CHAPTER 1.3

From Mobility to Ubiquity: Ensuring the Power and Promise of Internet Connectivity… for Anyone, Anywhere, Anytime

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A decade ago, few could have predicted that the start of 2009 would see one-and-a-half billion Internet users around the world. And only the sharpest prognosticator might have foreseen that more than half of the world's population would own a mobile phone and 80 percent would live within range of a cellular network.

If telephones are now nearly ubiquitous, how quickly can we expect the Internet to span the globe? What can be learned from the remarkable mobile phone success story to help countries pave the way for broad, affordable, portable, and transparent ubiquitous Internet service for businesses and citizens? And, most importantly, what policies and models can governments use to help their countries get there?

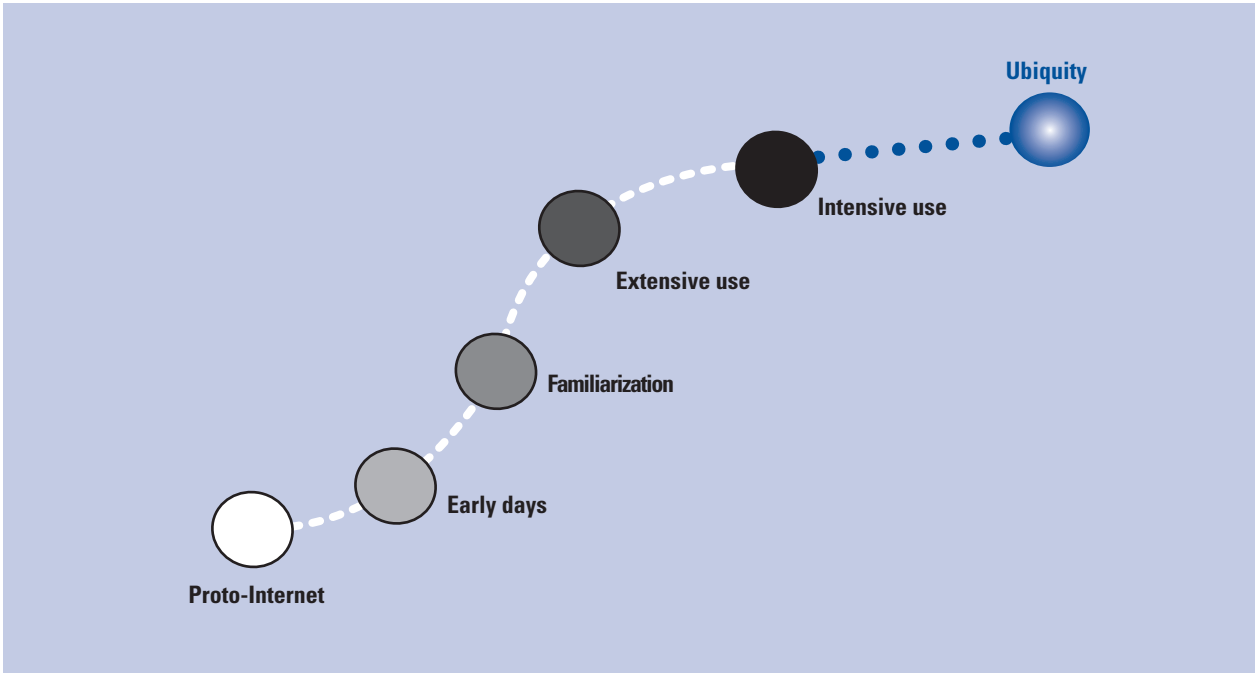
The goal may be simple but it is ambitious: Internet *ubiquity* offers connectivity to people wherever they are, whenever they want to access the network, with the device of their choosing. Ubiquity features safe, reliable, and continuous high-speed connectivity. Above and beyond Internet availability, ubiquity means that the Internet follows users seamlessly rather than users searching for it as they move about during the day from place to place, device to device. It may sound too good to be true, but this advanced state of technological development is not an unreachable utopia. It can be built, but it will require a solid technical, regulatory, and market foundation. The closer countries get to this goal, the more they will reap the benefits, both in terms of economic productivity and personal welfare.

Advanced and emerging countries have reached the Internet through different paths. Personal computers (PCs) were widespread in advanced countries well before broadband became available. In emerging nations, many people have had their first Internet experience in cybercafés, Internet kiosks, or community centers. Increasingly, all countries are seeing a range of devices and an array of fixed and wireless lines for their Internet connectivity—and these are quickly going broadband.

In many countries, however, it is not realistic to expect that everyone will have a connection to the Internet. Indeed, shared-access Internet facilities will remain the only viable approach for quite some time for a large portion of the world's population. But the "stretch" goal of ubiquitous access is worthy if countries wish to tap the potential that the Internet offers in terms of productivity and standards of living.

But how can we build on current progress to move toward ubiquity? When it comes to Internet access, we know that broadband offers much more than telephony ever did—in terms of breadth of information; interactivity across media; economic opportunities; and access to education, health care, and government services. Harnessing the potential that networks and the Internet have to offer is as much about creating the right policy and institutional environment as it is about adopting the right technology and investing in related infrastructure.

Figure 1: The five stages to Internet ubiquity



As we end the first decade of the 21st century, it is clear that high-speed networks must be considered an integral part of the basic infrastructure of any country. Indeed, broadband networks are the infrastructure foundation of the knowledge economy. And for many countries these networks offer a unique, cost-effective opportunity to enhance their competitiveness and rise above physical or geographical constraints. We have already seen in advanced economies—and even remarkably more so in emerging economies—how connectivity empowers citizens, improves productivity, generates jobs, enables education, and improves health care. We also believe that we are about to witness broadband networks powering an economic recovery.

