.0	0.4	0.2
Madagascar	3.4	11.3	0.9	0.3	0.2
Mozambique	3.4	5.1	1.7	0.4	0.2
Burkina Faso	3.1	6.1	2.7	0.1	0.2
Mali	2.9	8.7	0.9	0.1	0.3
Uganda	2.3	4.5	0.4	0.3	0.3
Cambodia	1.9	4.2	1.1	0.1	0.1
Malawi	1.7	1.4	1.1	0.1	0.2
Central African Rep.	1.7	2.8	0.8	0.2	0.1
Myanmar	1.4	3.1	2.1	0.1	0.0
Ethiopia	1.3	2.0	1.5	0.1	0.0
Chad	0.8	0.8	0.3	0.2	0.1

average, while 39 countries have values less than 10. These are mostly African, with the inclusion of Albania, Armenia and Yemen.

The contribution to the Digital Divide by the gaps in Internet users is not far behind. The top value is 521.7 and the bottom just 0.2, therefore representing a sizeable gap. In fact, the concentration is such that the extremes are bigger, with only 44 countries above average and 42 countries below 10, of which 32 are below 5. A number of countries at the bottom are barely registering.

Residential phone lines give rise to comparatively smaller gaps. Here half the countries (74 of 149) are above the average. However, the bottom countries continue to be subject to very small values – a few even smaller than those for PCs.

Somewhat similar is the case of television households. While not a cause of differentiation among very developed and somewhat-developed countries, it is still quite an issue in less developed ones. Even though 90 countries are above average and several more not far behind, still a sizeable group of countries registered extremely low values, especially Chad, Malawi and Ethiopia.

The Uptake index, together with the values of the indicators for television households, residential phone lines per 100 households, PCs and Internet users per 100 inhabitants are shown in Table 9. (Annex Table 3 contains the individual indices).

Intensity of use: While not measured independently, the inclusion of indicators on the use of broadband and international incoming and outgoing telecommunications traffic moderates somewhat the Uptake gaps in overall Info-use. Broadband use is very unevenly spread. It represents the newest technology and the asymmetries are huge – practically two-thirds of the countries do not have any such users. (In the index this is not reflected as much - see methodology). S. Korea is the leader among Internet users, followed by Hong Kong and Canada. This technology is expected to evolve more. Telephone usage, as indicated by international traffic statistics, is also a Divide cause but not as much as the others.

Therefore, while everything matters in the Information Society, not everything matters the same. Much of the huge Digital Divide observed is mostly due to the newer technologies of the Internet and PCs, while a significant contribution continues to be made by fixed and mobile telecommunications networks and usage. Even televisions continue to be a problem.

4.3 The evolution of the Digital Divide

That a Digital Divide exists is known. The empirical application so far quantified how huge it is, who is subject to it and to what extent, as well as identified the main contributing factors to the Divide. From a policy viewpoint, however, a far more interesting question is: **How is the Digital Divide evolving**? This key policy issue revolves around a set of questions, such as: Is the Digital Divide closing or widening over time? Which countries are making more progress, how fast and why? One of the unique features of this model is that it can really take this type of questions head on and provide answers. These are not based on comparisons reduced to changes in rankings from one year to the next, but rather by explicitly monitoring Infostates, their main components, as well as individual indicators. This makes possible an in-depth investigation of the evolution of the Digital Divide. Such analyses can be very complex, especially when outside intelligence is brought into context that would shed light on causal effects by linking policies to performance. Moreover, they can be performed at various levels of desired detail, such as grouping countries by region, income or focusing on aspects of individual technologies. What follows offers only a sample of what is analytically possible.

First, we can observe immediately that over the period under examination, the Infostates of all countries increased and, on average, they increased significantly. In addition, they increased for every year studied. Ranked by their 2001 values, the time series of countries' Infostates are shown in Table 10. This is very useful to know and quantify, and serves as the beginning of this line of inquiry. Over the 1996-2001 period, Infostates increased in each and every country and this has been the case for each and every intervening year. No country has regressed at any time, but progress was made everywhere – to varying degrees.

Some countries have made considerable progress, while others more modest. We can see, for instance, that Hypothetica and Planetia nearly doubled their Infostates in this six-year period. We can also get early signs of relative evolution, as some countries have moved from below Hypothetica in 1996 to above it in 2001. This has been the case for Malaysia, Croatia, Poland and Argentina – countries that were classified in group B. Several other movements are detectable too, since relative movements are affected by the different degrees of change among countries and over time (and in a more detailed treatment, across components).

Table 10. **Evolution of infostates**

	1996	1997	1998	1999	2000	2001
Sweden	150.3	174.3	192.8	212.7	222.7	230.5
Denmark	140.7	162.5	187.0	204.0	216.0	230.0
Canada	146.5	166.7	185.3	199.4	215.4	224.8
Netherlands	129.2	144.6	167.4	194.9	213.4	224.2
United States	148.2	165.8	179.7	194.1	206.7	217.9
Switzerland	131.1	148.8	167.0	188.3	203.5	216.8
Norway	145.2	166.0	179.8	200.4	210.8	214.4
Belgium	114.9	132.9	152.6	174.8	196.1	202.6
Hongkong	118.1	137.2	148.3	167.0	186.5	202.6
Finland	138.0	156.4	168.7	180.4	189.7	199.5
Luxembourg	117.8	127.8	148.3	164.0	180.2	197.1
Iceland	124.3	141.3	155.8	173.4	188.7	195.6
Singapore	115.0	135.1	148.5	166.9	184.4	194.3
Germany	107.0	126.2	141.0	160.6	182.0	191.8
United Kingdom	115.0	129.0	148.0	168.3	180.0	190.2
Australia	112.9	132.3	152.0	164.0	179.5	189.5
New Zealand	116.2	132.1	140.8	161.3	172.5	185.2
Austria	111.3	126.5	144.8	163.5	183.3	184.7
S. Korea	83.7	100.6	117.2	150.1	172.0	183.8
Japan	103.0	120.4	135.3	150.9	166.3	178.7
Ireland	93.6	111.5	131.0	145.2	166.0	175.6
France	96.3	112.1	127.5	147.6	159.2	168.9
Israel	96.4	113.0	129.7	140.9	150.2	159.0
Portugal	78.8	93.5	109.9	121.6	134.1	151.7
Slovenia	80.7	95.8	107.1	123.6	132.8	149.1
Italy	73.4	88.4	103.0	121.7	143.6	148.5
Spain	77.0	90.4	102.0	116.3	132.9	144.3
Malta	64.4	80.1	93.3	107.0	124.2	143.4
Estonia	70.2	85.7	102.6	115.7	134.2	140.5
Czech Republic	63.0	76.3	87.5	101.0	114.7	129.0
Cyprus	68.9	93.1	109.0	120.2	131.1	128.0
Hungary	61.5	76.4	88.0	99.4	107.8	122.6
United Arab Emirates	52.6	69.5	93.5	108.7	116.8	122.6
Greece	62.3	70.8	84.2	100.0	110.9	121.2
Bahrain	63.8	67.6	78.5	91.2	96.8	116.3
Brunei Darussalam	67.3	73.0	83.9	91.7	104.3	113.4
Slovak Republic	47.2	63.9	75.3	87.4	100.0	111.7
Macau	64.5	73.5	86.2	93.0	99.6	111.2
Chile	48.8	55.3	66.6	79.5	100.7	110.8
Uruguay	53.1	70.2	83.7	96.8	105.5	109.9
Argentina	42.2	51.6	65.9	84.2	99.4	107.9
Poland	46.0	57.4	71.0	82.3	94.3	107.2
Latvia	46.1	59.5	73.0	83.8	97.8	104.8
Croatia	49.2	59.8	67.7	76.5	92.5	102.3
Malaysia	50.5	60.3	72.6	82.6	90.5	101.5
PLANETIA	**55.9**	**64.4**	**72.7**	**82.8**	**92.6**	**100.6**
HYPOTHETICA	**55.4**	**64.5**	**73.2**	**83.1**	**92.3**	**100.0**
Lithuania	40.0	54.0	67.7	74.8	87.4	98.7
Mauritius	34.0	44.0	58.2	66.9	82.2	92.5
Brazil	36.6	43.6	52.1	63.9	77.3	91.6
Barbados	47.8	53.3	63.9	69.9	79.6	91.2
Qatar	51.6	72.6	65.7	92.4	102.4	90.8
Trinidad and Tobago	36.2	49.5	59.8	71.7	84.7	90.6
Kuwait	60.2	69.1	75.4	78.7	82.6	88.1
Lebanon	38.6	55.5	66.0	75.5	82.5	87.4
Bulgaria	38.1	46.3	53.7	65.0	77.0	86.8
Costa Rica	48.6	53.9	59.8	67.6	76.4	86.0
Mexico	35.0	42.2	51.6	63.6	73.6	83.0
Turkey	36.4	45.3	52.4	66.0	70.9	79.9
Belize	31.3	48.0	53.4	62.3	69.7	75.5
South Africa	46.6	54.1	61.9	67.5	71.8	74.5
Romania	28.2	38.1	51.7	59.3	68.7	73.4
Russia	35.1	43.3	48.8	50.6	63.8	72.9
Panama	32.1	39.7	48.7	57.2	74.6	72.6
Venezuela	36.7	42.8	51.9	61.9	65.8	72.3
Jamaica	34.2	40.5	49.8	54.5	66.3	70.8
Yugoslavia	29.3	38.0	44.2	49.5	64.0	69.1
Colombia	37.2	44.1	51.8	58.6	62.3	67.8
Jordan	20.7	31.3	40.8	49.0	56.0	66.9
Thailand	32.1	39.1	41.9	48.9	55.6	64.7
Oman	20.0	36.7	42.6	48.1	52.8	64.3

	1996	1997	1998	1999	2000	2001
Peru	31.5	35.4	42.2	49.0	53.2	61.8
Saudi Arabia	23.3	23.3	31.0	46.6	52.3	61.5
Fiji	27.6	33.1	40.2	47.0	54.2	58.4
Ukraine	26.2	31.7	36.5	41.2	49.4	58.2
Georgia	20.3	26.8	31.5	39.1	46.0	54.7
Samoa	12.5	20.4	24.1	28.0	44.4	54.1
Ecuador	24.4	28.7	31.8	41.4	46.6	53.9
Namibia	17.6	24.9	34.6	36.0	48.3	53.7
El Salvador	20.6	25.3	32.7	42.4	47.1	51.9
China	15.7	19.6	26.0	36.3	44.7	51.4
Philippines	21.0	24.7	34.1	37.9	44.1	50.4
Botswana	10.2	14.1	29.5	41.0	46.4	50.3
Guyana	21.5	24.2	25.4	32.3	45.3	49.4
Iran	18.1	22.5	26.4	35.0	42.1	49.0
Moldova	11.2	19.1	29.8	34.1	45.5	48.9
Tunisia	15.5	17.4	21.3	30.9	35.8	48.0
Bolivia	20.9	25.2	30.7	37.5	42.6	47.0
Paraguay	17.7	24.1	31.3	36.2	40.7	45.0
Armenia	17.3	23.5	26.9	36.1	40.8	44.5
Guatemala	13.5	18.6	24.3	29.6	35.8	41.9
Kyrgyzstan	6.2	9.7	18.3	25.2	33.5	41.3
Egypt	15.8	19.9	23.2	29.7	35.5	40.4
Mongolia	11.6	15.5	19.1	26.0	36.2	38.6
Nicaragua	19.7	22.9	25.9	29.5	34.7	38.4
Indonesia	17.7	21.8	23.7	27.5	32.1	37.6
Morocco	12.8	16.8	22.7	25.9	33.4	37.5
Honduras	12.7	16.8	21.5	25.5	28.6	33.7
Gabon	6.2	12.7	16.8	19.1	28.2	33.5
Cuba	12.7	15.0	17.8	21.6	26.5	32.4
Albania	10.3	13.2	16.1	19.3	22.6	32.2
Sri Lanka	13.7	17.6	21.2	24.9	29.4	31.7
Zimbabwe	6.5	13.9	17.6	22.9	27.4	30.2
Senegal	8.9	11.8	15.6	20.7	25.3	29.4
Viet Nam	5.5	7.8	12.1	17.9	21.7	29.2
Algeria	9.9	13.0	14.9	22.2	22.6	29.0
Togo	4.2	10.8	13.7	17.3	23.9	28.4
India	10.5	13.2	15.8	19.1	23.4	27.9
Côte d'Ivoire	8.9	11.8	14.8	18.1	21.8	26.9
Gambia	7.3	9.7	13.2	17.1	18.9	26.8
Syria	3.0	7.6	8.5	17.4	21.7	26.6
Pakistan	8.2	11.6	14.3	15.8	18.7	21.9
Kenya	6.9	8.8	10.0	13.1	17.6	21.0
Papua New Guinea	6.5	10.4	12.7	17.5	19.8	20.2
Mauritania	3.0	4.0	6.1	8.0	15.9	20.2
Djibouti	10.8	12.6	12.9	15.6	16.7	20.1
Cameroon	5.4	6.2	7.2	12.1	16.5	18.7
Zambia	9.2	9.6	11.6	15.4	17.7	18.6
Lao P.D.R.	4.1	6.0	7.6	9.4	11.6	17.3
Yemen	5.7	9.2	10.8	13.2	14.8	17.0
Ghana	7.2	9.3	10.6	13.0	13.0	16.2
Benin	4.5	6.5	7.4	9.2	9.2	15.4
Nepal	3.1	4.0	4.9	10.6	13.0	14.5
Nigeria	5.8	7.3	8.9	10.0	10.8	14.4
Tanzania	3.6	5.3	6.5	8.9	11.8	14.3
Sudan	1.9	6.1	8.4	11.8	10.9	13.5
Madagascar	4.9	5.9	8.2	11.2	12.7	12.9
Guinea	3.6	4.6	5.4	9.6	10.8	12.1
Uganda	4.2	5.0	7.9	9.2	10.7	11.5
Cambodia	3.9	6.0	7.1	8.3	9.6	11.2
Burkina Faso	2.5	4.8	6.2	7.0	8.6	10.7
Angola	4.2	5.8	6.9	8.8	9.3	10.6
Mozambique	2.4	5.3	6.8	8.2	10.2	10.5
Mali	3.1	3.5	4.1	6.0	8.3	9.9
Bangladesh	2.0	4.2	6.9	10.2	12.3	9.5
Malawi	3.1	3.8	4.6	6.2	8.2	9.5
Eritrea	1.7	3.3	3.7	4.7	8.0	8.5
Central African Rep.	4.5	5.2	5.8	6.9	7.3	7.8
Myanmar	2.2	2.5	3.3	4.8	6.3	6.5
Ethiopia	1.2	1.9	2.2	4.4	5.1	6.1
Chad	1.2	1.6	2.1	2.6	5.1	5.2

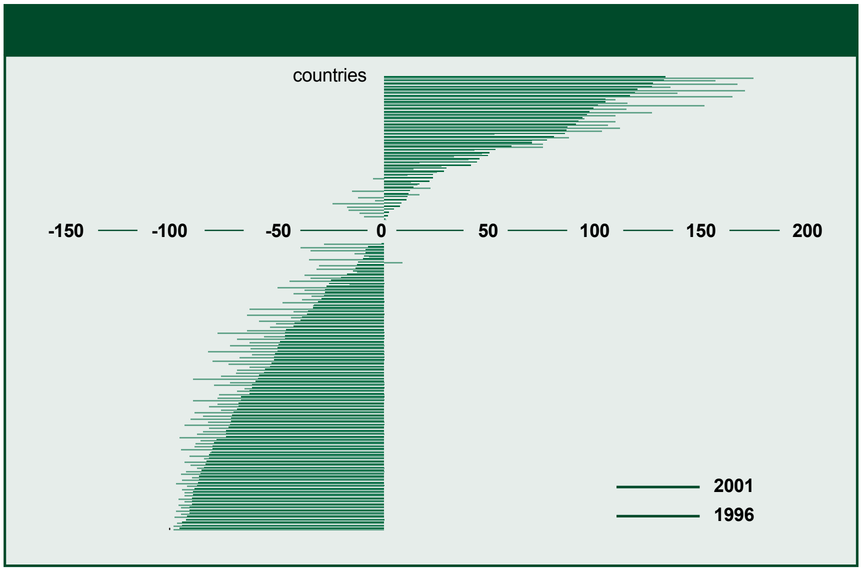
But the Digital Divide is a relative concept and much more is needed to answer the questions posed, including precision in tracking relative movements - all of which are upwards but at different "speeds". Mauritania and Djibouti, for instance, had similar Infostates in 2001, but Djibouti arrived there very slowly (or Mauritania much faster), as evidenced by their 1996 levels. The nearly 10 points achieved by Mali in 2001, was the Infostate value of Botswana in 1996. Therefore Mali caught up to Botswana in five years. Of course, by 2001 Botswana had moved up to 50. Analogously, Argentina's 2001 value (107.9) was comparable to Germany's in 1996 (107). It is examination of the pace of such movements that supports the argument that decades are literally needed for the countries at the bottom of the Infostate scale to achieve the levels of today's top countries. But more systematic analysis is needed to generalize findings.

One way to begin is to compute the differences between the Infostate values of each country and Hypothetica for each year available. This then will serve as the basis for relative comparisons. Doing so for 1996 and 2001, while keeping Hypothetica constant (at 100, since the average is also moving upwards over time) and plotting the values we can get a first overall glimpse into the evolution of the Digital Divide. This is shown in Chart 4. The 2001 line lies visibly 'inside' the 1996 line, both at the top and the bottom ends. This increased steepness is indicative of a generally closing Digital Divide. Even visual inspection reveals that the gap between the top countries and the average closed more than the gap between the bottom countries and the average. Alternatively, the average increased more than the top, which means that the Infostates of countries below average increased proportionately more than the Infostates of highly advanced countries.

Benchmarking vis-à-vis Hypothetica rather than between countries with very high and very low Infostates, some countries will, by necessity, improve their situation while others will be subject to deterioration. In this specification, even countries with very high Infostates can improve and countries with very low Infostates can deteriorate. We find that a total of 111 countries improved their situation and only 28 'deteriorated'[3]. While, on average it has been countries at the top that lost ground (the U.S., Canada, Scandinavian countries, New Zealand and Kuwait more than others), we also find that this has been the case for the Central African Republic, Qatar and Costa Rica - the only countries among those that started from below average. On the other hand, the most progress was comparatively made by S. Korea, followed closely by Botswana, Argentina, Samoa, Mauritius, Kyrgyzstan, Jordan and Moldova - most of these countries were, and still are, below average.

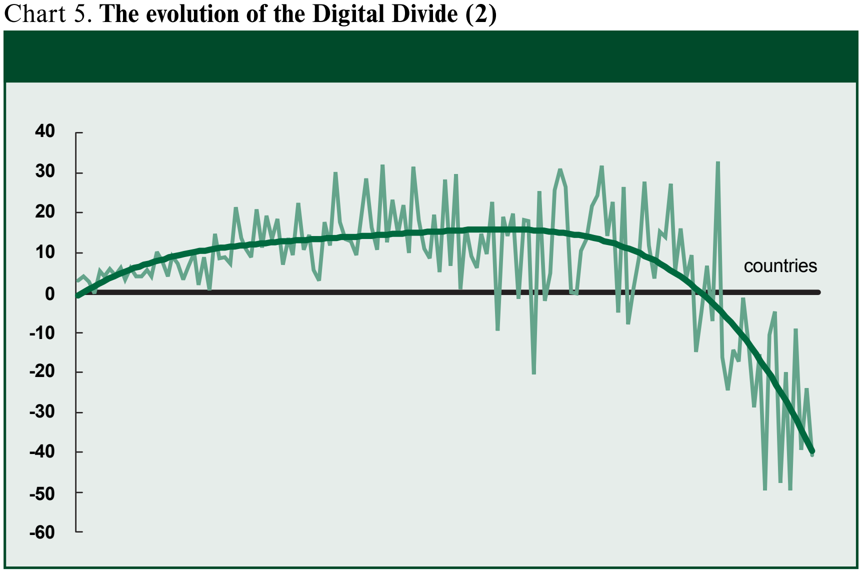
[3] *This should be interpreted in the relative sense and should not be confused with lower infostate values.*

Chart 4. **The evolution of the Digital Divide (1)**



The slow closing of the Digital Divide in an overall sense can be further substantiated by computing the changes of the differences in 1996 and 2001 that were plotted in Chart 4. In this specification, a positive number denotes a closing divide vis-à-vis the average and a negative number a widening divide – the more so, the bigger the change in the divide. This is displayed in graphical form in Chart 5, which clearly reveals that most countries gained ground against Hypothetica, while many of the top ones lost ground. The degree to which this happened varies widely, though, and there are exceptions.

Chart 5. **The evolution of the Digital Divide (2)**



Inside the Digital Divide

While useful insights on the evolution of the Digital Divide in an overall sense can be obtained, the devil is in the details as has been shown in analyses of internal country divides. By definition, the subject requires comparisons; thus, it matters which is compared to what. The analysis therefore proceeds to investigate the evolution of the Digital Divide at the level of the five country groupings introduced earlier.

To begin, the average Infostate values for each group are computed for each year, as well as their respective change and rates of growth over the 1996-2001 period. (This is shown in part A of Table 11). This type of analysis produces several interesting findings, all of which are consistent with those found in detailed studies of internal country divides. The following are of interest to advance our knowledge:

Table 11. **Evolution of the Digital Divide, by group**

Group	1996	1997	1998	1999	2000	2001	change 1996-2001	growth 1996-2001
(A) Infostates								
A	120.8	138.6	155.4	174.2	189.8	199.9	79.1	65.5
B	61.2	74.1	87.6	100.0	112.6	123.1	62.0	101.3
C	36.1	45.2	52.8	61.8	70.6	77.4	41.4	114.8
D	14.1	18.6	23.4	29.2	35.5	41.1	27.0	191.4
E	4.4	6.0	7.4	9.7	11.7	13.5	9.2	211.0
Hypothetica	**55.4**	**64.5**	**73.2**	**83.1**	**92.3**	**100.0**	**44.6**	**80.5**
(B) normalized Infostates								
A	218.1	214.9	212.4	209.6	205.7	199.9		
B	110.4	114.9	119.7	120.3	122.0	123.1		
C	65.1	70.0	72.1	74.3	76.6	77.4		
D	25.5	28.8	32.0	35.1	38.4	41.1		
E	7.9	9.3	10.1	11.7	12.7	13.5		
Hypothetica	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**		
(C) Digital Divides								
A-E	210.2	205.6	202.3	197.9	193.0	186.4		
A-D	192.6	186.1	180.4	174.5	167.3	158.8		
A-C	153.0	144.9	140.2	135.2	129.1	122.5		
A-B	107.7	100.0	92.7	89.2	83.7	76.8		
B-E	102.6	105.6	109.6	108.6	109.4	109.6		
C-E	57.2	60.7	62.0	62.6	63.9	63.9		
D-E	17.6	19.4	21.9	23.4	25.8	27.6		
B-D	84.9	86.1	87.7	85.2	83.6	82.0		
B-C	45.3	44.8	47.6	46.0	45.5	45.7		
(D) Changes in difference								
A-E		-4.6	-3.3	-4.4	-4.8	-6.6		
A-D		-6.5	-5.8	-5.9	-7.2	-8.4		
A-C		-8.1	-4.6	-5.0	-6.1	-6.6		
A-B		-7.7	-7.3	-3.5	-5.6	-6.9		
B-E		3.0	4.0	-1.0	0.7	0.3		
C-E		3.5	1.3	0.6	1.3	0.0		
D-E		1.8	2.5	1.5	2.4	1.8		
B-D		1.2	1.6	-2.5	-1.6	-1.6		
B-C		-0.5	2.7	-1.5	-0.6	0.2		

- Over time, Infostates increase across the board. Each and every country had a higher level of Infostate every year, and this of course holds true for the country groupings used. But this is not a measure of the Digital Divide – the differences in Infostates are.
- The differences between the top and the bottom, in absolute terms, increase over time. This can be verified easily by subtracting the values of group E from those of group A. Similar findings have been found consistently from the very first study of internal country divides (U.S. 1996). The average is also increasing, though, and before the Digital Divide is computed the average must be normalized. This increase in the (unadjusted) differences between haves and have-nots occurs despite the fact that:
- The rates of growth of countries with lower Infostates are higher than those with higher Infostates. This has also been a consistent finding in Digital Divide research (Dickinson and Sciadas 1999, OECD 2001, Sciadas 2002) and can be seen clearly in the last column of Table 11. Indeed the Infostate values of the bottom group more than tripled, as almost did those of group D, the values of the second group (with above average countries) doubled, while those of the first increased by only (!) 65%.

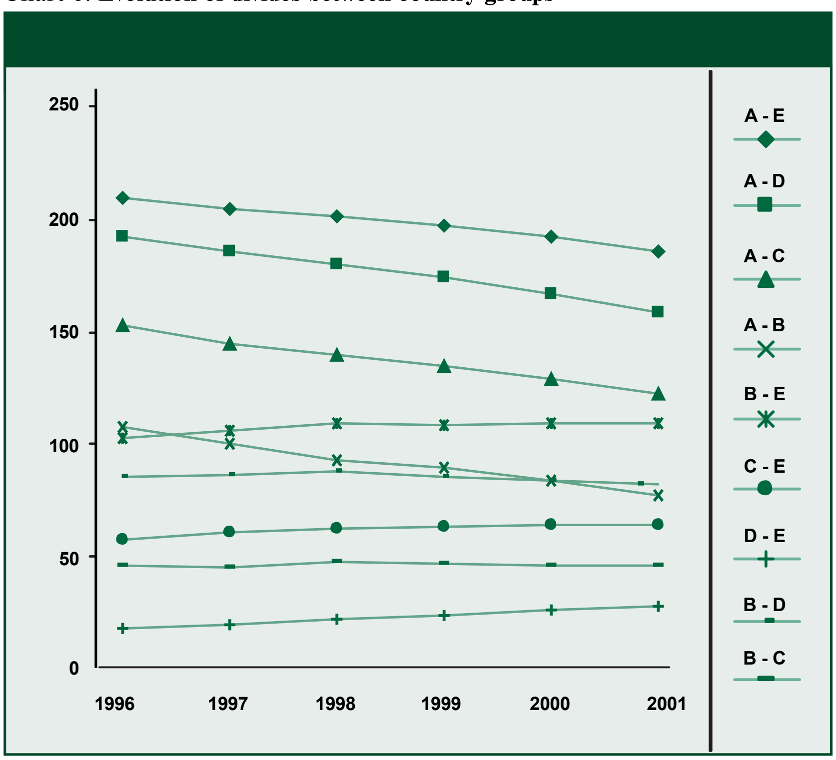
This is directly related to the inescapable interplay between absolute and relative magnitudes involved. The lower rates of growth of the "haves" result in a higher absolute increase because they start from a very high level, whereas the high rates of growth of the "have-nots" yield a smaller absolute increase because they start from very low levels[4]. (The highest rates of Infostate growth were achieved by Syria, Sudan, Togo, Kyrgyzstan, Mauritania, Gabon, Vietnam, Ethiopia, Botswana and Eritrea).

Therefore, computations based on a normalized average were carried out, and they are contained in part B of Table 11. It is only then that the Digital Divide between pairs of the five groupings can be meaningfully measured. These are shown in part C of Table 11.

[4] *Sometimes the growth in the absolute gap is interpreted as a growing divide and the higher rates of growth of the have-nots as a closing divide. In internal country divides, however, it has been documented (Sciadas 2002) that this is not the case. For the divide to close the rate of growth of the have-nots not only must be higher than that of the haves, but must be at least as many times higher as the ratio of their initial difference.*

The direction of these measures over time points to the evolution of the Digital Divide. They are plotted in Chart 6 for the selected pairs of groupings. We can now see that the divide between the top and the bottom groups is slowly closing. This is also the case for the divides between the top group and each of the other groups – in fact, the pace is faster, indicating that countries in groups B, C and D catch up more to the top than the least-connected group. At the same time, we can see from this analysis that the bottom group (E) actually loses ground against all other groups. Even the divide with group D, which is just above, does not close. The message then is that the Digital Divide is closing overall because the middle groups are making good progress against the top. The problem with the bottom group remains. It is outpaced by middle groups and the only gains are against countries with whom they are separated by huge gaps. These findings can also be seen with the alternative specification based on the change of the differences, as explained above - part D of Table 11.

Chart 6. **Evolution of divides between country groups**

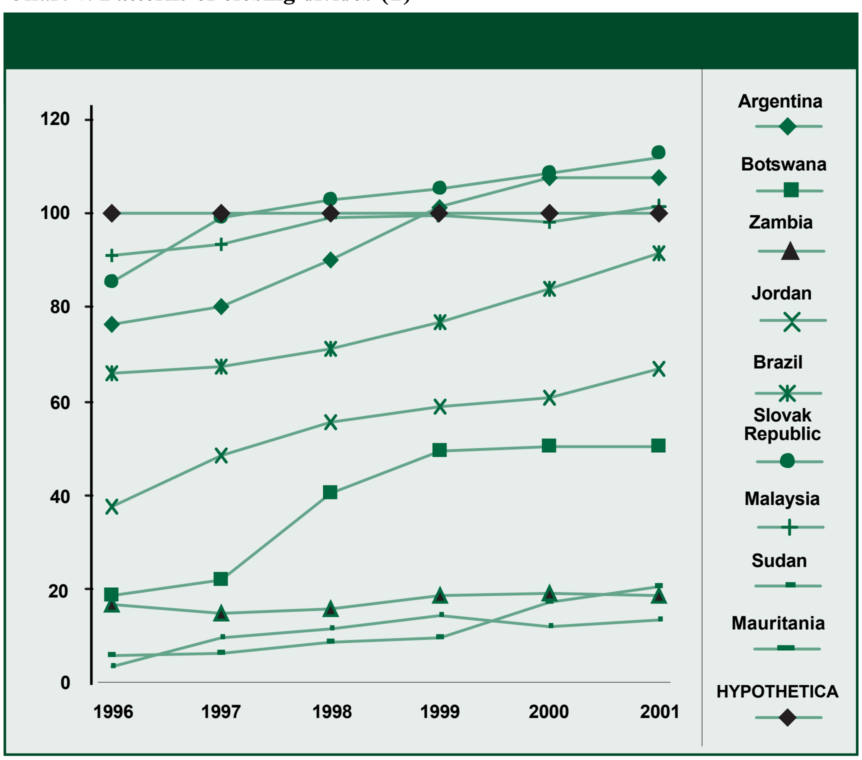


Country analysis

Carrying the analysis to the level of individual countries, even more insights can be obtained with regards to comparative performances. One way to do so is through normalizing the Infostate values by keeping the average country, Hypothetica, constant over the period of examination. The evolution of a cross-section of countries is displayed in Chart 7. (The results for the entire list of countries included in Infostate is presented in Annex Tables 4, 5 and 6).

The underlying patterns of evolution are telling. While the situation of Sudan improved, it started slightly behind Mauritania in 1996, to surpass it during the 1997-1999 period, only to fall behind again in 2000. At the same time, Mauritania ended higher than Zambia. Although Zambia started from a much higher state in 1996, its progress has been rather marginal over the period. This contrasts sharply with the performance of Botswana that started from about the same state as Zambia, but managed to gain substantial ground (due to its performance in the 1997-1998, since it remained flat over the last couple of years of the period).

Chart 7. **Patterns of closing divides (1)**



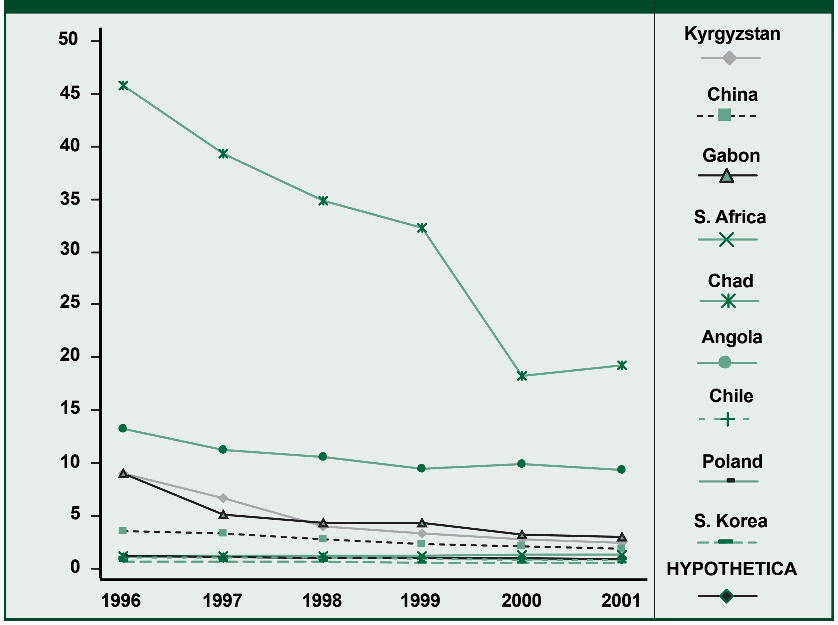
Also visible is the steady progress made by Jordan; by 2001 it had achieved the state Brazil had in 1996 - while the latter also experienced good progress, approaching Hypothetica. The Slovak Republic, Argentina and Malaysia are examples of countries that started below average in 1996 but ended above it by 2001, crossing Hypothetica's line (at 100). While both the Slovak Republic and Argentina started behind Malaysia, though, their progress was much stronger and they edged ahead.

Analogous snippets of different patterns of behaviour can be obtained by taking the ratios of the normalized values of country Infostates against Hypothetica. An example of another cross-section of countries is contained in Table 12 and displayed in Chart 8.

Table 12. **Benchmarking ratios**

Kyrgyzstan	9.0	6.6	4.0	3.3	2.8	2.4
China	3.5	3.3	2.8	2.3	2.1	1.9
Gabon	9.0	5.1	4.4	4.4	3.3	3.0
South Africa	1.2	1.2	1.2	1.2	1.3	1.3
Chad	45.7	39.3	34.9	32.3	18.3	19.3
Angola	13.2	11.2	10.6	9.5	10.0	9.4
Chile	1.1	1.2	1.1	1.0	0.9	0.9
Poland	1.2	1.1	1.0	1.0	1.0	0.9
S. Korea	0.7	0.6	0.6	0.6	0.5	0.5
Hypothetica	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

Chart 8. **Patterns of closing divides (2)**



Here we can see that Chad, one of the countries consistently at the bottom of the scale, made relative progress, but still remains at almost twenty times below the average. Angola's progress was smaller, starting from a much better situation. In the beginning of the period, noticeable progress was also made by Kyrgyzstan and Gabon, two countries that followed parallel paths. China also improved its relative position, while S. Africa did not. Both Chile and Poland outperformed Hypothetica, while S. Korea, the only country in this cross-section to start above the average, ended even higher.

Similar analyses can be carried out not only against Hypothetica but against any benchmark country or group of countries desired, and performances can be compared. As well, they can be performed not only at the Infostate level, but at the level of aggregate components or individual indicators. A sample of the latter follows next.

Drivers of the evolution

To uncover the main forces of the movements identified above, the analysis digs deeper into components and indicators of interest. As well, it does so separately for each of the five country groupings and Hypothetica.

As much as Infodensity and Info-use accounted almost equally for the existence of the Digital Divide, they also account almost equally for its closing. On average, between 1996 and 2001, Infodensity increased by about 74% and Info-use by 87%. Consistent with earlier findings, growth was consistently higher among the have-not (or have-less) groups (Table 13). The same holds true, but is even more pronounced, within specific components. These movements account for the somewhat diminished divide between the top and bottom groups identified earlier.

ICT networks and uptake account for most of the growth, registering 184.5 and 113.2, respectively. Working with the 139 Infostate countries, we compute that network growth for the bottom group exceeded 500% during the period, much greater than the 142% for the top group. Extraordinary growth was experienced by Kyrgyzstan, Mauritania, Zimbabwe, Togo, Syria, Ethiopia, Nepal, Botswana and Samoa - starting from very low levels.

Most of the gains came from mobile networks, followed closely by the Internet. This was much more so in the have-not countries than in the countries with higher Infostates. It is noteworthy that group D, and not the bottom group, experienced the highest rates of growth both in mobile networks and the Internet – outgrowing the top group by a factor of

Table 13. **Detailed component analysis, by group**

Group	Networks 1996	Networks 2001	Skills 1996	Skills 2001	Infodensity 1996	Infodensity 2001	Uptake 1996	Uptake 2001	Info-use 1996	Info-use 2001	Infostate 1996	Infostate 2001
A	108.7	263.6	134.9	138.0	119.8	189.5	129.1	245.5	122.6	212.4	120.8	199.9
B	37.0	120.6	116.1	124.6	64.1	121.4	57.1	144.1	58.7	126.3	61.2	123.1
C	14.1	53.3	100.5	108.4	36.5	75.4	29.4	78.2	36.1	80.3	36.1	77.4
D	3.6	20.6	87.9	93.5	16.4	42.7	7.3	29.7	12.8	40.4	14.1	41.1
E	0.8	4.9	48.7	55.1	5.8	15.6	1.2	5.2	3.5	12.2	4.4	13.5
Hypothetica	35.1	100.0	93.7	100.0	57.4	100.0	46.9	100.0	53.5	100.0	55.4	100.0
growth, 1996-2001 (%)												
A	142.6		2.3		58.2		90.2		73.2		65.5	
B	225.7		7.3		89.3		152.3		115.1		101.3	
C	277.1		7.9		106.6		165.8		122.1		114.8	
D	475.8		6.3		160.8		309.3		216.8		191.4	
E	502.9		13.1		169.4		350.5		245.3		211.0	
Hypothetica	184.5		6.7		74.2		113.2		86.9		80.5	
normalized values												
A	309.3	263.6	143.9	138.0	208.8	189.5	275.3	245.5	229.2	212.4	218.1	199.9
B	105.4	120.6	123.9	124.6	111.8	121.4	121.8	144.1	109.7	126.3	110.4	123.1
C	40.2	53.3	107.2	108.4	63.6	75.4	62.8	78.2	67.6	80.3	65.1	77.4
D	10.2	20.6	93.8	93.5	28.5	42.7	15.5	29.7	23.9	40.4	25.5	41.1
E	2.3	4.9	52.0	55.1	10.1	15.6	2.5	5.2	6.6	12.2	7.9	13.5
Hypothetica	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
divides												
A - E	306.9	258.7	92.0	82.9	198.7	173.9	272.9	240.3	222.6	200.2	210.2	186.4
change in differences, 1996-2001												
A - E	48.2		9.0		24.8		32.6		22.4		23.8	

seven and eight, respectively. However, while in mobile it outgrew the bottom group only slightly, the difference in the Internet was substantial. In addition, group D was the only group whose Internet growth was higher than its mobile network growth (Table 14).

These findings explain to a good extent why the bottom group lost ground vis-à-vis group D. In mobile networks, phenomenal growth was experienced by Zimbabwe, Botswana, Syria, Mozambique, Togo, Mauritania and Haiti, again countries that started from extremely low levels. Many other African and Eastern Europeen countries experienced huge growth as well. In Internet, growth was led by Kyrgyzstan, Samoa, Oman, Tonga, Turkmenistan, Bhutan and Rwanda. Many countries, however, still barely registered values in 2001.

Table 14. **Analysis by indicators and group**

	1996	2001	1996	2001	1996	2001	1996	2001	1996	2001	1996	2001
	A		B		C		D		E		Hypothetica	
wireline	224.1	274.0	113.0	156.3	52.0	78.2	13.5	25.2	1.6	2.5	77.3	100.0
mobile	55.9	296.3	23.6	208.8	7.7	77.3	0.9	27.2	0.1	3.6	13.3	100.0
Internet	106.8	514.3	15.6	96.7	2.5	16.6	0.2	7.5	0.0	0.2	16.2	100.0
literacy	120.1	120.3	115.7	116.8	107.8	110.2	95.3	98.7	62.6	68.3	97.1	100.0
enrollment (combined)	152.5	159.3	117.1	133.4	94.3	107.4	81.8	89.4	38.9	45.9	90.5	100.0
enrollment (tertiary)	204.0	226.1	116.4	167.1	82.1	100.5	53.4	66.1	9.4	13.1	81.2	100.0
TV households	138.3	145.1	132.6	138.4	117.2	127.6	73.3	85.3	23.9	33.5	91.0	100.0
residential phones	195.2	195.5	154.5	169.4	101.2	121.2	35.8	52.9	3.7	6.1	88.1	100.0
PCs	208.5	371.7	52.9	123.8	25.5	57.3	6.9	16.5	2.3	4.4	50.3	100.0
Internet use	55.5	356.1	12.8	164.1	3.4	51.6	0.4	16.2	0.0	2.3	12.0	100.0
growth, 1996-2001 (%)												
wireline	22.3		38.4		50.2		86.3		61.7		29.3	
mobile	430.1		783.6		901.0		2,996.7		2,702.4		651.1	
Internet	381.5		518.1		553.8		3,282.2		1,273.8		517.6	
literacy	0.2		1.0		2.2		3.5		9.1		3.0	
enrollment (combined)	4.5		14.0		13.9		9.3		17.9		10.5	
enrollment (tertiary)	10.8		43.5		22.5		23.7		38.8		23.2	
TV households	4.9		4.4		8.9		16.5		39.8		9.9	
residential phones	0.2		9.7		19.7		47.5		66.3		13.5	
PCs	78.3		134.1		124.4		141.1		9.9		99.0	
Internet use	542.1		1,186.8		1,397.7		4,024.5		6,806.4		733.0	
normalized values												
wireline	289.8	354.4	146.1	202.1	67.3	101.1	17.5	32.6	2.0	3.3	100.0	100.0
mobile	419.9	2,225.8	177.5	1,568.3	58.0	580.5	6.6	204.5	1.0	26.7	100.0	100.0
Internet	659.7	3176.3	96.6	597.0	15.7	102.7	1.4	46.4	0.1	1.3	100.0	100.0
literacy	123.7	123.9	119.1	120.3	111.1	113.5	98.2	101.7	64.5	70.4	100.0	100.0
enrollment (combined)	168.5	176.0	129.4	147.4	104.1	118.6	90.4	98.8	43.0	50.7	100.0	100.0
enrollment (tertiary)	251.3	278.5	143.4	205.7	101.1	123.8	65.7	81.3	11.6	16.2	100.0	100.0
TV households	152.0	159.4	145.7	152.1	128.8	140.3	80.5	93.8	26.3	36.8	100.0	100.0
residential phones	221.6	222.0	175.4	192.4	114.9	137.6	40.7	60.0	4.1	6.9	100.0	100.0
PCs	414.8	739.5	105.2	246.4	50.8	114.0	13.7	32.9	4.6	8.7	100.0	100.0
Internet use	461.9	2,966.2	106.2	1,366.9	28.7	430.0	3.3	135.3	0.3	19.6	100.0	100.0

The highest growth in fixed networks was experienced again by group D, which grew almost three times the average. Growth in the wireline networks was led by Sudan, followed by Albania, Sri Lanka, Cape Verde, Tanzania, Bhutan, Saudi Arabia and Brazil. By contrast, these networks did not increase in French Guyana, Samoa, Kenya, Morocco, Armenia, Guyana and French Polynesia, while there were declines in Congo, Congo D.R. and the Central African Republic. Minor declines were also observed in Finland and Lichtenstein, countries with highly advanced networks.

The growth in skills was low both for inherent reasons, as skills improve slowly, and for reasons related to their measurement. Literacy rates and enrollment in primary education, in particular, are subject to less variability than other Information Society indicators and they have little room to grow among a good number of countries. Again, as we move to higher skills, growth was significant and generally more so among the have-not countries, with group E outgrowing group A by a factor of six. This was true for both literacy and enrollment. In literacy the gains came primarily from African countries with Chad, Burkina Faso, Benin, Niger, Gambia, Central African Republic, Liberia, Ethiopia and Mali topping the list. A more mixed group of countries led growth in overall enrolment - Liberia, Uganda, Ethiopia, Brazil, Bangladesh, Jordan, Mozambique, Bolivia, Mali, Thailand, Albania and Yemen. In tertiary education, while growth was still strong among the bottom groups - and stronger than the top - growth was led by the second group of countries and was stronger in Djibouti, Kyrgyzstan, Rwanda, Yemen, Ghana, Samoa, Libya, Malaysia, Vietnam, Latvia, Niger, Ethiopia and Mongolia.

Growth in ICT uptake was 350% for the bottom group compared to 90% for the top group. The fourth group (D) had a growth rate double that of the second group (B). Overwhelmingly, this growth came from Internet use, which exploded in the period under consideration. It increased by 733%, more than any other indicator used, not only in uptake but also in networks. This is mostly due to the two bottom groups ushering in the new technology, which again started from next to nothing. But even in the top two groups, growth in Internet usage was the highest and exceeded that of mobile phones which was very strong. These movements are indicative of the continuing inroads made by the newest technology and its universal appeal. Countries that led this growth were Syria, Sudan, Gabon, Vietnam, Myanmar, Eritrea, Mauritania, Chad, Papua New Guinea, Algeria, Bangladesh, Kyrgysztan, Moldova, Lao, Togo, Morocco, Benin and China.

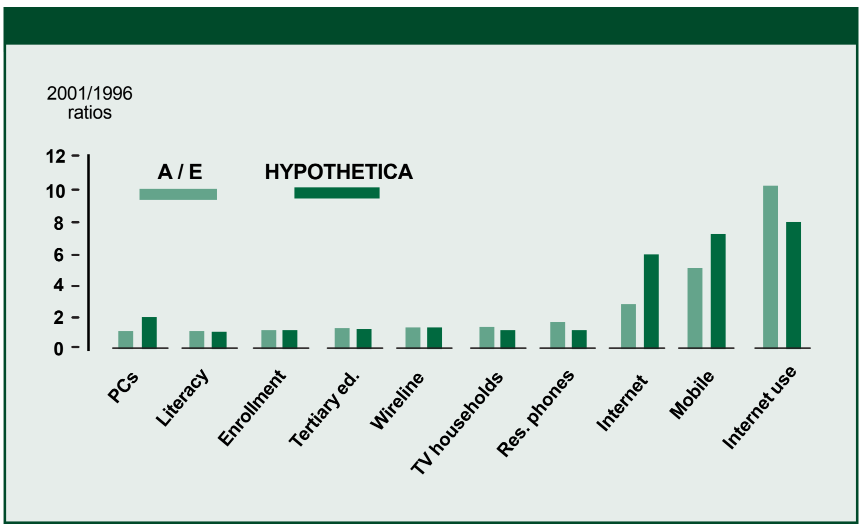
Growth in PCs was a distant second in ICT uptake and took place mainly in the three intermediate groups. Growth in the bottom group was proportionately weak, albeit stronger than the top group. Countries with higher growth were Cape Verde, Bangladesh, Honduras, Latvia, Gambia, Armenia, Moldova and Jamaica.

More modest growth occurred in residential phone lines, with the situation in the top group remaining largely unchanged, as it is close to saturation. Again growth was led by the bottom group. Countries that led growth were Sudan, Ghana, Albania, Sri Lanka, China, Lao, Mauritania and Brazil.

Even more modest growth took place in the case of TV households. Among countries with considerable room to grow, proportionately stronger gains were registered in Eritrea, Gabon, Lao, Ethiopia, Gambia, Mozambique, Pakistan, Syria, Bangladesh and Nepal.

To summarize, the relative contribution of individual factors in the slow closing of the Digital Divide overall, the ratios of the top and the bottom group were computed for each indicator and for the years 1996 and 2001. Then, their 2001/1996 ratio was plotted, together with the 2001/1996 ratios of Hypothetica (Chart 9). This shows the extent to which each factor contributed to the closing gap between the top and the bottom groups, as well as it offers comparisons with the average movements over the period. Clearly, much of the upward movement is accounted for by the use of the Internet, followed by mobile phones and Internet networks. Thus, the same factors that account the most for the Digital Divide are also the ones that move more in the direction of alleviating it – although the movement is painfully slow.

Chart 9. **Contributors to the closing Digital Divide**



Chapter 5

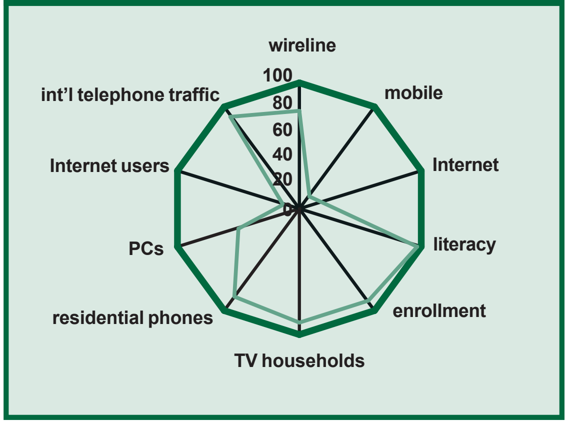
COUNTRY PROFILES

Similarities and differences in the patterns of infostate growth among countries have been identified. These are useful in assessing a country's comparative performance, identifying its relative strengths and weaknesses and, at a more detailed level, linking the changes to specific initiatives and policies. The latter is directly applicable to individual countries. Such exercises can then lead to the redrafting, refinement or calibration of such initiatives and policies in a way that would reflect the accumulated performance experiences. What works and what does not work, what works more and in what context, can be uncovered and understood. This will be accomplished best if it is not based solely on the experiences of the country concerned, but rather drawing on the reservoir of experiences everywhere - some of which will be inevitably more relevant to the reality of a country than others.

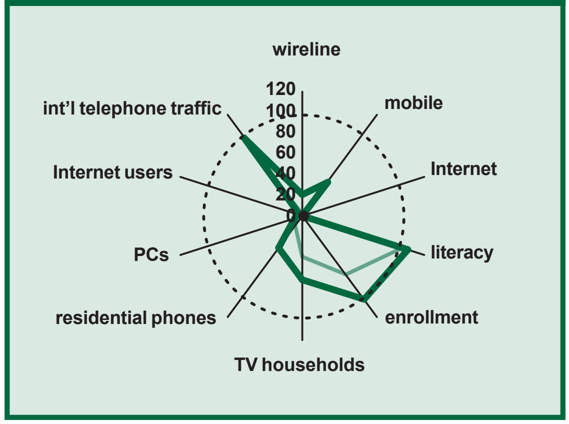
Such investigations can be made for country groupings, whether they are arrived at through Infostate rankings, incomes, regional or other considerations, or for country pairs. Moreover, they can entail a comprehensive approach, encompassing simultaneously all areas of interest or they can be more targeted to a well-defined priority area, say, telecommunications policy. Early examples of this approach were provided in Chapters 3 and 4. In any case, the specific situation of an individual country is always the starting point, and this involves both the identification of where things stand and the dynamics of arriving there. What follows shows in graphical form the situation of each country with respect to a set of several key indicators used to arrive at Infostates, as well as the country's evolution over the 1996-2001 period. In addition, it contains the 2001 situation of the average country, Hypothetica,for easy benchmarking. (All values are in index form).

1996 values   2001 values   2001 average values (Hypothetica)

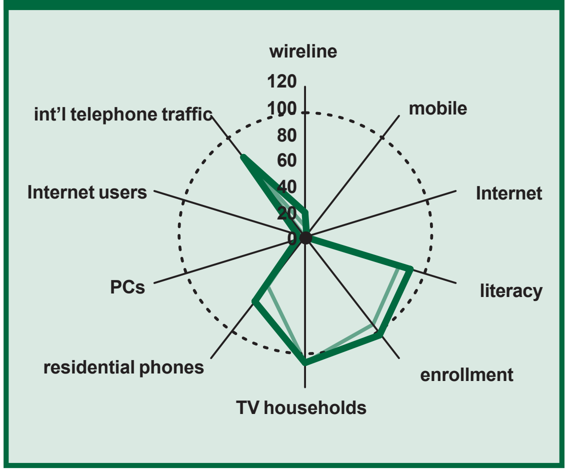
HYPOTHETICA



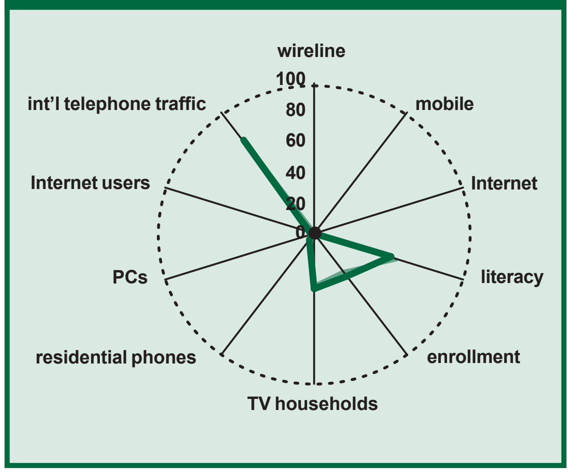
ALBANIA



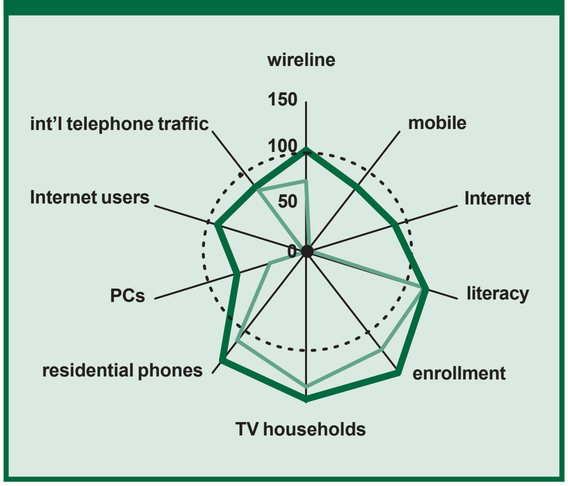
ALGERIA



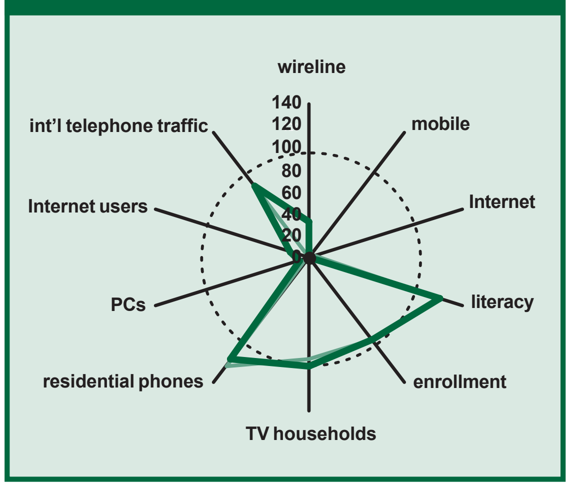
ANGOLA



ARGENTINA

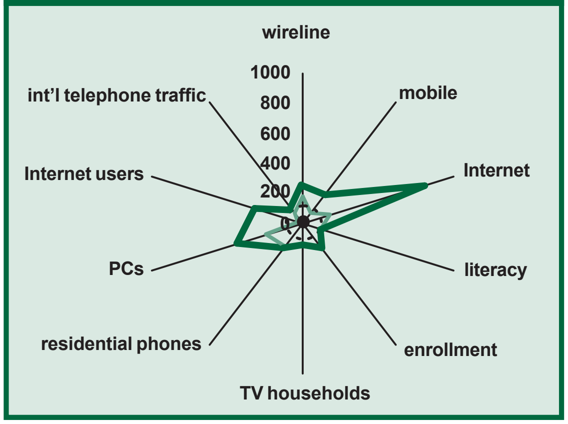


ARMENIA

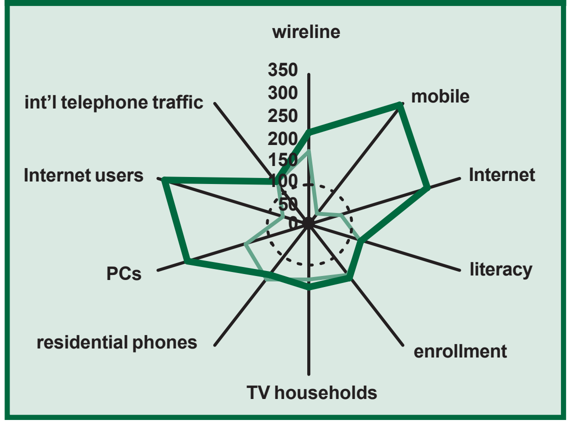


1996 values   2001 values   2001 average values (Hypothetica)

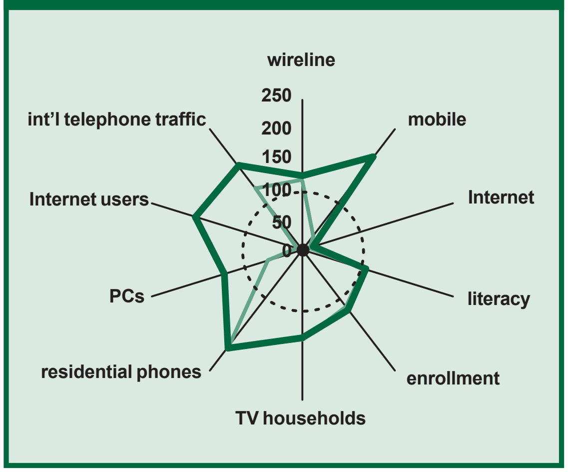
AUSTRALIA



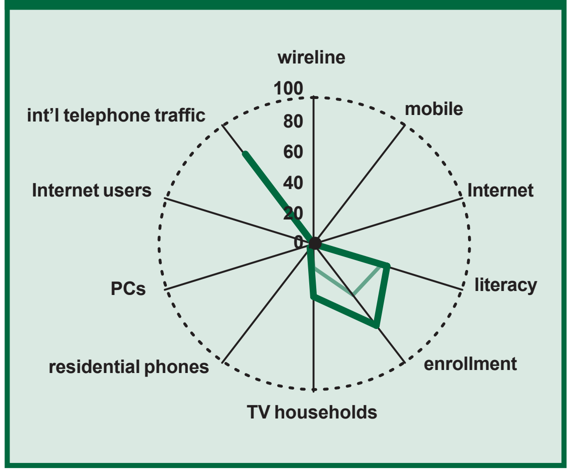
AUSTRIA



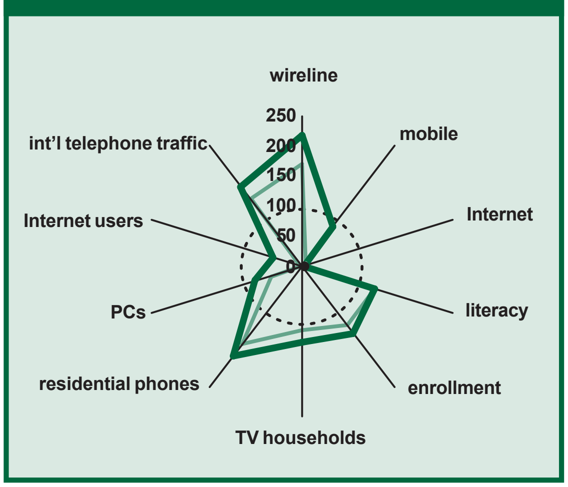
BAHRAIN



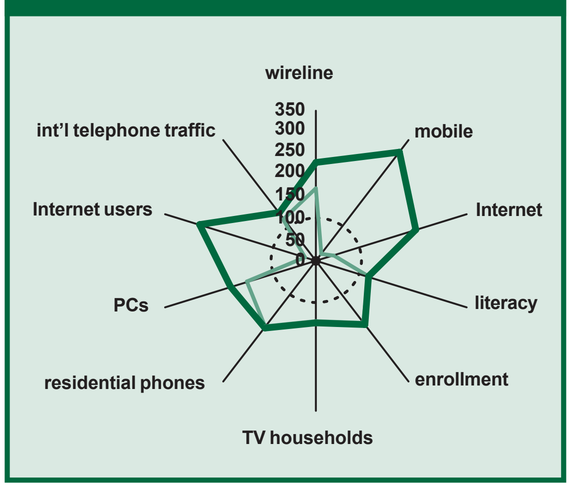
BANGLADESH



BARBADOS

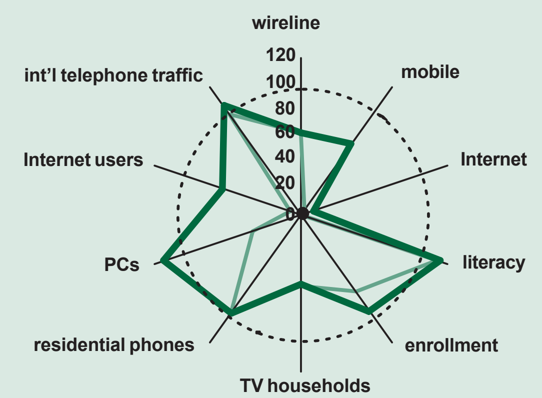


BELGIUM

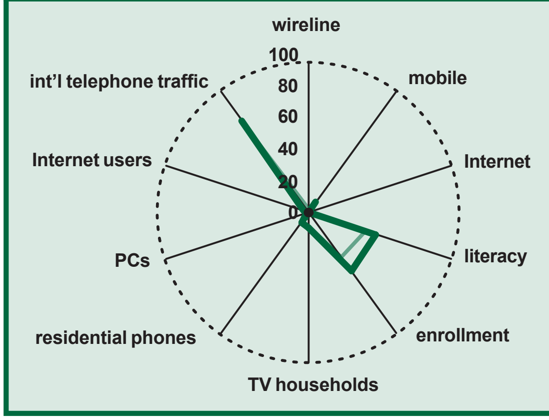


1996 values   2001 values   2001 average values (Hypothetica)

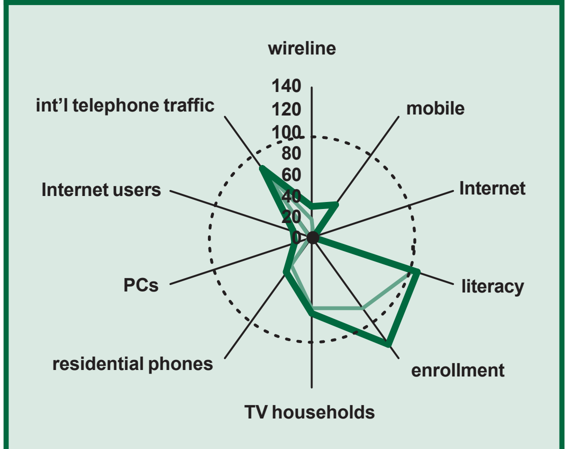
BELIZE



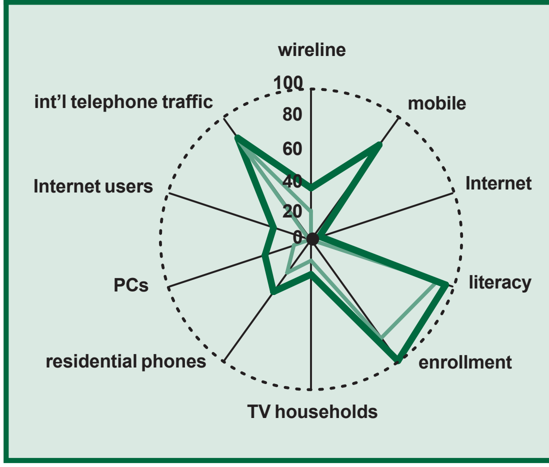
BENIN



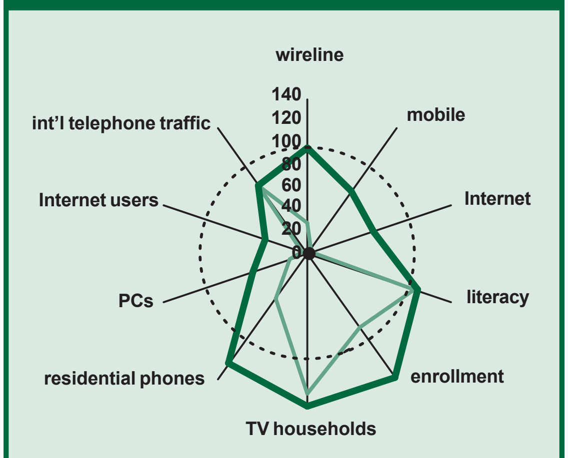
BOLIVIA



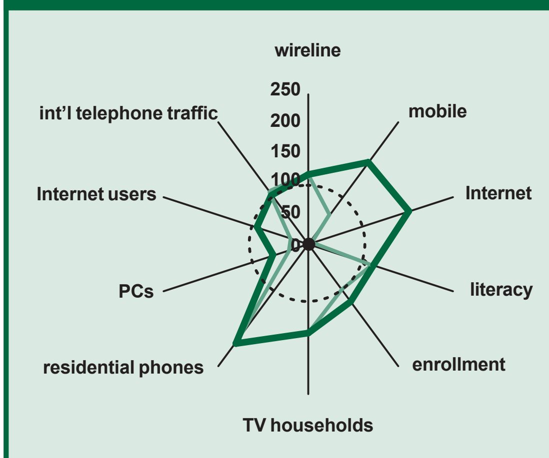
BOTSWANA



BRAZIL

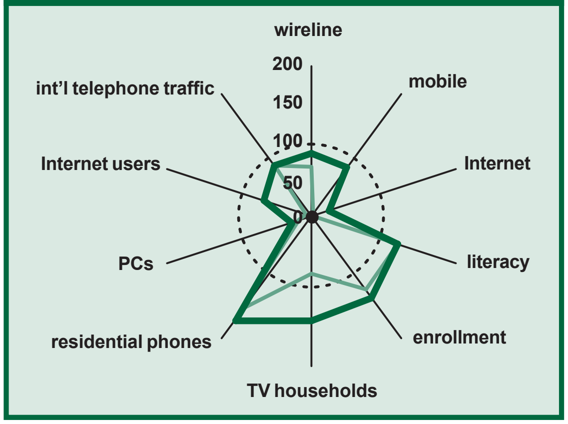


BRUNEI DARUSSALAM

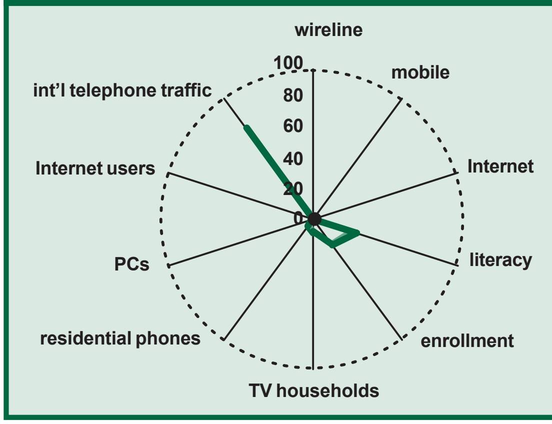


1996 values — 2001 values — 2001 average values (Hypothetica)

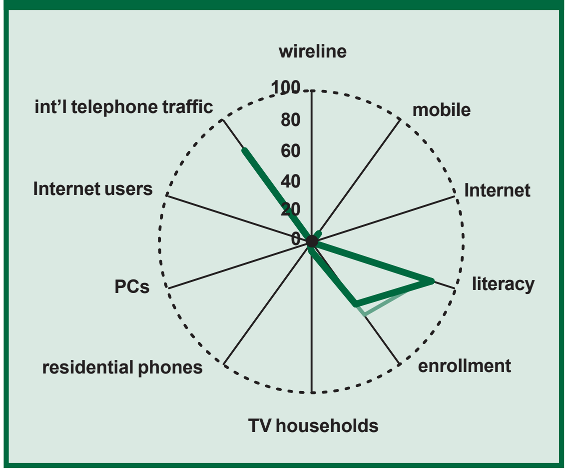
BULGARIA



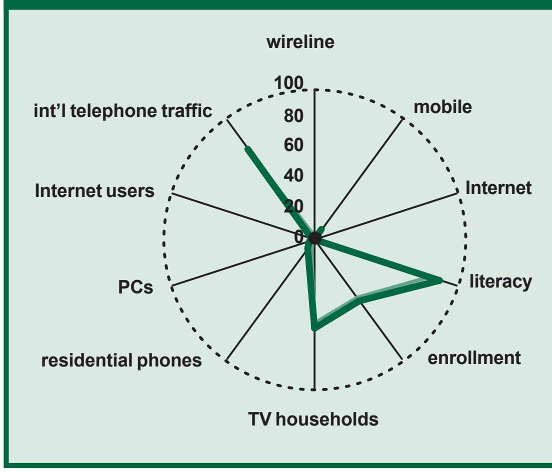
BURKINA FASO



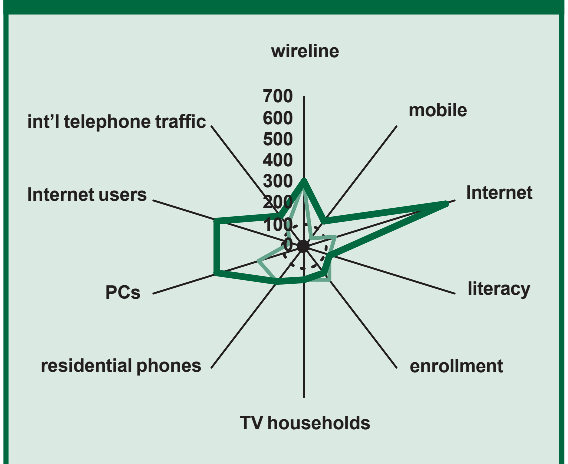
CAMBODIA



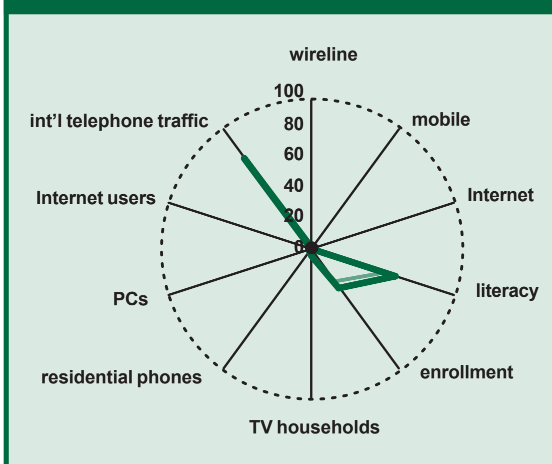
CAMEROON



CANADA

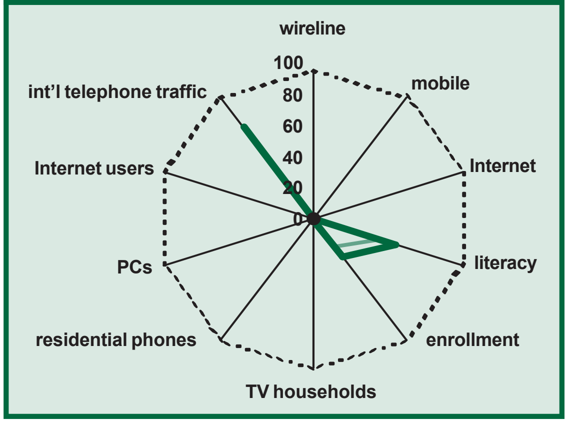


CENTRAL AFRICAN REPUBLIC

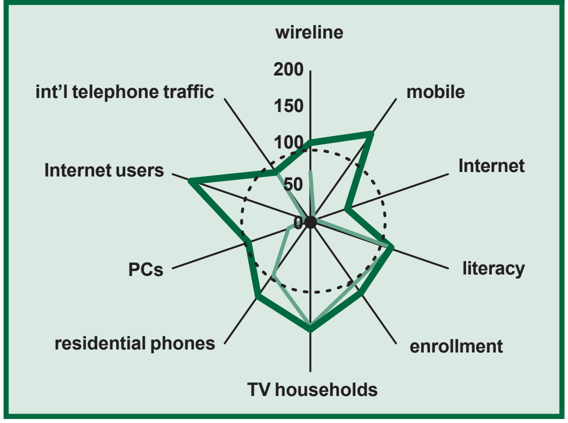


1996 values — 2001 values — 2001 average values (Hypothetica)

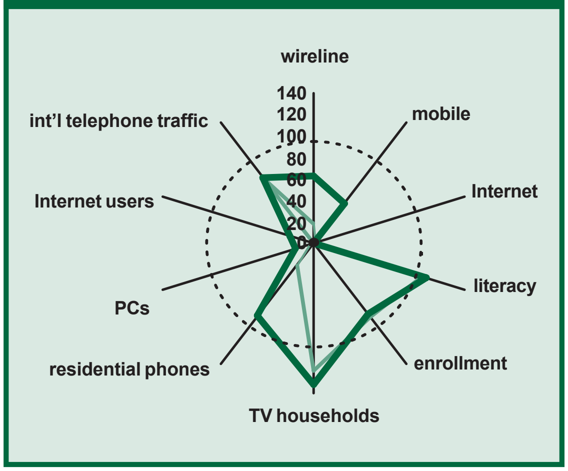
CHAD



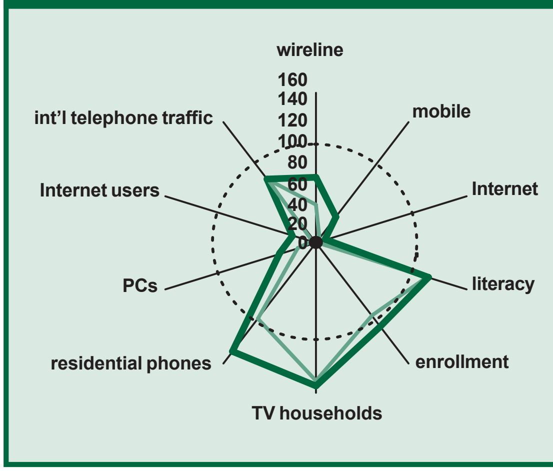
CHILE



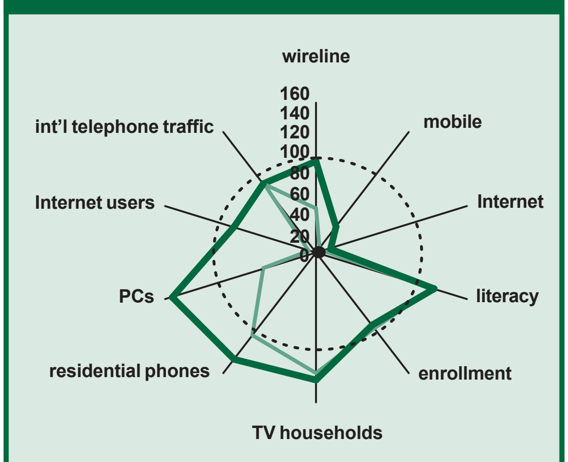
CHINA



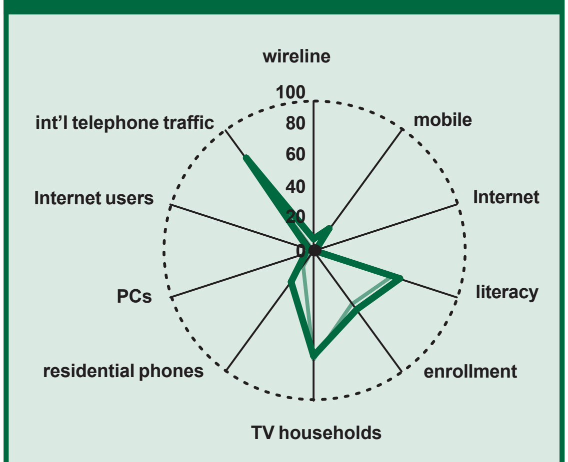
COLOMBIA



COSTA RICA

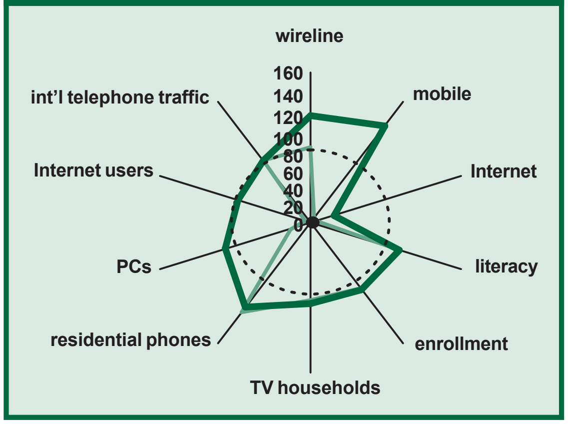


COTE D'IVOIRE

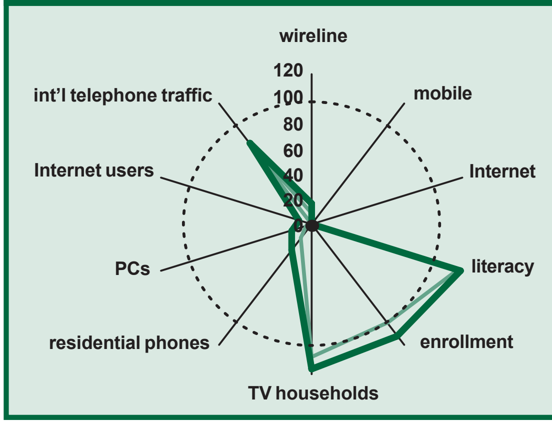


1996 values — 2001 values — 2001 average values (Hypothetica)

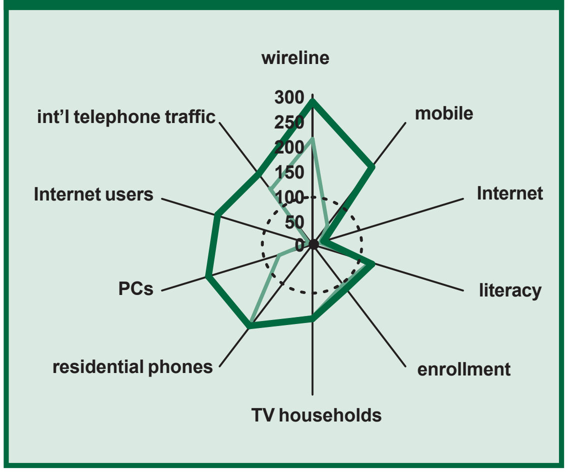
CROATIA



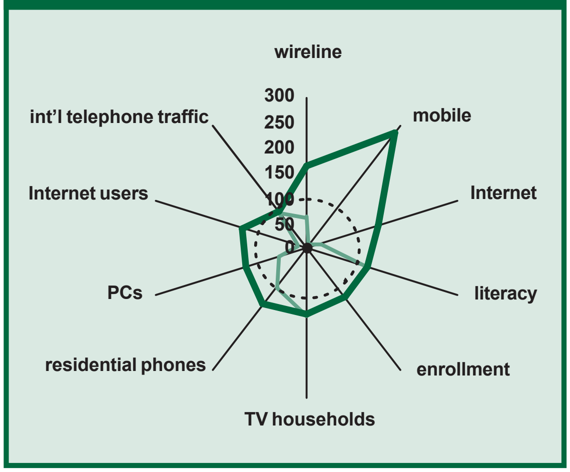
CUBA



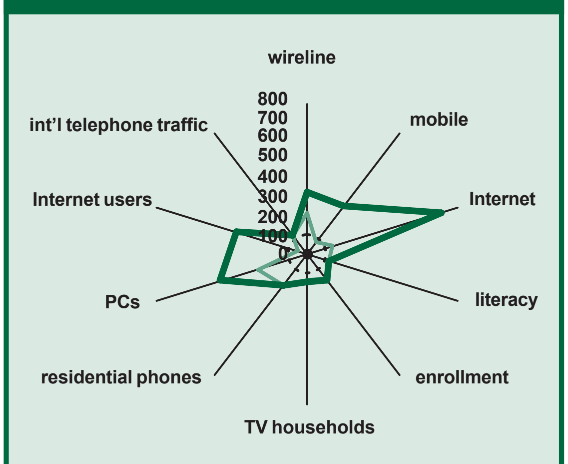
CYPRUS



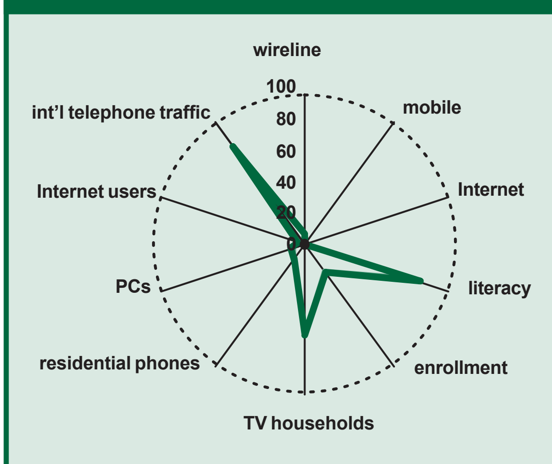
CZECH REPUBLIC



DENMARK

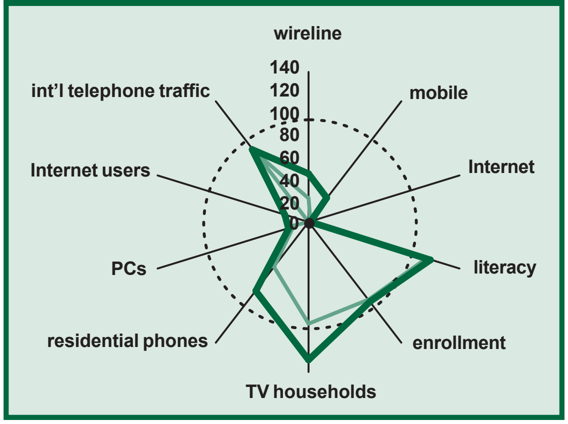


DJIBOUTI

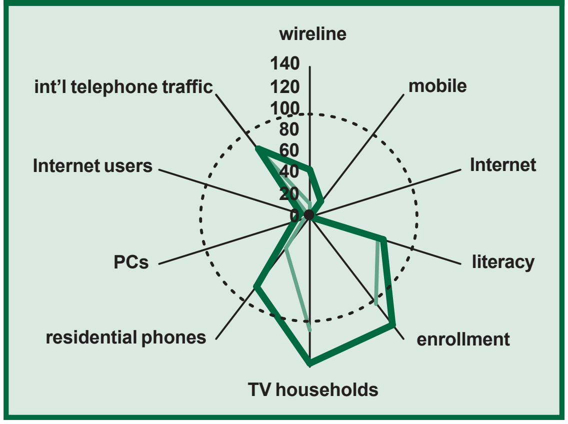


1996 values 2001 values 2001 average values (Hypothetica)

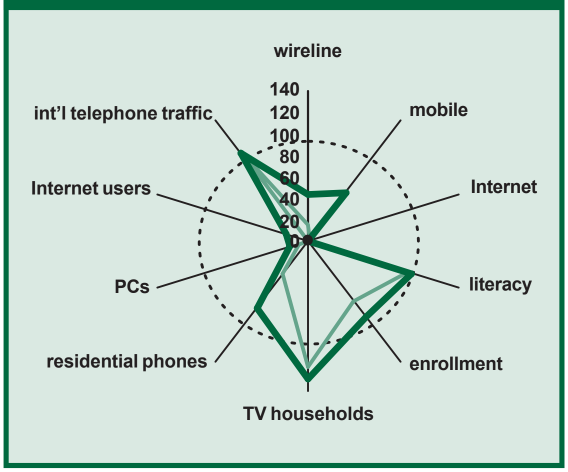
ECUADOR



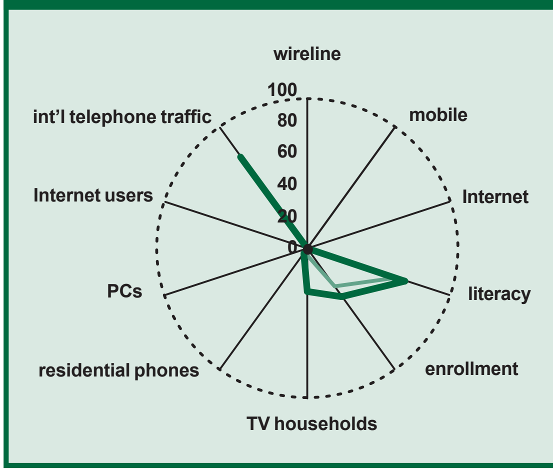
EGYPT



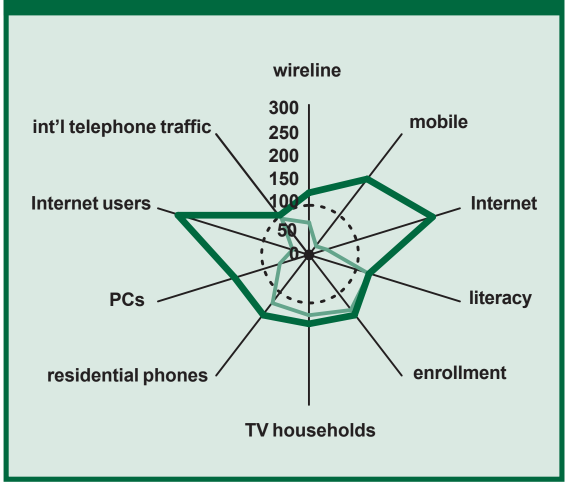
EL SALVADOR



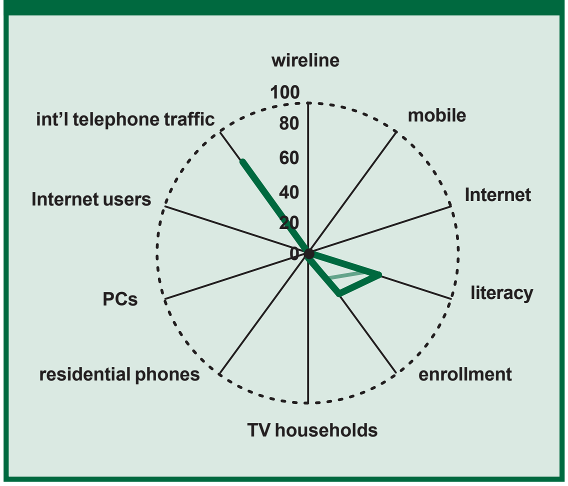
ERITREA



ESTONIA

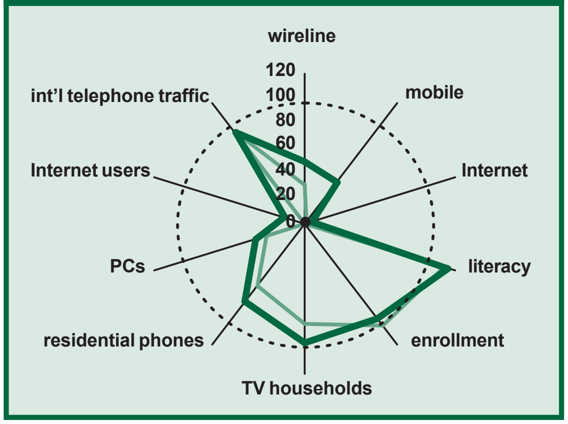


ETHIOPIA

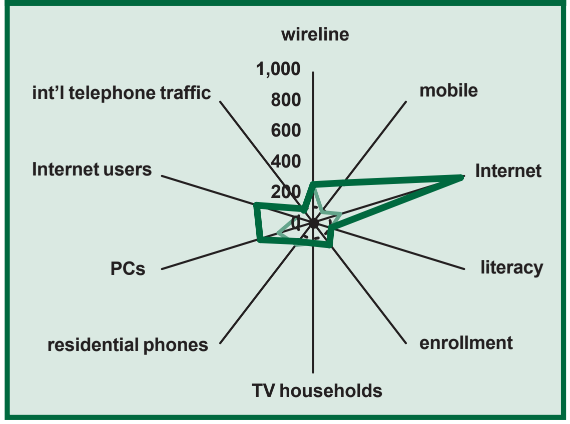


1996 values | 2001 values | 2001 average values (Hypothetica)