In this chapter we propose to do three things. First, we put into perspective the different stages of Internet connectivity for countries and their progress in fostering the broad ICT foundations (or lack thereof) behind that connectivity. We do this by proposing a typology of stages and classifying countries accordingly, and by revisiting and updating the ICT Development Map (ICT Map) presented in *The Global Information Technology Report 2007–2008*.[1]

Second, we look at the key ingredients of successful efforts to advance ICT development and Internet connectivity—what we will call the *keystones of a Net Strategy*. These represent a framework around which it is possible to assess strengths and weaknesses and to identify priorities for action for governments and private actors alike.

Finally, we consider the more specific factors—beyond the solid foundation that the Net Strategy framework proposes—to take countries from broad and accessible connectivity to that end-state goal of Internet ubiquity.

A definition of the stages and underlying factors of Internet progress

We begin with a model that tracks a country's progress along five stages of Internet connectivity, each one getting progressively closer to the stage that can serve as launching pad for Internet ubiquity. Each stage reflects a different breadth and depth of connectivity. The model revolves around key thresholds, marking the progression that countries have followed and pointing to what they can look forward to, depending on their stage (see Figure 1).

The stages focus specifically on Internet penetration but do not limit themselves to one dimension. Instead we show the progression from occasional or rare Internet access to familiarization with the use of the Internet to widespread connectivity and, finally to more regular, intensive use of Internet-based services. The thresholds are based on 2007 data from ITU consistent with those used in the Networked Readiness Index (NRI) featured in this *Report*—they escalate as we move up the stages: from Internet usage to Internet connections and finally to broadband connectivity.

As we will elaborate below in connection with the ICT Map, it should be noted that progress along the stages does reflect income levels but is not solely determined by them. There are examples of countries that, through strategic improvements in their ICT ecosystem and infrastructure, have managed to move further in connectivity than richer countries.

We classify into these stages a total of 157 countries (see Appendix A for a list of these countries and how it compares with the list of countries included in the NRI 2008–2009)—essentially the whole world, except for countries with very small populations or for which data are not available.

Proto-Internet. A country is considered to be in this stage when less than 5 percent of its population has had experience with the Internet. We find 45 countries in this stage, with a total population of about 800 million. These countries are typically low-income, rural economies (only 35 percent of the population on average lives in urban areas), with Internet connectivity largely available only to larger businesses, universities, the government, and small elite groups in the cities. In these countries, less than 1 in 20 people had experienced the Internet by 2007. Examples include populous countries such as Bangladesh and Ethiopia and smaller ones such as Cameroon, Nicaragua, and Tajikistan.

Early days. In the next stage, countries have significantly higher Internet usage rates (between 5 percent —or slightly less but growing fast—and 15 percent), but the large majority of the population has yet to experience the Internet directly. We find 32 countries at this stage—including major ones in Asia (India, Indonesia, and Pakistan) and Africa (Egypt, Nigeria, and South Africa), together with smaller countries (such as Albania, Bolivia, Senegal, and Sri Lanka)—with a combined total population of about 2.2 billion people. These are generally countries with significant urban populations (about half of their population lives in cities, on average), and Internet use averages conceal major differences between urban and rural areas. Many people in these countries use the Internet through shared-access connections (cybercafés or community centers), so that the number of Internet users is a multiple of about five times the number of Internet connections in the country.

Familiarization. In this stage we include countries with at least 15 percent Internet use, but switch the upper boundary to focus on household connections, with an upper boundary that is equivalent to about one-quarter of all households having their own connections. We find 39 countries in this stage, with an average of 28 percent of the population having used the Internet. These numbers are fueled by high urbanization rates (two-thirds of the people live in urban areas). There are 2.2 billion people who live in countries at this stage, which are wide-ranging in income levels and characteristics—from Brazil and China to Chile, Poland, Thailand, Tunisia, and Turkey. At this stage, virtually all businesses (beyond micro-enterprises) have Internet connections, as do many urban households. Familiarization with the Internet breeds high expectations, and the pent-up demand for online services and greater connectivity is a considerable factor behind Internet momentum (see Box 1 for a summary of a study of Internet use in emerging market cities).

Extensive use. The next stage—indicative of extensive Internet connectivity—is largely a transitional stage. Here we find 18 countries—with total population of about 400 million—where at least one-quarter of all households are connected to the Internet (and nearly half of the population, on average, are Internet users), but broadband is not yet prevalent. While earlier stages comprise only emerging economies, the countries at this stage are a mix of emerging (Czech Republic, Malaysia, and Russia, for instance) and advanced ones (Italy, Portugal, and Spain).

Intensive use. Finally, in the intensive use stage we find 23 countries—with about 850 million population in total—where half or more of the households (plus all businesses and institutions) have broadband connections. These are advanced economies in which, on average, two-thirds of the population uses the Internet. E-commerce, e-government services, business collaboration, and social networking, among others, are pervasive and have become an integral part of the social fabric and economy. Countries with a strong ICT foundation have reached this stage and derive many benefits from it. The best-practice examples for our Net Strategy come from this group and include countries such as Finland, Korea, Rep. (Korea), and the United States. This stage is the launching pad for ubiquity.

Ubiquity. We are still exploring the metrics that we will need in the future to determine if and when countries have moved to the stage of ubiquitous Internet. We do not believe any country has yet come close, but developments in technology, regulation, and business models are paving the way for some countries to make fast progress in this direction. Ubiquity is not about 100 percent connectivity; rather it is about the ability to connect everywhere at anytime by a majority of citizens. This stage of ubiquity un-tethers the user from device or connection and instead envisages a world in which the Internet connection follows the user rather than the user seeking the connection.

The stages identified above help us get a clearer picture of the critical mass thresholds needed to accelerate network connectivity, but they are not meant to provide a diagnostic of a country's ICT development. For that we defer to the ICT Development Map we introduced in *The Global Information Technology Report 2007–2008* to explore the interaction among ICT infrastructure, ecosystem coordinates, and technology adoption.