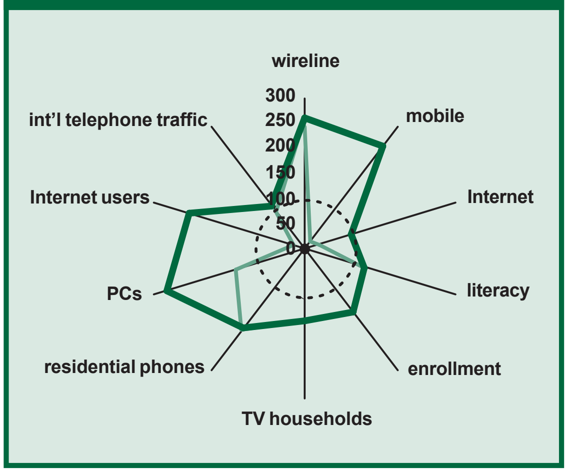
FIJI



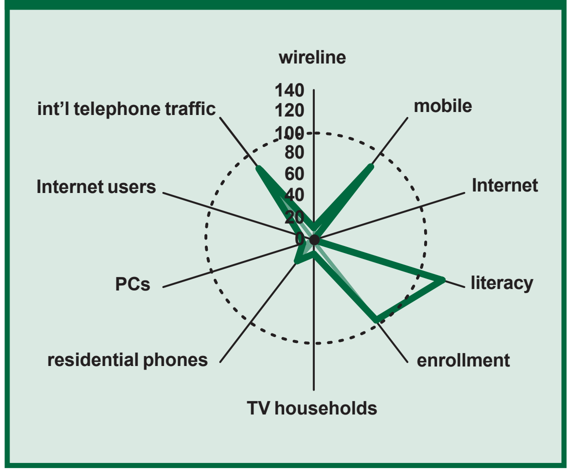
FINLAND



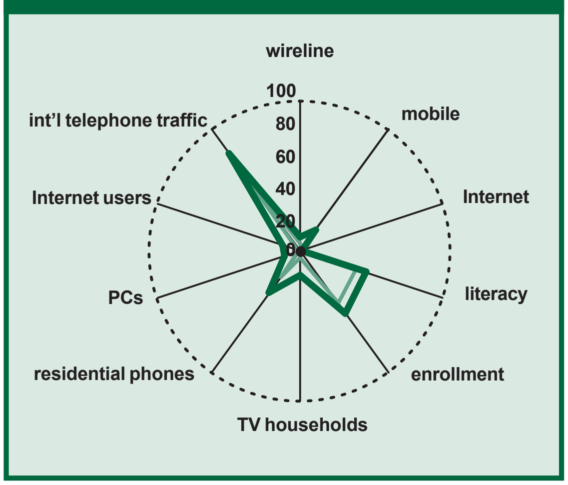
FRANCE



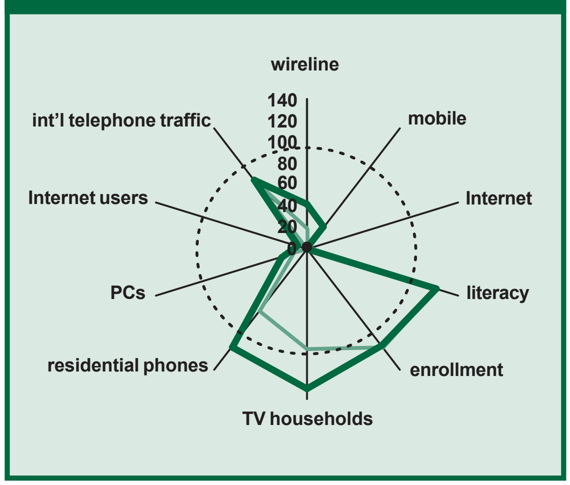
GABON



GAMBIA

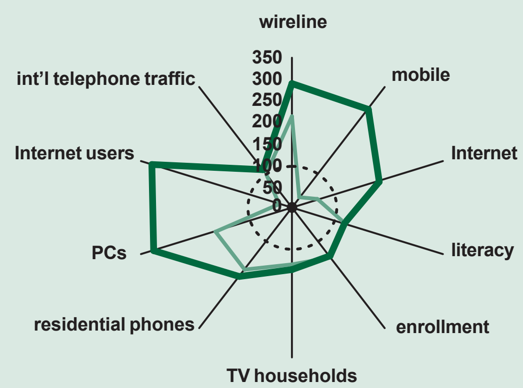


GEORGIA

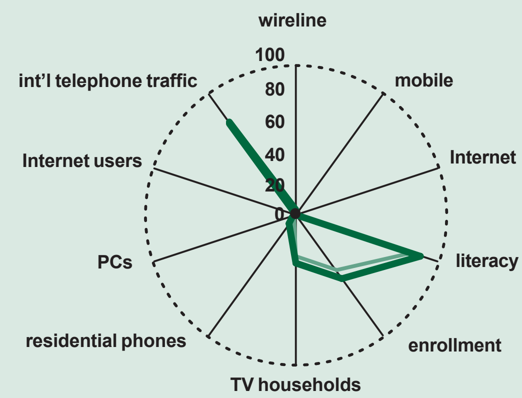


1996 values   2001 values   2001 average values (Hypothetica)

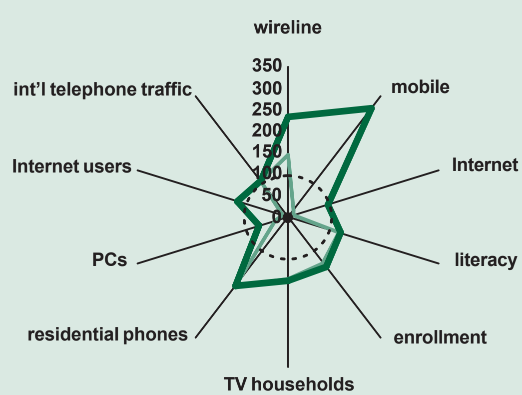
GERMANY



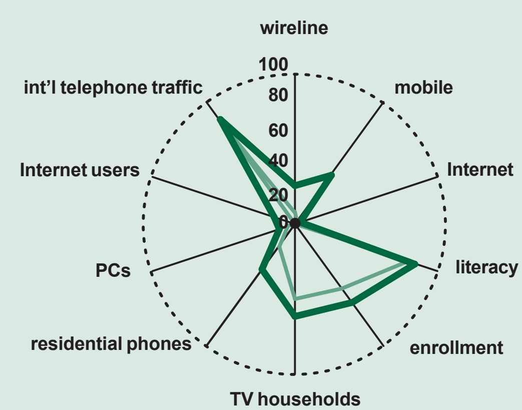
GHANA



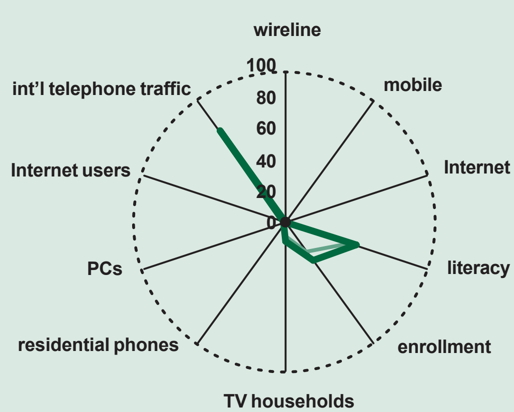
GREECE



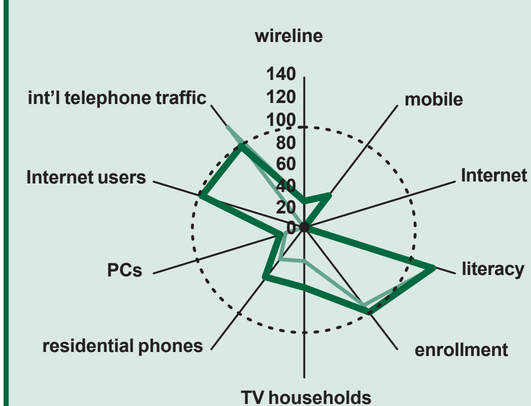
GUATEMALA



GUINEA

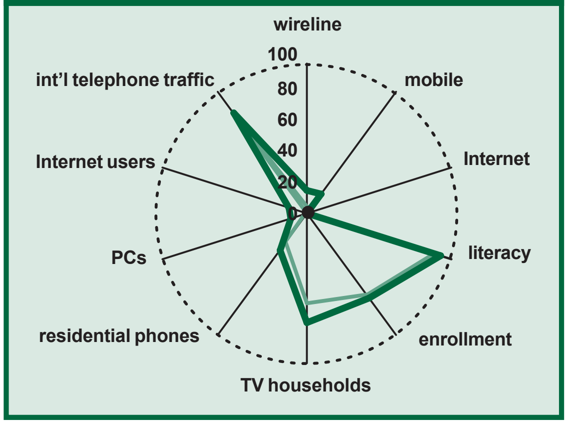


GUYANA

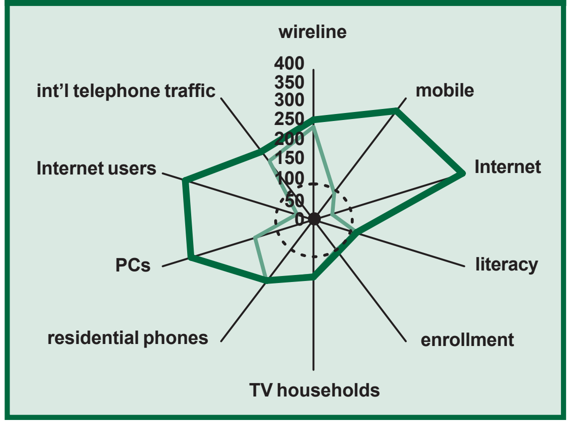


1996 values   2001 values   2001 average values (Hypothetica)

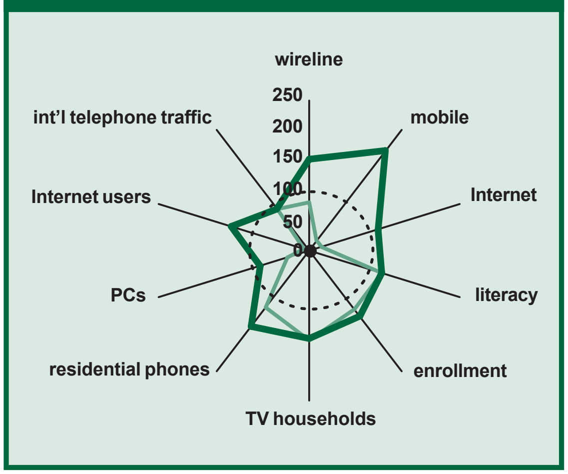
HONDURAS



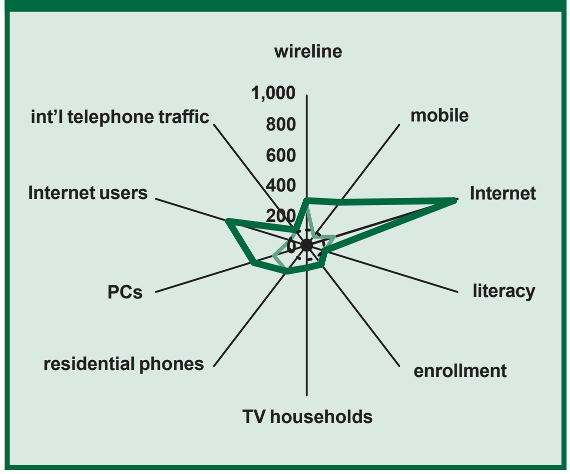
HONGKONG



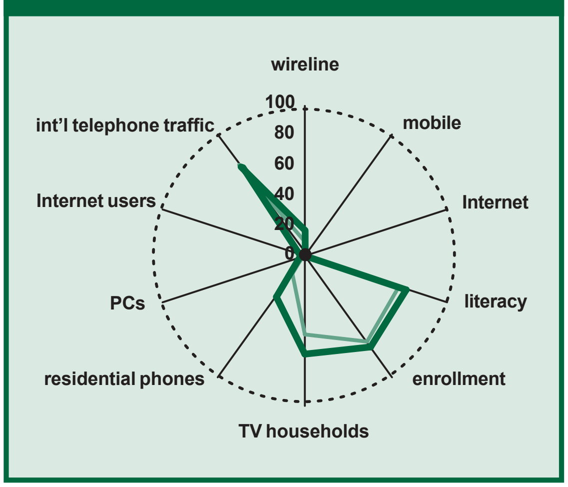
HUNGARY



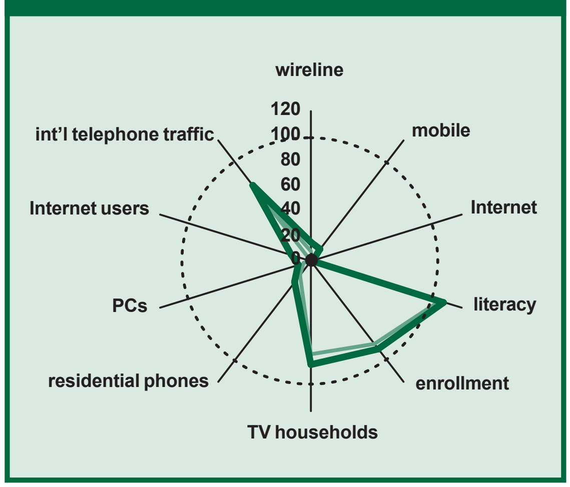
ICELAND



INDIA

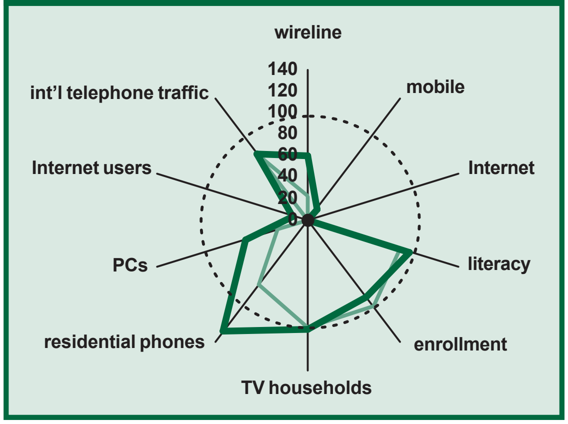


INDONESIA

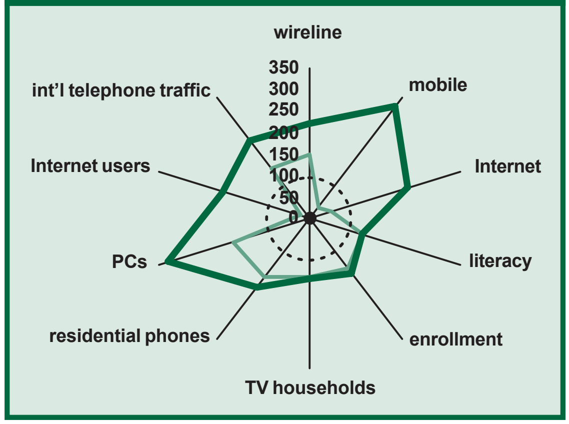


1996 values — 2001 values — 2001 average values (Hypothetica)

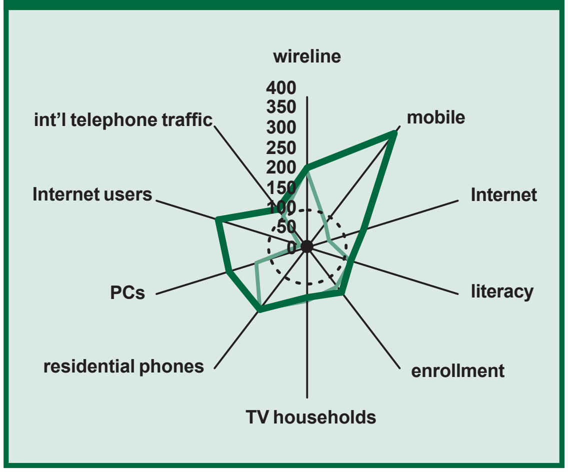
IRAN



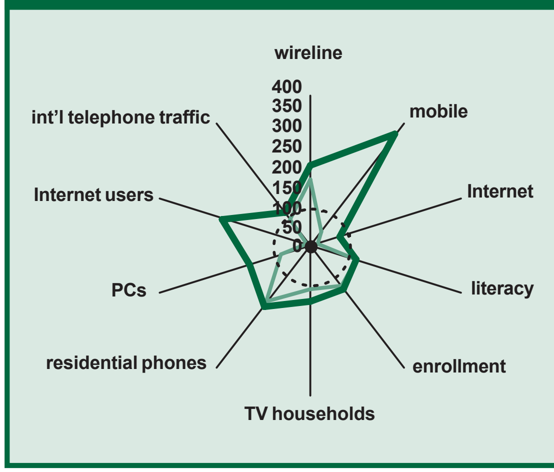
IRELAND



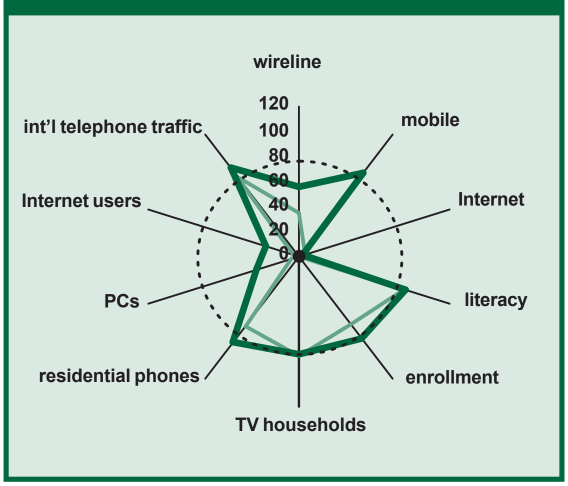
ISRAEL



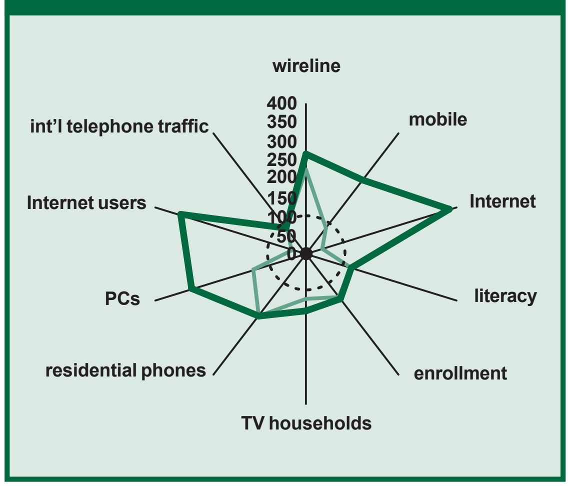
ITALY



JAMAICA

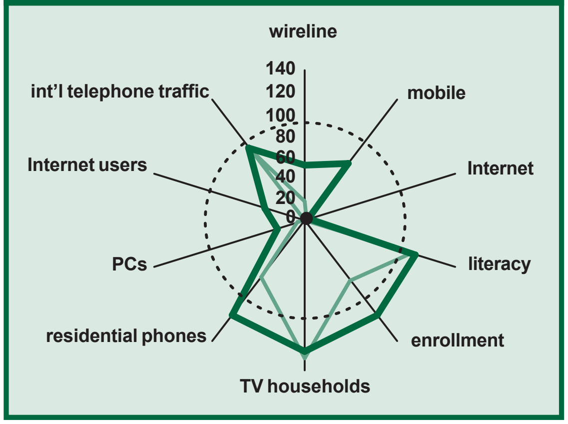


JAPAN



1996 values — 2001 values — 2001 average values (Hypothetica)

JORDAN



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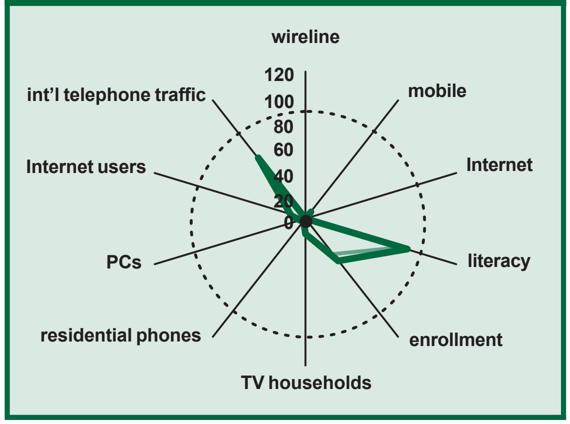

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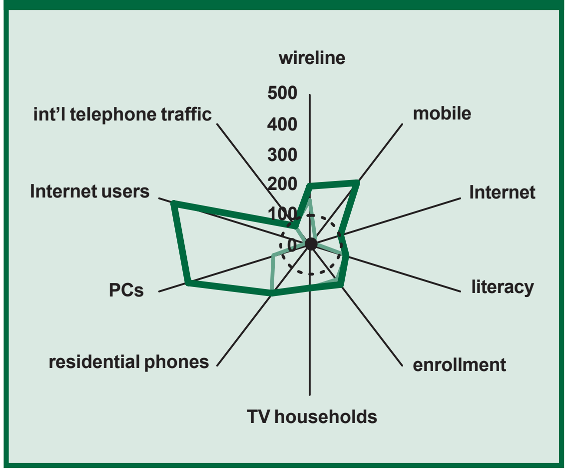

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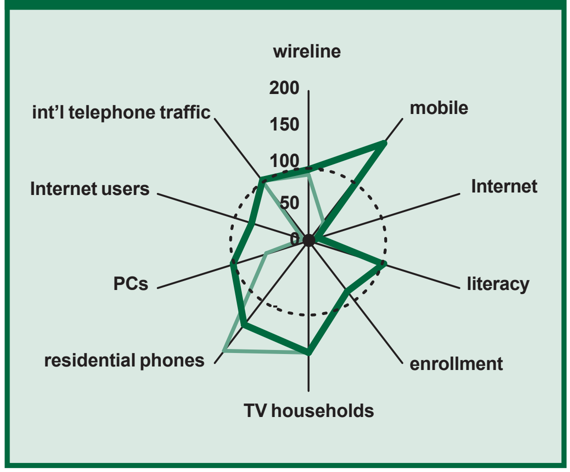

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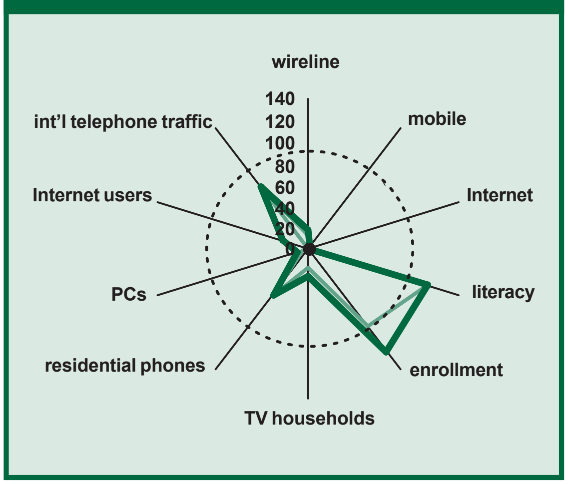

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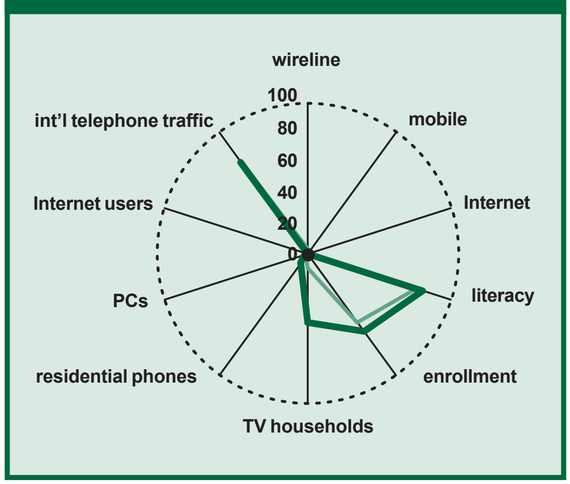

1996 values — 2001 values — 2001 average values (Hypothetica)

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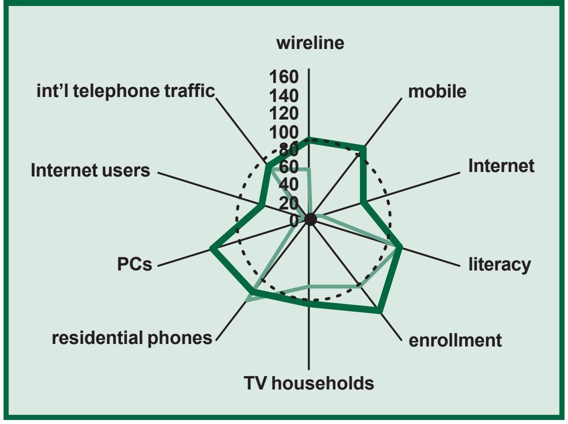

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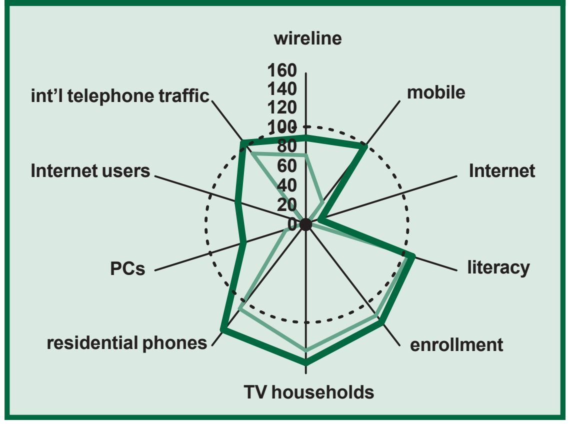

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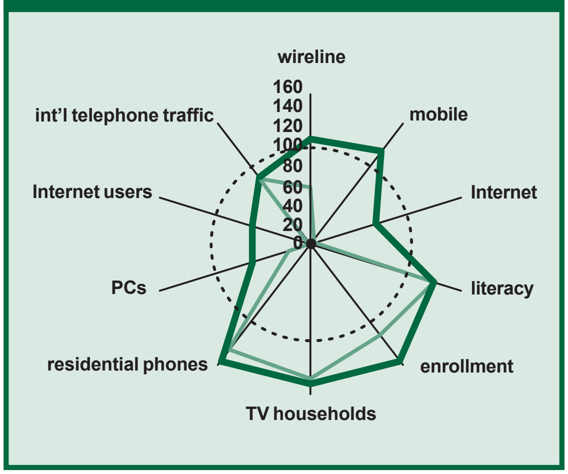

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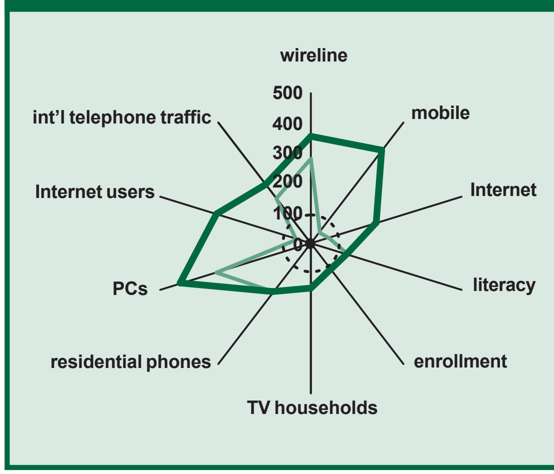

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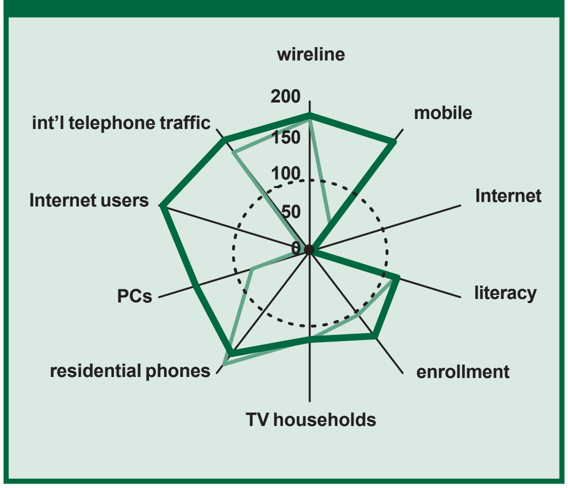

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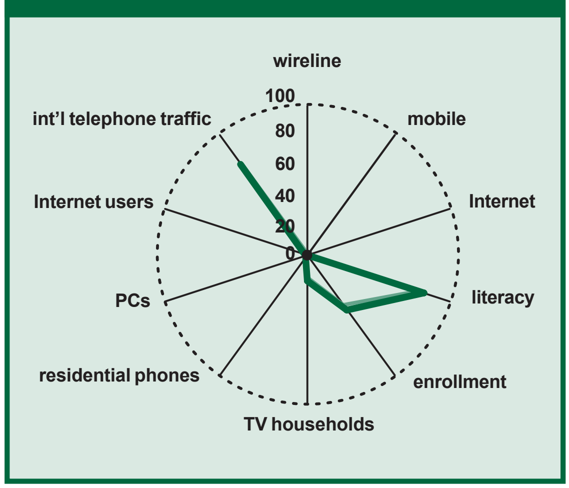

1996 values — 2001 values — 2001 average values (Hypothetica)

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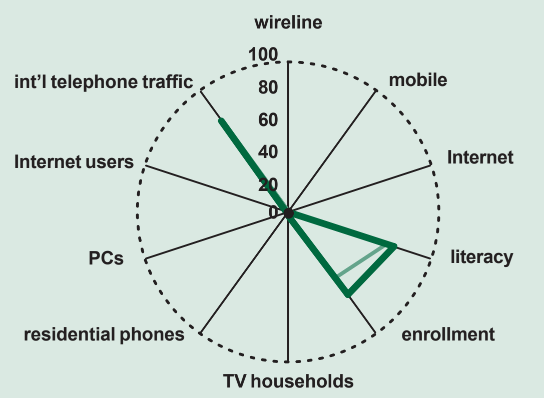

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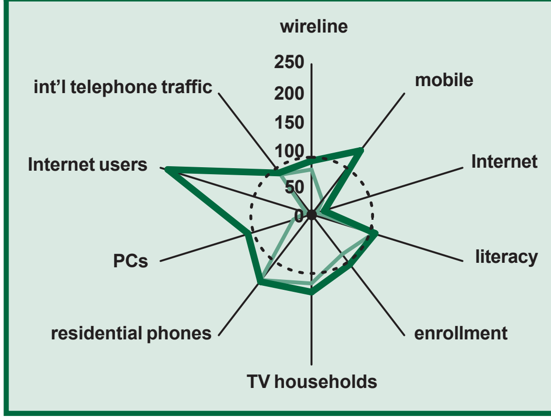

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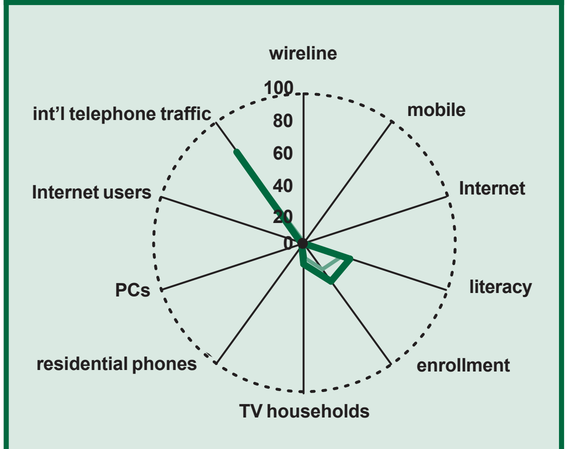

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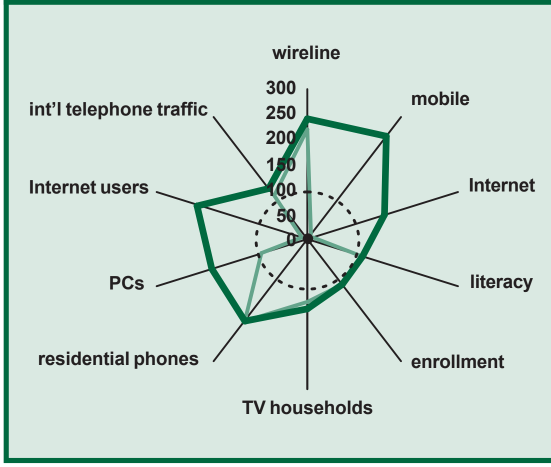

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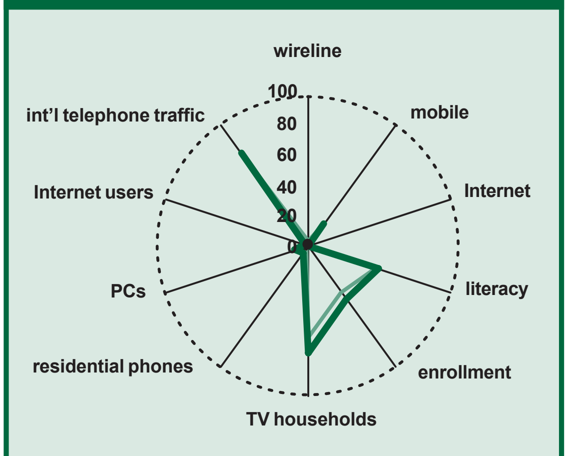

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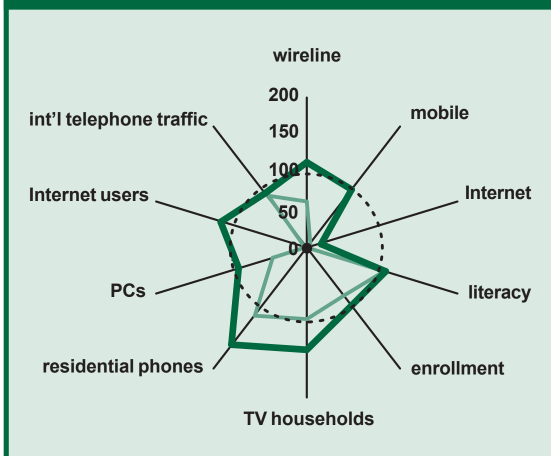

1996 values   2001 values   2001 average values (Hypothetica)

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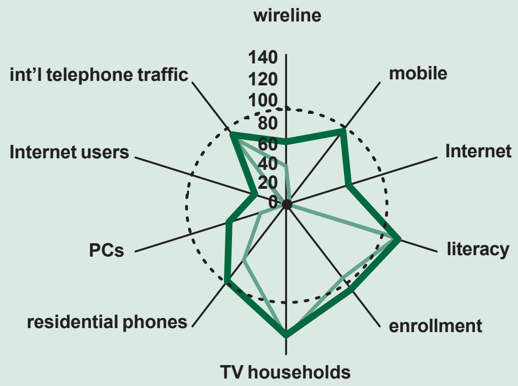

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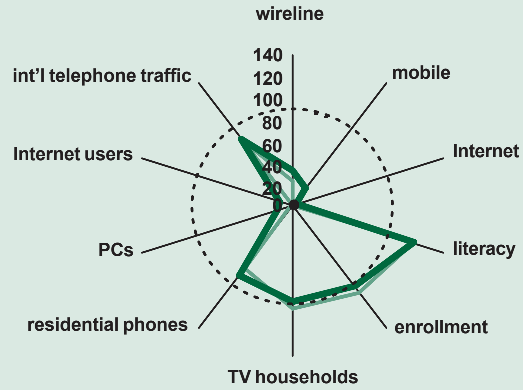

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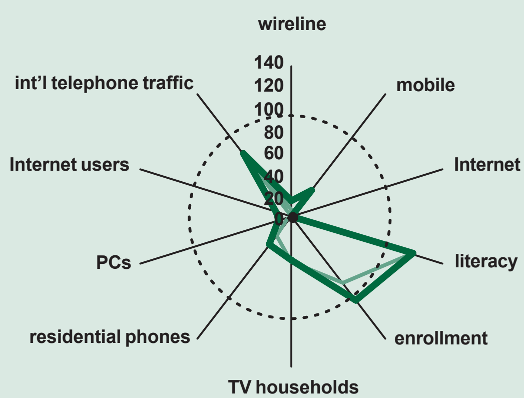
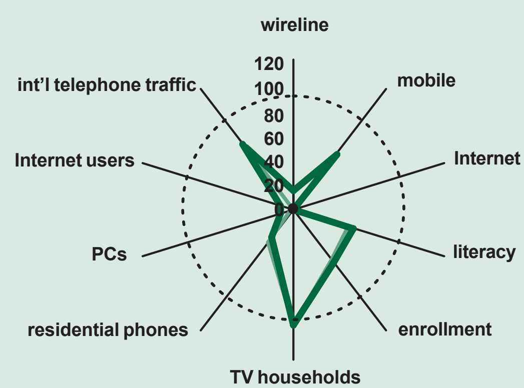


MOROCCO



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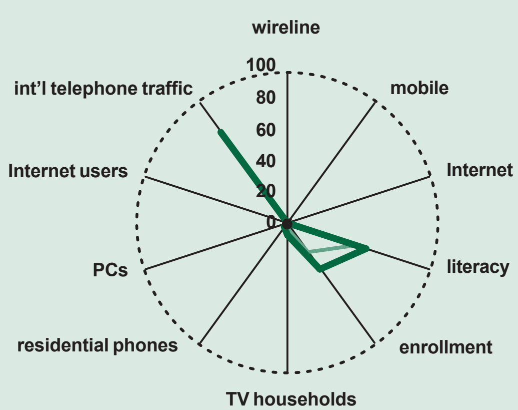

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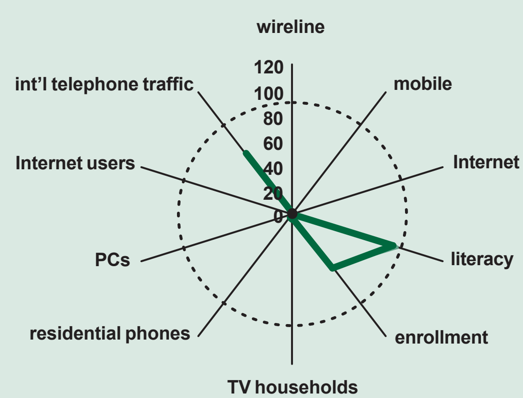
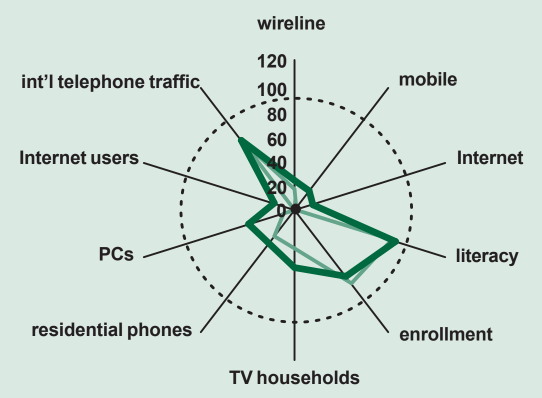


1996 values   2001 values   2001 average values (Hypothetica)

NAMIBIA



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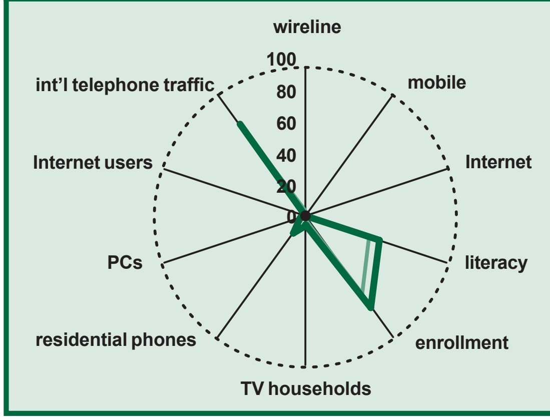

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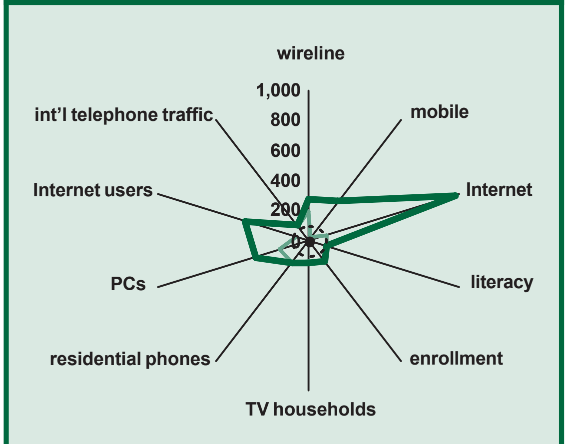

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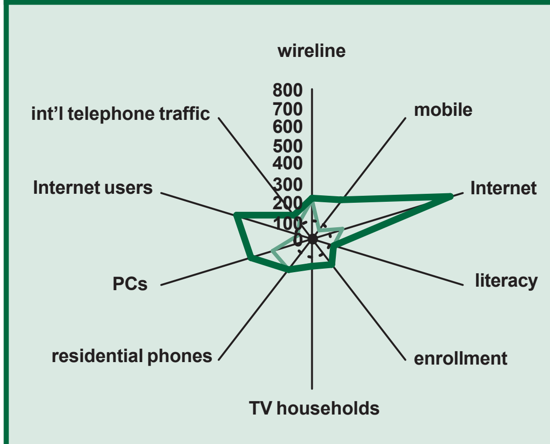

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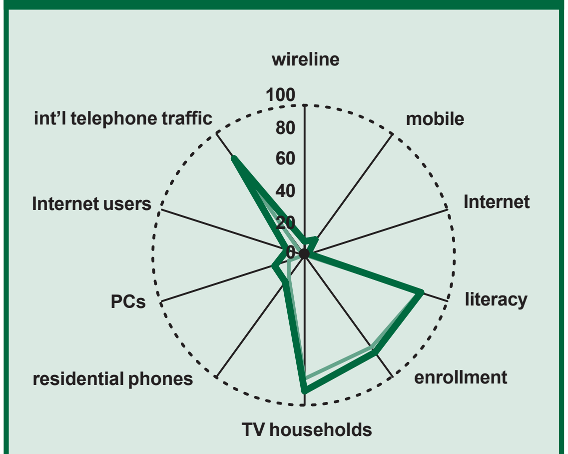

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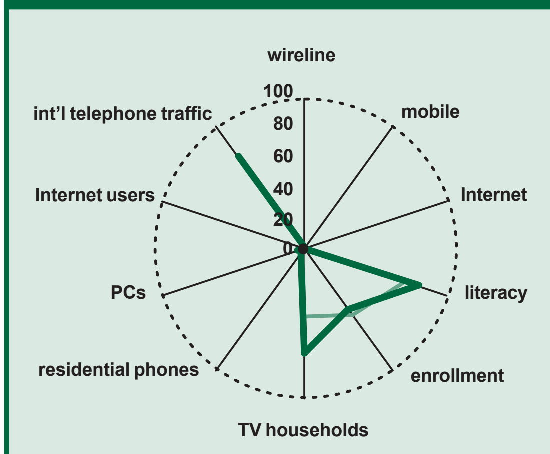

1996 values — 2001 values — 2001 average values (Hypothetica)

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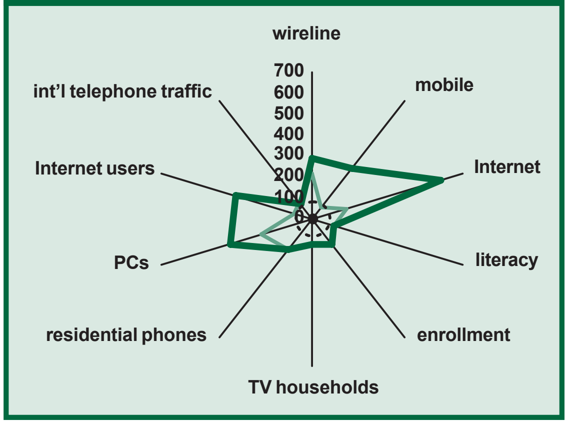

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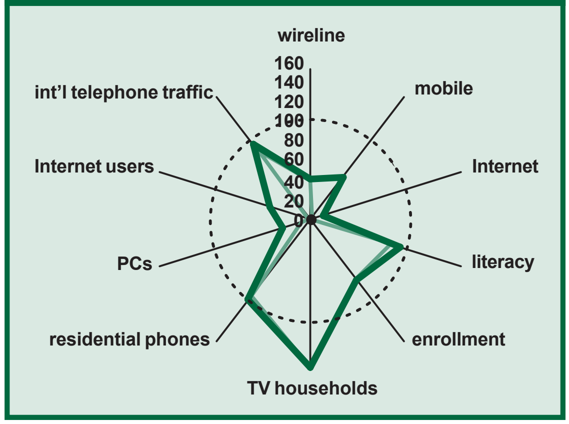

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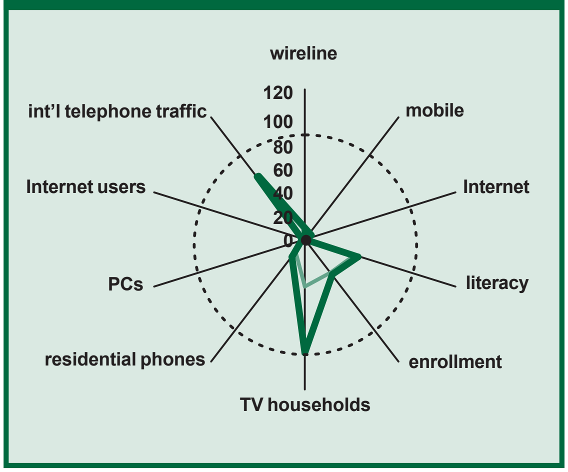

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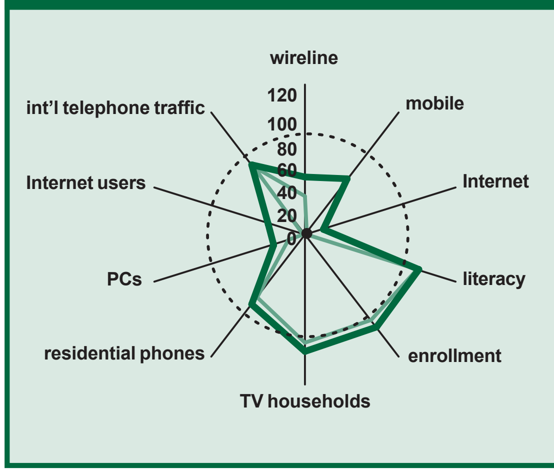

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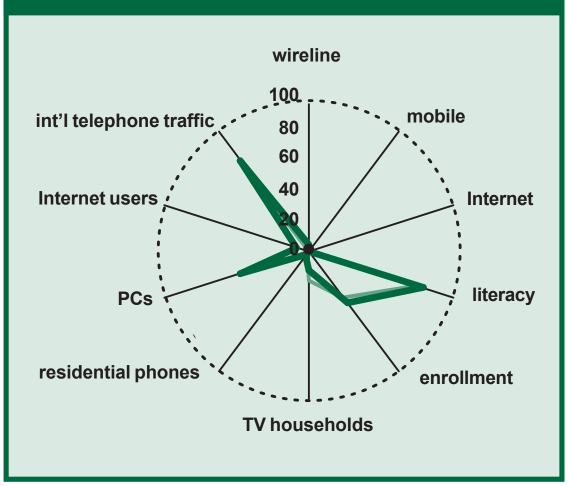

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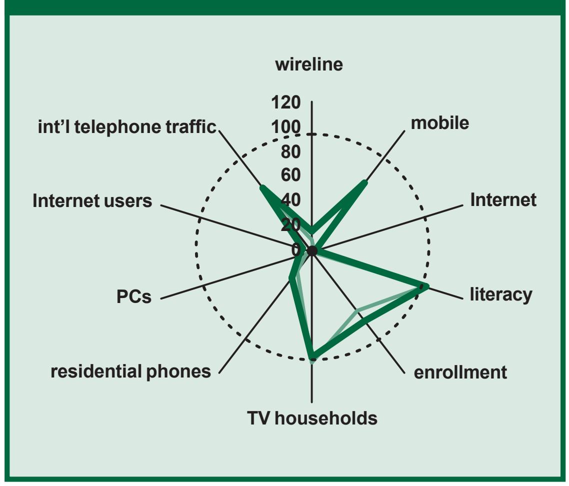

1996 values

2001 values

2001 average values (Hypothetica)

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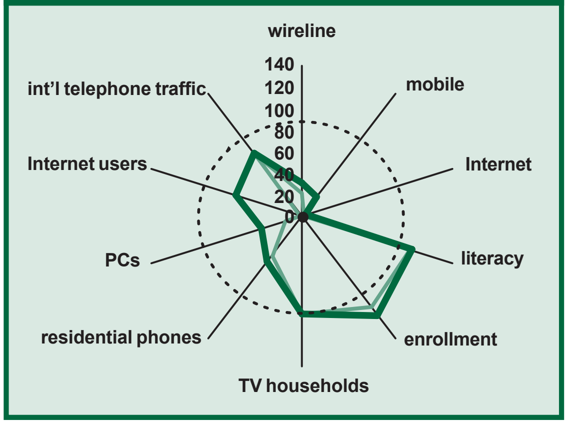

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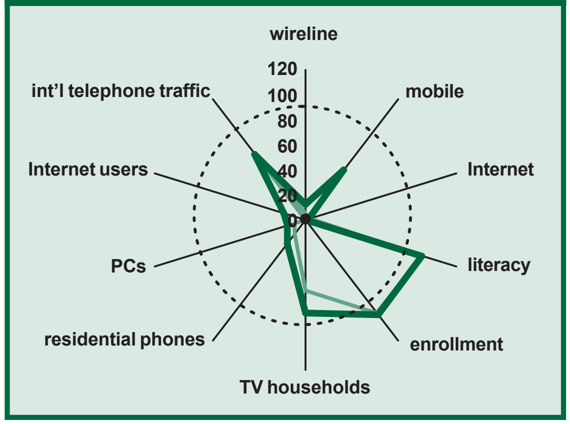

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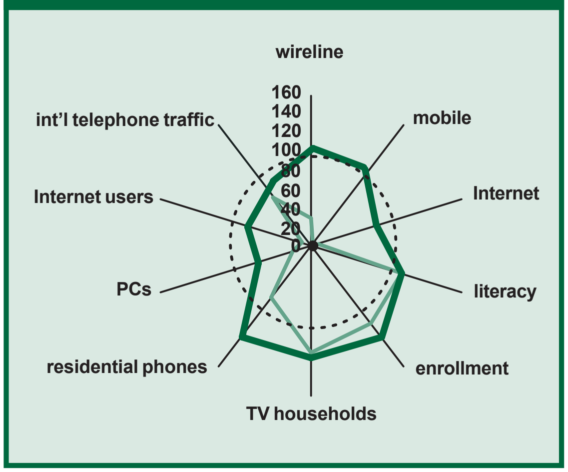

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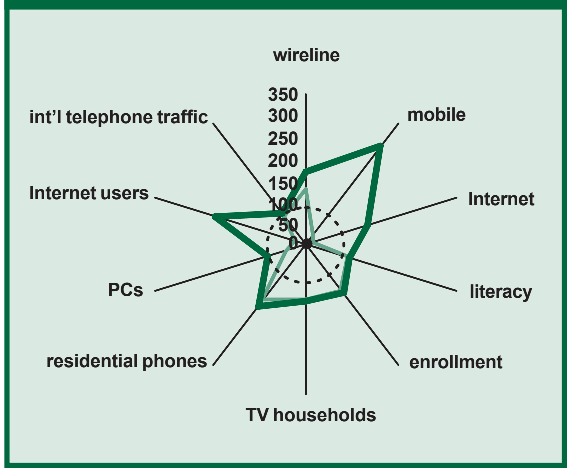

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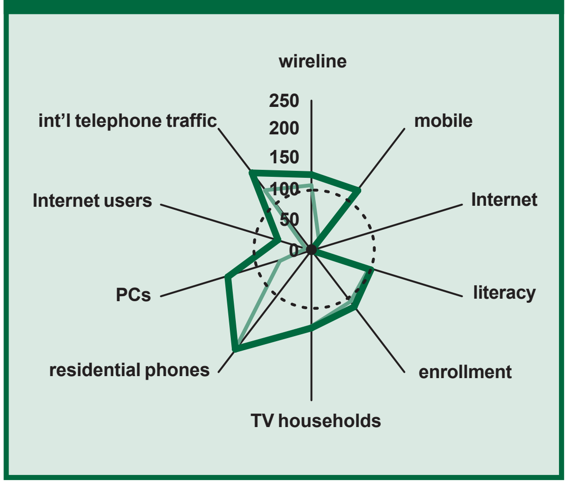

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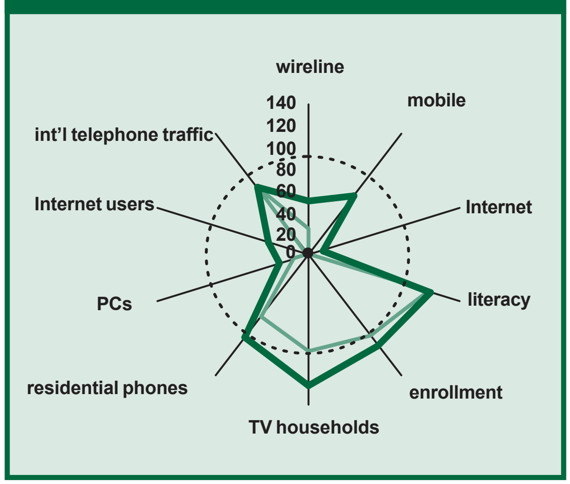

1996 values   2001 values   2001 average values (Hypothetica)

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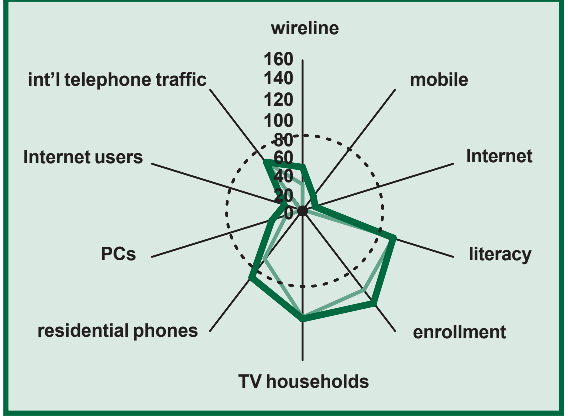

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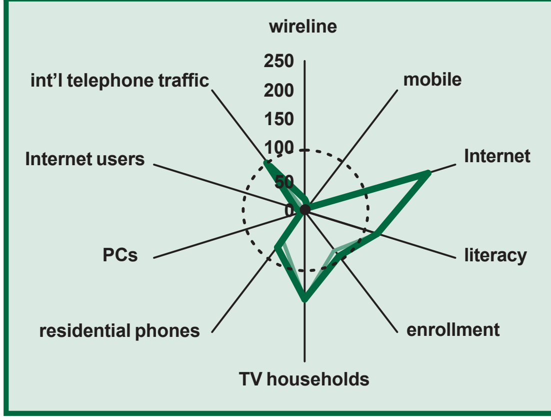

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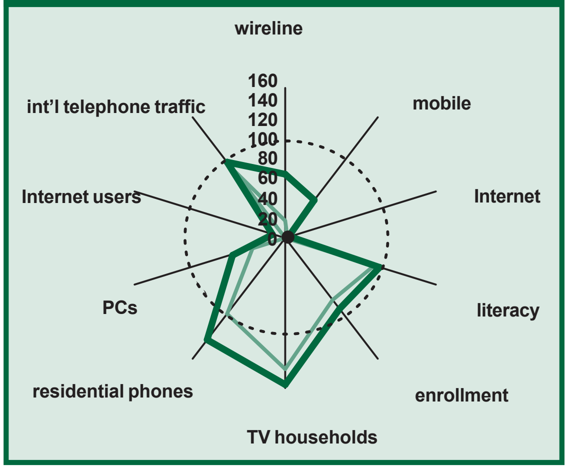

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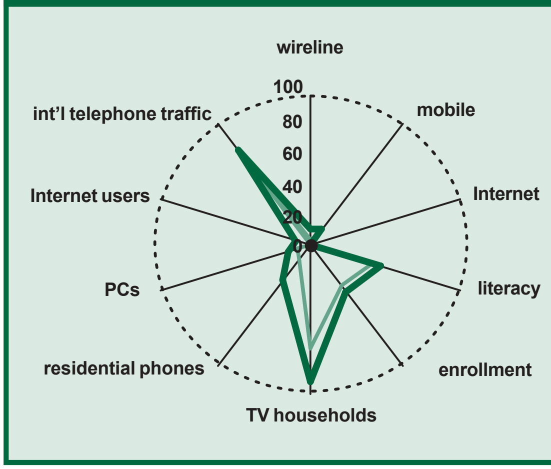

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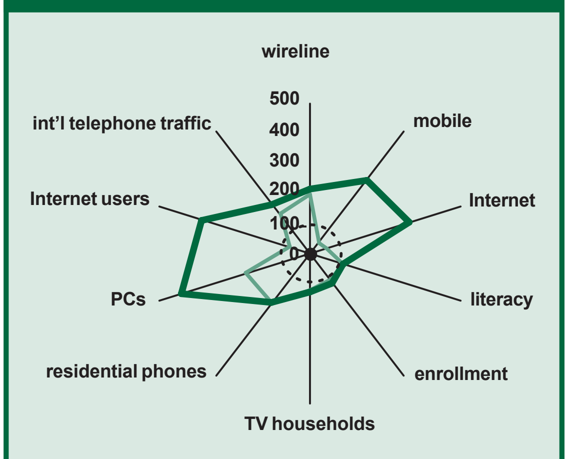

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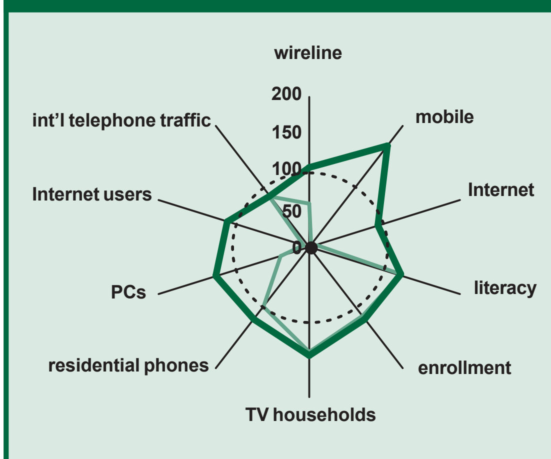

1996 values   2001 values   2001 average values (Hypothetica)

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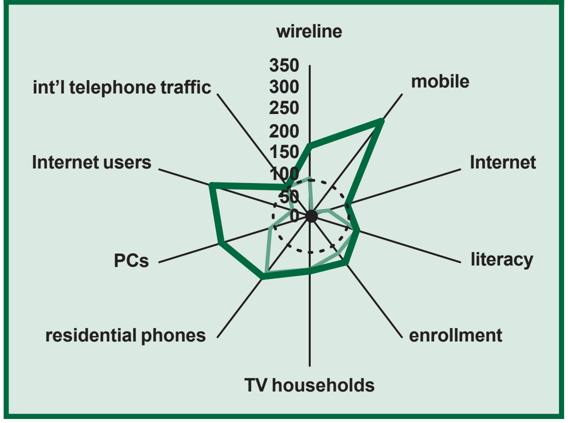

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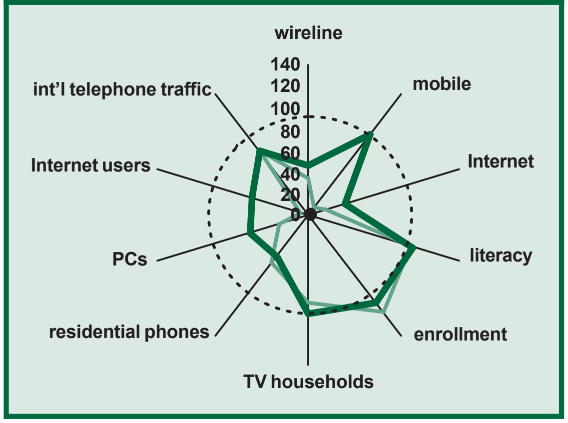

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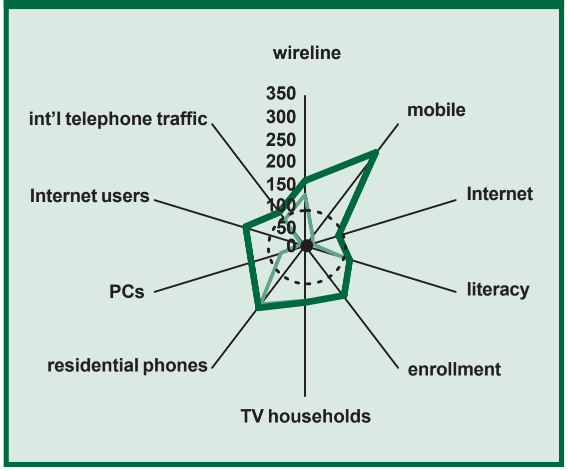

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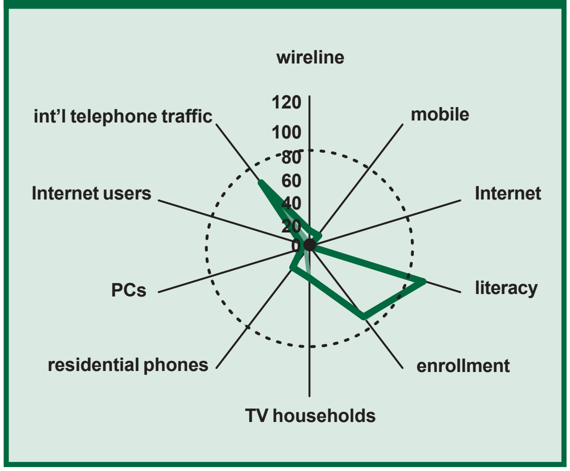
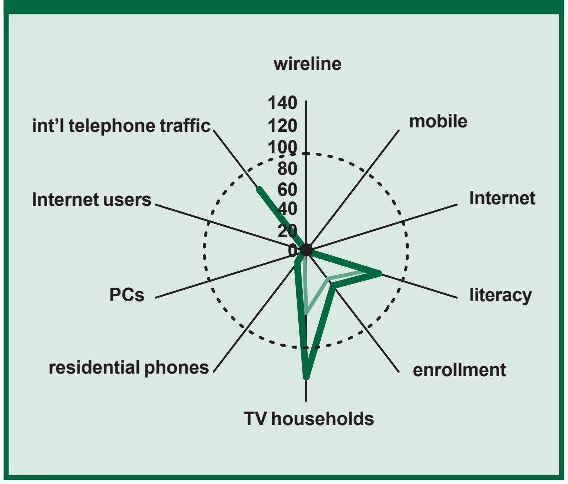


SUDAN



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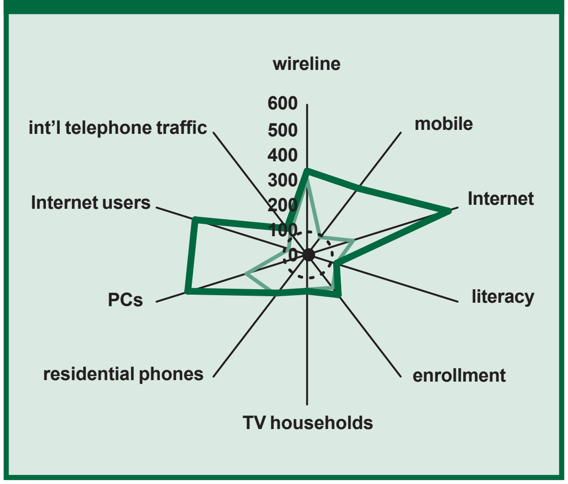
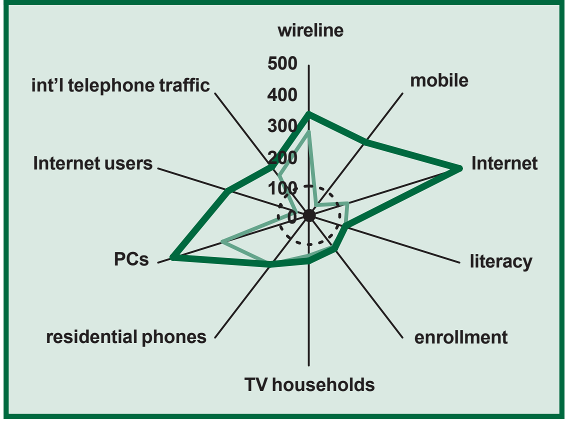


1996 values   2001 values   2001 average values (Hypothetica)

SWITZERLAND



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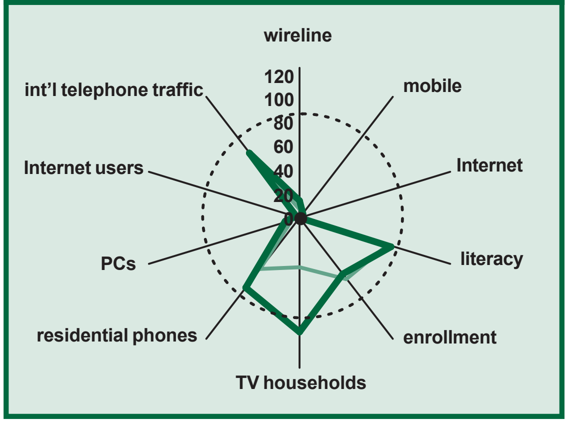

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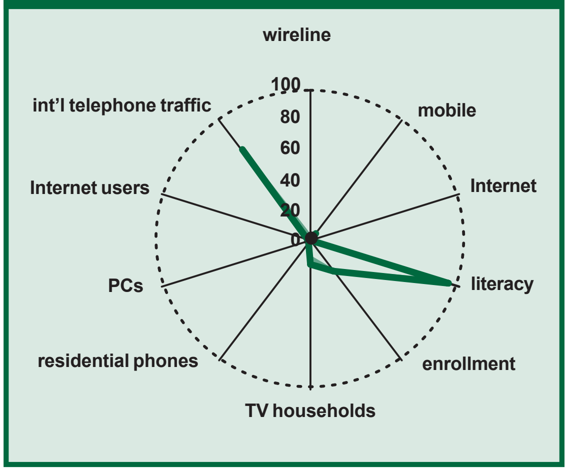

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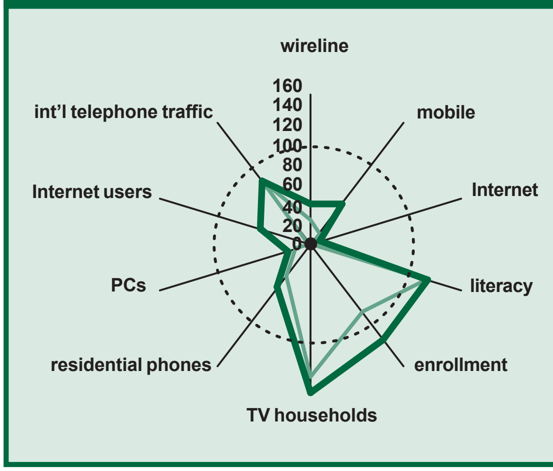

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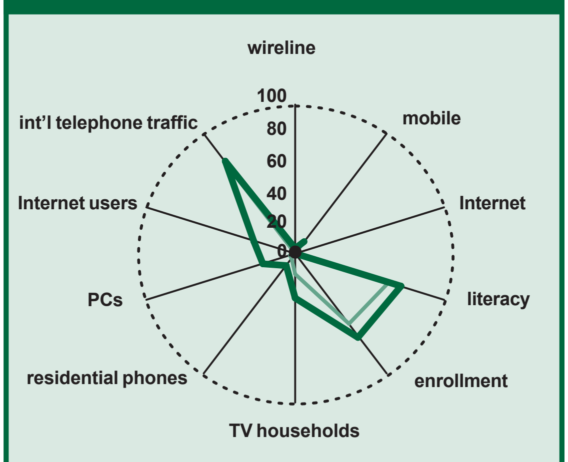
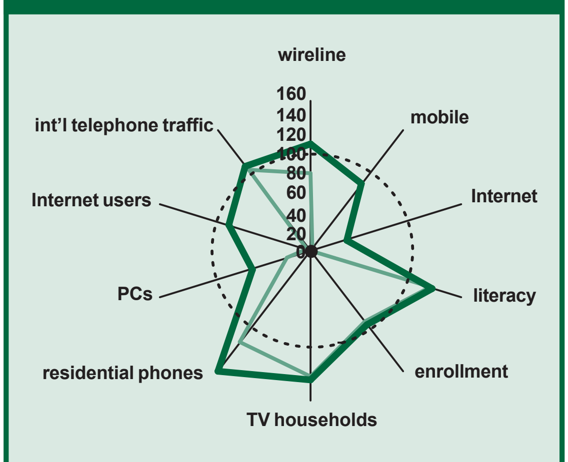
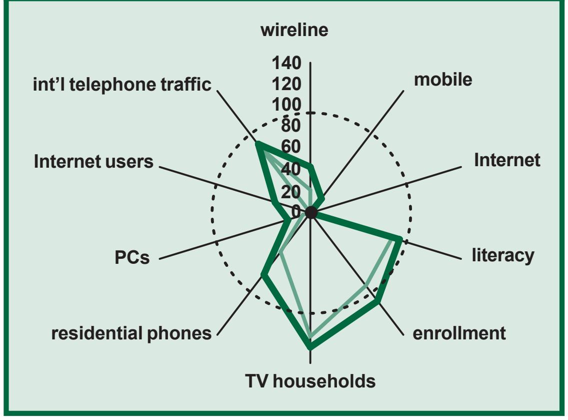


TRINIDAD AND TOBAGO



1996 values   2001 values   2001 average values (Hypothetica)

TUNISIA



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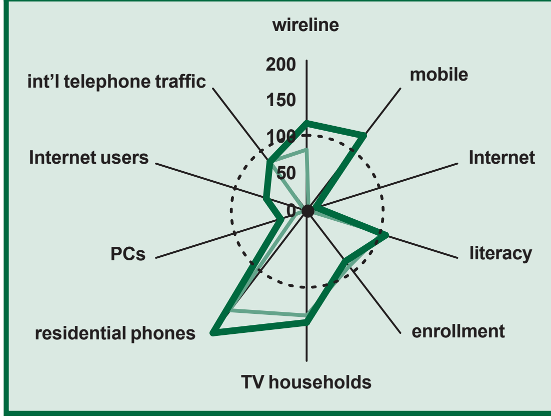

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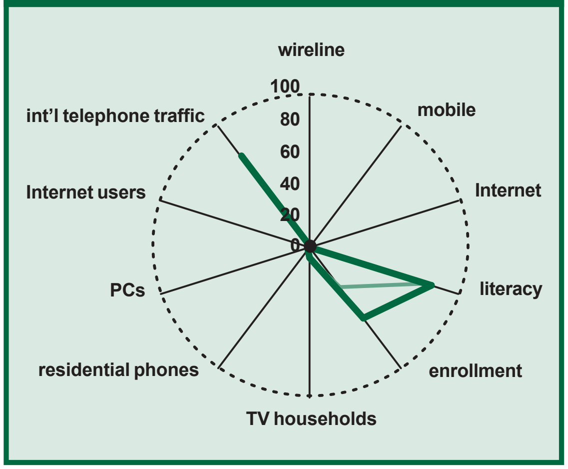

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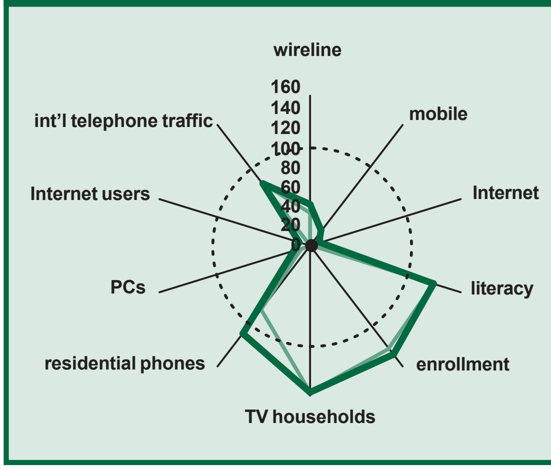
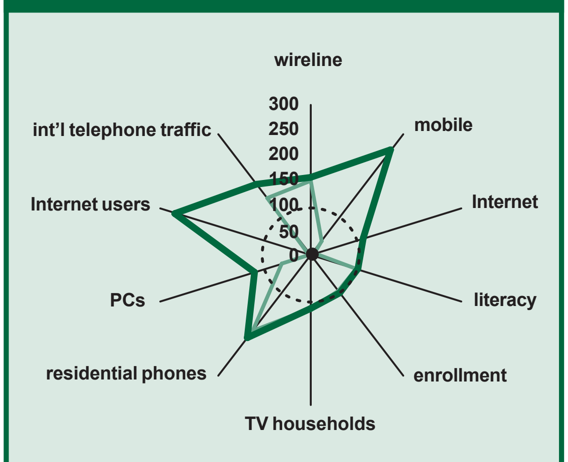


UNITED ARAB EMIRATES



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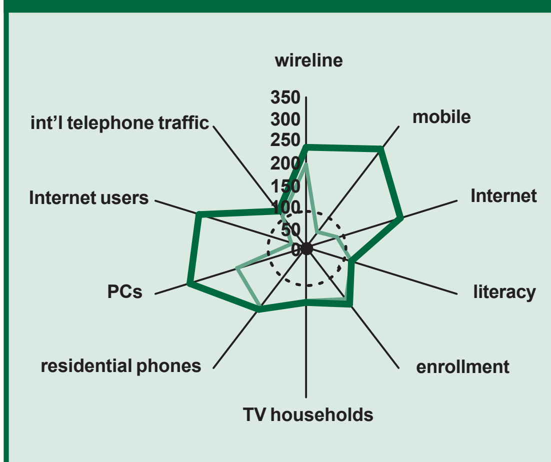
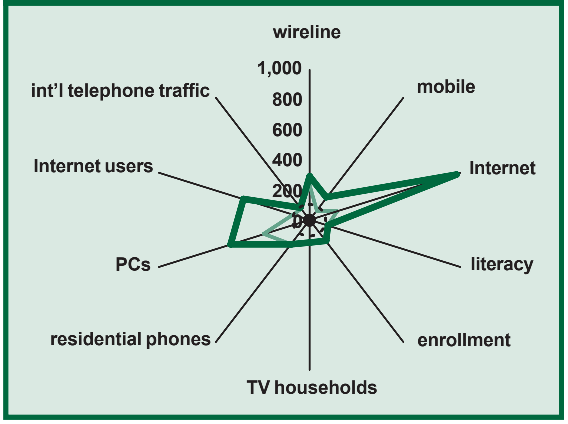


1996 values — 2001 values — 2001 average values (Hypothetica)

UNITED STATES



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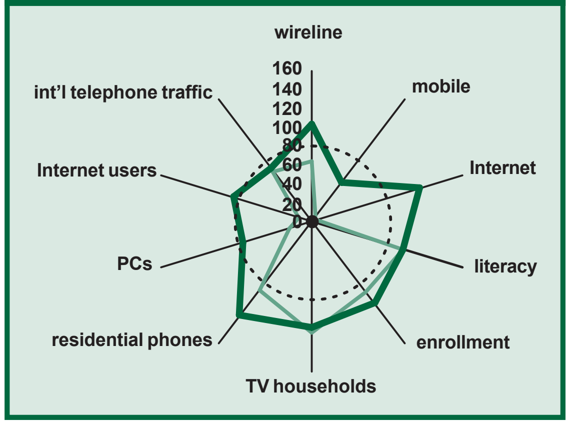

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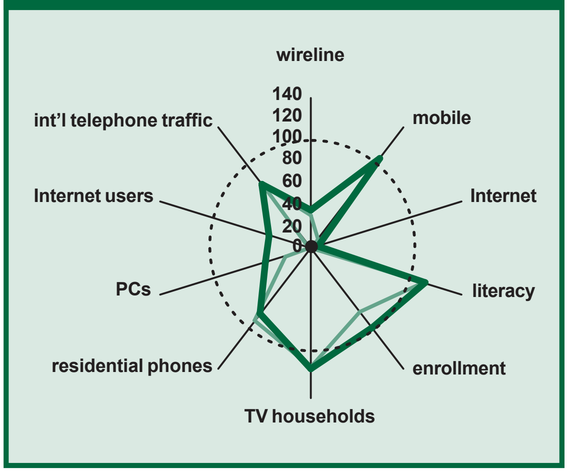

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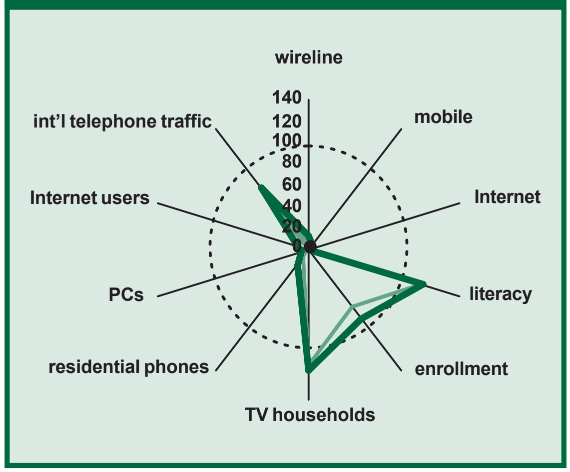

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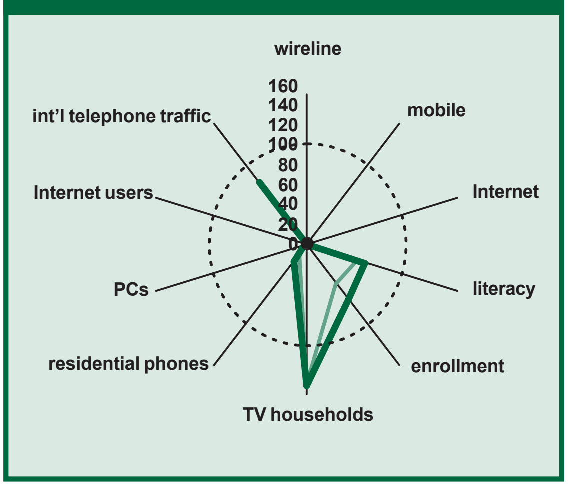

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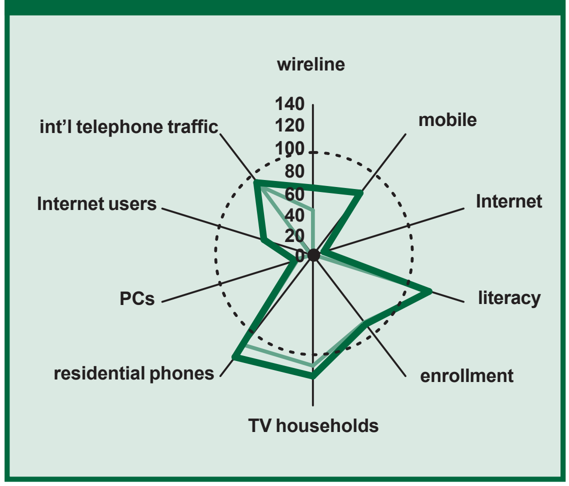
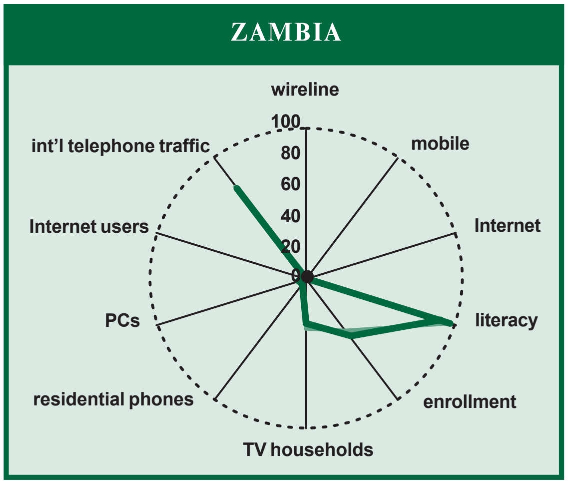
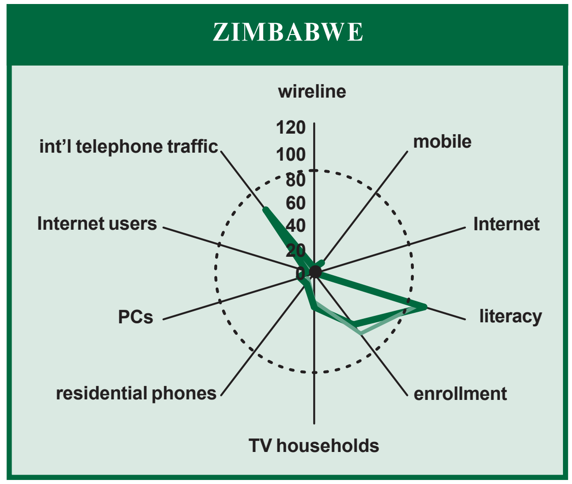


1996 values 2001 values 2001 average values (Hypothetica)





Chapter 6

MACROECONOMIC PERSPECTIVES[5]

Having quantified the Digital Divide and its evolution, we proceed to relate the measured Infostates to one key macroeconomic variable: Gross Domestic Product. As a measure of aggregate output and overall economic performance GDP is heavily correlated with connectivity, a result demonstrated often in studies of the internal divide. Although there are other influential variables interacting in a complex way, we limit the focus of this analysis to the examination of the impact of Infostates and Infodensities on GDP.

The GDP per capita series were reconciled with the Infostate indices for the years 1996-2001. Only those countries for which observations were available for both series and for all years were retained. The combined data set contains a total ranging from 118 to 131 countries, depending on the year. Simple scatter plots of GDP per capita and these indexes suggest a strong positive relationship. Representative of these results are Charts 10 and 11 below plotting Infostate and Infodensity against GPD per capita for 2001. (GDP per capita is measured in purchasing power parity terms).

Chart 10. **Infostate and GDP per capita, 2001**

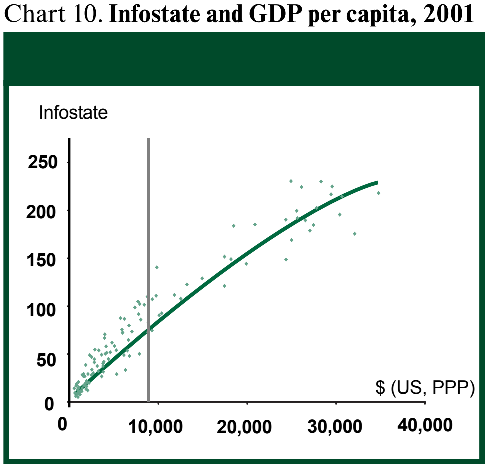
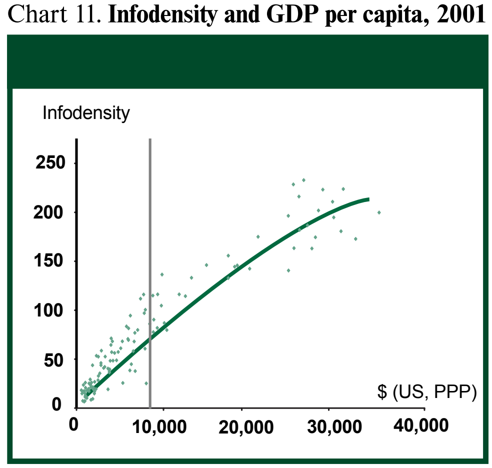


Chart 11. **Infodensity and GDP per capita, 2001**



[5] *Authored by Brenda Spotton Visano, Susan (Sam) Ladner, Aqeela Tabussum and Xiaomei Zhang (York University).*

The scatterplots suggest that the positive relationship between the Infodensity and Infostate indices and per capita GDP is non-linear. Specifically, the cross-sectional data suggest that the impact of the indices on GDP per capita is greater the higher the value of the index. Furthermore, those countries with below-average GDP per capita (approximately $9,000 US in 2001 and indicated by the vertical lines in Charts 10 and 11 above) are the same countries appearing in the Infostate groups C, D, and E in Chapter 4 ("The Empirical Application") above. It follows that the countries with above-average GDP per capita are the same countries as those in groups A and B above.