Box 1: Cities as spearheads for online service use[1]

Citizens and businesses located in the cities of major emerging economies are not only quite familiar with the Internet but, as they become more exposed to it, they develop high expectations for future access to online services—commercial and governmental alike. While some key factors of ICT adoption are under the primary influence of central governments, other factors come under the purview of municipal or metropolitan governments, and these entities can make a significant difference. Both central and local government broadband strategies are necessary to take advantage of the opportunity that Internet Protocol (IP) networks offer and to extend the advantages of the early stages of Web 2.0.

Because of population density, connectivity spreads faster in cities and, hence, early indications of demand (present and future) for online services can be observed. Cities therefore are excellent proving grounds for online service deployment and can provide central governments with clear indications of what the rest of the country's population might want—and potentially expect—in this area.

Using cities to spearhead ICT development is not just about providing urban dwellers with the benefits of connectivity. It is also an effective approach for creating strong hubs of connectivity and commercial viability and thus extending the reach of networks across the country, laying the groundwork for national ubiquity.

Awareness of the Internet and of its benefits is virtually universal in cities across the world, according to the "Cities Net Opportunities" study by Cisco—based on a survey by Illuminas Global in four cities each in Argentina, Brazil, Mexico, Poland, Russia, and South Africa. The survey found that businesses have seen the Internet improve sales, customer satisfaction, and productivity; while citizens generally believe that Internet access improves people's lives.

In six of these cities (in Brazil, Mexico, and Russia), Cisco was able to conduct a follow-up survey in late 2008.

Comparison of the two surveys (Figure A) found very lively dynamics at play: the proportion of regular Internet users (people moving from familiarization to extensive—and even intensive—use of the Internet) in the sample grew from 44 percent to 51 percent within the span of just one year.

The survey also found the following:

1. Citizens' "thirst" for online services regardless of their experience using the Internet:

   —Those that already use online services expect to continue using and potentially expanding their use, and many consider these online services to be worth paying for.

   —Those not currently using the Internet and those who do so infrequently expect to use online services in the future nearly to the same degree as regular users.

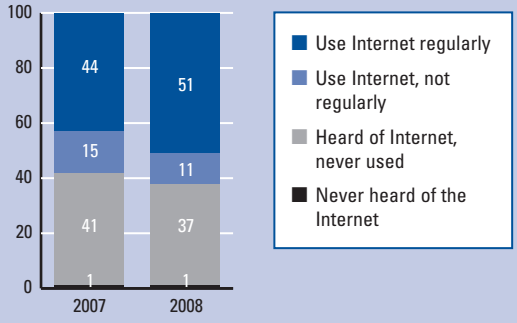
   —Citizens show particular interest in (and willingness to pay for) new value-added services such as education or health care.

2. Virtually all businesses already use the Internet, but they see major potential for expanding their use of the Internet for all kinds of e-commerce.

3. There is a clear desire from citizens and businesses for more active involvement by the government to promote Internet access and use. The overwhelming majority of businesses and citizens think government should have a role in making access to the Internet easier (Figure B).

(Cont'd.)

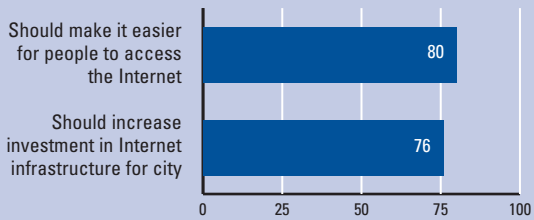
Figure A: Citizens: Internet use in urban areas (percent)



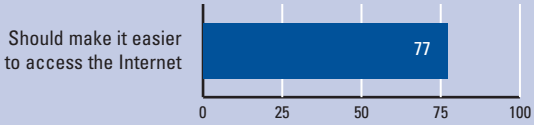
Source: Rueda-Sabater and Lamus, 2008.

Figure B: Expectations of government's role

Businesses' expectations (percent)



Citizens' expectations (percent)



Source: Rueda-Sabater and Lamus, 2008.

Box 1: Cities as spearheads for online service use[1] *(cont'd.)*

4. Concerning e-government, most businesses—and a large majority of citizens—feel that the government should do more to provide information and services online.

5. As for barriers to greater use of the Internet, citizens and businesses rank skills as the top obstacle. Other major factors are accessibility and cost.

6. People in households with their own connection access the Internet more frequently than those who use shared-access facilities such as a cybercafé. This shows that having a PC at home seems to be a key factor in increasing the frequency and use of the Internet, also considering citizens do not feel that access via mobile phones could satisfy their connectivity needs.

Note

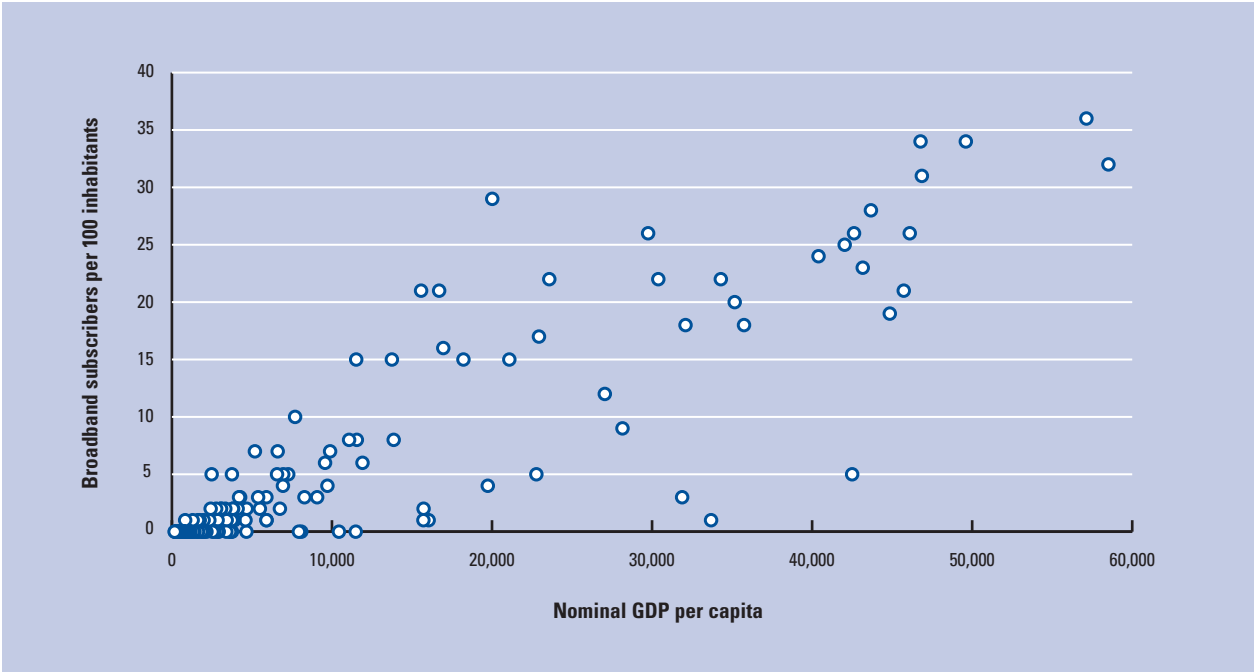
1 This box draws on Rueda-Sabater and Lamus 2008.