While the positive relationship between these indices and GDP per capita is clearly visible, closer examination reveals noticeable deviations. Countries with comparable Infostates appear subject to sizeable GDP-per-capita differences. For example, Algeria and Senegal had identical Infostates (29 points) and were only slightly higher than Kenya (at 21 points), yet Algeria's per capita GDP was more than three time that of Senegal ($5,329 US versus $1,600 US) and more than five times that of Kenya ($1,014 US), in 2001. Estonia and Italy had comparable Infostates (141 and 149, respectively) in that same year, yet Italy's GDP per capita (at $24,371 US) was more than double Estonia's (at $9,834 US). Table 15 lists examples from selected countries.

Table 15. **Deviations in per capita GDP for countries with similar Infostates, 2001**

High GDP-PC (Infostate)		Low GDP-PC (Infostate)		GDP-PC difference as % of low	Infostate difference as % of low
Italy .. 24,371	*(149)*	Estonia ... 9,834	*(141)*	147.8%	5.7%
Russia 8,830	*(73)*	Panama ... 5,989	*(73)*	47.4%	0%
Russia 8,830	*(73)*	Jamaica ... 3,993	*(71)*	121.1%	2.8%
Botswana 7,876	*(50)*	Philippines ... 4,050	*(50)*	94.5%	0.0%
Botswana 7,876	*(50)*	Bolivia 2,511	*(47)*	213.7%	6.4%
Gabon 6,304	*(34)*	Honduras ... 2,520	*(34)*	150.2%	0.0%
Gabon 6,304	*(34)*	Zimbabwe ... 2,681	*(30)*	135.1%	13.3%
Algeria 5,329	*(29)*	Senegal ... 1,600	*(29)*	233.1%	0.0%
Algeria 5,329	*(29)*	Kenya ... 1,014	*(21)*	425.5%	38.1%

Contrariwise, some countries with similar per capita GDPs exhibited very different Infostates. For example, in 2001, Bangladesh had a similar per capita GDP to that of Mongolia ($1,672 US versus $1,845 US) but an Infostate of only 10 compared with Mongolia at 39. Where per capita GDP in Italy and Sweden were $24,371US and $24,930 US, respectively, Sweden's Infostate was 231 compared with Italy's 149. Table 16 lists examples from selected countries.

Table 16**. Deviations in Infostates for countries with similar per capita GDP, 2001**

High Infostate Country (GDP-PC)		Low Infostate Country (GDP-PC)		Infostate difference as % of low	GDP-PC difference as % of low
Sweden 231	*(24,930)*	Italy ... 149	*(24,371)*	55.0%	2.3%
Bulgaria 87	*(6,195)*	Gabon 34	*(6,304)*	155.9%	-1.7%
Estonia 141	*(9,834)*	Trinidad & Tobago 91	*(10,092)*	54.9%	-2.6%
Lebanon 87	*(5,748)*	Algeria 29	*(5,329)*	200.0%	7.9%
Moldova 49	*(2,289)*	Guinea 12	*(2,052)*	308.3%	11.5%
Mongolia 39	*(1,845)*	Bangladesh 10	*(1,672)*	333.3%	10.3%

6.1 Infodensity as an Input into an Aggregate Production Function

The relationship between a country's 'ICT-ization' and its state of economic development is complex, with connectedness influencing and being influenced by the nature and degree of development of a country. In a preliminary attempt to estimate the strength of this relationship, we examine the impact of Infodensity on per capita GDP, where Infodensity captures the per capita stock of ICT capital and labour skills and GDP per capita measures aggregate per capita output as a proxy for development.[6]

[6] *The "per capita" transformation of networks and skills in the calculation of the Infodensity index is not identical to the per capita transformation of GDP. In the Infodensity index the capital stock is measured per 100 persons in some cases and per household in other cases. In the GDP per capita calculation, GDP is divided by the population. A subsequent and more detailed examination of the relationship between Infodensity and GDP per capita might ideally explore the sensitivity of the results to these data differences.*

Theoretically, the possibility that Infodensity contributes to GDP derives from the likelihood that the components of Infodensity have become a necessary input into the aggregate production function. As a measure of productive connectedness in a world that becomes increasingly interconnected and globalized, this approach of modelling Infodensity as an input to GDP is consistent with that laid out in the Framework.

Given the apparent non-linear relationship between Infodensity (ID) and GDP per capita (GDPPC), the aggregate production function postulated is a version of the constant elasticity of substitution production function, where ***e*** denotes the base of the natural logarithm:

$$(1)\quad GDPPC = e^{a0} * ID^{a1}$$

In the absence of other input data, the constant term (a_0) will capture not only scale effects but the effect of any omitted inputs. In log-log form (with ***ln*** denoting the natural logarithm), equation (1) becomes:

$$(1a)\quad \ln GDPPC = a_0 + a_1 \ln ID$$

Table 17 below reports the results of linear regressions of GDP per capita on Infodensity for the years 1996-2001.

Table 17. **Regression results***

Sample year	a_0 (t-stat)	a_1 Elasticity (t-stat)	R squared	# of countries in sample	GDP per capita mean ($US PPP)	Info density mean (x100)	Marginal effect** ($)
1996	9.691 (153.62)	0.844 (24.94)	0.828	131	8,281	42.7	164
1997	9.596 (160.71)	0.902 (24.94)	0.828	131	8,448	49.9	153
1998	9.465 (166.58)	0.917 (24.43)	0.822	131	8,488	57.3	136
1999	9.396 (185.86)	1.004 (26.50)	0.848	128	8,747	65.6	134
2000	9.332 (197.21)	1.082 (27.35)	0.856	127	9,205	74.0	135
2001	9.210 (203.50)	1.10 (27.56)	0.879	118	8,738	77.5	124

* *The reported values of the parameter estimates correspond to an Infodensity index of a base equal to 1; regression errors are normally distributed.*

** *The marginal effect of a change of Infodensity on GDP per capita is given by:* a_1*(GDPPC/ID) *and is evaluated at the mean of the variables.*

For the sample here, the marginal effect of an increase by one point in the Infodensity Index is to increase GDP per capita anywhere from $124 US to $164 US (calculated around the sample mean). If appropriate estimators of the true values, these results suggest that there is a significant benefit—measured in terms of raising GDP per capita—to increasing a country's Infodensity. The results also indicate that the GDP raising effects of Infodensity are higher at lower levels of Infodensity – as evidenced by the over-time movement of the marginal effects column and that of the Infodensity mean.

6.2 Competitiveness

"Competitiveness"—a broad and multi-faceted concept—is closely related to productivity. Thus, competitiveness is identified as a country's primary source of actual and potential economic growth. While several quantitative and qualitative factors combine and interact to determine a nation's overall competitiveness—and thus any one indicator will prove inadequate in gauging it—the overall economic performance of a nation is one important indicator. Because reliable data from the National Accounts are available for a wide range of countries, overall economic performance and productivity have been variously estimated by average annual rates of growth in per capita GDP, per capita Gross National Product, real GDP per worker, and the like.

In this section, we consider briefly the extent to which the growth in a nation's technological capacity and overall state of connectedness may influence its competitiveness, as measured by the growth in its per capita GDP. While closely related to the issue of Infodensity as an input into the aggregate production function, as explored above, the variable appropriate to this line of reasoning is Infostate, rather than Infodensity. For a given stock of ICT capital and labour (as measured by Infodensity), the greater the expected uptake and intensity of use, and the more competitive we might expect a nation to be. Thus, Infostate (as an indicator of both a country's productive capacity and its effective use of that capacity) is the relevant variable for this analysis.

Employing a logarithmic specification similar to that used above, we examined the extent to which a percentage change in per capita GDP is related to the percentage change in Infostate. For the years 1996 through 2001, inclusive, the results (not reported) are similar to those reported for Infodensity. The marginal effects of a unit increase in

Infostate are comparable in significance and magnitude and again appear to diminish somewhat, on average, over time as Infostates generally increase.

6.3 Further Research

These results suggest a critical role for connectedness in contributing to the overall economic well-being of a nation, echoing results found elsewhere. Further research into this aspect of the Digital Divide might explore the sensitivity of the results to the data employed, expand the range of indicators of competitiveness to include those more directly related to international trade and investment, and attempt to untangle and explain two important phenomena.

One, apparent in the regression results reported above, is the fact that the degree of the Infostate influence on per capita GDP evident in the cross-sectional analysis does not appear to hold over time. In the cross-sectional analysis, the positive impact on per capita GDP appears to be greater the higher the Infostate. Over time, however, as the mean value of GDP per capita rises, the marginal effect of a change in the mean Infostate appears to decline.

A second phenomenon, and one that is potentially related to the first, arises when we pair these results with those presented earlier in this report and consider the implication of both for global income distribution. From the analysis here, an increasing degree of connectedness is strongly and positively correlated with per capita GDP growth. The analysis of the evolution of the Digital Divide presented in Chapter 4 suggests that the Divide is closing and, indeed, the trend in the deviations referred to above reveal that for countries with similar Infostates, the per capita GDP difference diminished between 1996 and 2001.[7] It follows, then, that we might expect to see a similar closing of the gap between the richest and poorest countries over this same time period. A comparison of the 2001 distribution of global income with the 1996 distribution suggests, however, that the income gap has been widening, not closing. In 2001, the average GDP per capita of those countries in the top quintile of the sample was more than 24 times that of those countries in the lowest quintile, whereas in 1996 the richest sample countries were 22 times richer, on average, than the poorest sample countries.

[7] *For example, in 1996, Italy's per capita GDP was 209 per cent greater than Estonia's; by 2001, this difference had dropped to 148 per cent. The percentage difference between Algeria's per capita GDP and that of Senegal dropped from 272 per cent in 1996 to 233 per cent in 2001.*

Chapter 7

FROM DIGITAL DIVIDE TO KNOWLEDGE DIVIDE – A PRIMER[8]

7.1 Introduction

The web provides access to vast amounts of data, information, and codified knowledge. However, many important forms of knowledge cannot be codified and are not available in the digital form required by computer-based information and communication technology (ICT) systems. Consideration of the *knowledge divide* therefore raises issues beyond the concerns with access to, or participation in, the web and the digital economy, although these remain important and relevant.

In this context, as in many others, knowledge is associated with power and capacity for action. Access to information on the web or anywhere else is useless without the knowledge to understand the content, make sense of it and use it. Arguably, the inability to transform the contents of the web into economic and social value is part of a 'knowledge divide' far more significant than the access issue which can be remedied with investment and technology.

While it is undoubtedly the case that a lack of knowledge is disadvantageous, we should bear in mind that knowledge comes in many forms, which are valued differently in different cultures and at different times. A global consideration of knowledge demands sensitivity to this variety.

This paper explores a number of development issues raised by the subject of knowledge. Knowledge is a concept that is inherently complex, and here we can only begin to flag issues that require further attention. We focus in particular on the facets of knowledge that distinguish it from data and information, the plural nature of knowledge, issues around the protection of knowledge resources, or intellectual property, and the key issue of knowledge capability or capacity for action. A number of examples of knowledge issues in specific development contexts illustrate these issues.

[8] *Authored by Joanna Chataway, Paul Quintas, David Wield (Open University, Milton Keynes, U.K.) and Fred Gault (Statistics Canada).*

The paper is a primer on the subject of the knowledge divide. It provides a critical assessment of the issues and of the statistical indicators and case study information needed to illuminate them. It then goes on to suggest priorities and approaches for further work.

Knowledge and information

Consideration of a *knowledge divide* raises issues that are somewhat different from the digital divide. Moreover, the concept of *knowledge* poses a range of challenges over and above those associated with data and information. Data and information may be digitised, but only those forms of knowledge that can be codified can similarly be digitised. There are many forms of knowledge, from knowing how to ride a bicycle or play a violin to knowing how to be an empathetic listener, that are not amenable to codification. Whereas data and information may be regarded as a commodity which can be traded, many forms of knowledge are tacit and indeed personal (Polanyi 1958). You can purchase an engineering drawing, a recipe or a musical score, but you cannot buy the knowledge of how to play the violin – you can buy tutelage, but you will have to practice and learn for yourself.

As Prusak (2001) strongly argues, practice is fundamental to knowledge acquisition. Acquiring knowledge, or learning, requires effort. Learning new things depends on personal experience and reflection. It also demands a level of prior knowledge that enables us to understand and assimilate the new. Moreover, this personal knowledge acquisition through practice often happens in social contexts – communities of practice (Lave and Wenger 1991) – where people share similar work experiences and help each other learn (Prusak 2001). Knowledge therefore has a social dimension, in addition to being personal. We return to the topic of social knowledge in section 7.2.

A further key distinction between knowledge and information focuses on action. Knowledge here may be seen as a 'capacity for action' to distinguish it from information, which can be regarded as data in context, and which requires an added element of experience to become 'knowledge'. Knowledge that has been codified in language or symbols is itself information, but that information is only of use if the recipient can understand it – that is, use their existing knowledge and skills to make sense of it, turning it into actionable new knowledge.

In this vein, Castells (2001) notes that whereas the phrase *digital divide* conventionally refers to inequality of access to the Internet, there is also a *knowledge gap* in terms of the knowledge and skills required to understand and use the information available on the net. We shall argue here that differentials in the ability to make sense of new knowledge, absorb it and act upon it, are key dimensions of the knowledge divide.

Whereas information can be shared between those who understand the same language or other codes, much of our knowledge is difficult to communicate to others. For Polanyi (1958, 1966) knowledge is fundamentally tacit in nature, being based on our own internalisations of our own experiences. Tacit knowledge poses many conceptual and practical challenges. We can only know of its existence in others if it is demonstrated in the process of some purposeful activity. Moreover, much of our own knowledge is held and indeed employed without our conscious awareness (Baumard 1999). These two aspects combine to conspire against others' attempts to 'capture' our knowledge (a current *knowledge management* preoccupation) and they present serious challenges for the researcher seeking to 'gather data' about others' knowledge (a perennial preoccupation of academic researchers).

Tacit knowledge is not directly transferable, although we can often gain our own experiential knowledge in a social context, for example in an apprenticeship, where we learn by observation, trial and error in the presence of an experienced 'master'.

A useful distinction can be made between *declarative knowledge* of which we are conscious and which we can express (Polanyi's foreknowledge), and *procedural knowledge* upon which we draw subconsciously when reacting to situations or making decisions (Anderson 1983). Doctors may be unaware of, and unable to express, the rules they employ in order to appraise a patient's symptoms and reach a diagnosis. The implication of Polanyi's analysis is not only that 'we know more than we can tell' but that 'we know far more than we are prepared to believe' (Baumard 1999, p.59).

Knowledge comes in many forms

It is important to recognise that knowledge is viewed differently in different cultures. Grossly simplifying, Western and Eastern traditions differ in their views of the extent to which knowledge can be separated from the knower. In the West, we tend to think about knowledge as a 'thing' or commodity that can easily be moved around, managed and traded. Conversely the Eastern traditions are more likely to emphasise the inseparability of what is known from the individual or groups that know it. Put another way, a non-Western approach would tend to emphasise *knowing* as a *process* rather than the Cartesian (Western) knowledge as a *thing*.

The World Bank's report Knowledge for Development (1998) focused on two types of knowledge: 'how-to' (or know-how) knowledge, such as farming or accounting; and 'knowledge about attributes', such as knowledge of the quality of a product, the credibility of a borrower, or the diligence of an employee. The report argued that the unequal distribution of both know-how and knowledge about attributes is worse in developing countries than in developed countries, and that they especially hurt the poor. In section 7.2 we explore other ways of distinguishing different knowledge types in the context of knowledge creation.

Context matters

Current perspectives on knowledge suggest that knowledge is created in specific contexts and is to varying degrees 'situated' (Lave and Wenger 1991) and may be 'sticky' and difficult to transfer or share (von Hippel 1994). Much of the knowledge generated through, for example, research and development (R&D) activity is of a tacit nature and located in the specific context in which it was developed (Nelson and Winter 1982). Tacit organizational processes are difficult to transfer or share between contexts, as is illustrated by the example of Chaparral Steel. The CEO is happy to tour competitors through the Chaparral plant, showing them 'almost everything and we will be giving away nothing because they can't take it home with them' (Leonard 1995, p.7).

What has value and meaning in one context may have little or no meaning in another context. It follows that in order to transfer knowledge between contexts it must be de-contextualised, or made independent of context. Indeed, many authors argue that the only way to transfer tacit knowledge is through guided joint social interaction during, for example, apprenticeship within a community of expert practitioners (Lave and Wenger 1991). Similarly, where knowledge associated with technology is being transferred between organizations: 'in the absence of intimate human contact, technology transfer may sometimes be impossible' (Teece 1981, p.86).

There are significant cultural differences in the extent to which knowledge may be shared between contexts. A revealing study of collaborative projects involving Western and Japanese firms found that Western companies tended to bring easily imitated technology to a collaboration, whereas Japanese firms' strengths were often 'difficult to unravel' competencies which were less transferable (Hamel *et al.* 1989).

The influential Japanese author Ikujiro Nonaka (1998) uses the term 'ba' (a Japanese word which translates approximately to 'place') to indicate 'the shared context for knowledge creation' (Nonaka *et al*. 2001, p.21). Nonaka *et al.* contrast their *ba* approach with the Cartesian assumption that knowledge is absolute and independent of context.

Local/indigenous knowledge

In 1945, Nobel Laureate Friedrich Hayek critically observed of his contemporary economists: '...it is fashionable today to minimize the importance of the knowledge of the particular circumstances of time and place (Hayek 1945, p.3). Hayek placed great emphasis on the role of local knowledge in the functioning of the market (Hayek 1937, 1945). He argued that the market is a system for communicating the local knowledge that is widely distributed amongst the plethora of suppliers, customers and brokers, who each know about their local circumstances. No one person or indeed any kind of centralised agency (such as a government) can have access to all this local knowledge, but, Hayek argued, the market pools and communicates the interactions of this context-specific knowledge.

For many development thinkers today, local knowledge is an essential in development practice and the broad acceptance of this idea is a key achievement of the 1990s. Writers such as Robert Chambers (1997) have been enormously influential in promoting ideas about Participative Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) that focus on the importance of local expertise. Other authors have provided evidence of the importance of local knowledge in understanding environmental issues. In debates about industrialisation, proponents of an approach based on the importance of local knowledge have tended to promote alternative, smaller scale, technologies which use local resources instead of importing large-scale capital-intensive equipment (for example Schumacher 1973, Willoughby 1990). We argue rather the importance of integrating local knowledge with other knowledge.

In the era of knowledge-intensive production, debates about what kind of knowledge is important for industrialisation have developed out of older preoccupations with the ability of smaller units to compete by means of technological innovation. The theory is that smaller production units and small firms stand a better chance of competing with larger, international counterparts in an era dominated by knowledge rather than capital intensive production. An associated line of thinking holds that local, contextual knowledge and resources assist competitiveness in the global market place.

Local knowledge and knowledge management have been important components of industrial clusters. In the 1980s and early 1990s, the success of industrial districts such as Emilia Romagna in northern Italy and Baden Wurttemburg in Germany led some to argue that this model of use of local knowledge and resources might be more generally applicable as internationally competitive alternatives to traditional manufacturing models (Best 1990). Silicon Valley was also used by some to argue that clusters of small firms, sharing essential costs and knowledge, could compete with larger firms. In fact, in all of these very different examples, large international firms have played an important role in helping small firms access international markets and technology. And, more recently, debates about local clustering and local industrialisation strategies have addressed the question of the balance required between generation and use of local resources and access to international resources.

7.2 Knowledge Capabilities

Vast knowledge resources exist across the world, but the capabilities to use this knowledge are not always present. A library is a resource full of codified knowledge, but if it is all written in Japanese and you do not understand that language then the knowledge is not available to you. The very minimal capability we need is the capacity to make sense of the information and to learn. Resources, it seems, require complementary *capabilities* in order to render them useful (Grant 1996).

Within the current new-found enthusiasm for 'knowledge management' in the West, we often find little beyond a re-labelled interest in the management of information. A second popular theme focuses on a rediscovery of the 1970s concept of human capital (Becker 1975). The over-arching concern is with the management of knowledge *resources*. Firms are encouraged to value, manage and exploit their knowledge *assets*, whether these are patents and other forms of intellectual property, or the many other forms of knowledge that help the organization function, create profits or innovate. This preoccupation with the knowledge that firms already have greatly outweighs concern for the ability to create new knowledge. However, there is a real frustration with knowledge that is not easily available as a management resource:

> 'If TI only knew what TI knows' – Jerry Junkins, CEO of Texas Instruments.
>
> 'I wish we knew what we know at HP' – Lew Platt, Chairman of Hewlett Packard.
>
> *(O'Dell and Grayson, 1998, p. 154)*

The identification, 'capture' and codification of existing knowledge within organizations, with the aim of turning individuals' knowledge into a widely available resource, has therefore become a major theme in knowledge management (KM). Such 'capture' is problematic in many ways, with fundamental problems stemming from the tacit and experiential nature of human knowledge, and also its context specificity. There is also some evidence that capture and codification are not always supported by the capability to share and use that knowledge (Hall 2003). Much expensively-gathered information sits on shelves or on databases without any interest or take-up.

Like other resources, knowledge assets require the complementary capabilities to manage them: to communicate, share and to use such resources. These capabilities are predicated on the underpinning capability to make sense of the information, to understand it and assimilate it.

All this is a preoccupation with the firm and what happens within the single organization. Yet the proportion of knowledge resources located within even the largest organization is a minute percentage of the relevant knowledge that exists, or is created, externally. The implication of this is that one of the fundamental capabilities is to be able to track and assimilate knowledge from outside the organization. This capability is termed *absorptive capacity* (Cohen and Levinthal 1990) and is discussed below.

As noted previously, much Western knowledge management has little emphasis on the key capability of knowledge creation. Indeed some accounts of 'KM' do not even consider this important. Yet in many fields it is the ability to create new knowledge and to innovate that ensures survival. The next section uses the concept of mode 1 and mode 2 knowledge to explore knowledge creation.

Knowledge creation

The creation of knowledge[9] is a defining characteristic of human societies. The generation of knowledge can be formal, through research and development (R&D) activities, or informal, for example resulting from learning-by-doing in a work environment. New knowledge can also be created as a result of a focussed combination of existing knowledge, from different sources, or from different domains or disciplines.

In the West there is a tendency to privilege knowledge that is produced through formal activity, particularly through the scientific method. Such knowledge is widely thought to have greater validity than other forms of knowledge, because of its claimed objectivity, transparency and repeatability. However, it is apparent that many other forms of knowledge contribute to economic and social life, and indeed no society could function without, for example, the ubiquitous presence of craft knowledge and other forms of knowledge created in the context of practice.

In *The New Production of Knowledge*, Gibbons *et al.* (1994) write about a shift in modes of knowledge creation from mode 1 to mode 2. Mode 1 knowledge is produced in institutions, is disciplinary, with high homogeneity of knowledge producers, a hierarchical control system through peer review, an emphasis on individual creativity and on generating codified knowledge which is transferable. Mode 1 knowledge grows cumulatively, is stored in libraries and forms the content of university syllabuses and professional qualifications.

In contrast, mode 2 knowledge is created in the context of application – it results from practice. It is knowledge created in the context of application, transient and often unrecorded. It is transdisciplinary, and the capability to produce it is widely diffused. Gibbons *et al.* argue that mode 2 has hitherto been under-valued, and also that it is increasing in importance. The following table 1 compares modes 1 and 2.

[9] *The word 'creation' (of knowledge) is used here and regarded as being synonymous with 'development' or 'generation'.*

On the face of it, recognition of the importance of mode 2 knowledge creation offers considerable hope to countries that are deficient in mode 1 institutions. It suggests that knowledge created in the context of practice has equal, and growing, validity and economic significance. However such a conclusion may underestimate the extent of interdependence between modes 1 and 2.

The new production of knowledge: Mode 1 and Mode 2 knowledge

MODE 1	MODE 2
Scientific knowledge	Practitioner knowledge
Discipline based	Trans-disciplinary
Agenda - academic	Agenda - practice
Hierarchical organization	Non-hierarchical organization
Maintains form	Transient form
Homogeneous knowledge	Heterogeneous Knowledge
Exclusive knowledge	Socially distributed Knowledge
Universal knowledge	Context-specific knowledge

Source: developed from Gibbons *et al* 1994

An important aspect of this new understanding about knowledge generation and use is the implication for industrial innovation. There is some evidence that mode 2 practices run in parallel to mode 1 institutions and are driven by increasingly competitive innovative environments. Industrial innovation is increasingly defined as a mixed-mode activity with knowledge, information and production generated in multiple sites rather than designated single locations. This requires the capabilities to coordinate these different processes, and between different sites.

For developing countries, such changes pose particular problems. First, the science and research base in many developing countries tends to be heavily rooted in colonial mode 1 institutions, built on the assumption that scientific knowledge is developed in one set of institutions (universities and research institutes) and used by others (firms or public services). The idea is that knowledge can be transferred between these institutions. In mode 2, however, much knowledge is generated with specific applications and contexts in mind and often it comes from a mixture of public and private institutions. Different institutional arrangements facilitate both generation and flow of knowledge. Restructuring of science and technology infrastructure is therefore required in many industrially developing countries.

Second, in some developing countries, mode 1 institutions are also breaking down. For example in some parts of Africa, R&D institutions and universities are in an extremely fragile state. Universities will continue to play a major role in building national educational and cultural capabilities, but simply rebuilding the very specialised R&D structures of the past is unlikely to be the best option in building industrial capabilities in the future and yet it is unclear which structures might be appropriate.

Third, much bilateral and multilateral development work is carried out by consultancy firms. Consultancy firms are important actors in mode 2 generation of knowledge and have been at the forefront of new management tools for coping with mode 2 interactions. Particularly in cases where remodelling of specific institutions is being contemplated or where bringing in specific technology and knowledge is required, consultants often play a crucial role. However, little is understood about the interaction around issues of knowledge management between consultants and clients in developing country contexts.

Social dimensions of knowledge capability

As has already been pointed out, knowledge has a social dimension – it may be created and held collectively. Knowledge can reside in people and be accumulated as 'human capital' through formal education (know what, know why) and through learning-by-doing in the workplace (know how). It can also reside in groups of people, created in group interactions and routines in such a way that the collective has a greater capacity to act than that of all its constituents. Knowing who the people are that know about your area of expertise (know who) is a key feature of being a member of a community. We therefore need to consider that social nature of these knowledge processes – especially where people work in teams or communities of practice. This will be called 'network capital' to distinguish it from 'social capital' which carries its own problems of definition and interpretation.

People who share work experiences and work problems have similar learning opportunities and may be said to form communities of practice (Lave and Wenger 1991). Wenger (2000) defines a community of practice (CoP) as a social learning system, united by joint enterprise, mutually recognised norms and competence, with shared language, routines and stories. The *discovery* of pre-existing communities of practice in organizations illustrates the long history of the management of knowledge without the 'knowledge management' label.

A community of practice is most often an informal grouping. It may be unrecognised (Scarbrough 1996) or ignored or taken for granted (Baumard 1999) in the organization. So too it may transcend organizational boundaries, including people in several organizations who hold experiences in common. CoP members act as resources for each other, 'exchanging information, making sense of situations, sharing new tricks and ideas' (Wenger 1998, p.47). In Xerox, photocopier engineers were observed working together on a problem machine, communicating like jazz musicians, exchanging truncated phrases and able to communicate non-verbally because of shared experience, shared learning, shared understandings (Brown and Duguid 1991). Communities of practice therefore represent oases within which knowledge processes function naturally.

The challenge posed by social knowledge is that it may not be acknowledged by management. Formal management styles may be at odds with the informality of communities of practice, and indeed attempts to formally manage communities of practice from outside may undermine them. Baumard (1999) identifies three communities of practice in the Australian airline Qantas: the pilots and their retinue, the financial group, and the marketing group. Each of these communities have their own language, which as Baumard emphasises, indicates different interpretations of reality. Qantas' top-down management style favours documents, manuals and computerised information, whereas the CoPs favour less explicit circulation of knowledge: '... communities of practice, conjectural knowledge and repertories of thought inscribed in practice are all tacit.' (Baumard 1999, p.135). The Qantas communities refused to use a new computer-based 'knowledge management system' introduced from outside the CoPs.

Cross-boundary knowledge processes

Cross-boundary knowledge transactions apply to boundaries between organizations, within organizations, between functional specialisations and between disciplines. Increasingly, knowledge is accessed and shared across cultural and national boundaries as organizations and markets become international.

Universities, which are key players in the mode 1 knowledge system, were originally repositories of knowledge passed on to generations of students, until they began to create new knowledge and changed the way they interacted with students, governments and business.

Universities and research institutions are generators of mode 1 knowledge, but increasingly research funding is linked to, and often conditional upon, direct commercialisation links to industry and commerce. The challenges of university-industry interactions in a changing political and economic context are explored in Massey, Quintas and Wield (1992).

Arguably no firm has ever been independent in knowledge terms: 'Firms are not islands but are linked together in patterns of co-operation and affiliation' (Richardson 1972, p.895). Today all organizations are likely to be increasingly dependent on external sources of knowledge: 'Technology has become so sophisticated, broad, and expensive that even the largest companies can't afford to do it all themselves' (Robert Z. Gussin, former VP for Science and Technology, Johnson & Johnson, quoted in Weber (1989, p.132).

The key role of external linkages was noted a century before by Alfred Marshall, in building the case for industrial districts. As Freeman (1991) argues, the external network has increased in importance as a source of resources available to the innovating firm. Knowledge interdependence creates new management challenges resulting from the risks and difficulties of knowledge transactions across boundaries. So too the development of new goods, systems and services increasingly requires the integration of knowledge from many disciplines. Alliances, networks and collaborations provide the means by which firms can reduce the risk, share costs and scarce resources, especially with regard to new or currently 'peripheral' technology areas (Quintas and Guy 1995).

Stigler (1951) linked networks with progress through specialisation and learning. He observed that firms substitute inputs from external suppliers because (*pace* Adam Smith) these suppliers *learn* through specialisation to provide these at lower cost than the vertically integrated firm can achieve. As two of us noted in an earlier publication, 'this specialization in turn depends on a new division of labour requiring increased co-ordination between firms... the new division of labour requires more horizontal integration between firms' (Massey, Quintas and Wield 1992, p.71). Specialisation results in greater barriers to the sharing of knowledge between organizations, and indeed across functional and disciplinary boundaries, since different communities and disciplines may have little common ground for shared understandings. These 'divisions of knowledge' are explored in Quintas (2002).

The importance of cross-boundary knowledge transactions is now widely accepted, although the nature and extent of the costs of such transactions is by no means understood. Barely 30 years ago the dominant neoclassical microeconomic assumption was that transaction costs were zero (Coase 1988, Loasby 1999)[10]. What is now clear is that the capability to understand and assimilate knowledge across boundaries of all types is of increasing importance and requires investment in learning capacity (Amsden 2001).

Absorptive capacity

The capability to track, make sense of, understand and assimilate externally sourced knowledge is known as absorptive capacity (Cohen and Levinthal 1990). Knowledge is not a free good; its acquisition requires strategies for learning and assimilation (Pavitt 1991). Indeed, one of the primary reasons why firms invest significant resources in research and development is in order to track and understand external developments (Cohen and Levinthal 1989). The skills required to absorb knowledge include techniques of sourcing, sense-making and acquisition. Essentially, firms must become adept at searching and learning. Brown and Duguid (2000) summarise the challenge as: 'the way forward is paradoxically to look not ahead, but to look around'

There are however many factors that make absorbing knowledge from external sources particularly challenging. Navigating the vast array of external knowledge is of course one of these. We shall emphasise two others. The first is that knowledge is created in particular contexts, has meaning and value within those specific contexts, and these may not be appropriate for any other context. The second is that unless we have internal capability to understand enough to conclude whether it is worth putting effort into learning more about any particular external knowledge resource, we cannot even distinguish those areas in which to place our efforts.

Knowledge that can be written down, or codified, can be transmitted electronically or through print media, and read. The abilities to transmit and absorb depend in part on the capabilities of the recipient. However the context in which the knowledge was created and codified are likely to embed particular perspectives, priorities and values. These may be alien or inappropriate to a recipient. Even codified knowledge has a tacit dimension (Polanyi 1966).

[10] *Coase in a 1970 address to the US National Bureau of Economic Research. Edith Penrose had come to similar conclusions in her seminal* The Theory of the Growth of the Firm *published eleven years earlier (Penrose 1959).*

As we saw above, many forms of knowledge cannot be written down or codified, and are inherently difficult to share or to absorb.

> "The key to acquiring tacit knowledge is experience. Without some form of shared experience, it is extremely difficult for people to share each others' thinking processes. The mere transfer of information will often make little sense if it is abstracted from embedded emotions and nuanced contexts that are associated with shared experiences" (Nonaka 1994, p. 19).

Apprenticeships have long been used for the transmission and absorption of applied knowledge. Young research scientists and physicians, for example, acquire knowledge by working with experienced practitioners. Such techniques are generally more difficult to employ in the external quest to absorb knowledge.

As with individuals, a firm's capacity to track and absorb external knowledge is constrained by what they already know (Pavitt 1991, Patel and Pavitt 1997, Pavitt 1998). The knowledge base of a firm develops cumulatively and is path-dependent, constraining what can be learned. Even large firms that have capabilities across a number of fields constrain their search activities close to what they already know: 'In this sense, there are clear cognitive limits on what firms can and cannot do' (Pavitt 1998, p.441).

Absorptive capacity may also be applied to nations as well as organizations. Even countries that formerly dominated mode 1 knowledge production now find that each year they produce a smaller percentage of the world's new knowledge, and so absorbing knowledge from outside becomes ever more important. This requires investment in tracking, learning and assimilation processes.

While there is a vast accumulation of knowledge in the industrial countries, in universities, businesses and governments, it is not providing people in the developing world with a capacity to improve their existence. The key issue is the capacity to adapt and absorb this existing knowledge and to use it to create value.

7.3 Lessons from the Industrial World

Knowledge confers a capacity for action and firms use that capacity to create value. The ability to absorb knowledge, from inside or from outside the firm, and then to apply it in order to add value, allows the firm to meet its management objectives. These objectives could include social responsibility in investment and employment, greater market share or more exports, more creative use of the inputs used to produce and deliver products, improving the production and delivery processes, or managing better the information held about clients.

However, the managing of the knowledge of the firm is not just about inputs, the transformation process, and outputs; it is also about how the firm navigates towards its goals in an ever-changing economic and social environment. At this more strategic level the firm must go beyond just reacting to market signals and develop a memory, a foresight capacity, and a strategic vision to enable it to deal with change. At an even higher level, the management must be prepared to abandon the existing vision and make a radical change if the firm is to survive and prosper in a world of turmoil. This hierarchy of management practices, from the basic and tactical through the complex and strategic to the radical and transforming, does not just apply to firms but to any organization, including governments.

Organizations that can generate and absorb knowledge, and store and use it, have a distinct advantage in a world where knowledge generates value, and survival depends upon novelty. The difference between organizations that can convert and use knowledge and those that are not as good at it is part of the knowledge divide. This is not just a problem in developing countries. The Organization for Economic Co-operation and Development (OECD) has co-ordinated a study of the use of knowledge management practices in business in four countries, Canada, Denmark, France and Germany (Foray and Gault 2003). Some of the findings offer insights into the knowledge divide.

The first finding is that it is actually possible to measure the use of a set of knowledge management practices and to arrive at some conclusions about how firms do manage their knowledge. This was not immediately obvious at the start of the project but it does mean that statistical offices or research institutes can make these measurements with confidence and build indicators of firm behaviour. After some pilot surveys, and accumulated experience, it is now clear that the measurement of knowledge management practices in 2001 is little different from the preoccupation in the 1980s with the measurement of the use of advanced manufacturing technologies (Ducharme and Gault 1992) or of office automation and the indicators derived from the surveys of such activities.

A second finding is that size matters (Earl and Gault 2003, Kremp and Mairesse 2002, 2003). This is not a new insight, as size matters for most economic activities of which R&D, patenting, innovation, or technology use are examples. However, there may be a difference in how size matters for the adoption of knowledge management practices, as opposed to technologies, and it may have to do with complexity (Kash and Rycroft 1999). Earl and Gault (2003) show that the knowledge management practices used by micro firms (1-19 workers) and small firms (20-49 workers) differ in number and type from those used by mid-sized (50-249) and large (250+ workers) firms and that the threshold for change varies according to the practice from 20 to 50 workers.

There is an implication here for development and for policy. Firm size tends to depend on the size of the economy and smaller economies have smaller firms. This may suggest that any attempt to encourage the use of knowledge management practices in the developing world should take account of what works, and what does not, in the micro and small firm. While there are preliminary results in Foray and Gault (2003) more has to be done on what does work, and in what context.

A finding in the work of Kremp and Mairesse (2002) is that the use of knowledge management practices is positively correlated with a higher propensity to innovate and to patent, as well as with a higher intensity of innovation and patenting. This does suggest that knowledge management is part of a successful, creative, innovative and productive firm and the observation is also made that this effect persists even when size of firm is controlled for.

As there appear to be benefits to the managing of knowledge in firms, and smaller firms have a lower propensity to use such practices, there may be a case for promoting their use, whether in developing or developed countries. The Government of the Republic of South Africa, for example, has a Chief Knowledge Office in its Department of Communications and a Knowledge Management Development Initiative with a web site (*http://www.KM-debate.co.za*) which promotes profitability and innovation, as well as improving the transfer of tacit knowledge.

While the OECD project has identified a number of issues, there is still a question of why knowledge is now a subject that merits so much attention. Part of the answer lies in the pervasiveness, certainly in the industrialized countries, of ICTs and their use. In developing countries, access to the web remains an issue for policy, whereas in the developed countries the issue is more the speed of connection and the volume of data transfer, and policies deal more with the availability of broadband connection than with access to the web. The emerging issue is the use of the web and the Internet for finding, storing, and publishing knowledge.

The web, and electronic networks more broadly, have promoted the codification of knowledge. It is the electronic network that allows the complex medium to large-sized firm to see, for the first time in history, the information and knowledge accumulated about all aspects of its operation and to manage that knowledge strategically. It is the network, for example, that allows the firm to publish its codified knowledge for all to see. This could include patents and other intellectual property instruments, or databases of information and commentary on, say, regulations on safety in the workplace and related case law. The client who, in the past, would have bought low value knowledge products from the firm can now access these products at no cost and use the knowledge. In principle, the firm gains from the former clients seeking counsel on high value-added problems rather than on many low value-added ones.

While the web is pervasive, and is becoming more so with wireless broadband delivery, there is still a fundamental challenge for the creation, transmission, absorption and application of knowledge. It is people.

The firm can give its codified knowledge away, but it will still make money using the tacit knowledge in its highly skilled staff. To take advantage of the freely available codified knowledge, people have to be sufficiently literate to absorb the knowledge, and the context for its application, in order to have a capacity for action. Quintas (2002) has looked at the sharing of knowledge across functional and disciplinary boundaries and noted the challenges for communities and discipline with little common ground. While this is an issue for developed countries, it is a major one for the developing world where culture, computer literacy and organizational structures may inhibit the use of knowledge and contribute to the knowledge divide.

7.4 The North-South Knowledge Divide

In this section we begin to map the nature of the knowledge divide, using available data. However we also seek to go beyond this and explore real issues in the context of local practice within the global economy. To this end, three vignettes are presented, each highlighting different key knowledge issues for development.

Measuring knowledge globally

It is important to begin to build a picture of the nature of the global knowledge divide. However, mapping and measuring knowledge is a challenging task, even for a single nation, as Machlup's pioneering work on the knowledge economy of the US illustrates (Machlup 1962). Beginning to grasp at the nature of knowledge inequities by looking at global numbers is no straightforward task!

The previous sections emphasising the importance of tacit knowledge suggest that mapping and measuring knowledge is made complicated in part by its elusive nature. Another complicating factor is that defining knowledge is in itself political, socially defined and often controversial. What counts as valuable knowledge depends on the social and political context. Ideally, we need to understand knowledge issues 'on the ground' in specific contexts (Chataway and Wield 2000). We adopt this approach in sections 4.2 to 4.4.

The following commonly used indicators are examples of some statistical evidence drawn from a huge amount of data collected by UN and other agencies. Though limited, this information offers a start in the quest to build a comprehensive picture of the nature of the global distribution of knowledge.

Resources devoted to education (as a proxy for capacity)

Statistics compiled by UNIDO suggest that in 1998 Canada led the world in ranking by the Harbison Meyers index of skills of educational attainment[11]. Out of 87 countries, South Korea is ranked as the leading developing country at 10th place. Taiwan is placed 23rd. Brazil is 57th, China 59th and India 69th. The only country in Sub-Saharan Africa (SSA) to appear in the first 50 is South Africa (42nd). The next SSA country is Zimbabwe (68th). Moreover, South Africa and Zimbabwe have both descended in table rankings between 1995 and 1998.

[11] *The Harbison-Meyers Index is the average of the percentage of the relevant age groups in secondary and tertiary education, with tertiary enrolments given a weight of five.*

Although interesting, these numbers have some very obvious limitations. For example, in countries with large numbers of people with very little education the numbers are misleading as a proxy for capacity; India and Brazil may have huge numbers of people with no or minimal amounts of education, bringing the overall average down, but they also have substantial populations with relatively high educational levels. And the statistics certainly do not capture any particular areas of strength in scientific, technical or educational terms.

R&D investment (as proxy for both knowledge creation and absorptive capacity)

Investment in Research and Development (R&D) is one (albeit partial) measure of knowledge creation and absorption with thirteen developed countries spending more than 2% of GNP per annum on R&D in the period 1987-97 (Human Development Report 2001), compared with just one developing country (South Korea). Only one other developing country, Singapore, spent more than 1%. And many developing countries with significant volume of R&D expenditures (like Brazil, China and India) spend quite low proportions of their R&D on business (close to application) R&D.