- *ICT ecosystem* refers to institutional factors that underpin entrepreneurial creativity and competitive dynamics for service provision. These factors are hard to measure but include the legal and regulatory framework around ICT deployment and the ease of doing business in general.

- *ICT infrastructure and capacity* refers to assets, such as networks and other infrastructure, as well as the existence of skills to use and manage the hardware effectively.

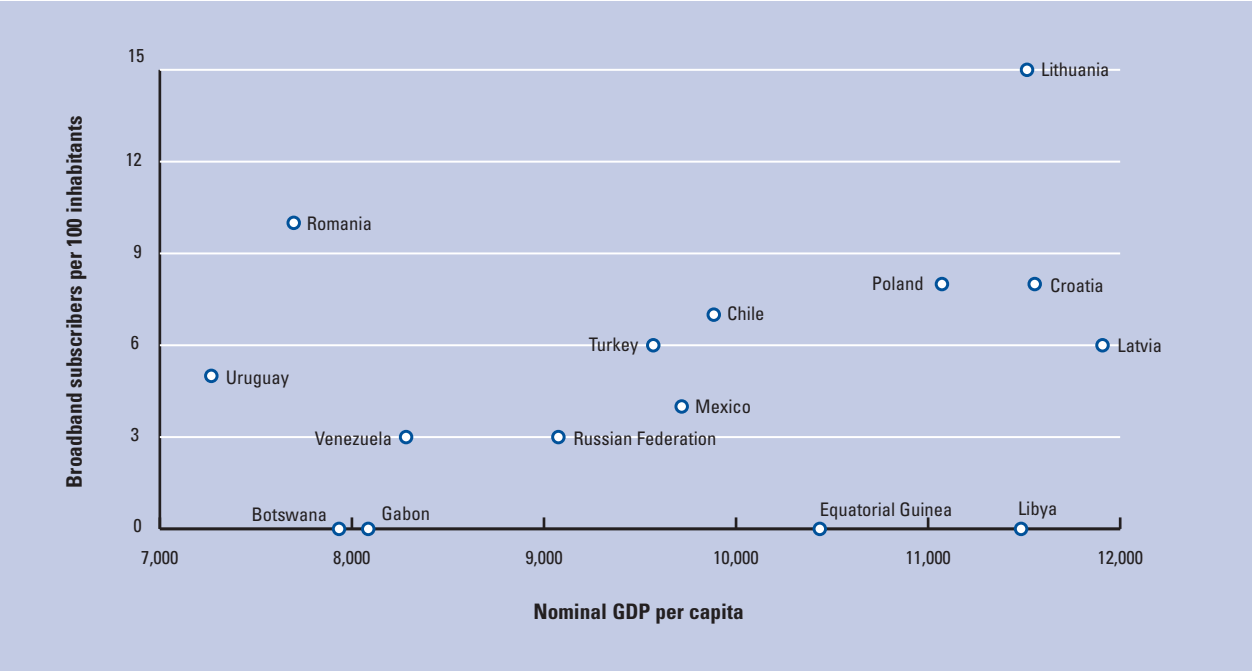
In last year's *Report*, we used these two dimensions to develop a cartographic model and map countries on the basis of their ICT development—providing a perspective on their current situation and illustrating how to chart a course forward that balances both dimensions. This ICT Development Map relied solely on indicators that were part of the NRI; it did not explicitly consider income levels. Income levels play a role in ICT adoption (see Figure 2), but so do a number of the factors reflected in the ICT Map coordinates. Simple correlation analysis confirms that our ecosystem rating, in particular, is much less influenced by income than is the infrastructure rating (see Appendix A).

Figure 2: Broadband penetration and per capita income levels, 2007



Source: ITU, 2008; IMF, 2008.

Figure 3: Broadband penetration levels in countries with similar income, 2007



Source: ITU, 2008; IMF, 2008.

This is a phenomenon that can be observed both in emerging and advanced markets:

- Russia's income level, for instance, is similar to that of Chile, but its broadband penetration is less than half. Similarly with Venezuela and Romania (the former has slightly higher income but the latter has more than twice the broadband penetration). Figure 3—showing a "slice" of the scatter plot—provides further illustration of how non-income factors (differences in ecosystem and infrastructure) can be significant enough to account for major disparities in ICT adoption even after income levels have been factored in (see Appendix A for statistical validation of this significance).

- Among advanced economies, similarly, Austria has a slightly higher income level than Belgium, but the latter had broadband penetration of 26 percent (in 2007) compared to 19 percent for Austria. Ireland and Switzerland also had similar income levels, but broadband penetration (at 32 percent) was almost twice as high in Switzerland than in Ireland.