Patents (as proxy for knowledge creation)

Patent data is another measure of a country's ability to generate new knowledge-based creations and scientific findings. But patent data must also be viewed with caution. For example, a UNIDO report (2000) notes that, as might be expected, in general there is a strong correlation between R&D effort and patents. But there are some important anomalies, which highlight some limitations of patent data; Hong Kong SAR ranks low in R&D spending and high in patents, and so does Taiwan. By contrast Brazil has considerable R&D spending but ranks low in patents and China shows a somewhat similar pattern. The report notes that "The variations may be due to several factors, such as foreign companies' affiliates patenting technology based on R&D elsewhere, differences in the quality or orientation of R&D [patenting is more prevalent in some sectors than others] and differences in the propensity to take out international patents" (UNIDO 2002).

Comprehensive indicators

Because any one of the data sets taken on their own is limited, a number of agencies have tried to bundle or cluster indicators to give a more comprehensive picture (RAND 2001, UNIDO 2002). RAND researchers tried to get a broader idea of science and technology capacity with the following index.

The RAND (2001) Science and Technology Composite index:

- The per capita gross national products (GNP) of the country to serve as a proxy for general infrastructure;
- The number of scientists and engineers per million people to capture the human resources available for S&T activities;
- The number of S&T journal articles and patents produced by citizens of the nation to characterise S&T outputs;
- The percentage of GNP spent on R&D to measure the society's level of input into S&T;
- The number of universities and research institutes in the nation per million people to characterise the infrastructure for S&T;
- A measure of the number of the nation's students studying in the United States adjusted for those who chose not to return home at the conclusion of their studies to characterise the country's contact with external knowledge sources;
- The number of patents filed through the U.S. Patent and Trademark Office (USPTO) and the European Patent Office (EPO).

In order to combine these disparate components into a common index, the value of each national characteristic is compared to the international average[12].

Four categories emerge from the above. One of the interesting results of this more sophisticated approach, and one which begins to incorporate a wider set of indicators, is that a significantly more differentiated picture

[12] *Footnote weightings.*

and, for developing countries, perhaps a slightly more positive one, begins to emerge:

Scientifically Advanced Countries (SACs).

The 22 countries included in this category have greater S&T capacity than the mean. These countries are responsible for 86% of all scientific articles published in internationally recognised journals and they fund 85%-90% of all the world's R&D (RAND 2001). This category includes industrially advanced countries and some developing and transition countries such as Taiwan, Israel, South Korea and Russia.

Scientifically proficient countries (SPCs).

This category includes 24 countries which possess an overall S&T capacity index value at or over the international average, but they are not as "uniformly capable" as those in the first category. This category includes Singapore, Cuba, China, Brazil, South Africa and India.

Scientifically developing countries (SDCs).

The next set of 24 countries includes Argentina, Chile, Mexico, Pakistan Colombia, Costa Rica, Egypt and Indonesia. Although these countries are below the international average they have made some positive investments and some components of the index exceed the international mean.

Scientifically lagging countries (SLCs).

The remaining 80 countries fall into the category of scientifically lagging countries. This includes most of SSA, apart from South Africa.

Although the RAND index is an advance on single indicators, particularly those which focus on counting patents or telephone lines there are still limitations to this approach. It is a still a statistical representation and ignores the fact that the list of SACs and SPCs include several countries with centuries of scientific tradition and significant investment that outstrip that of scientific newcomers next to them. Nor does the index capture dynamism.

The RAND index is a useful snapshot and in particular it gives an idea of how there is more than a straightforward knowledge divide between rich and poor countries. In fact the index shows there are several divides. But the concept of knowledge divide is even more complicated than that. It implies that a resolution might be achieved by simply transferring knowledge from one place to another. And this in turn implies that it might be a rather technical procedure, which could be achieved by attention to detail. However, underlying the concept of knowledge and knowledge divide is an institutional framework. Within this framework, knowledge is valuable because it is apparently useful, commercially valuable and, as its origins can be traced, its originators can be rewarded. But not all parts of the world operate with the same norms, values, understandings and institutions and there are a number of reasons why this conceptualisation leads to some both politically and practically problematic programmes, projects and strategies undertaken in the name of 'development'.

One more thing that is important to note about the statistics, indicators and indexes discussed are that they roughly confirm to mode 1 type of knowledge creation (*pace* Gibbons *et al.* 1994). The context specific, tacit, mostly mode 2 (practitioner) knowledge, which tends to be trans-disciplinary, practice-based and transient in form, for example, is much harder to measure. But the importance of mode 2 knowledge does become apparent in recent discussion of cases and issues related to the knowledge divide. Here we present three vignettes of current issues and discussions which highlight the importance of different types of skill and knowledge for developing countries and communities in the developing world and focus attention on the way in which international institutions must be rooted in the needs of all players rather than an elite. The first vignette concerns traditional indigenous knowledge and in particular the case of the San people and the hoodia plant. The second discusses recent debates surrounding intellectual property rights (IPRs), and the third looks at the development of the network-based Indian software industry.

Traditional Knowledge - The San People and the hoodia plant

In some areas it is very clear that new commercially valuable knowledge rests on old indigenous or traditional knowledge (TK). That older knowledge often goes unrewarded and unacknowledged. As the following example shows, exploiters of knowledge, or those who perform the feat of turning new knowledge to gold, are often not working from a blank sheet. With many industrial processes and products there are ways in which 'value added' in terms of knowledge creation can be assessed, and all those who have contributed at different stages also get recompense through a variety of licensing or royalty agreements. But in cases where TK is involved this has not been the case although as the following example shows, pressure on corporations and other institutions to behave in 'socially responsible' ways may mean that profits are more equitably divided in the future.

For many years the San people (or bushmen as some still prefer to be called) have used the Xhoba or hoodia plant to combat hunger, especially useful when on hunting trips. "All the San people here use the Xhoba and in Namibia they even give it to their dogs to eat when they are hungry. In the old days the men often went hunting and they never felt hungry or thirsty, and now it is going to make life better for me and for my children" said a San woman in a recent interview (Evans 2003).

The reason that hoodia may be the source of new benefits to the San people is that the pharmaceutical firm Pfizer is using it to develop a dieting drug. The history of the drug 'discovery' began when the South African Council for Scientific and Industrial Research (CSIR) started to test San claims for the hunger busting properties of the plant in 1963. Its curiosity was inspired by two sources. The first, a 1937 research paper from a Dutch ethno-biologist who quoted San hunters, and the second was information supplied to the military by San people who also used the plant as a supply of water. During the 1980s the CSIR isolated the relevant bioactive compound and in 1997 patented it as "P57" (Evans 2003).

The CSIR licensed P57 to the British drug research company Phytopharm, which specialises in trails based on traditional medicines. Phytopharm confirmed CSIR's findings and sub-licensed it to Pfizer, a large pharmaceutical firm. Pfizer plans to develop a slimming aid based on the product.

Many of the drugs used in industrially developed countries are derived from plants originating in the global South, from poor countries. Often, initial indications of which plants may have useful properties are based on indigenous knowledge, as with the hoodia and San. In the past, the norm was that no acknowledgement of the importance of TK has been made. The difference in this case is that the commercial success of any product derived from the hoodia will be shared with the San although initial plans for drug development did not include benefit sharing. It was claimed by a number of those involved to be impossible. The head of Phytopharm claimed that the San people "have disappeared" (Evans 2003). The situation began to change when a human rights lawyer, who had previous involvement with the San helping them to win land rights, took on the case on behalf of a newly formed San council. This effort coincided with a political will in South Africa to acknowledge the rights of indigenous people and with a corporate responsibility movement that was gaining strength in industrially developed countries.

The end result was that in February 2002 the CSIR and the San Council reached a memorandum of understanding acknowledging the rights of the Bushmen as the "custodians of the ancient body of traditional knowledge". No precise formula as yet exists about how profits from any commercialised drug will be divided. But if Pfizer meets its goal of marketing P57 in 2007, the San hope to receive several million rand a year to be shared between the San community all over Southern Africa (Evans 2003).

The P57 deal is an example where 'bioprospecting' did reward traditional knowledge (TK) holders. In cases where no compensation is provided, many contend that this type of activity amounts to intellectual piracy or 'biopiracy' as it has become known. One of the advocacy groups arguing for compensation for traditional knowledge is the North American group Action Group on Erosion, Technology and Concentration (ETC Group), formerly known as Rural Advancement Foundation International (RAFI). ETC and others argue that many patents have been wrongly awarded in the past precisely because they have ignored traditional knowledge. Patent awards have been inadequate for the following reasons: examiners have not had enough time to conduct 'prior art' searches; the required standards of inventiveness being applied to patent applications maybe too low; or the companies or scientific institutions applying for the patent may deliberately fail to cite the prior art upon which their inventions are based (Dutfield 2002).

ETC claim to have uncovered many cases of either patents being acquired for 'inventions' that are closely based on traditional knowledge or of plant breeders rights (a form of IPR given to seeds) being awarded to plant varieties that are identical to traditional varieties. Some challenges to patents on TK have been successfully challenged. Graham Dutfield details the following cases "...in May 2000 the European Patent Office revoked a patent covering the fungicidal properties of neem tree seeds due to the absence of an inventive step. And a US patent awarded in 1995 to the University of Mississippi for the use of turmeric powder in wound healing - a property well known in India - was revoked following a legal challenge by the Indian government" (Dutfield 2002). He goes on to note that the challenge to the turmeric patent would not have succeeded if it had relied on the argument that the 'invention' was common knowledge in India since US patent rules "do not recognise foreign undocumented knowledge as 'prior art' if it is not also known in the United States. It was only when the Indian government provided written proof (including an ancient Sanskrit text) that the patent was revoked due to lack of novelty" (Dutfield 2002).

Efforts of governments and activists to overturn unjust patent decisions and to claim compensation for TK have received widespread support, although there is disagreement as to the adequacy of IPR as a means of protecting indigenous rights (Correa 2001). Tensions have arisen between the large sections of the development community which support these efforts and those who see any form of bioprospecting as indicative of dangerous commercialisation which will undermine indigenous communities even if benefit sharing is achieved. In late 2001, a programme of legal bioprospecting in Mexico undertaken by the International Cooperative Biodiversity Group (ICBG), an organisation committed to benefit sharing, was terminated as a result of pressure from RAFI. Joshua Rosenthal from US National Institutes of Health, which was involved in the project, writing on behalf of a diverse group of scientists and researchers in Nature, said that the termination of the project in Chiapas, "may have a chilling effect on the ability of scientists to develop transparent and ethical collaborations in natural-products drug discovery, biotechnology and other sustainable uses of biodiversity for local and global benefit. In our opinion, all parties have lost, not least local communities in developing countries. These stand to benefit from improvements in health care and from enhanced capability to use and conserve their disappearing biological resources and associated traditional knowledge" (*Nature*, 416, 15: 07 March 2002)

Issues of traditional knowledge, IPR and compensation have been widely debated in the UN, WTO and WIPO (Correa 2001). A number of policy measures are under discussion to ensure that bioprospecting is regulated in ways that benefit all stakeholders. Measures might include the introduction of 'access and benefit sharing' legislation that require bioprospectors to negotiate access to genetic resources with governments and indigenous peoples, and to share any financial benefits from these activities. The Philippines already has this type of legislation (Dutfield 2002).

The benefit sharing approach institutionalises formal recognition of a more complicated knowledge 'map' than more crude depictions of a knowledge divide allow for. The issues clearly are not simply about transferring knowledge from an erudite group of rich countries to the ignorant poor. They are in part at least about creating institutions, which enable a more just and accurate reflection of how knowledge is accumulated and shared. Viewed this way, debates about the knowledge divide reflect a broader set of 'development discussions' about whose knowledge counts[13].

Knowledge divide in intellectual property

Other revealing and topical examples of the complex nature of the knowledge divide are associated with intellectual property rights (IPR). The simplistic divide, once more, is between *those few* companies and countries with extreme sensitivity to the need to protect their intellectual property rights with a vast number of different types of professionals working in and around the IPR protection arena, and *those other* companies and countries with weaker capabilities which make it hard or impossible to protect their knowledge claims.

One example of the quantity of effort required to protect IPRs is the case of basmati rice. A long-running dispute has been going on between India and Pakistan, where Basmati rice originates, and the US that disputes the right to protection of the name Basmati. In 1997 a US rice breeding firm was granted a patent seeking a monopoly over various rice breeding lines similar to Basmati. After India requested a re-examination, the firm withdrew their applications of the Basmati type lines. But the dispute over the geographical focus of Basmati continues, taking up massive amounts of professional and advocate time. The US claims Basmati is a generic term, India and Pakistan claim it is geographically specific depending on a unique combination of environment, soil, climate agricultural practices and genetics of the Basmati varieties - in short a complex mix of knowledge forms and practices (CIPR 2002, p.89).

The key institutional debate presently is over the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). This agreement requires all WTO members to provide minimum standards of protection of IPRs. The overarching argument (summarised in CIPR 2002) is between those who argue that IPRs are necessary to stimulate economic growth and thus help alleviate poverty, and others who argue "equally

[13] *Development writers such as Robert Chambers (1997) and many others such as Warschauer (2002) have written extensively about how development initiatives and activities are routinely undermined when local knowledge is ignored. Sustainable and equitable development rests on local knowledge being acknowledged.*

vehemently the opposite. IP rights do little to stimulate invention in developing countries, because the necessary human and technical capacity may be absent. They are ineffective at stimulating research to benefit poor people because they will not be able to afford the products, even if developed. They limit the option of technological learning through imitation. They allow foreign firms to drive out domestic competition by obtaining patent protection and to service the market through imports, rather than domestic manufacture. Moreover, they increase the costs of essential medicines and agricultural inputs, affecting poor people and farmers particularly badly" (CIPR 2002, p.1).

There are a range of important implications for the knowledge divide, including access to medicines for poor people, protection of tacit and local knowledge of those least able to protect it formally (like the San), and access to and ownership of plant genetic resources. A key aspect for those interested in bridging knowledge divides is the issue of science and technological capabilities. Developing countries are not homogeneous. Their scientific and technological capabilities differ widely. Policies on IPRs for countries with relatively advanced technological capabilities and with huge numbers living in extreme poverty, like India and China, will differ from countries with very weak technological capabilities.

The cost of meeting the requirements of TRIPS will be disproportionately high for those countries with weak overall innovation systems. For example, the numbers staffing IP offices differ widely – around 600 in India, 25 in Jamaica, 97 in Kenya, 20 in Tanzania, 128 in Vietnam (CIPR 2002, p.142). Even the decision in Doha to extend the period to legislate the protection of pharmaceutical patents to 2116 for the least developed countries is not straightforward, since many countries need to amend their legislation and change bilateral and multilateral agreements to take advantage of the concession.

In summary, the interests of developing countries are best served by tailoring their intellectual property regimes to their particular economic and social circumstances. Just as developed countries currently exhibit significant variations in how they apply IPRs, and did so to an even greater extent in the past, so should developing countries be free to proceed accordingly. Indeed, it is perhaps more important for developing countries because costly errors of policy will be harder to ear (CIPR 2002).

However, tailoring policies to circumstances begs the question of how complex knowledge capabilities can be built under pressure to conform to global regulatory regimes set up by those with the vast majority of capabilities to create and police them.

Knowledge networks and the development of the Indian software industry

Nearly a quarter of the engineers employed by India's largest software company, Tata Consulting Services (TCS), are abroad for between two weeks and two years. 'About half of Wipro's 13,000 engineers are abroad on short-term assignments, while some 4,000 out of Infosys' 14,000 engineers are on overseas assignments at any one time' (Merchant 2003, p.1).

The Indian software industry has often been criticised for its call centre and body-shopping origins and mentality and thus relatively 'low-tech' status in comparison with the software giants (Heeks 1996). It is perhaps easy to critique an industry set up as a low-wage alternative to US and European locations. However, the Indian software industry has grown at 56% a year for the five years to 2002, two-thirds due to exports. Arguably this results from a winning combination – low wage costs and high skill – but it is more than this, reflecting the difference between simple and more complex notions of IT and knowledge management. Arora and Athreye (2002, p.253) argue that the success of the Indian software industry has "increased the relative value of professional workers, not only programmers, but also managers and analysts. The growing importance of human capital, in turn, has led to innovative models of entrepreneurship and organization ... . A potentially important and under-appreciated contribution of the software industry is thus its exemplar of good entrepreneurship and corporate governance to the rest of India".

US companies highlighted the ability of Indian firms to mobilise large teams of developers at short notice, requiring capabilities of project and team management (recruitment, screening, training and retaining software professionals, not to mention building the medium and longer term knowledge of working with overseas clients). Undoubtedly, the diasporic nature and extensive links of experienced Indian software professionals, and their informal knowledge of working and living in the US, Europe, the Middle East, China and many other places, builds up the trust in the quality of software services that is mentioned by the large companies. 185 of the top 500 Fortune companies now outsource software production to India. Indian companies distinguish themselves from competition by highlighting the quality of their processes and employees, as well as their experience. This is an excellent example of knowledge being stored in a network, or of network capital.

Athreye emphasizes the fact that early entrants were able to learn how to transform a set of skills into specific capabilities "and become leading firms in their chosen market niche. This market niche was the unglamorous area of large volume outsourced software services, where Indian firms successfully pioneered a business model based on the ability to deliver outsourced technical services to different specifications and exacting quality" (2003, p.1). Leading firms like TCS and Infosys set up development centres dedicated to specific clients. Other firms entered, including hybrid US-Indian firms. TCS and Infosys concentrated on financial and insurance domains, Pentafour on creating digital assets in animation, Satyam on software for automated systems in transport manufacturing, Wipro in telecoms and R&D services.

Athreye suggests that the outsourced business model could in principle be applied to a range of business processes, such as payroll management, data transcription, call services, technical support and R&D services, for example.

Firms have built capabilities through a mix that includes making good use of diasporic relations between Indians in the Silicon Valley, other international centres and India, and in developing project turnkey expertise that allows management skills to add value to software engineering.

7.5 Conclusion

There is a classic tension in development between mapping the facts concerning divides and inequalities and doing something about them. That the chasms are vast between economically and industrially most developed regions and those less developed is obvious. The 'leading edge' seems so far removed from the rest that the chasms are wide enough for us to notice the difference between, for example, the UK's South East and 'the rest' of the UK, or between Boston/Cambridge and the Bay Area and other parts of the USA. What hope then, even for Brazil's most industrialised zone (Sao Paulo) or indeed Manaus, or the hi-tech centre of Bangalore in India, Guandong in China, the Guateng district in South Africa, Prague, or Monterey on Mexico's northern border with the USA? Let alone Malaysia, Slovakia or Colombia, and so on 'down' to Dar Es Salaam, Dacca, or Tegucigalpa.

It is easy to drown in helpless and cynical critique of the 'facts' of divide, and of the international institutions that seem to have so little ability to bridge them. It is much less easy to look for what is possible in however difficult circumstances. And yet, not to engage in what is possible is to miss some of the most extraordinary and interesting aspects of how new knowledge based economies operate.

This chapter has hopefully provided a window on the analysis of knowledge, knowledge divides, and related development issues. Through that window lies a panorama of complex constraints and opportunities. For example, we know that to some extent knowledge accumulation depends on absorptive capacities (in other words, what you can acquire and use depends on what you already have). But we also know that some things make a difference, as for example firm-based strategies, some policy measures and some complementing factors, and also powerful diasporic communities and their networks. In some ways cumulative pathways do imply a certain linearity and order of progression. But precisely because context is so important and because so much of knowledge acquisition is tacit rather than codified, a set of possibilities exist. The Indian software industry has grown in capacity in ways that have defied initial predictions. Absorptive capacities are not static. Firms and networks can become more adept at creating 'learning environments' which enhance 'sense-making' and sourcing capacities. In the Indian software example, a focus on human resources and innovative organisation has created a new set of opportunities. And there is evidence that these new sets of possibilities are being echoed in India's pharmaceutical sector (Chaturvedi, 2003). But, as we have also pointed out, institutional reforms such as those governing trade and IPRs may have a very significant impact.

A very different example of change that highlights possibilities of policy and institutional modification comes from Southern Africa. The San people have used advantageous political climates and legal structures to gain some recognition for the role of traditional knowledge in modern economies. The examples point out how national and international institutions can be pressured to protect the rights of those without huge economic power, albeit so far in a modest way.

One thing that emerges from this chapter is the idea that the study and practice of knowledge and its management have something to offer as a way forward in the rethinking of what needs to be done. One of the main things it contributes is a glimpse of a way of operating that transcends the normal 'to do lists' that characterise much of development and technology management and policy thinking. If top-down approaches are not enough, if firms cannot work alone, if technology cannot just be copied, that certainly complicates the process of bridging gaps. On the other hand, it allows serious ways of assessing what is possible and what is not. In short, it offers a more nuanced analysis of what might be possible and thus what capabilities and capacities for action are required. The new emphasis on knowledge, not surprisingly, serves to reinforce those approaches to development, dominant for some time, that argue for a more complex, more human resource-dependent, more institutionally-aware perspective.

Chapter 8

METHODOLOGICAL ISSUES

8.1 The data

The work starts with the raw data. All data used in the empirical application of the model come from well-known sources. They have history and continuity, they are well-tested over time and their pros and cons are well-known. The strictest standard, that of the lowest common denominator, was applied; every series must be available for every country and for each year. Therefore, estimation of missing cells was kept to a minimum.

Nevertheless, in a statistical operation of a large size, where up to 192 countries, 21 indicators and 6 years of observation are utilized, it is not surprising that missing cells existed. Whether the average of two years was used to fill in missing values in intermediate years or the applicable rates of growth, the estimation relied overwhelmingly on a series' own trend and each country's own information - rather than donor imputation. (The fact that we deal with series that generally grow over time is tremendously conducive to this type of estimation). In total, the proportion of cells estimated represents 4% of the total, and the quality of the fits is estimated to be in the 95%-99% confidence interval. Only about 1% of the values were imputed from donor information, selected on the basis of geographical proximity rather than through the application of generic rules. While this adds to the complexity of the calculations, it also adds to the specificity of the estimates – although obviously the quality of these fits cannot be assessed.

All in all, considering the approach to use well-known and well-tested indicators, in conjunction with the quality of the raw data, the relatively small proportion of estimated values, and the high fit of the estimates that can be assessed, the data used are deemed to be of the best quality possible.

8.2 Discussion of indicators

The conceptual framework calls for the measurement of the notions of Infodensity and Info-use, their sub-components and their aggregation to a country's overall Infostate. As is always the case, adaptations must be made in moving from the conceptual purity of the concepts to an empirically applied modeling exercise. Any model fit will inevitably be an approximation of the framework.

The empirical application is based on an indicators model. As explained earlier, the key to such an approach is the appropriateness of the indicators used and not their quantity. Selecting good but not multiple indicators for individual components of the model also avoids the problem of high autocorrelation among indicators, something that our particular application is free of. In practice, sometimes, the choice of a suitable indicator between model components becomes blurred and the same indicator could be potentially used in either component. Judgment must be exercised, based on a combination of subject-matter knowledge and data availability. Thus, the end result of the empirical application represents a combination of statistical work and subject matter knowledge.

Having a complete set of data for all countries, all variables and all the years for which each variable is available, the next step was to convert the raw data to indicators for purposes of comparability across countries and eventual aggregation. While in most cases individual indicators derived from the raw data were constructed, where appropriate, indicators were combined to form composite indicators that would come closer to the concepts that the model calls for.

Moreover, some indicator series are subject to an extreme range. A thorough statistical analysis was performed for each and every indicator, complete with its statistical moments. Although the model does not admit to any maximum values, since Infostates are unbounded upwards, this type of individual series analysis was used to apply a smoothing procedure. This was of the minimal intervention type and took care of some 'outlier' values, which distort the data more than anything else. At the same time, it is believed that this procedure takes care of some data anomalies, such as the problem with the allocation of too many Internet hosts in the United States. This procedure is based on the mean, the standard deviation (variance) and their ratio (the coefficient of variation) and was applied in a systematic way, on the basis of set rules, across individual series and years.

Infodensity

The measurement of Infodensity calls for the measurement of ICT capital and ICT skills. No adequate statistical information exists to measure either of these components at a detailed level. In the case of ICT capital, there are enough good indicators, though, that allow the measurement of networks. Thus, ICT capital will be restricted to networks. This is useful as it is indicative of a country's infrastructure readiness and potential.

NETWORKS: The following indicators are used to measure networks:

- Main telephone lines
- Waiting lines
- Digital mainlines
- Cell phone subscriptions
- Cable connections
- Internet hosts
- Secure servers
- International bandwidth

For our purposes, we first need to measure the extent of the wireline telecommunications network, which is traditionally measured by the indicator of main telephone lines (per some population measure). The reason for the widespread use of this indicator for many years is an implicit assumption that over time the demand and the supply match. In other words, if the demand is not there, it is unlikely that the network will continue to expand, as this would be uneconomical. While this assumption works reasonably well in the context of developed countries, it cannot be said to reflect reality equally well in developing countries where there is a substantial amount of unsatisfied demand, as demonstrated by the data. Recognising that it is really the extent of the network that we wish to measure, the following two adjustments are introduced: first, the number of waiting lines is used to adjust the main telephone lines in order to reflect better the actual extent of the network (considering that the level of demand in countries with waiting lists clearly exceeds supply, either in terms of actual geographical/population coverage or in the capacity of the switches), and; second, the degree of the network's digitization is used as an additional adjustment for the extent of the network, in so far as its capacity to deliver value-added services is concerned. The former may be perceived as a 'quantity' adjustment and the latter as a 'quality' one.

It is for the same reason, of the parallel movement of demand and supply over time, that cell phone subscribers are used as an indicator of the extent of the mobile telecommunications network. Ideally, the indicator should exclude lines used purely by households. Lines used for business and government purposes, however, cannot be isolated in the data.

Cable connectivity is another network indicator, but it poses a peculiarity. Many countries have no cable networks at all, and using the indicator indiscriminately would violate the desirable property of technological neutrality. This is so because the principal service offered by cable networks has been signals of television channels, something that is accomplished elsewhere via satellites and dishes or antennas. Thus, the use of this indicator would unduly bias the comparisons against those countries devoid of cable networks. On the other hand, cable today is not used only for the transmission and reception of television signals, but serves increasingly as a channel for the provision of Internet services (considered broadband) and telephone services. In that sense, it is undoubtedly an extra valuable piece of the overall converging infrastructure. Thus, the availability and extent of cable networks in countries that have them should be reflected in the measurements, albeit countries that do not have them should not be penalized to the same degree as if they did not have, say, a wireline telecommunications network - given the multiplicity of services offered via cable, coupled with the fact that there are alternatives for what is still the main service. In this case, a monotonic transformation was applied.

So far, the extent of the Internet is commonly measured by Internet hosts, an indicator for which several caveats have been identified. For 2001 we also have data for secure servers and international bandwidth. From a subject matter point of view, the significance of each of these is very different. However, they both improve on the Internet hosts indicator, which admittedly is subject to several caveats. Secure servers denote the sophistication of a country's Internet infrastructure. However, in many ways, they are not yet a widespread phenomenon. Even in highly developed countries, their number is very small proportionally to Internet hosts and placing this indicator on equal footing with hosts would not be sensical as it could seriously distort reality. In many island states, the mere existence of one or two of these servers, for whatever reasons they are located there, would represent an enormous percentage if expressed in terms of their small population bases. This would not indicate anything of particular importance but would rather confuse things. Therefore, a good treatment for secure servers is to incorporate them as an adjustment in the Internet hosts indicator. This way, they are used to differentiate between country infrastructures to some extent, but at the same time their importance is kept in perspective, without unduly biasing the results in a meaningless way.

International bandwidth is emerging as a significant indicator and heralded as much superior to Internet hosts (IDRC 2002). True, bandwidth matters enormously in the overall scheme of things and is at the heart of important aspects of the Digital Divide, including the issue of prices. However, the structure and architecture of the Internet infrastructure internationally, with its physical backbones, nodes, interconnections and the like is well-known and can give rise to biases of a different nature than Internet hosts. For instance, cities such as Brussels and Geneva have the 'big pipes', something not unrelated to the presence of big international and transnational organizations there. While this does not change the fact that these big pipes are indeed there and form part of the countries' infrastructure, reflecting them to their full extent today would result in figures of such massive overcapacity that would border the meaningless. A simple test, the ratio of a top-bandwidth country per capita over that of a bandwidth-starving one, will produce dubious figures extremely difficult to comprehend, digest and make sense of. Again, a monotonic transformation is performed to put the differences in conceivable scale, while still keeping the scale intact.

A final note here concerns the applicability of a country's bandwidth not only to the Internet but to all networks, as it is used to carry all traffic.

SKILLS: There is increasing interest in work to measure ICT skills but at this point it is still at very early stages, particularly with regards to data across a large number of countries needed for international comparisons. Therefore, skills are approximated with generic education indicators, which progressively become more advanced. The following indicators are used:

- Literacy rate
- Gross enrollment ratio
    - Primary education
    - Secondary education
    - Tertiary education

While little differentiation is offered by literacy rates - as the indicator is situated early on the skills continuum - and gross enrollment in primary education, especially among developed countries, the use of such indicators is consistent with theories and frameworks that view skills as a continuum, with ICT skills embedded there (ETS 2002). More differentiation is offered as we move to enrollment in secondary and tertiary education indicators, which denote the acquisition of more advanced skills and, in that sense, offer a better proxy for ICT skills. For this reason they are weighed more in the calculations. Although this treatment is the best we can do at this point for an application of this scale, this should most definitely be an area where serious improvements must be sought by the international community.

Info-use

The model calls for separate measures of ICT uptake and ICT intensity of use.

It was judged, however, that not enough information exists that would capture the intensity of use in a way that could be deemed satisfactory. Therefore, while uptake is measured on its own and identified as such, the available intensity of use indicators are aggregated with those of uptake to arrive at a measure of Info-use.

Uptake is measured by the following indicators:

- Television equipped households per 100 households
- Residential phone lines per 100 households
- PCs per 100
- Internet users per 100

The proportion of television-equipped households over 100 households serves as an indicator of the capacity to receive information through this medium, still vitally important in many countries as the data indicate. Obviously, it does not offer any differentiation among developed countries, where penetration rates have achieved saturation for some time.

Residential phone lines are a good indicator of uptake among households, and is used as a proxy for the better indicator, namely the proportion of households with a telephone. Unfortunately, the latter exists only in countries that have regular household surveys. One limitation of the residential lines is that there are many households with more than one line. These differ by country and these numbers are not known for possible adjustments to be made. Therefore, in several instances involving mostly developed countries, the indicator exceeds 100 and it is capped there.

PCs is one of those indicators that could fit equally well in measures of ICT capital rather than uptake. Given that it is not possible to differentiate between availability in business, governments and households, in combination with the focus on networks and the need for such an indicator in uptake, this indicator is used here and provides a good idea of overall ICT uptake.

Internet users is a very good indicator for our purposes and is expressed per 100 inhabitants.

The following intensity of use indicators complete the measurement of Info-use:

- Broadband users
- International outgoing telephone traffic per capita
- International incoming telephone traffic per capita

Data on broadband users are available only for 2001 and are relevant here as broadband is associated with intensity of use. Once again, though, we encounter a situation similar to that of cable: many countries have no broadband users at all, and treating broadband on an equal footing with other indicators would bias the comparisons. (Implicitly, the argument is that more differentiates Internet users from non- users than narrowband Internet users from broadband users). Moreover, some controversy surrounds the area as to what exactly constitutes broadband, something that could impose additional biases. The indicator used here represents DSL and cable connections. To mitigate these problems, a monotonic transformation was applied.

Incoming and outgoing telephone traffic measured in minutes per inhabitant are combined and used as an indicator of intensity of use. National traffic, if added, would offer an even better view, but such statistics are not measured in a consistent way across countries and therefore are not available as indicators. In dealing with traffic statistics one must be cognizant that, on a planetary scale, one country's outgoing traffic is the rest of the world's incoming traffic and vice versa. Moreover, such data are also subject to several anomalies, such as the capturing of traffic routed through countries intermediating between those where the calls were originated and terminated. Even though this requires usage of a country's infrastructure, it does not represent usage by its inhabitants. The way international traffic takes place is a function of many things, and results in certain anomalies. For this reason, this series too was subject to a monotonic transformation.

8.3 Reference year and country

The model calls for a reference (base) period and a reference country. These provide the benchmarks to quantify and monitor the evolution of the Digital Divide across countries and over time, while admitting all along to the reality that infostates and their components can continue to expand from year to year everywhere. The year 2001 was chosen as the base, because this is the year for which additional indicators exist and therefore it can produce the best measurements.

Rather than picking a specific country as the base, Hypothetica was created. This country represents the average among all countries used in each component of the model. In effect, Hypothetica has as values the average of each indicator among all countries examined and provides an initial delineation among countries, serving as a useful analytical tool for benchmarking.

Another imaginary country was created with its own analytical usefulness; Planetia represents the planet. In other words, rather than be the hypothetical country of the average values of all countries, it contains the aggregate values of the whole planet, if it was viewed as a country. Planetia is based on the sum total of all countries available for each component. In 2001, these countries account for: 99% of the population of the planet in networks, 98% in skills and infodensity, and 95% in info-use and the overall infostate. (In skills, the available indicators used are expressed in percentages and no cumulative totals can be constructed. Planetia and Hypothetica are assumed to be the same). While Planetia could be a good alternative reference country, Hypothetica was preferred, as our world still evolves around comparisons among countries more than planetary averages (effectively, of the weighted type - the weights being populations). However, Planetia was kept throughout the calculations, the presentation of the results and the analysis.

8.4 Technical specifications and indexes

Starting from the raw data indicators were constructed with the appropriate denominators. Then the smoothing adjustment for outlier values was applied. This was based on the specific nature and characteristic behaviour of each and every series and practically it establishes only permissible maximum values. The indicators used are such that admissible minimum values are at zero. Specifically, the following rule was applied:

$$\text{for } 1.5<CV<3,\ \max = \bar{x} + 3std$$
$$\text{for } CV<1.5,\ \max = \bar{x} + 4std$$
$$\text{for } CV>3,\ \max = \bar{x} + 2std$$

with *CV* being the series' coefficient of variation, $\bar{x}$ its mean and *std* its standard deviation. This produced only a few but useful maximum values and not in all series. It should be noted that this adjustment does not pose an upward boundary to measurements over time.

While many indicators are used individually, some others are combined to form composite indicators. These indicators (and the associated indices) were arrived at as follows:

For the fixed telecommunications network;

$$I^{fixed} = \frac{\text{mainlines} \times 100}{\left(1 + \frac{\text{waiting lists}}{\text{mainlines}}\right) + \left(2 - \frac{\text{digital lines}}{\text{mainlines}}\right) \times \text{population}}$$

For the Internet;

$$I^{Internet} = \frac{1 + \left(\frac{\text{secure servers}}{\text{Internet hosts}}\right) \times 100}{\text{population}}$$

The gross enrollment indicator;

$$I^{gross\ enrollment} = (\text{primary} + 2 \text{ x secondary} + 3 \text{ x tertiary})/6$$

The traffic indicator;

$I^{traffic}$ = (int'l outgoing + int'l incoming)/2

Some indicators were subject to the monotonic transformations discussed earlier. These were of the linear type, with a scalar. Again, rather than arbitrarily selected, the scalars were arrived at through a simple and systematically applied rule based on statistical analysis of each individual series. Specifically,

for CV<1.5, scalar = 4 $\bar{x}$

for 1.5<CV<3, scalar = 3 $\bar{x}$

for CV>3, scalar = 2 $\bar{x}$

Having moved from the raw data to a complete set of indicators, each indicator was converted to an index regardless of its original unit of measurement. During this conversion, a reference country (Hypothetica) and a reference year (2001) were specified, since our objective is to compare both across countries and within countries over time. (The exact choices do not distort the rankings). This is done at the level of each and every indicator, country and year.

Thus, for the reference country (c) we get:

$$I\,t^{\,i,c} = (Vt^{\,i,c} / Vt_o^{\,i,c}) \times 100$$

where *I* stands for the value of the index, *i* refers to individual indicators, *V* to raw values of indicators, t_o refers to the reference year and *t* to any other year.

Using the notation *j* for all other countries we have:

$$I\,t^{\,i,j} = (Vt^{\,i,j} / Vt_o^{\,i,c}) \times 100$$

This normalization allows immediate comparisons between other countries and the reference country, and for any country over time.

Once every indicator has been expressed in index form, we proceed to aggregate across each component. Indexes are obtained as:

$$\hat{I}\,t^{\,i,j\,(c)} = \sqrt[n]{\prod_{i=1}^{n} I_{n,t}^{i,j(c)}}$$

with P denoting product and n the number of each component's individual indices. In 2001, for networks, n=5 (fixed, mobile, cable, Internet and bandwidth), for skills, n=2 (literacy and gross enrollment) and for uptake n=4 (television, residential lines, PCs, Internet users).

We continue likewise for the subsequent level of aggregation. Networks and skills are combined into the Infodensity index as:

$$\textbf{Infodensity} = \sqrt[k]{\prod_{i=1}^{k} I^{i,j(c)}_{n,t}}$$

with k=2.

While no index is computed for intensity of use, Info-use is arrived at as:

$$\textbf{Info-use} = \sqrt[z]{\prod_{i=1}^{z} I^{i,j(c)}_{n,t}}$$

where z=6, that is all the four uptake indices plus broadband users and combined international traffic.

Finally, when we have both Infodensity and Info-use, we arrive at the highest level of aggregation, a country's infostate, simply as:

$$\textbf{Infostate} = \sqrt[2]{(\text{infodensity x info-use})}$$

Clearly, once indicators have been constructed as previously explained, what follows is an unweighted average, indifferent to each individual ICT good or service, as we have no knowledge basis to do otherwise. The choice of a geometric rather than an arithmetic mean represents a value judgment that favours symmetrical rather than lopsided development across indicators of interest.

In order to take care of the situation whereby indicators available for 2001 are not available for prior years, the computations for the reference year 2001 were carried out twice: once with all variables and a second time with only the variables present for the 1996-2000 period. This yielded the link factors both for Infodensity and Info-use, which were then applied to all previous years. (Link factors are only relevant for networks and the intensity of use component of Info-use). Considering the transformations that were necessary, the end figures do not really represent percentage changes, but only approximations (only roughly one index point corresponds to one percentage point).

It is clear from this methodology that the reference country will have a value of 100 for the base year throughout the exercise – for each and every indicator, each component and the overall Infostate. The indices for all other countries will assume their corresponding values. It may well be that for some countries individual indicators will have values below 100, while for others they will exceed 100. The same holds true for the aggregates. Then, each country can be compared with the reference country. But the reference country's score is not static. It will be moving over time. It is only the base year that has a uniform value. So, consistent with the terms of reference, two-fold comparisons can be made: across countries at any given point in time, and within each country over time. In a sense, for specific indicators, aggregate components of interest or the overall Infostate index, the values of different countries will effectively reflect each other's timeline. For instance, if a country had 20% Internet penetration in 1999 while another country achieved that in 2001, it can be said to be two years behind.

8.5 Sensitivity analysis

In statistical work of such scale numerous decisions come into play and various alternatives open up. From creating composite indicators, to applying smoothing techniques, to the alternative ways of performing monotonic transformations (scalars, logarithms, square roots etc.), to grouping variables for aggregation, to using geometric or arithmetic means, a very large number of permutations is possible. As is well-known, each different choice, such as the particular method of aggregation, affects the end figures. To ascertain the robustness of the conclusions of the overall results – rather than the figures – numerous tests were carried out, effectively including a vast number of permutations, and therefore an equal set of estimates. While the precise figures change, especially among the top countries, the conclusions stand. They were found to be extremely robust to different methodologies – with the exception of the top tier of countries.

Among the countries that top the Infostate list, no definitive conclusions can be reached. At least half the countries there can come up on top of one another depending on the specific application. Therefore, comparisons based on the ranking of these countries cannot be supported by the results. This would require much more detailed information than is available and would represent a totally different exercise. That the same groups of countries comes up on top, though, and that their difference from countries at the bottom is huge, comes out loud and clear and is in no way affected by the exact choice of technique or method of aggregation. This is consistent with the terms of reference places the emphasis on developing countries.

Chapter 9

DATA SOURCES AND DEFINITIONS

All the data used in this report come from well-known and credible sources. As well, they have a history and continuity and are available to all.

Data on telecommunications, broadcasting and information technology come form the ITU. Primary sources to compile these data include annual ITU questionnaires, as well as reports from national statistical offices, telecommunication ministries, regulators, broadcasting agencies and operators. Depending on the specific data series concerned, a variety of other selected sources are also used. For instance, publications of the European Audiovisual Observatory are consulted for broadcasting data, the Internet Software Consortium and the Internet Domain Survey are consulted for statistics on Internet hosts, while data on personal computers are estimated based on stock and shipment data from many national and international sources

The education statistics come from UNESCO and World Bank databases. Interested readers are referred to numerous publications and metadata information available at these sources. Consult *http://www.itu.int*, *http://www.unesco.org* and *http://www.worldbank.org*.

Valiant efforts are devoted into the compilation of these statistics so that they serve the policy and research needs of the international community. However, gaps exist, as identified earlier, and there is need for concerted efforts to address this "information deficit". Resources for such activities are either scarce or misallocated. The value of quantitative information in a global Information Society setting cannot be underestimated.

ITU data

Demography, Economy

The indicators in this category are useful for deriving ratios in order to make comparisons across countries. They are generally obtained from international organizations or national statistical offices.

Population
The data for population are mid-year estimates. They typically refer to the de facto population within the present boundaries.

Households
The data for households refer to the number of housing units consisting of persons who live together or a person living alone. Estimates are based on growth rates between censuses.

Gross domestic product (GDP)
The data for Gross Domestic Product (GDP) are current price data in national currency. GDP is the sum of final expenditures on goods and services in the domestic economy.

Telephone Network

The indicators in this category refer to the fixed telephone network.

Main telephone lines in operation
The number of telephone lines connecting the subscriber's terminal equipment to the public switched network and which have a dedicated port in the telephone exchange equipment. This term is synonymous with the term main station or Direct Exchange Line (DEL) which are commonly used in telecommunication documents. It may not be the same as an access line or a subscriber. The definition of access lines used by some countries varies. In some cases, it refers to the total installed capacity (rather than lines in service). In other cases it refers to all network access points including mobile cellular subscribers. Telephone subscribers would not generally include public telephones which are included in main lines.

Digital main lines
Refers to the per cent of main lines connected to digital exchanges. This percentage is obtained by dividing the number of main lines connected to digital telephone exchanges by the total number of main lines. This indicator does not measure the percentage of exchanges which are digital, the percentage of inter-exchange lines which are digital or the percentage of digital network termination points.

Residential main lines
Refers to the per cent of main lines in residences. This percentage is obtained by dividing the number of main lines serving households (i.e.,

lines which are not used for business, government or other professional purposes or as public telephone stations) by the total number of main lines.

Waiting list for main lines

Unmet applications for connection to the Public Switched Telephone Network (PSTN) which have had to be held over owing to a lack of technical facilities (equipment, lines, etc.). This indicator refers to registered applications and thus may not be indicative of the total unmet demand.

Mobile Services

The indicators in this category refer to mobile (wireless) networks.