The indicators behind each ecosystem and infrastructure are combined to produce the two coordinates that allow us to classify each country along the two axes. Figure 4 indicates how the indicators are combined to generate measures for the ecosystem and infrastructure dimensions.

To analyze the implications of positions in the ICT Map, we break each axis into four simple categories. The thresholds for the four categories reflect logical breaks in the distribution of countries along each axis rather than evenly spread groupings. These thresholds are unavoidably arbitrary; they are designed simply as a sorting device that is then validated by the differences in Internet penetration across countries in the different categories.

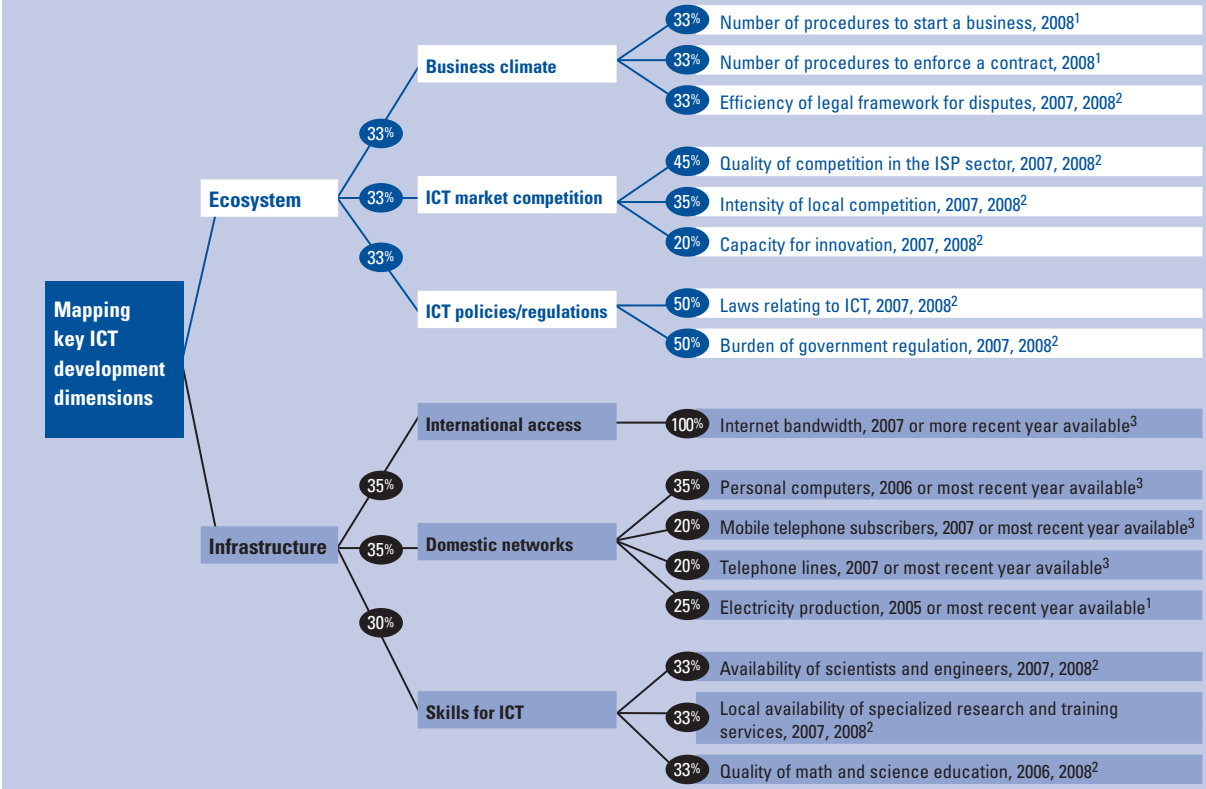
Revisiting the ICT Development Map with information from the NRI 2008–2009, we can look at how the 127 economies for which data are available are spread through the relevant areas of the ICT Map.[3] We find 50 countries still in the "poor" category (including most of the countries included this year for the first time in the NRI), a slight increase (to 33) in the number of countries in good/best practice territory, and 44 countries in between (see Table 1).

The period between 2005 and 2007 was a time of significant expansion of Internet use around the world (possibly a key inflection point in that regard). We offer three views of the dynamics of ICT adoption:

First, we depict ICT Map positions using the data included in the NRI 2007–2008 (black dots) compared with those (blue dots) based on data in the NRI 2008–2009 (Figure 5).

The mapping of one year's changes suggest very little progress on the ecosystem front. This points to a missed opportunity (given that ecosystem improvements are not resource-intensive) and underscores the untapped