Cellular mobile telephone subscribers

Refers to users of portable telephones subscribing to an automatic public mobile telephone service which provides access to the Public Switched Telephone Network (PSTN) using cellular technology. This can include analogue and digital cellular systems (including micro-cellular systems such as DCS-1800, Personal Handyphone System (PHS) and others) but should not include non-cellular systems. Subscribers to fixed wireless (e.g., Wireless Local Loop (WLL)), public mobile data services, or radio paging services are not included.

Traffic

The indicators in this category refer to the volume of traffic carried over the Public Switched Telephone Network. There is wide variation in the way telephone traffic is reported. Specifically there is no standard convention among countries for measuring the unit in which telephone traffic is recorded. Calls refer to the actual number of completed calls. Minutes refer to the number of minutes of use. Pulses refer to charging units used by the country to measure telephone traffic. Note that telephone traffic measured in pulses is often not comparable across time for the same country and is not comparable across countries. This is because the length of the charging unit varies within countries (depending on the type of traffic or the time of day) and across countries. Furthermore, the length of the charging unit can be changed. The following factors also affect the measurement of telephone traffic: mobile traffic (for some countries this is included); whether total attempted or completed calls are used; whether calls to directory and other services are included and whether both automatic and manually placed calls are included.

International incoming telephone traffic

Effective (completed) traffic originating outside the country with a destination inside the country.

International outgoing telephone traffic

This covers the effective (completed) traffic originating in a given country to destinations outside that country. Many countries have now shifted to reporting international traffic volumes based on point of billing. This means that the data refers to traffic billed in the country.

Broadcasting

The indicators in this category refer to television broadcasting equipment and networks.

Television equipped households

Refers to the number of television households that have television receivers. This is not the same as the number of television receivers since households can have more than one receiver and other entities besides households may have receivers (e.g., businesses). In some countries, the number of licenses (i.e., system where television sets must be registered) are used as a proxy for television households. Since households may not register, the number of licenses may underestimate the number of television households.

Cable TV subscribers

The number of cable television subscribers. Refers to households which subscribe to a multichannel television service delivered by a fixed line connection. However some countries report subscribers to pay television using wireless technology (e.g., Microwave Multi-point Distribution systems (MMDS)). Other countries include the number of households that are cabled to community antenna systems even though the antennas are simply rebroadcasting free-to-air channels because of poor reception.

Information Technology

The indicators in this category refer to computer equipment and networks.

Personal computers

The number of personal computers (i.e., designed to be operated by a single user at a time) in use in the country. Primarily ITU estimates based on a number of national and international sources.

Internet hosts

The number of computers that are directly connected to the worldwide Internet network. This statistic is based on the country code in the host address and thus may not correspond with the actual physical location.

Estimated Internet users

The number of Internet users.

Broadband users

Refers to fast-speed and always-on Internet connections. There is no internationally agreed upon standard of what constitutes broadband. Only cable and DSL connections are included here, not ISDN.

International bandwidth

It measures how fast data flows on a given transmission path, and it also refers to the width of the range of frequencies that an electronic signal occupies on a given transmission medium. It affects both the quantity and the speed of information transmitted.

Secure servers

A server is a host computer on a network that sends stored information in response to requests or queries. The term server is also used to refer to the software that makes the process of serving information possible. A secure server typically offers encryption with a key length greater than 40 bits, since messages encoded with systems less than can be broken relatively quickly with specialist knowledge and tools. Secure servers are conducive to the protection of online transactions.

UNESCO and World Bank Definitions

Illiteracy rate, adult total (% of people ages 15 and above)
Adult illiteracy rate is the percentage of people ages 15 and above who cannot, with understanding, read and write a short, simple statement on their everyday life.

School enrollment, primary (% gross)
Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music.

School enrollment, secondary (% gross)
Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers.

School enrollment, tertiary (% gross)
Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level.

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STATISTICAL ANNEX

Chart A1. **Networks, 2001**

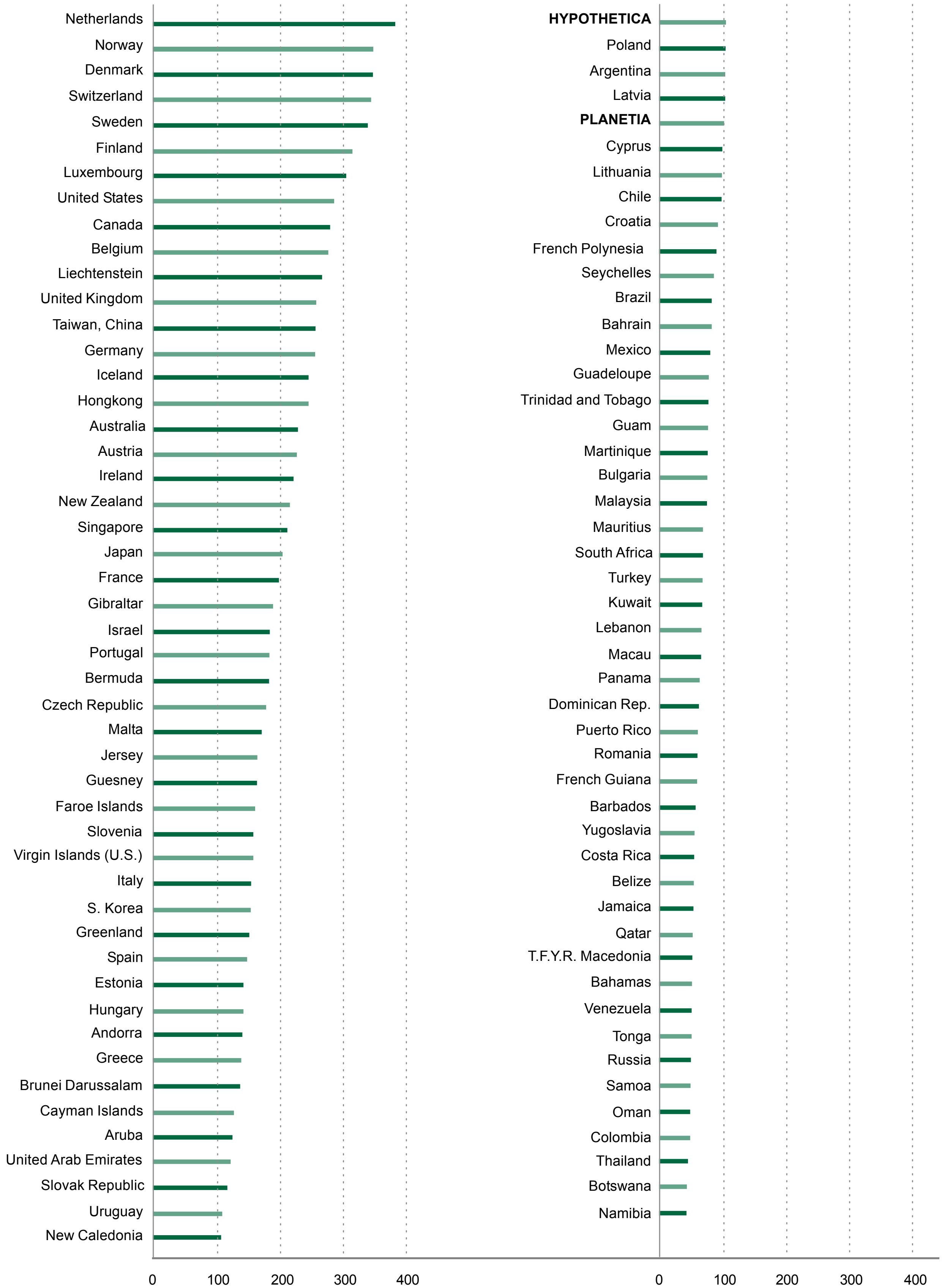

Chart A1. **Networks, 2001** *(cont'd)*

Chart A2. **Infodensities, 2001**

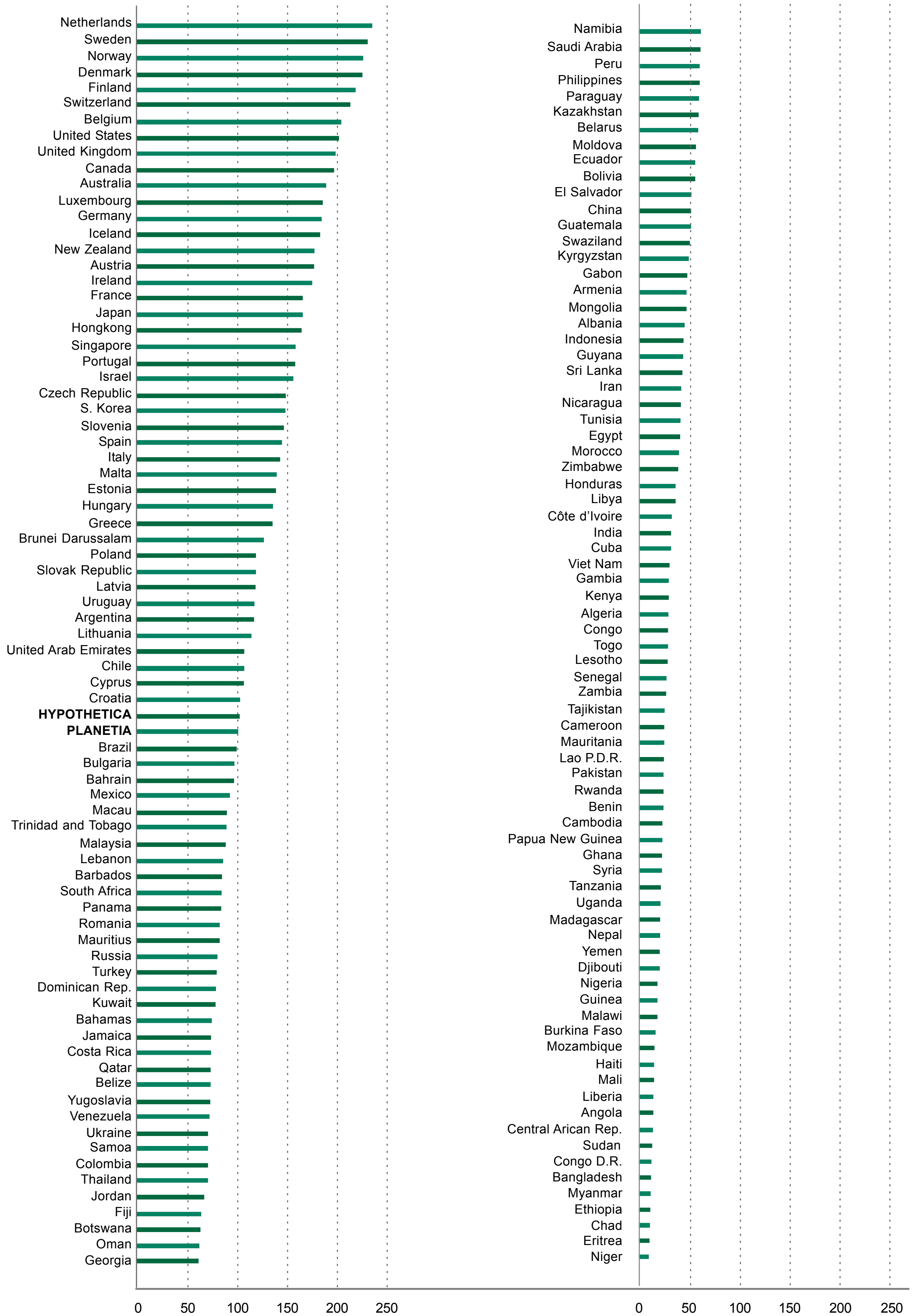

Chart A3. **Info-use, 2001**

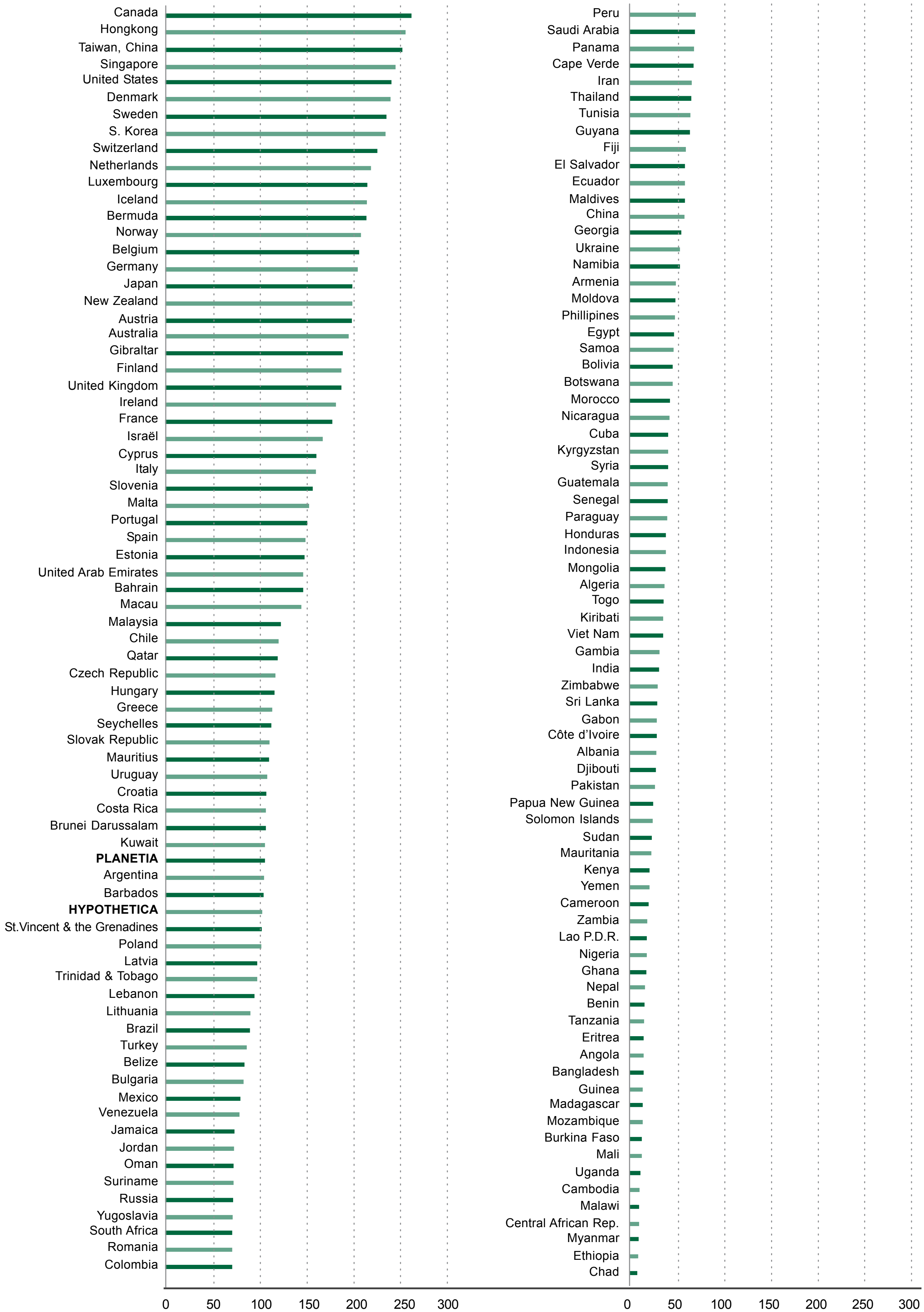

Table A1. **Networks, 2001**

	Networks	Wireline	Mobile	Internet
Netherlands	378.9	274.7	320.5	982.1
Norway	344.5	335.0	340.5	688.6
Denmark	343.5	330.3	309.0	717.8
Switzerland	340.8	334.8	304.3	499.7
Sweden	335.2	338.3	330.3	565.7
Finland	310.8	250.7	335.9	982.1
Luxembourg	301.0	357.0	384.5	216.1
United States	282.2	296.2	188.4	982.1
Canada	275.3	309.3	151.3	660.8
Belgium	272.5	227.8	312.0	233.9
Liechtenstein	262.6	274.4	193.2	728.5
United Kingdom	253.2	268.9	321.9	255.0
Taiwan, China	252.5	262.4	403.5	523.3
Germany	251.7	290.3	285.1	202.0
Iceland	241.4	303.9	361.3	982.1
Hongkong	241.0	265.3	358.9	395.2
Australia	224.5	247.5	240.0	809.3
Austria	222.9	214.2	341.4	274.9
Ireland	217.4	221.8	323.3	229.2
New Zealand	211.8	218.4	250.2	732.9
Singapore	207.6	215.8	302.6	328.8
Japan	200.3	268.1	245.6	383.0
France	194.1	262.5	253.0	91.2
Gibraltar	185.1	407.3	148.9	316.3
Israel	179.6	212.4	378.8	151.4
Portugal	179.1	193.7	323.6	163.9
Bermuda	178.6	397.9	86.2	550.7
Czech Republic	174.0	163.9	284.0	144.5
Malta	166.7	242.3	255.2	153.1
Jersey	160.1	388.1	294.4	123.8
Guernsey	159.5	400.5	209.9	165.5
Faroe Islands	156.4	254.5	248.2	245.4
Slovenia	153.6	183.7	307.9	101.8
Virgin Islands (U.S.)	153.5	287.8	156.8	155.1
Italy	150.3	215.8	369.1	80.4
S. Korea	149.3	197.6	259.4	101.6
Greenland	147.4	213.9	124.8	315.4
Spain	143.7	175.3	306.5	91.4
Estonia	138.1	123.1	190.3	244.8
Hungary	137.9	152.6	208.1	115.1
Andorra	135.9	200.6	140.8	275.0
Greece	134.2	231.7	314.0	92.6
Brunei Darussalam	132.6	117.0	167.4	174.3
Cayman Islands	122.7	388.7	158.8	81.5
Aruba	120.3	157.2	208.9	60.2
United Arab Emirates	117.6	155.4	257.4	105.3
Slovak Republic	112.2	104.9	166.8	92.5
Uruguay	104.4	129.5	64.7	144.5
New Caledonia	102.6	104.4	129.4	147.4
HYPOTHETICA	**100.0**	**100.0**	**100.0**	**100.0**
Poland	99.2	113.5	108.2	86.9
Argentina	98.7	101.4	80.5	88.0
Latvia	98.6	104.8	116.8	72.9
PLANETIA	**97.0**	**72.5**	**66.3**	**160.1**
Cyprus	94.0	286.0	190.5	21.2
Lithuania	93.7	105.2	115.6	65.5
Chile	92.8	105.5	143.0	54.6
Croatia	87.3	141.6	157.6	32.5
French Polynesia	84.8	101.0	118.9	50.2
Seychelles	80.8	113.0	225.1	22.3
Brazil	77.2	96.4	69.9	65.6
Bahrain	77.2	122.2	192.4	18.1
Mexico	75.0	62.3	90.6	62.6
Guadeloupe	72.6	207.1	265.7	6.9
Trinidad and Tobago	72.1	107.4	82.3	36.2
Guam	71.7	232.9	86.7	6.7
Martinique	71.2	195.1	298.9	5.9
Bulgaria	70.3	83.7	79.9	22.8
Malaysia	69.7	88.9	131.3	21.3
Mauritius	63.6	113.3	94.9	17.9
South Africa	63.2	50.0	101.2	36.7
Turkey	62.8	116.1	123.4	11.0
Kuwait	62.0	95.0	161.3	10.4
Lebanon	61.3	85.5	95.6	14.6
Macau	60.2	180.2	181.4	2.9
Panama	58.4	57.0	68.5	18.6
Dominican Rep.	56.9	42.0	61.2	33.0
Puerto Rico	55.1	155.2	131.9	3.0
Romania	54.9	54.1	71.8	14.2
French Guiana	54.1	121.5	165.7	4.3
Barbados	52.0	217.7	82.7	3.8
Yugoslavia	49.8	67.8	78.2	10.0
Costa Rica	49.6	92.0	31.6	14.4
Belize	49.1	62.5	66.4	9.4
Jamaica	48.5	69.2	102.1	3.8
Qatar	46.9	125.6	122.5	1.4
T.F.Y.R. Macedonia	46.5	91.1	45.6	8.7
Bahamas	46.1	174.5	82.2	1.2
Venezuela	45.6	38.7	110.1	6.3
Tonga	45.4	36.5	1.0	982.1
Russia	44.0	58.6	22.1	16.5
Samoa	43.9	18.0	7.4	205.1
Oman	43.2	40.6	51.7	12.2
Colombia	42.9	65.5	31.9	9.2
Thailand	39.4	41.4	51.5	8.1
Botswana	37.8	34.9	78.6	5.2
Namibia	37.2	28.9	22.9	17.4
Saudi Arabia	36.8	64.6	47.3	3.5
Jordan	36.5	54.9	69.8	2.9
Ukraine	36.2	42.1	18.5	7.9
Fiji	36.1	49.3	41.2	5.6
Northern Marianas Islands	35.1	196.5	25.9	1.9
Grenada	32.3	149.8	26.8	1.4
Paraguay	32.2	20.0	85.3	3.3
Guatemala	31.4	25.3	40.5	3.9
Georgia	29.6	41.8	25.3	2.9
Peru	28.4	33.6	24.7	3.6
Philippines	28.0	15.0	62.5	2.7

Table A1. **Networks, 2001** *(cont'd)*

	Networks	Wireline	Mobile	Internet
Suriname	27.8	38.6	82.6	0.9
Ecuador	27.3	44.5	27.9	1.8
Kazakhstan	26.1	30.6	15.1	4.7
Moldova	25.9	34.8	21.4	2.7
El Salvador	25.9	43.9	56.0	0.6
China	25.3	62.4	46.1	0.5
Swaziland	24.7	9.9	22.5	7.7
St. Vincent and the Grenadines	24.5	98.2	27.2	0.4
Bolivia	24.2	28.6	39.4	1.3
Azerbaijan	23.8	31.5	39.2	1.2
Belarus	23.4	72.9	5.8	2.3
Saint Lucia	23.3	138.1	7.2	1.0
Cape Verde	22.2	62.4	30.1	0.5
Morocco	20.9	18.6	68.4	0.6
Gabon	19.0	11.8	85.5	0.4
Reunion	18.7	187.1	240.7	0.0
Armenia	18.3	31.1	2.8	4.3
Nicaragua	18.2	9.3	12.4	2.9
Indonesia	17.4	15.4	13.0	1.5
Albania	17.4	20.5	41.3	0.3
Kyrgyzstan	17.2	19.5	2.3	6.3
Mongolia	17.1	16.5	33.9	0.4
Iran	16.2	59.5	13.5	0.3
Sri Lanka	16.0	15.5	14.9	0.8
Côte d'Ivoire	15.8	7.6	18.6	1.3
Egypt	15.2	43.2	18.1	0.2
Zimbabwe	15.2	6.0	11.9	2.1
Guyana	15.1	24.1	36.2	0.2
Tunisia	14.5	45.2	16.8	0.2
Gambia	13.9	9.1	17.2	0.6
Kiribati	13.5	19.3	2.4	1.8
Honduras	13.5	15.1	15.2	0.3
Senegal	13.1	10.8	13.1	0.5
Marshall Islands	12.1	33.4	3.7	0.4
Solomon Islands	11.9	7.8	0.9	6.2
Maldives	11.2	45.0	28.8	0.0
India	11.2	16.5	2.6	0.6
Turkmenistan	11.0	18.8	0.7	2.3
Mauritania	9.8	3.1	18.0	0.3
Kenya	9.2	2.6	8.0	0.6
Pakistan	9.1	9.4	2.3	0.5
Libya	9.1	36.2	3.7	0.1
Togo	9.1	3.3	10.8	0.3
Benin	9.0	2.6	8.1	0.5
Zambia	8.7	2.7	4.8	0.7
Congo	8.0	3.1	20.1	0.1
Lesotho	7.9	2.7	11.0	0.2
Algeria	7.4	20.1	1.4	0.1
Viet Nam	7.3	14.3	6.4	0.0
Cuba	6.9	17.0	0.3	0.5
Tanzania	6.9	1.9	5.3	0.3
Rwanda	6.9	0.9	3.4	1.0
Cameroon	6.7	1.8	8.4	0.2
Djibouti	6.6	7.1	1.9	0.1
Papua New Guinea	6.5	4.5	0.8	0.6
Burkina Faso	6.4	1.8	2.7	0.4
Lao P.D.R.	6.3	4.0	2.3	0.2
Cambodia	6.0	0.6	6.9	0.3
Uzbekistan	5.7	17.9	1.1	0.1
Guinea	5.5	1.4	3.1	0.2
Ghana	5.5	3.2	3.9	0.1
Sierra Leone	5.5	1.0	2.3	0.4
Madagascar	5.0	1.4	4.0	0.1
Nepal	4.8	3.1	0.3	0.5
Yemen	4.7	4.2	3.4	0.0
Syria	4.6	17.7	5.0	0.0
Uganda	4.6	0.9	4.8	0.1
Tajikistan	4.4	8.3	0.1	0.3
Mali	4.1	2.1	1.8	0.1
Nigeria	3.5	1.6	1.4	0.0
Bhutan	3.4	10.8	0.0	11.5
Malawi	3.1	1.6	2.2	0.0
Mozambique	2.9	1.9	3.6	0.0
Angola	2.6	2.1	2.7	0.0
Central African Rep.	2.4	1.0	1.2	0.0
Haiti	2.3	2.7	4.6	0.0
Niger	2.0	0.7	0.1	0.1
Liberia	1.7	0.5	0.3	0.0
Congo D. R.	1.6	0.1	1.2	0.0
Burundi	1.6	1.0	1.9	0.0
Sudan	1.6	3.3	1.4	0.0
Ethiopia	1.3	1.0	0.2	0.0
Chad	1.3	0.6	1.2	0.0
Bangladesh	1.2	1.2	1.7	0.0
Eritrea	0.8	1.7	0.0	0.5
Myanmar	0.8	1.8	0.1	0.0

Table A2. **Skills, 2001**

	Skills	Literacy	Enrollment	Primary	Secondary	Tertiary
Sweden	155.4	121.0	199.5	110.5	217.2	287.7
Australia	154.9	121.0	198.2	102.6	234.7	259.8
United Kingdom	151.9	121.0	190.7	99.4	228.3	244.5
Finland	150.0	121.0	185.8	102.1	183.9	303.4
Belgium	149.3	121.0	184.2	105.5	214.8	234.1
Norway	145.4	121.0	174.7	102.0	167.3	287.6
Denmark	144.6	121.0	172.9	102.5	187.2	241.8
New Zealand	144.3	121.0	172.0	100.5	164.1	284.4
Netherlands	142.8	121.0	168.5	108.1	181.7	225.9
S. Korea	142.1	119.7	168.7	101.6	137.4	318.8
United States	141.1	121.0	164.5	101.5	138.9	298.3
Spain	140.9	119.5	166.2	105.6	168.8	243.8
Canada	137.6	121.0	156.3	99.1	149.8	246.4
France	137.2	121.0	155.5	105.5	157.3	220.1
Ireland	137.0	121.0	155.1	120.0	159.3	195.2
Russia	136.8	121.7	153.7	117.3	121.7	263.2
Latvia	136.3	122.0	152.3	100.8	132.7	259.2
Austria	136.3	121.0	153.4	104.2	144.6	237.0
Poland	135.9	121.9	151.5	100.1	148.0	228.1
Slovenia	135.5	121.8	150.6	100.7	134.6	248.7
Portugal	135.1	113.1	161.3	121.9	165.9	206.2
Iceland	135.0	121.0	150.5	102.8	158.8	199.9
Estonia	134.5	122.0	148.3	103.5	133.9	236.4
Lithuania	132.9	121.7	145.1	101.8	139.0	215.5
Japan	132.5	121.0	145.0	101.3	149.6	195.9
Belarus	132.4	121.9	143.9	109.1	123.3	229.8
Argentina	132.3	118.5	147.8	120.8	141.1	197.0
Germany	131.3	121.0	142.4	104.3	144.6	190.2
Israel	131.2	116.2	148.1	114.5	136.2	216.4
Italy	131.2	120.4	142.9	101.4	140.1	204.9
Greece	131.1	118.9	144.6	99.9	143.7	207.3
Switzerland	130.1	121.0	139.9	107.8	145.5	173.1
Barbados	129.8	121.9	138.3	110.6	148.4	156.9
Ukraine	128.3	121.8	135.1	78.4	153.5	177.8
Hungary	128.3	121.5	135.5	102.6	143.9	164.3
Bulgaria	126.9	120.4	133.8	103.7	137.6	167.7
Uruguay	126.3	119.4	133.7	110.0	143.2	148.3
Macau	126.2	115.0	138.5	104.3	123.1	214.0
Kyrgyzstan	123.2	118.6	127.9	101.9	125.0	168.8
Czech Republic	122.4	121.0	123.8	104.9	138.2	122.6
Brazil	121.6	106.7	138.5	163.2	158.4	67.8
Kazakhstan	120.3	121.5	119.0	99.3	129.2	127.0
Slovak Republic	120.1	121.0	119.1	103.5	127.5	124.5
Libya	118.6	98.8	142.5	116.2	130.7	200.4
Chile	117.8	117.3	118.3	103.2	110.2	154.1
Thailand	117.4	117.0	117.8	95.3	119.6	144.9
Singapore	116.9	113.2	120.8	94.8	108.2	180.0
Philippines	116.5	116.3	116.6	113.2	112.9	128.2
Georgia	116.1	121.0	111.4	96.0	106.4	141.8
Brunei Darussalam	116.1	111.9	120.4	104.7	164.3	59.3
Romania	115.8	120.1	111.6	99.3	120.2	112.2
Peru	115.7	110.3	121.4	128.2	117.9	118.5
Croatia	115.4	120.3	110.7	91.8	119.9	119.3
Bahrain	115.1	107.5	123.3	103.8	148.0	103.5
Cyprus	114.9	118.9	111.0	97.1	136.4	82.1
Cuba	114.6	118.3	111.0	102.4	123.4	99.2
Bolivia	113.9	105.1	123.5	116.5	116.3	146.5
Jordan	113.7	110.4	117.0	101.3	128.0	117.5
Panama	113.6	112.6	114.6	112.2	101.0	143.3
Lebanon	113.5	105.7	121.9	99.4	110.5	173.8
Malta	112.7	112.8	112.6	106.9	129.8	88.3
Bahamas	112.0	116.7	107.6	91.0	122.5	102.0
Mongolia	111.7	120.4	103.7	99.3	89.2	136.6
Luxembourg	111.4	121.0	102.6	101.4	137.9	38.1
Moldova	110.1	121.0	100.1	84.3	103.9	114.7
Tajikistan	109.1	121.3	98.1	104.8	114.7	57.7
Hongkong	108.8	114.3	103.5	94.8	105.0	112.6
Mexico	108.5	111.8	105.3	113.8	110.0	85.0
Guyana	108.3	120.5	97.4	120.3	107.2	47.6
Colombia	108.1	112.3	104.1	113.0	102.0	95.8
Qatar	107.2	99.8	115.2	105.2	129.9	101.1
Malaysia	106.0	107.4	104.6	99.3	102.7	115.7
South Africa	105.9	104.7	107.2	112.0	127.5	62.6
Venezuela	105.9	113.5	98.9	102.4	86.6	117.1
Gabon	105.9	121.0	92.7	144.6	87.0	32.8
Samoa	105.7	120.6	92.6	103.4	110.2	44.9
Armenia	105.4	120.4	92.2	78.6	107.0	82.9
Trinidad and Tobago	104.6	120.3	90.9	101.0	118.0	26.6
Jamaica	104.3	106.7	102.0	100.1	121.7	67.5
Fiji	103.5	114.0	94.0	111.0	102.2	55.6
Albania	102.0	104.3	99.8	107.6	114.4	62.0
Costa Rica	102.0	117.0	89.0	107.4	87.9	65.9
Dominica Republic	101.8	102.7	100.9	124.6	86.8	94.8
Belize	101.5	114.2	90.1	128.8	108.1	3.8
Ecuador	101.3	112.3	91.3	115.6	83.9	72.3
PLANETIA	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
HYPOTHETICA	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Mauritius	99.8	103.7	95.9	109.2	112.6	46.7
Yugoslavia	99.4	114.9	86.0	69.7	90.6	99.4
Viet Nam	99.2	113.3	86.9	106.2	97.9	40.0
Sri Lanka	98.3	112.3	86.0	106.5	105.3	21.9
Tunisia	98.3	88.2	109.5	117.9	114.3	89.2
Paraguay	98.2	114.3	84.4	111.8	87.3	41.7
Botswana	97.5	95.4	99.7	108.8	136.0	19.1
Indonesia	96.1	106.8	86.5	110.6	83.2	59.9
Turkey	93.9	104.5	84.3	101.1	84.3	61.6
United Arab Emirates	93.0	93.8	92.3	99.6	109.6	49.7
China	92.8	104.9	82.2	107.0	91.7	30.6
Egypt	92.7	68.6	125.4	100.1	125.1	160.2
El Salvador	91.9	96.8	87.3	109.9	79.1	72.0
Kuwait	91.9	100.8	83.7	85.3	81.1	86.6
Iran	91.1	94.2	88.0	86.9	114.0	40.7

Table A2. **Skills, 2001** *(cont'd)*

	Skills	Literacy	Enrollment	Primary	Secondary	Tertiary
Namibia	91.0	101.1	81.9	112.8	90.1	24.4
Swaziland	90.8	98.2	83.9	125.2	87.4	21.2
Saudi Arabia	90.7	94.2	87.4	67.9	99.0	92.2
Algeria	89.4	82.9	96.4	112.6	103.3	61.5
Zimbabwe	83.1	109.2	63.2	95.5	65.0	16.2
Oman	82.2	89.3	75.7	72.7	99.6	34.9
Myanmar	82.1	103.9	64.9	89.5	56.3	47.4
Nicaragua	80.8	81.7	79.8	104.1	78.8	48.7
Honduras	80.0	92.4	69.2	106.6	46.7	60.5
Syria	79.8	92.0	69.2	109.7	63.2	25.0
Congo	79.5	100.0	63.2	97.4	61.1	20.7
Lesotho	79.0	102.6	60.8	115.6	47.9	10.6
Guatemala	74.2	84.6	65.0	102.7	54.0	34.4
Kenya	73.5	101.9	53.1	94.5	44.7	12.3
India	72.7	70.9	74.5	102.1	71.1	43.1
Lao P.D.R.	71.7	80.2	64.0	113.7	54.8	13.6
Malawi	71.0	74.6	67.6	137.7	52.1	1.3
Togo	70.2	71.4	69.0	124.8	57.1	15.3
Uganda	69.9	83.1	58.8	136.5	27.2	12.2
Ghana	68.3	88.9	52.5	80.6	52.8	13.6
Cameroon	68.0	88.5	52.3	108.4	28.6	20.2
Liberia	66.3	67.0	65.6	118.6	55.7	11.8
Cambodia	65.1	84.0	50.4	110.7	27.3	11.7
Zambia	64.4	96.6	42.9	78.6	34.4	10.1
Morocco	63.3	60.9	65.9	94.9	57.4	42.3
Nigeria	63.2	79.9	50.0	82.4	44.2	16.5
Rwanda	63.0	83.2	47.8	119.3	17.7	6.9
Nepal	62.9	52.4	75.4	118.8	73.9	19.0
Yemen	62.4	58.3	66.8	79.6	69.5	44.2
Madagascar	60.6	82.3	44.6	103.7	20.9	8.9
Haiti	58.9	62.1	55.8	111.0	42.8	5.1
Papua New Guinea	58.3	79.0	43.0	84.2	30.9	9.6
Bangladesh	58.2	49.6	68.3	100.8	66.8	27.1
Sudan	55.6	71.9	43.0	55.3	42.1	28.1
Côte d'Ivoire	54.0	60.7	48.1	81.7	33.9	28.8
Eritrea	52.1	69.3	39.1	59.8	41.3	6.8
Gambia	48.9	46.2	51.8	82.7	52.8	7.7
Pakistan	48.2	53.8	43.1	74.8	35.2	14.6
Tanzania	48.0	93.0	24.8	63.4	8.4	2.9
Benin	47.8	47.2	48.4	96.0	31.8	14.8
Mauritania	46.8	49.8	43.9	83.4	30.6	15.0
Congo D.R.	46.7	76.7	28.4	47.1	26.8	5.8
Mozambique	45.7	55.3	37.8	92.0	17.4	2.3
Central African Republic	43.6	58.9	32.3	75.4	14.1	7.9
Djibouti	43.3	80.0	23.4	40.6	21.5	3.6
Senegal	42.9	46.8	39.3	75.2	26.1	15.4
Angola	42.0	51.4	34.4	74.0	22.6	2.7
Chad	41.6	54.1	31.9	73.6	16.8	3.6
Ethiopia	40.9	49.3	34.0	64.8	26.3	6.5
Guinea	39.9	50.1	31.8	67.4	20.1	5.2
Mali	31.8	32.3	31.3	61.5	21.9	7.9
Burkina Faso	25.7	30.3	21.8	44.5	14.9	3.8
Niger	18.5	20.2	16.9	35.7	9.1	6.1

Table A3. **ICT Uptake, 2001**

	Uptake	TV households	Res. phones	PCs	Internet
United States	288.7	149.5	202.3	526.2	436.6
Sweden	274.4	143.2	186.4	472.4	449.5
Iceland	271.9	147.1	202.3	352.0	521.7
S. Korea	269.7	142.5	202.3	404.7	453.6
Denmark	266.8	146.8	202.3	455.9	373.9
Canada	264.9	150.4	202.3	398.4	406.2
Bermuda	264.7	144.0	202.3	417.0	404.3
Norway	262.9	136.7	202.3	427.6	403.8
Luxembourg	254.0	150.9	202.3	435.5	313.3
Australia	253.8	146.0	202.3	434.2	323.3
Netherlands	252.2	145.1	181.1	360.7	427.0
New Zealand	251.2	148.3	202.3	330.5	401.5
Singapore	251.0	128.0	202.3	427.9	358.3
Switzerland	246.7	151.1	202.3	453.2	267.2
Hongkong	240.2	150.1	202.3	325.5	336.8
Japan	235.2	150.1	202.3	301.6	334.4
Germany	234.5	142.9	202.3	321.8	325.3
Finland	233.1	137.9	160.4	356.5	374.6
Taiwan, China	229.9	148.2	202.3	306.6	303.9
United Kingdom	226.8	147.8	202.3	308.3	286.9
Gibraltar	218.0	124.1	202.3	459.4	195.7
Austria	212.8	147.0	146.7	282.3	336.9
Ireland	209.4	142.3	202.3	328.9	203.0
Slovenia	206.8	148.9	202.3	232.1	261.8
France	205.6	143.6	196.1	276.6	229.6
Belgium	196.2	144.0	194.1	196.0	270.2
Israel	191.1	132.4	202.3	207.0	240.8
Malta	186.6	140.9	202.3	193.3	219.9
Cyprus	185.0	147.4	202.3	207.5	189.4
Italy	184.0	147.8	202.3	164.0	234.1
Estonia	167.4	138.5	147.1	147.2	261.6
Portugal	164.7	151.3	200.8	98.9	245.0
Spain	161.7	149.9	202.3	141.6	159.1
Bahrain	161.5	146.8	202.3	129.4	177.1
United Arab Emirates	161.1	106.5	202.3	114.1	274.1
Macau	156.0	118.3	169.9	150.3	196.3
Malaysia	145.6	128.4	138.6	106.1	237.8
Czech Republic	130.7	133.2	139.0	123.5	127.7
Chile	129.6	144.5	124.1	89.6	175.4
Slovak Republic	124.6	145.8	121.2	125.2	109.1
Hungary	124.6	146.4	158.8	80.2	129.2
Greece	123.8	147.8	202.3	68.3	115.0
Mauritius	123.2	135.9	162.2	91.2	114.6
Seychelles	121.8	114.3	163.0	123.3	95.7
Uruguay	120.5	141.0	155.8	92.7	103.6
Qatar	120.0	130.1	202.3	138.0	57.1
Costa Rica	118.2	126.8	131.9	143.3	81.3
Brunei Darussalam	113.4	149.1	202.3	61.5	89.1
Croatia	113.3	108.3	140.0	112.1	96.9
Kuwait	111.9	148.6	136.9	100.7	76.5
Poland	108.2	149.0	149.4	71.9	85.6
Argentina	104.0	147.0	134.4	67.4	87.7
Latvia	102.2	112.9	119.1	128.9	63.0
HYPOTHETICA	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Trinidad &Tobago	97.6	129.4	149.7	58.3	80.4
Barbados	96.9	125.0	184.8	78.4	48.7
Lebanon	94.4	140.4	133.3	62.8	67.6
St. Vincent and the Grenadines	93.9	127.1	154.2	95.2	41.6
Lithuania	92.0	140.1	145.4	59.5	59.1
PLANETIA	**89.8**	**115.1**	**104.5**	**74.3**	**72.7**
Turkey	85.4	148.0	199.8	34.3	52.5
Bulgaria	80.5	139.5	171.3	27.0	65.0
Brazil	77.8	137.8	123.8	52.9	40.5
Belize	77.3	53.3	93.7	112.7	63.5
Mexico	68.6	130.0	93.4	57.9	31.5
Venezuela	64.8	121.0	80.6	44.4	40.7
Russia	64.2	144.9	109.8	41.9	25.5
Jordan	64.0	131.3	118.0	27.6	39.3
South Africa	63.7	97.9	50.8	58.6	56.5
Oman	63.2	148.6	98.8	27.3	39.8
Colombia	63.2	142.8	134.2	35.4	23.5
Romania	62.8	131.3	101.1	30.1	38.9
Suriname	62.4	99.4	139.1	38.3	28.7
Jamaica	61.9	98.5	105.9	42.1	33.5
Peru	61.9	98.4	55.5	40.3	66.7
Yugoslavia	61.9	120.4	126.2	19.7	48.9
Panama	58.2	116.2	86.0	31.9	36.0
Saudi Arabia	58.1	146.4	126.1	52.8	11.7
Iran	56.8	102.2	127.9	58.6	13.5
Cape Verde	56.5	60.7	121.6	57.8	23.9
Thailand	55.3	148.5	53.8	23.4	50.3
Tunisia	53.3	134.0	75.9	22.2	35.9
Guyana	51.4	56.5	58.3	22.3	95.1
Fiji	46.2	95.4	76.8	39.0	15.9
Ecuador	46.0	128.7	78.8	19.6	22.5
Maldives	45.8	92.8	81.2	18.4	31.8
China	44.7	132.3	83.9	16.0	22.3
El Salvador	43.9	128.1	77.1	18.4	20.4
Georgia	41.2	129.9	112.8	24.2	8.1
Ukraine	40.1	147.1	109.5	15.4	10.4
Namibia	39.1	57.5	41.0	46.1	21.4
Armenia	34.5	99.6	115.1	7.8	16.0
Moldova	33.8	96.1	84.8	13.4	11.9
Egypt	32.8	136.2	80.4	13.0	8.1
Philippines	32.7	93.2	30.1	18.3	22.3
Bolivia	31.1	71.5	40.0	17.3	18.9
Botswana	30.3	23.2	42.8	32.6	25.9
Samoa	30.1	146.4	73.9	5.2	14.6
Morocco	27.3	116.1	34.7	11.5	11.9
Nicaragua	27.0	90.6	22.3	21.0	12.5
Kyrgyzstan	25.9	28.0	56.8	10.8	26.3
Cuba	25.8	115.4	24.9	16.5	9.3
Syria	25.6	114.7	87.5	13.7	3.1
Senegal	24.9	92.1	29.6	15.7	9.0
Paraguay	24.6	104.7	31.5	11.9	9.3
Guatemala	24.6	61.2	37.1	10.8	14.9
Honduras	23.0	72.8	31.0	10.3	12.0
Mongolia	22.9	43.1	35.7	12.3	14.5
Indonesia	22.8	82.6	21.2	9.3	16.6
Algeria	21.6	100.1	63.9	6.0	5.6

Table A3. **ICT Uptake, 2001** *(cont'd)*

	Uptake	TV households	Res. phones	PCs	Internet
Togo	20.7	29.9	10.1	21.7	28.0
Viet Nam	20.6	120.7	18.9	7.3	10.8
Kiribati	20.4	32.5	30.1	8.8	20.2
Gambia	16.5	16.8	35.2	10.7	11.7
India	15.8	65.1	32.8	4.9	5.9
Zimbabwe	14.9	33.6	13.2	14.6	7.6
Sri Lanka	14.6	31.2	26.5	7.9	7.0
Côte d'Ivoire	14.2	70.4	25.5	6.1	3.7
Gabon	14.1	13.6	24.5	10.0	11.7
Albania	13.3	61.3	37.0	6.4	2.2
Djibouti	13.3	60.2	12.6	9.2	4.5
Pakistan	12.7	113.4	21.6	3.5	3.0
Papua New Guinea	11.0	12.3	3.1	47.7	8.2
Solomon Islands	10.6	6.5	14.8	33.1	4.0
Sudan	9.8	126.6	15.7	3.0	1.5
Mauritania	9.5	71.7	5.7	8.7	2.3
Kenya	8.1	15.6	4.2	4.7	13.9
Yemen	7.9	142.0	21.4	1.7	0.8
Cameroon	7.5	60.3	6.5	3.3	2.5
Zambia	6.4	33.2	4.2	6.0	2.1
Lao P.D.R.	6.1	45.4	7.6	2.5	1.6
Nigeria	6.0	69.7	3.8	5.8	0.9
Ghana	5.7	32.4	7.0	2.8	1.7
Nepal	4.9	5.8	14.2	3.0	2.3
Benin	4.5	10.0	8.2	1.4	3.4
Tanzania	4.3	15.7	2.8	3.0	2.6
Eritrea	4.1	29.0	4.7	1.5	1.4
Angola	4.1	36.5	5.6	1.1	1.3
Bangladesh	4.0	36.0	3.6	1.6	1.2
Guinea	3.6	12.7	2.1	3.6	1.7
Madagascar	3.4	17.1	1.8	2.2	2.0
Mozambique	3.4	7.7	3.5	3.3	1.5
Burkina Faso	3.1	9.3	5.4	1.2	1.4
Mali	2.9	13.2	1.9	1.1	2.5
Uganda	2.3	6.9	0.8	2.5	2.2
Cambodia	1.9	6.3	2.3	1.3	0.6
Malawi	1.7	2.2	2.2	1.1	1.7
Central African Rep.	1.7	4.3	1.7	1.6	0.7
Myanmar	1.4	4.7	4.2	1.0	0.2
Ethiopia	1.3	3.0	3.1	1.0	0.3
Chad	0.8	1.2	0.6	1.3	0.5

Table A4. **Evolution of Networks**

	1996	1997	1998	1999	2000	2001
Netherlands	111.2	141.1	196.8	264.6	343.5	379.8
Norway	151.7	194.7	250.4	281.7	318.5	344.5
Denmark	156.5	194.9	249.3	284.4	294.3	344.4
Switzerland	140.4	174.7	217.1	255.7	284.5	341.6
Sweden	178.5	218.5	245.6	289.0	313.2	336.0
Finland	146.8	181.7	208.7	255.3	281.8	311.5
Luxembourg	107.1	128.6	183.5	227.2	271.9	301.7
United States	138.1	168.2	189.5	222.4	255.8	282.8
Canada	143.9	166.4	189.6	223.8	259.1	276.0
Belgium	84.2	116.1	161.8	218.5	247.9	273.1
Liechtenstein	103.2	155.8	176.0	224.5	268.6	263.2
United Kingdom	112.5	131.9	167.2	206.0	231.7	253.9
Taiwan, China	42.6	73.6	114.5	169.8	221.3	253.1
Germany	94.7	124.3	152.1	180.9	233.6	252.3
Iceland	100.7	126.0	150.6	189.7	215.4	242.0
Hongkong	97.5	117.3	135.1	166.0	211.3	241.6
Australia	104.4	123.6	135.5	155.2	194.3	225.1
Austria	82.6	105.7	144.2	188.4	242.7	223.4
Ireland	78.1	106.1	135.4	163.0	208.3	217.9
New Zealand	96.5	117.7	123.1	168.9	183.4	212.3
Singapore	75.2	107.7	120.0	167.1	201.1	208.1
Japan	81.4	101.8	120.6	144.1	176.8	200.7
France	71.7	99.8	129.7	190.4	201.7	194.6
Gibraltar	47.8	46.2	87.6	107.4	149.8	185.5
Israel	95.1	123.3	141.7	161.9	161.9	180.0
Portugal	46.1	69.6	93.9	116.4	122.9	179.5
Bermuda	109.6	132.6	130.0	155.0	163.2	179.0
Czech Republic	36.1	55.2	77.4	104.6	141.3	174.5
Malta	37.2	46.9	61.8	95.8	131.2	167.1
Jersey	21.5	20.8	45.9	119.0	141.3	160.4
Guernsey	22.4	37.2	40.1	123.1	137.9	159.9
Faroe Islands	43.8	65.4	86.4	101.8	137.2	156.7
Slovenia	43.5	61.7	77.9	115.2	136.8	154.0
Virgin Islands (U.S.)	31.7	72.6	88.0	101.4	92.5	153.8
Italy	56.9	77.7	100.8	106.2	157.9	150.6
S. Korea	45.8	64.6	85.0	121.1	136.8	149.6
Greenland	52.2	64.7	111.2	134.6	142.3	147.7
Spain	51.6	67.1	84.2	112.6	128.4	144.0
Estonia	38.4	57.6	79.6	100.5	125.7	138.4
Hungary	42.2	62.2	77.1	94.5	110.4	138.3
Andorra	45.8	65.2	74.7	88.5	111.2	136.2
Greece	35.3	46.7	68.9	92.9	115.2	134.6
Brunei Darussalam	36.1	41.4	59.0	70.1	103.3	132.9
Cayman Islands	35.7	73.8	83.8	100.1	111.3	123.0
Aruba	38.8	37.7	41.9	70.8	69.7	120.6
United Arab Emirates	33.5	38.0	76.9	94.3	108.6	117.9
Slovak Republic	18.4	37.5	54.3	66.5	81.9	112.5
Uruguay	22.3	41.0	51.3	71.9	93.3	104.6
New Caledonia	11.7	20.2	27.4	34.9	42.0	102.8
HYPOTHETICA	**35.3**	**45.4**	**55.9**	**71.3**	**85.8**	**100.0**
Poland	16.1	27.4	40.3	55.6	79.4	99.4
Argentina	20.6	31.1	48.5	67.0	85.5	99.0
Latvia	25.6	35.6	53.9	67.0	82.4	98.8
PLANETIA	**32.1**	**42.3**	**52.2**	**67.3**	**84.0**	**97.2**
Cyprus	56.3	72.9	90.8	103.1	120.0	94.2

	1996	1997	1998	1999	2000	2001
Lithuania	16.4	28.7	42.1	50.1	63.4	93.9
Chile	25.3	29.2	42.5	56.0	73.5	93.0
Croatia	23.1	32.6	38.6	49.8	72.3	87.5
French Polynesia	14.5	28.0	36.3	55.7	72.5	85.0
Seychelles	7.5	9.3	18.6	18.1	29.3	81.0
Brazil	14.7	19.7	26.7	41.5	58.9	77.4
Bahrain	39.7	34.7	44.4	57.5	63.4	77.4
Mexico	13.2	16.5	25.9	45.1	58.2	75.2
Guadeloupe	3.4	16.8	26.1	58.3	65.9	72.8
Trinidad and Tobago	11.0	20.9	28.4	39.5	62.5	72.2
Guam	46.3	40.9	54.9	62.9	68.4	71.8
Martinique	6.6	14.8	27.4	55.6	61.9	71.4
Bulgaria	11.7	18.2	23.8	37.3	50.3	70.4
Malaysia	34.8	40.8	47.0	53.6	61.4	69.9
Mauritius	13.0	18.7	26.9	33.6	55.8	63.8
South Africa	26.7	33.8	42.3	49.9	56.0	63.4
Turkey	16.6	24.5	32.8	46.1	53.4	62.9
Kuwait	40.6	46.1	53.2	50.8	53.6	62.2
Lebanon	21.7	30.9	39.9	47.7	55.0	61.4
Macau	41.7	41.2	45.4	51.1	54.6	60.3
Panama	10.6	15.0	22.0	32.6	69.0	58.5
Dominican Rep.	12.5	17.6	19.9	26.0	31.5	57.0
Puerto Rico	19.3	26.3	46.2	48.1	51.7	55.2
Romania	7.5	17.0	27.2	38.5	48.7	55.0
French Guiana	2.5	3.6	27.1	39.9	47.9	54.3
Barbados	17.9	20.0	26.1	33.4	40.8	52.1
Yugoslavia	8.3	15.5	23.4	32.4	43.6	49.9
Costa Rica	22.0	24.5	28.2	36.9	41.9	49.7
Belize	5.9	24.1	25.9	31.2	39.0	49.2
Jamaica	14.8	16.8	19.0	23.3	42.9	48.7
Qatar	18.8	36.9	21.3	68.8	90.2	47.0
T.F.Y.R. Macedonia	5.3	13.2	21.0	29.1	34.0	46.6
Bahamas	40.4	44.2	57.9	20.7	38.4	46.2
Venezuela	13.4	18.4	25.4	34.1	39.6	45.7
Tonga	6.7	16.1	23.0	28.3	32.5	45.5
Russia	10.2	16.4	19.4	19.3	33.5	44.1
Samoa	0.7	3.6	5.0	7.5	34.4	44.0
Oman	2.4	17.9	20.7	21.3	22.8	43.3
Colombia	15.0	20.2	25.6	33.6	36.7	43.0
Thailand	14.9	18.7	20.2	24.6	29.8	39.5
Botswana	0.5	1.2	14.1	30.9	38.8	37.9
Namibia	9.0	13.6	21.8	22.7	32.4	37.2
Saudi Arabia	5.9	4.0	8.7	20.3	23.4	36.8
Jordan	5.6	8.7	12.4	17.8	23.6	36.6
Ukraine	6.1	8.8	11.8	15.7	24.0	36.3
Fiji	8.8	10.5	14.7	21.9	30.6	36.2
Northern Marianas Islands	15.0	24.9	32.6	28.1	32.7	35.2
Grenada	9.4	10.9	15.7	17.3	21.1	32.4
Paraguay	6.2	9.4	17.7	22.6	24.9	32.3
Guatemala	4.9	7.4	9.6	15.8	27.5	31.5
Georgia	3.8	8.9	12.9	17.1	23.5	29.7
Peru	12.3	14.0	17.2	22.6	24.7	28.4
Philippines	7.1	8.3	11.4	14.8	20.9	28.1

Table A4. **Evolution of Networks** *(cont'd)*

	1996	1997	1998	1999	2000	2001
Suriname	3.9	3.9	4.9	6.5	14.4	27.8
Ecuador	7.6	11.3	15.0	18.3	21.5	27.4
Kazakhstan	4.4	5.1	6.9	11.2	17.3	26.2
Moldova	1.4	4.7	10.0	12.1	22.1	26.0
El Salvador	5.8	7.5	14.8	24.1	25.6	25.9
China	6.0	7.2	9.0	15.7	20.0	25.4
Swaziland	1.0	1.1	9.4	15.3	20.6	24.7
St. Vincent and the Grenadines	7.3	14.6	10.0	12.1	16.5	24.6
Bolivia	7.0	10.2	13.3	17.6	21.4	24.3
Azerbaijan	3.0	7.0	8.6	15.0	20.8	23.9
Belarus	4.6	6.5	8.3	9.7	15.1	23.4
Saint Lucia	20.0	18.9	22.5	21.0	27.5	23.4
Cape Verde	0.5	1.2	3.3	11.8	17.7	22.2
Morocco	4.4	6.7	8.4	11.3	17.0	20.9
Gabon	2.6	4.3	5.2	6.1	13.3	19.0
Reunion	7.8	9.2	15.3	13.2	16.8	18.7
Armenia	3.1	7.8	10.5	13.5	16.9	18.3
Nicaragua	5.8	6.4	8.1	10.9	14.4	18.2
Indonesia	5.6	6.6	7.9	10.5	12.9	17.5
Albania	2.3	3.3	4.3	5.7	7.9	17.4
Kyrgyzstan	0.2	0.5	3.7	8.6	12.5	17.2
Mongolia	1.8	2.5	4.3	7.6	16.2	17.2
Iran	3.1	4.2	5.1	8.5	11.6	16.3
Sri Lanka	3.9	5.7	7.0	10.1	13.6	16.0
Côte d'Ivoire	2.4	3.5	4.5	6.6	9.7	15.9
Egypt	2.7	4.7	5.7	9.0	12.3	15.2
Zimbabwe	0.3	3.2	5.1	10.7	13.9	15.2
Guyana	7.0	7.9	6.8	5.6	15.8	15.1
Tunisia	2.8	3.3	3.9	5.3	6.2	14.5
Gambia	1.8	3.7	3.6	4.1	4.5	13.9
Kiribati	1.2	1.2	2.7	12.2	12.5	13.6
Honduras	3.5	4.0	5.6	7.6	9.4	13.5
Senegal	1.6	2.8	4.6	7.1	11.7	13.2
Marshall Islands	8.7	10.9	10.2	10.9	10.7	12.1
Solomon Islands	3.4	5.4	5.6	11.1	12.4	11.9
Maldives	4.4	14.5	18.6	26.3	35.2	11.2
India	1.8	3.0	4.0	5.5	7.5	11.2
Turkmenistan	0.2	1.7	5.6	8.1	10.2	11.1
Mauritania	0.1	0.1	0.3	0.4	4.6	9.8
Kenya	1.5	2.0	2.5	4.5	7.1	9.2
Pakistan	2.1	3.2	4.7	5.6	6.3	9.1
Libya	0.2	1.8	3.3	3.5	6.7	9.1
Togo	0.2	2.0	3.5	4.6	6.5	9.1

	1996	1997	1998	1999	2000	2001
Benin	1.3	1.5	1.6	2.1	1.5	9.0
Zambia	2.2	2.5	3.3	5.1	7.8	8.7
Congo	1.0	1.2	1.3	1.9	4.2	8.0
Lesotho	1.0	1.4	3.7	5.0	6.8	7.9
Algeria	1.6	2.1	2.5	4.5	3.3	7.4
Viet Nam	0.9	0.8	2.2	3.4	4.8	7.3
Cuba	1.7	2.2	2.7	3.6	5.6	7.0
Tanzania	0.4	1.0	1.9	2.5	5.0	6.9
Rwanda	0.1	0.1	0.6	2.7	4.3	6.9
Cameroon	0.5	0.6	0.7	2.1	5.2	6.7
Djibouti	2.2	2.5	2.5	4.8	4.7	6.6
Papua New Guinea	1.0	3.0	4.1	5.6	6.3	6.5
Burkina Faso	0.3	1.1	1.8	2.3	4.1	6.4
Lao P.D.R.	0.9	1.0	1.0	1.3	1.8	6.4
Cambodia	0.6	1.9	2.3	3.2	4.7	6.0
Uzbekistan	2.9	3.2	4.6	5.0	5.8	5.7
Guinea	0.5	0.8	1.3	4.2	4.8	5.6
Ghana	2.5	3.2	3.6	4.4	2.7	5.5
Sierra Leone	0.1	0.1	0.2	0.3	3.9	5.5
Madagascar	1.0	1.0	1.9	3.9	5.2	5.0
Nepal	0.1	0.2	0.2	2.3	3.7	4.8
Yemen	1.0	1.6	2.0	2.6	3.2	4.7
Syria	0.1	0.1	0.1	1.5	2.8	4.6
Uganda	0.8	1.0	2.2	2.8	3.8	4.6
Tajikistan	0.5	1.2	2.1	3.8	3.9	4.4
Mali	0.9	0.6	0.7	1.4	2.7	4.1
Nigeria	0.4	0.8	1.3	1.6	1.8	3.5
Bhutan	0.4	0.5	1.3	2.5	2.9	3.4
Malawi	0.6	0.7	0.8	1.1	2.4	3.1
Mozambique	0.2	1.5	2.4	2.7	3.6	3.0
Angola	0.7	1.1	1.4	1.7	1.9	2.6
Central African Rep.	1.4	1.5	1.5	2.0	2.0	2.4
Haiti	0.2	0.1	1.3	1.6	2.2	2.3
Niger	0.1	0.3	1.0	1.3	2.0	2.0
Liberia	0.1	0.1	0.2	0.1	0.9	1.7
Congo D. R.	0.3	0.4	0.5	0.5	0.8	1.6
Burundi	0.6	0.6	0.6	0.6	1.3	1.6
Sudan	0.3	1.5	2.5	4.0	1.0	1.6
Ethiopia	0.0	0.1	0.1	0.9	1.3	1.3
Chad	0.1	0.1	0.1	0.2	1.4	1.3
Bangladesh	0.2	1.6	3.0	4.6	5.7	1.2
Eritrea	0.2	0.2	0.2	0.3	0.9	0.9
Myanmar	0.5	0.6	0.6	0.9	0.9	0.8

Table A5. **Evolution of Infodensity**

	1996	1997	1998	1999	2000	2001
Netherlands	126.1	141.1	166.5	192.4	220.2	232.6
Sweden	159.2	177.7	192.2	211.5	219.9	228.2
Norway	145.9	166.6	180.8	201.6	214.8	223.8
Denmark	146.8	164.9	186.2	200.8	205.2	222.9
Finland	145.9	163.4	175.1	194.3	204.9	215.9
Switzerland	131.9	147.2	163.9	180.9	191.3	210.6
Belgium	111.7	131.5	155.4	180.4	192.1	201.7
United States	141.4	155.9	165.5	177.8	189.2	199.5
United Kingdom	127.1	137.6	154.2	176.3	187.1	196.2
Canada	146.7	157.8	168.5	175.3	188.5	194.6
Australia	126.5	138.8	146.5	155.5	172.4	186.5
Luxembourg	107.3	118.3	142.1	158.6	173.9	183.1
Germany	111.8	128.4	141.5	153.9	175.0	181.8
Iceland	112.9	127.4	140.1	158.0	169.5	180.5
New Zealand	116.1	128.4	132.0	155.0	161.9	174.8
Austria	104.6	118.3	137.1	158.6	181.1	174.3
Ireland	101.8	119.3	136.5	149.3	168.3	172.6
France	99.0	116.8	133.3	161.1	166.0	163.2
Japan	102.8	115.7	125.6	136.9	152.3	162.9
Hongkong	101.9	112.2	120.7	133.9	151.3	161.9
Singapore	91.2	110.4	117.9	139.3	153.0	155.8
Portugal	77.0	94.8	110.8	123.3	127.8	155.5
Israel	107.2	122.6	132.6	144.0	144.8	153.5
Czech Republic	65.6	80.6	94.3	110.2	129.8	146.0
S. Korea	77.5	93.4	108.5	129.7	138.2	145.6
Slovenia	72.9	87.6	100.1	123.0	135.0	144.3
Spain	84.2	96.3	107.5	124.0	133.5	142.3
Italy	84.9	100.1	114.4	116.4	142.4	140.4
Malta	64.3	72.5	85.0	103.5	121.3	137.1
Estonia	69.8	86.3	102.4	115.9	130.9	136.3
Hungary	71.1	87.1	96.5	108.3	118.2	133.0
Greece	66.3	77.0	94.2	109.6	122.1	132.7
Brunei Darussalam	60.3	64.1	78.6	89.0	109.1	124.1
Poland	44.8	58.9	72.0	85.0	102.6	116.1
Slovak Republic	46.4	66.4	79.0	88.2	98.6	116.1
Latvia	54.3	65.1	81.2	92.9	104.4	115.9
Uruguay	51.1	69.7	78.4	94.0	107.4	114.8
Argentina	49.4	61.1	77.2	93.0	105.7	114.3
Lithuania	43.8	58.5	71.5	79.2	90.5	111.6
United Arab Emirates	54.9	58.8	83.9	92.6	99.6	104.6
Chile	52.6	57.5	69.5	80.3	92.8	104.5
Cyprus	77.5	88.6	100.5	109.0	117.2	103.9
Croatia	51.2	60.8	66.6	75.6	91.2	100.4
HYPOTHETICA	**57.4**	**65.4**	**73.1**	**83.3**	**91.9**	**100.0**
PLANETIA	**54.7**	**63.2**	**70.7**	**80.9**	**91.0**	**98.5**
Brazil	36.9	43.5	52.1	67.5	83.8	96.9
Bulgaria	37.3	46.8	54.6	68.7	79.8	94.4
Bahrain	66.3	61.7	69.8	80.1	85.2	94.2
Mexico	36.4	40.9	51.7	68.8	78.9	90.2
Macau	66.9	66.8	70.7	76.5	78.7	87.2
Trinidad and Tobago	33.5	46.1	54.2	64.1	80.5	86.8
Malaysia	56.7	61.7	66.8	73.2	79.9	86.0
Lebanon	48.3	57.8	66.7	73.2	78.2	83.4
Barbados	46.4	49.2	56.9	65.0	72.5	82.1

	1996	1997	1998	1999	2000	2001
South Africa	54.4	61.5	68.5	73.4	77.5	81.8
Panama	33.8	40.5	49.5	60.5	88.1	81.4
Romania	28.6	43.6	55.6	65.6	74.2	79.7
Mauritius	34.2	41.4	49.9	56.4	73.3	79.7
Russia	35.8	45.5	49.5	50.5	67.8	77.6
Turkey	39.8	48.7	56.2	66.2	70.6	76.8
Dominican Rep.	33.7	40.4	43.5	50.6	56.3	76.1
Kuwait	60.4	64.8	69.1	67.4	69.9	75.5
Bahamas	67.9	70.9	80.9	48.2	65.4	71.9
Jamaica	37.1	39.5	42.7	48.4	66.3	71.2
Costa Rica	47.8	50.5	54.3	60.0	64.2	71.1
Qatar	43.6	61.1	46.5	86.5	98.6	70.9
Belize	23.0	46.6	49.5	55.6	62.8	70.6
Yugoslavia	28.5	38.9	48.1	56.7	65.7	70.3
Venezuela	35.4	42.0	50.4	59.6	64.7	69.5
Ukraine	27.5	33.1	38.6	44.8	55.4	68.1
Samoa	8.2	18.7	22.2	28.0	60.2	68.1
Colombia	38.6	45.4	51.8	59.8	62.8	68.1
Thailand	38.1	43.2	45.5	51.8	57.9	68.0
Jordan	22.2	28.0	36.0	44.2	51.6	64.4
Fiji	30.5	33.5	39.3	47.5	56.1	61.1
Botswana	6.7	10.2	35.4	53.0	60.0	60.7
Oman	13.6	37.3	40.5	41.3	43.0	59.6
Georgia	21.2	32.5	39.5	44.3	52.6	58.7
Namibia	29.1	34.9	45.1	45.3	54.0	58.1
Saudi Arabia	22.1	18.3	27.3	42.5	46.0	57.7
Peru	36.7	39.1	43.7	50.9	53.3	57.3
Philippines	28.5	31.2	36.7	41.1	49.1	57.1
Paraguay	23.6	29.3	40.4	46.3	49.2	56.3
Kazakhstan	22.9	24.7	28.9	35.8	44.9	56.0
Belarus	24.0	28.8	32.3	35.3	44.8	55.7
Moldova	12.8	23.2	33.7	36.8	49.5	53.4
Ecuador	27.5	33.8	38.5	42.7	46.5	52.6
Bolivia	25.3	30.7	36.1	43.4	48.9	52.5
El Salvador	21.4	24.6	35.4	46.6	48.3	48.8
China	23.6	26.1	28.8	37.8	42.9	48.5
Guatemala	17.9	22.0	25.2	33.1	44.4	48.3
Swaziland	9.2	9.9	28.7	37.2	43.1	47.3
Kyrgyzstan	4.1	7.6	19.9	31.6	38.7	46.0
Gabon	16.7	19.3	20.8	22.7	34.6	44.8
Armenia	18.1	29.1	33.4	37.7	42.1	43.9
Mongolia	13.5	15.6	20.7	28.3	42.3	43.7
Albania	13.9	16.8	19.7	23.9	28.3	42.1
Indonesia	22.6	24.8	27.0	31.2	34.7	40.9
Guyana	26.7	28.5	26.7	24.5	41.3	40.4
Sri Lanka	19.6	23.7	26.3	31.4	36.5	39.6
Iran	16.9	19.7	21.9	28.1	32.4	38.4
Nicaragua	21.1	22.3	25.2	29.2	33.9	38.3
Tunisia	15.4	17.0	18.7	22.2	24.2	37.7
Egypt	14.6	19.5	21.7	28.5	33.4	37.6
Morocco	16.0	20.0	22.6	25.9	32.3	36.4
Zimbabwe	4.7	16.8	21.3	30.3	34.0	35.5
Honduras	16.4	17.5	20.9	24.4	27.2	32.8
Libya	4.3	13.9	18.7	20.6	28.3	32.8

Table A5. **Evolution of Infodensity** *(cont'd)*

	1996	1997	1998	1999	2000	2001
Côte d'Ivoire	10.8	13.1	15.1	18.2	22.4	29.2
India	11.1	14.4	16.6	19.4	23.3	28.5
Cuba	13.3	15.2	16.5	19.8	24.9	28.2
Viet Nam	9.1	8.5	14.3	18.3	21.8	26.9
Gambia	8.6	12.4	12.6	13.7	14.4	26.1
Kenya	9.7	11.4	12.9	17.7	22.5	26.0
Algeria	11.4	13.1	14.5	19.8	16.9	25.6
Congo	9.2	10.0	10.2	11.7	18.0	25.3
Togo	3.2	11.2	15.0	17.7	21.1	25.2
Lesotho	8.9	10.4	16.7	19.6	22.8	24.9
Senegal	7.7	10.4	13.5	16.9	22.2	23.7
Zambia	11.9	12.8	14.7	18.2	22.4	23.6
Tajikistan	7.6	11.7	15.3	20.0	20.5	21.9
Cameroon	5.4	6.0	6.6	11.6	18.1	21.4
Mauritania	2.4	2.5	3.5	4.3	14.6	21.4
Lao P.D.R.	7.6	8.0	8.4	9.4	11.2	21.3
Pakistan	9.8	12.1	14.9	16.4	17.4	21.0
Rwanda	2.1	2.1	5.9	12.8	16.5	20.9
Benin	6.9	7.8	8.3	9.5	8.3	20.8
Cambodia	6.4	11.2	12.3	13.8	17.1	19.7
Papua New Guinea	7.2	12.7	15.1	17.9	19.1	19.5
Ghana	12.4	14.1	15.2	17.0	13.5	19.4
Syria	3.0	3.0	3.1	10.7	14.9	19.1
Tanzania	4.5	6.9	9.5	10.8	15.4	18.2

	1996	1997	1998	1999	2000	2001
Uganda	6.4	7.1	11.8	13.9	16.2	17.9
Madagascar	7.3	7.7	10.4	15.0	17.6	17.4
Nepal	2.7	3.2	3.5	11.6	15.2	17.3
Yemen	6.9	8.9	10.5	12.5	13.9	17.2
Djibouti	9.2	10.0	10.2	14.3	13.9	16.9
Nigeria	5.0	6.7	9.0	9.9	10.5	14.9
Guinea	4.2	5.4	6.7	12.2	13.7	14.9
Malawi	6.0	6.6	7.0	8.8	13.2	14.9
Burkina Faso	2.7	5.0	6.6	7.4	10.1	12.8
Mozambique	2.4	7.3	9.5	10.5	12.5	11.6
Haiti	3.5	2.7	8.5	9.5	11.3	11.5
Mali	4.6	3.9	4.2	6.4	9.0	11.4
Liberia	2.1	2.2	2.7	2.9	7.6	10.7
Angola	5.6	6.6	7.3	8.7	8.7	10.5
Central African Rep.	7.2	7.5	7.6	8.9	9.2	10.2
Sudan	4.0	8.6	11.3	14.9	7.6	9.4
Congo D.R.	3.8	4.3	4.8	4.5	6.2	8.7
Bangladesh	3.2	8.6	12.3	16.0	18.0	8.5
Myanmar	6.4	6.8	6.7	8.2	8.5	8.1
Ethiopia	1.0	1.7	1.8	6.0	6.9	7.4
Chad	1.7	2.0	2.1	2.4	7.5	7.3
Eritrea	2.7	2.8	3.1	3.8	6.6	6.6
Niger	1.4	2.2	4.1	4.7	5.9	6.1

Table A6. **Evolution of Info-use**

	1996	1997	1998	1999	2000	2001
Canada	146.3	176.0	203.6	226.9	246.1	259.8
Hongkong	136.9	167.8	182.2	208.2	229.9	253.4
Taiwan, China	95.7	122.4	143.8	179.3	191.6	249.9
Singapore	144.9	165.3	187.0	200.0	222.2	242.3
United States	155.3	176.2	195.2	211.9	225.9	237.9
Denmark	134.8	160.2	187.9	207.3	227.5	237.4
Sweden	142.0	171.0	193.4	213.8	225.5	232.8
S. Korea	90.4	108.2	126.7	173.7	214.0	232.0
Switzerland	130.4	150.5	170.2	196.1	216.5	223.1
Netherlands	132.3	148.1	168.3	197.4	206.9	216.1
Luxembourg	129.4	138.2	154.7	169.7	186.7	212.1
Iceland	136.9	156.8	173.3	190.4	210.2	211.9
Bermuda	141.2	160.5	177.4	194.3	202.2	211.6
Norway	144.5	165.3	178.9	199.2	206.9	205.4
Belgium	118.2	134.3	149.9	169.3	200.2	203.6
Germany	102.3	124.0	140.5	167.6	189.3	202.3
Japan	103.3	125.4	145.8	166.2	181.6	196.1
New Zealand	116.2	136.0	150.2	167.8	183.9	196.1
Austria	118.5	135.3	153.0	168.5	185.5	195.8
Australia	100.8	126.1	157.7	172.9	186.8	192.5
Gibraltar	75.0	86.5	99.9	113.1	179.9	185.8
Finland	130.5	149.7	162.5	167.5	175.6	184.4
United Kingdom	104.1	121.0	142.1	160.7	173.2	184.4
Ireland	86.1	104.1	125.8	141.1	163.6	178.7
France	93.6	107.6	122.0	135.3	152.8	174.8
Israel	86.7	104.2	126.8	137.8	155.9	164.6
Cyprus	61.3	97.9	118.1	132.5	146.7	157.6
Italy	63.5	78.0	92.7	127.3	144.7	157.2
Slovenia	89.4	104.7	114.5	124.3	130.6	154.1
Malta	64.6	88.5	102.4	110.6	127.1	150.0
Portugal	80.8	92.2	109.0	120.0	140.7	148.0
Spain	70.5	84.8	96.7	109.0	132.2	146.3
Estonia	70.6	85.1	102.7	115.6	137.6	144.9
United Arab Emirates	50.5	82.1	104.2	127.6	136.8	143.8
Bahrain	61.5	74.0	88.4	103.8	110.0	143.6
Macau	62.1	80.7	105.0	113.1	126.1	141.8
Malaysia	45.0	58.9	79.0	93.2	102.5	119.7
Chile	45.2	53.3	63.7	78.8	109.2	117.3
Qatar	60.9	86.3	92.8	98.6	106.2	116.2
Czech Republic	60.4	72.2	81.3	92.5	101.4	113.9
Hungary	53.2	67.1	80.3	91.2	98.3	113.1
Greece	58.5	65.1	75.3	91.3	100.7	110.7
Seychelles	53.7	63.9	75.0	91.5	96.5	109.6
Slovak Republic	48.1	61.4	71.7	86.5	101.5	107.5
Mauritius	33.9	46.8	67.9	79.5	92.2	107.4
Uruguay	55.1	70.7	89.2	99.7	103.6	105.3
Croatia	47.4	58.7	68.9	77.5	93.9	104.3
Costa Rica	49.3	57.6	65.7	76.2	90.9	103.9
Brunei Darussalam	75.2	83.2	89.7	94.6	99.7	103.7
Kuwait	60.0	73.6	82.2	91.8	97.6	102.9
PLANETIA	**57.1**	**65.6**	**74.8**	**84.7**	**94.2**	**102.7**
Argentina	36.1	43.6	56.3	76.3	93.4	101.8
Barbados	49.3	57.7	71.9	75.2	87.3	101.4
HYPOTHETICA	**53.5**	**63.6**	**73.2**	**82.9**	**92.6**	**100.0**

	1996	1997	1998	1999	2000	2001
St. Vincent and the Grenadines	52.3	61.3	72.8	80.8	87.7	99.2
Poland	47.1	55.9	70.0	79.7	86.6	99.0
Latvia	39.2	54.3	65.7	75.6	91.7	94.7
Trinidad & Tobago	39.1	53.1	66.0	80.2	89.0	94.5
Lebanon	30.9	53.2	65.4	77.9	86.9	91.6
Lithuania	36.5	49.8	64.1	70.7	84.4	87.3
Brazil	36.3	43.7	52.1	60.6	71.2	86.6
Turkey	33.3	42.2	48.8	65.8	71.1	83.1
Belize	42.6	49.5	57.6	69.9	77.3	80.7
Bulgaria	38.8	45.9	52.8	61.4	74.2	79.9
Mexico	33.7	43.5	51.6	58.8	68.6	76.3
Venezuela	38.1	43.7	53.4	64.2	66.9	75.3
Jamaica	31.6	41.4	58.0	61.4	66.3	70.3
Jordan	19.2	35.0	46.2	54.3	60.6	69.5
Oman	29.4	36.1	44.9	55.9	65.0	69.4
Suriname	32.6	47.5	55.0	58.1	63.5	69.0
Russia	34.3	41.2	48.1	50.6	60.1	68.6
Yugoslavia	30.2	37.1	40.7	43.2	62.3	67.9
South Africa	40.0	47.6	56.0	62.0	66.6	67.9
Romania	27.7	33.2	48.1	53.7	63.6	67.6
Colombia	35.8	42.9	51.7	57.4	61.8	67.5
Peru	27.0	32.0	40.7	47.2	53.0	66.6
Saudi Arabia	24.7	29.6	35.4	51.0	59.6	65.5
Panama	30.4	38.9	47.8	54.1	63.1	64.7
Cape Verde	12.4	19.0	28.8	46.8	55.1	64.4
Iran	19.4	25.6	31.9	43.6	54.6	62.4
Thailand	27.1	35.4	38.6	46.3	53.4	61.6
Tunisia	15.7	17.7	24.3	43.1	52.9	61.0
Guyana	17.3	20.6	24.2	42.7	49.5	60.4
Fiji	25.0	32.7	41.2	46.5	52.4	55.9
El Salvador	19.9	26.0	30.3	38.5	46.0	55.2
Ecuador	21.7	24.4	26.2	40.1	46.8	55.2
Maldives	24.8	28.5	33.7	40.6	48.1	55.1
China	10.4	14.7	23.4	34.9	46.6	54.5
Georgia	19.4	22.0	25.2	34.5	40.3	50.9
Ukraine	25.1	30.4	34.5	38.0	44.0	49.6
Namibia	10.7	17.7	26.6	28.6	43.2	49.6
Armenia	16.6	19.1	21.7	34.5	39.6	45.2
Moldova	9.9	15.7	26.4	31.5	41.8	44.7
Philippines	15.5	19.6	31.7	34.9	39.6	44.5
Egypt	17.1	20.2	24.8	30.9	37.7	43.5
Samoa	19.0	22.3	26.2	28.0	32.8	42.9
Bolivia	17.2	20.7	26.1	32.3	37.2	42.0
Botswana	15.4	19.6	24.6	31.8	35.9	41.8
Morocco	10.2	14.1	22.7	25.9	34.4	38.8
Nicaragua	18.3	23.5	26.6	29.8	35.5	38.4
Cuba	12.1	14.7	19.3	23.7	28.1	37.2
Kyrgyzstan	9.4	12.4	16.8	20.1	29.0	37.1
Syria	2.9	19.0	23.5	28.4	31.7	37.1
Guatemala	10.2	15.8	23.4	26.4	28.9	36.4
Senegal	10.3	13.4	18.0	25.3	28.9	36.3
Paraguay	13.3	19.8	24.3	28.3	33.7	35.9
Honduras	9.9	16.2	22.0	26.6	30.1	34.7
Indonesia	13.8	19.2	20.8	24.3	29.6	34.5

Table A6. **Evolution of Info-use** *(cont'd)*

	1996	1997	1998	1999	2000	2001
Mongolia	10.0	15.3	17.7	24.0	30.9	34.1
Algeria	8.7	12.9	15.2	24.8	30.1	32.9
Togo	5.5	10.5	12.4	16.8	27.1	31.9
Kiribati	13.4	16.8	20.7	24.8	29.6	31.8
Viet Nam	3.3	7.3	10.2	17.5	21.6	31.7
Gambia	6.2	7.5	13.7	21.4	24.9	27.7
India	10.0	12.1	15.1	18.7	23.6	27.4
Zimbabwe	9.0	11.5	14.6	17.3	22.1	25.6
Sri Lanka	9.5	13.1	17.2	19.7	23.7	25.3
Gabon	2.3	8.4	13.5	16.1	22.9	25.0
Côte d'Ivoire	7.4	10.6	14.5	17.9	21.2	24.8
Albania	7.6	10.3	13.1	15.6	18.0	24.6
Djibouti	12.7	15.8	16.3	17.1	19.9	23.9
Pakistan	6.9	11.2	13.8	15.1	20.1	23.0
Papua New Guinea	5.9	8.5	10.6	17.1	20.6	20.9
Solomon Islands	13.7	15.9	16.9	19.3	20.6	20.7
Sudan	0.9	4.3	6.3	9.4	15.7	19.4
Mauritania	3.8	6.3	10.6	14.8	17.2	19.0
Kenya	4.8	6.8	7.7	9.7	13.8	17.0
Yemen	4.7	9.4	11.0	13.9	15.8	16.8
Cameroon	5.5	6.5	7.9	12.7	15.0	16.3
Zambia	7.1	7.2	9.2	13.0	14.0	14.6

	1996	1997	1998	1999	2000	2001
Lao P.D.R.	2.2	4.5	6.9	9.4	12.0	14.1
Nigeria	6.8	8.0	8.8	10.0	11.2	14.0
Ghana	4.2	6.2	7.3	9.9	12.6	13.5
Nepal	3.4	5.1	6.9	9.7	11.1	12.1
Benin	2.9	5.4	6.6	9.0	10.2	11.5
Tanzania	2.8	4.1	4.4	7.4	9.1	11.2
Eritrea	1.1	4.0	4.4	5.9	9.6	10.9
Angola	3.1	5.0	6.6	8.9	9.9	10.8
Bangladesh	1.3	2.1	3.9	6.5	8.5	10.6
Guinea	3.1	4.0	4.4	7.5	8.5	9.9
Madagascar	3.2	4.5	6.5	8.4	9.1	9.6
Mozambique	2.4	3.8	4.9	6.5	8.2	9.5
Burkina Faso	2.3	4.6	5.9	6.7	7.4	8.9
Mali	2.1	3.2	4.1	5.7	7.6	8.6
Uganda	2.7	3.5	5.3	6.1	7.1	7.4
Cambodia	2.4	3.2	4.1	4.9	5.4	6.4
Malawi	1.6	2.2	3.0	4.4	5.1	6.1
Central African Rep.	2.8	3.6	4.4	5.4	5.7	6.0
Myanmar	0.7	0.9	1.6	2.8	4.7	5.2
Ethiopia	1.6	2.2	2.7	3.2	3.8	5.1
Chad	0.8	1.3	2.1	2.7	3.4	3.7

Monitoring the Digital Divide… and beyond is a remarkable attempt to offer a global set of indicators… As the world prepares for the two parts of the World Summit on the Information Society (Geneva, 2003 and Tunis, 2005), the work produced by Orbicom to describe, measure and monitor the Digital Divide has a very distinct and important role to play. It offers a fresh and broad-ranging perspective of the ways in which 'info-ready' countries differ from 'info-challenged' ones. Governments, international organizations, business, non-governmental organizations, academia and civil society as a whole will be all the more interested in building a development-supportive, open and vibrant information society now that they will have at their disposal a reliable, action-oriented and diversified set of indicators to measure both the intensity of their efforts and the level of their impact.

José-Maria Figueres
CEO of the World Economic Forum and Chairman of the United Nations ICT Task Force

Bruno Lanvin
Manager of *info*Dev at the World Bank and Co-editor of the Global Information Technology Report (GITR)

This work comes at an opportune time. To measure the Digital Divide most attempts had concentrated on such aspects as connectivity measurements and e-readiness for a restricted number of countries. The Orbicom research breaks new ground with a conceptual framework that goes beyond infrastructure to examine the content and dimension of the Digital Divide through the inclusion of existing and reliable education data. In addition, it has the merit of covering a substantial part of the planet with an emphasis on developing countries. In this sense, *Monitoring the Digital Divide …and beyond* is an essential tool for policymakers, donors and other stakeholders concerned with access to information and the acquisition of knowledge and skills as a means to bridge the Digital Divide. It is also a very good example of innovative uses of data and their transformation into insightful synthesis.

Dr. Abdul Waheed Khan
Assistant Director-General for Communication and Information / UNESCO

Digital divides - both between countries and within countries - pose some of the most complex and difficult economic, social, and north-south policy questions that exist today. What is the situation? How is it evolving? What action is to be taken, where should it be directed, and why? Formulating, analyzing and monitoring policy requires measurement, and measurements require careful interpretation. *Monitoring the Digital Divide …and beyond* represents a big step forward in measuring and understanding many crucial aspects of the Digital Divide. Based on a coherent conceptual framework and the broadest possible coverage that existing data today allow, it offers a unique and authoritative perspective both on the magnitude and the evolution of the Digital Divide. The quantification of the situation in each country, component-by-component and over time, sets high standards in international benchmarking…

John Dryden
Deputy Director, Information, Communication and Computer Policy, DSTI, OECD

Claude-Yves Charron
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