Figure 4: ICT Development Map Framework

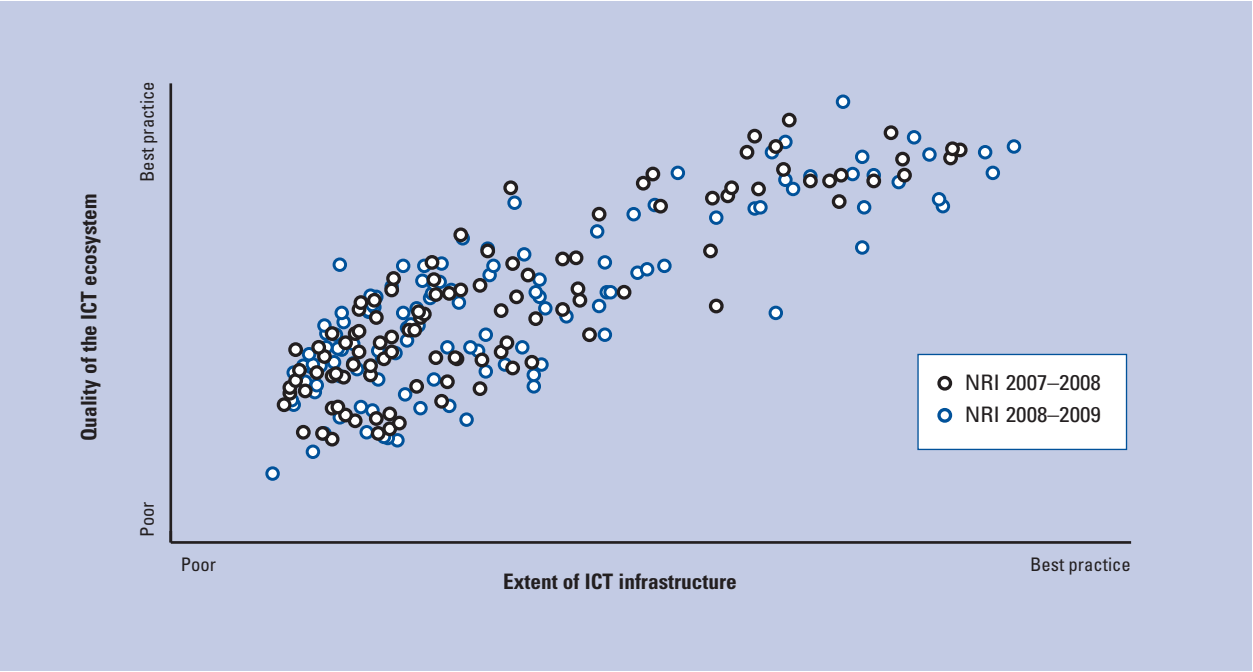


[1] World Bank 2009; [2] 2-year average, World Economic Forum, Executive Opinion Survey, 2007, 2008; [3] ITU 2008.

Table 1: Distribution of countries in the ICT Map

Ecosystem \ Infrastructure	Poor	Moderate	Good	Best practice
Best practice			3	13
Good	1	11	13	4
Moderate	20	21	12	
Poor	17	10	2	

Figure 5: Change in ICT Map positions, 2007–2008



Source: Authors' calculations, based on ICT Map 2008, 2009.

potential for the less wealthy countries to accelerate progress through policy and regulatory reforms.

Second, we analyze the impact that a balanced (diagonal) ICT Map position has on the progress achieved between 2005 and 2007 (see Table 2).

The results confirm the value of the balance between infrastructure and ecosystem—countries along the diagonal (indicative of balance between progress on the ecosystem and infrastructure fronts) saw the greatest increase in broadband line penetration. Countries with poor or even moderate ICT environments face the prospect of lagging further and further behind in their ability to harness the power of networks for competitiveness and social inclusion.

Third, we use the three summary categories (poor, moderate, and good/best practice ICT environments) to review differences in penetration and determine whether the gaps are closing or widening.

The new data from the NRI 2008–2009 validates last year's conclusions. The differences across country categories remain very large; this is particularly the case for broadband (see Figure 6).

Looking back from these penetration rates at the increase in Internet use and broadband penetration over two years shows how major gaps have continued to grow, because countries with weaker ICT environments did not manage to expand their connectivity fast enough to reduce them.

Table 2: Broadband penetration growth over two years, 2005–07

Ecosystem \ Infrastructure	Poor	Moderate	Good	Best practice
Best practice			4.7	8.8
Good		1.2	6.6	6.7
Moderate	0.3	1.5	5.5	
Poor	0.4	1.2	n/a	

Source: Authors' calculations, based on ITU, 2008.

- For Internet usage (Figure 7), the absolute gaps kept growing over the 2005–07 period (the proportion of the population that had used the Internet went from an average of 51 percent in 2005 to 60 percent in 2007 in good/best practice countries, compared with 6 percent in 2005 and 10 percent in 2007 for countries in poor environments).

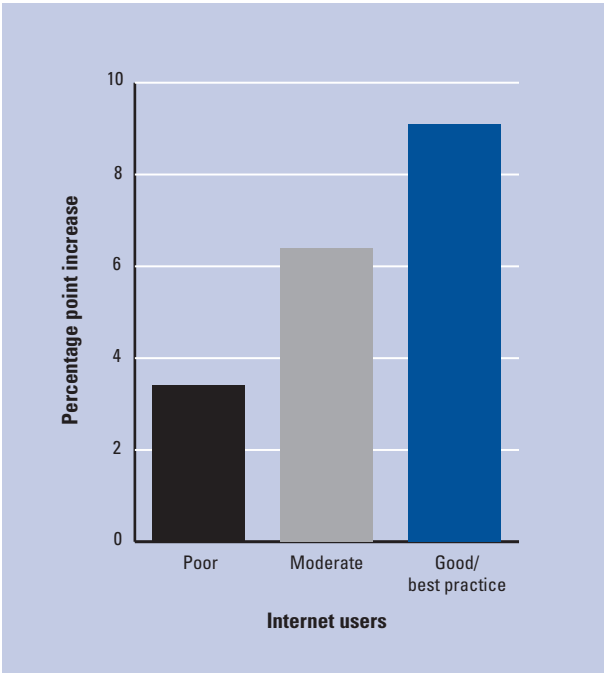
- For broadband connections (Figure 8), the even larger initial gaps kept growing (the proportion of the population that had used broadband Internet went from an average of 15 percent in 2005 to 22 percent in 2007 in good/best practice countries, compared with 1 percent in 2005 and 4 percent in 2007

Figure 6: Internet penetration by summary categories, 2007

Category	Number of countries	Internet users	Internet subscribers	Broadband subscribers
	Average (per 100 inhabitants)			
Good/best practice	33	60	28	22
Moderate	44	24	8	4
Poor	50	10	2	1

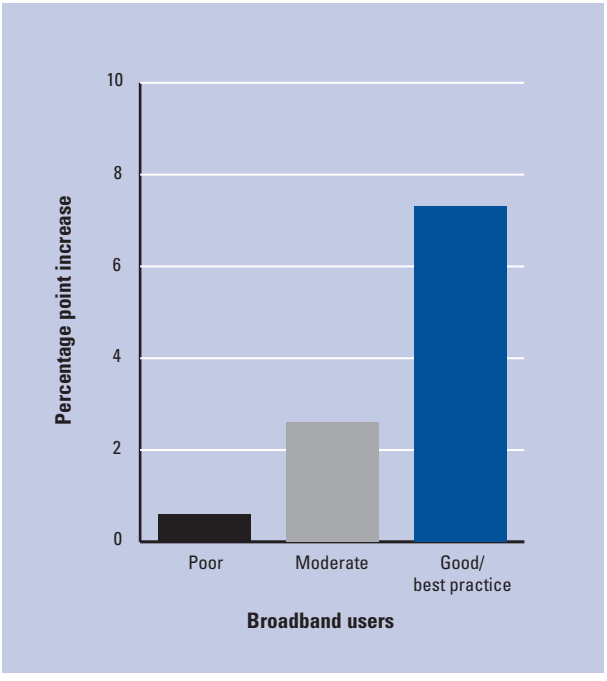
Source: Authors' calculations, based on ITU, 2008.

Figure 7: Increase in Internet penetration, 2005–07



Source: Authors' calculations, based on ITU, 2008.

Figure 8: Increase in broadband penetration, 2005–07



Source: Authors' calculations, based on ITU, 2008.

for countries in moderate environments—while countries in poor environments remained below 1 percent penetration throughout the 2005–07 period).

The momentum that countries build as they move through the Internet stages appears to be a powerful force. It has proven particularly difficult for countries with poor infrastructure and/or ecosystems to accelerate the rate of Internet penetration compared with that rate in other countries. While the relative growth, of course, is much higher for countries in the "poor" category, actual progress toward the critical mass of users and subscriptions is what represents key thresholds. In that respect, the gap has grown rather than shrunk in the two-year period.

Using ICT to reach economic and social objectives

As governments, businesses, and community leaders consider possible paths to improved connectivity with the ultimate goal of universal, ubiquitous connectivity, they will find it useful to think in terms of two major objectives: economic growth and social inclusion. The paths to these two goals overlap to some extent, but there are also separate avenues to pursue depending on the relative importance of each goal in a country.

- **Economic growth.** Potential benefits include productivity gains (e.g., through reduced transaction costs; scalability; and fast, reliable information flows) and enhanced innovation (through online collaboration tools and new ways to market goods and services). These are the same ICT productivity gains that have benefited developed economies over the last two decades and are accelerating their impact as they extend from large enterprises to smaller businesses, government, and nonprofit organizations.

- **Social inclusion.** This refers to the potential that improved access to networks offer people and communities across the world to education resources, health service providers, government assistance, and market information. This improved access works together with the networks' potential for empowering individuals to exercise their rights as citizens and become active participants in political processes and social dynamics.

The early stages of the Web 2.0 era of technology-empowered collaboration and knowledge development create unprecedented opportunities for both developed and developing economies. If leveraged correctly, an ambitious network connectivity strategy may very well represent the best hope of economic transformation, particularly at this time of global economic downturn. A strong foundation for ICT development with balanced ecosystem and infrastructure is crucial to reach the intensive Internet use stage, as a launching pad to Internet ubiquity.

A framework for action

The diagnostic models (ICT Map and Internet stages) that we have designed provide a good basis for providing perspective to a country's starting position and charting a course for progress.

Building on these models, and drawing from the fast-developing best practices of leading countries (including those of government policy and actions), we have identified six key action areas for an effective Net Strategy to improve ICT adoption (broadband in particular). These are consistent with the analytical logic of the ICT Map—with the addition of a more explicit role for government expenditure—and provide the basic structure of our framework for identifying priorities and establishing avenues for action.

These keystones for a Net Strategy represent a foundation in which each of the components needs to be solid and all six reinforce each other's effect. To reach the intensive use stage, countries need to ensure robustness in all six keystones. Areas where remedial action is needed will depend on the stage at which a country finds itself and on the strengths and weaknesses of its ICT environment.

The six keystones can be characterized through a series of questions and by examining lessons from best practice, as follows.

1. Market/Competition. Are the number of players, their technology platforms, and their market shares such that they foster competition (i.e., service innovation and responsiveness to potential demand)?

Simply put, monopolies innovate less and invest less than service providers in a competitive market. Best practice countries have found various ways to promote diversity in platform technologies and service provision, expanding the reach of networks, promoting usage, and ensuring affordability. But there is no blueprint that can be applied to all countries.

Countries ranking high in the NRI tend to have the healthiest competitive environments, where the needs and investment already made by incumbent players were taken into consideration while still providing incentives for newcomers. Competition does not work if regulation becomes confiscatory for incumbents or prohibitive for competitors.

Competition in the service provider market—broadly defined—also plays a vital role in ensuring a broad reach of networks, consumer choice, and efficient response to emerging demand. Needless to say, there is also a delicate balance here, as regulatory frameworks must also be mindful of the impact on incentives for service providers to invest. And diversity among technology platforms is a good indication of the potential for market dynamics that surround connectivity. In any

case, the goal is for markets, not regulators or incumbents, to select service and business models.

2. Policies and regulations. Has the institutional framework evolved from the traditional fixed telephony-based model to one that enables convergence around Internet Protocol (IP) and permits entry and efficient use of tangible and intangible assets?

Regulations, both ICT specific and more generic, can have the unintended effect of discouraging innovation around the development and deployment of applications. Outdated regulation can generate barriers and constrain access to existing assets while inhibiting opportunities for reducing entry costs and technology promotion.

Much of the thinking in the regulatory arena is still hampered by the legacy of the telephone industry and the regulatory environment that has historically surrounded it. In virtually every country around the globe, the traditional telephone industry was organized around five central concepts: the primary service is voice; the minute is the best metric for billing, regulation, and measurement; the location of the user is important; pricing is sensitive to the duration of the call; and pricing is sensitive to the distance between callers. These conditions, along with the heavy capital expenditures needed to deploy a telephone network, led to a heavily regulated marketplace and, hence, to generally monopolistic environments.

None of these conditions apply to broadband use. Distance, duration, and location are moot, making the billing increment of a minute of little value. Voice is but one application in a plethora of applications available to the end user. Incumbent telephone companies are joined by providers from the ICT world, where competition can be fierce, innovation occurs at a rapid pace, and precipitous drops in price are an everyday occurrence.

The only similarity between the telephone and broadband markets is the capital expenditures needed to create the foundational network. Fixed broadband networks still require digging ditches and hanging wires, and these civil-engineering costs can be penciled in at a fairly constant rate. But even this similarity is fading as a result of the advent of high-speed wireless technologies, which promise to drastically reduce capital costs for access networks and expand the range of options available to any location or community.

Countries that have made great strides in broadband connectivity have evolved from a regulatory framework designed for a telecommunications monopoly to recognizing IP convergence and treating networks as critical infrastructure. The old telecommunications regulation was focused on voice and reflected a very different cost structure in the industry. Well-intentioned but myopic regulations based on that model can have perverse effects—favoring monopolies, inhibiting innovation, and keeping prices unnecessarily high. In many countries, Voice over IP (VoIP), for example, is still illegal—hence depriving businesses and citizens of the benefits of a very cost effective technology.

3. Applications and content. Are the business environment and innovation culture such that demand and ICT entrepreneurship drive application development?

IP networks, by their nature, are best utilized when the ICT sector in a country consists of fluid structures —and clusters of innovation on content and applications. Users will obviously value broadband access more if they can go online to access government, education, and health-care services, or access potential jobs and sources of income.

Often the most effective intervention is an indirect one: promoting an environment in which ICT-related entrepreneurship can thrive and meet the demands for content and applications by local businesses and individuals. In addition, governments can promote demand by sponsoring the development of applications that meet the very real needs of the people with regard, for instance, to public services.

A business environment that facilitates business startups, operations, and conflict resolution is crucial for entrepreneurship and can have a disproportionately positive effect on the ICT sector. An active ICT sector is of paramount importance to accelerate technology adoption.

4. Government budgets. Are e-government practices contributing to both operational efficiency and citizen interaction online and is government procurement used to promote national ICT development?

Governments are very large buyers of ICT services and, hence, current government expenditure on ICT can also play a role by aggregating demand, acting as an "anchor tenant," promoting competition and/or "priming the pump" for a wide array of ICT services. Ambitious public online services and advanced use of ICT in government operations generates value and citizen satisfaction.

Strategic use of the government procurement can accelerate the commercial viability of services, promote competition and entrepreneurship in the sector, and create an opportunity for promising ICT business models to take off.

5. Skills for IT. Are the skill levels of ICT users (including those of school teachers) supporting the use of the Internet by businesses and individuals, and are specialist ICT skills developing in line with technology and potential?

Best practice countries have a solid base of ICT technical skills and a good level in broader science and math education. The range of interventions to improve ICT-relevant skills goes from sharply focused training and certification to pipelines of university graduates in engineering and information technology fields. Specialized education and research programs can play a major role over the longer term in contributing to the

ICT sector growth—both in adding value and in promoting efficiency.

Building basic ICT-user skills is, however, another hurdle many countries have to overcome.

An effective strategy must ensure that a lack of first-level ICT user skills are not preventing individuals and businesses from making the most of the opportunities technology has to offer. Programs designed to increase computer skills—and confidence—of older teachers can, for instance, offer a very high, immediate pay-off.

6. Infrastructure investment. Are there ICT infrastructure bottlenecks that affect critically the breadth, depth, and speed of ICT adoption?

Strategic investment (similar to that in trunk roads or interstate highways) may be required to establish a national foundation on which private investments and local initiatives can build. Often, this investment is best addressed through public-private partnerships. A number of different strands of private investment are worth highlighting and the incentives and disincentives affecting them well worth examining.

- Private investment by businesses in networks and service development is critical and has underpinned the development of networks and the growth of connectivity in many countries.

- Core networks should be seen as basic infrastructure. Depending on the starting situation, this may entail greenfield development, expansion, or upgrades. Public and private sectors have complementary roles to play, with government involvement mainly focused on filling gaps.

- In some circumstances, because of low density or difficult geography, government may have to take a more active role in ensuring investment in a broadband core network. For example, governments can make the rights of way they control available to core network operators. Additionally, since generally about two-thirds of the construction cost of core backbone networks is in civil engineering, governments can dramatically reduce the costs by providing empty ducts when they construct roads or maintaining highways and other infrastructure.

- At the other end of connectivity stand ICT devices—which represent an investment of sorts by individual users. There is a strong correlation between PC penetration and broadband use. The sequence in emerging markets is markedly different than that in advanced economies, where universal connectivity could be reached quickly because of the large PC pool already in use. In many emerging countries, device availability can be a critical bottleneck for connectivity.

Countries need to consider wide-ranging formulas for ensuring commercially viable and socially minded access to the Internet. Tariffs and taxes on PCs and constraints on the emergence of other Internet-ready devices can represent hurdles to the spread of connectivity. As appropriate, promotional programs can help facilitate access to devices for disadvantaged segments of the population.

Finally, a powerful though indirect effect, constraints on foreign investment or rigidities in the financial system can have a disproportionately negative effect on the ICT sector, placing a country at a competitive disadvantage.

Best practice examples

Experience from various parts of the world suggests measures and strategies that governments can take, including through public-private partnerships, to address bottlenecks and promote progress in connectivity. Key lessons from these experiences include:

- *Focus on market failures.* To accelerate adoption (rather than artificially create it) government actions should be designed to address market failures and bridge temporary gaps in demand or supply, as well as to create a dynamic of sustainable investment.

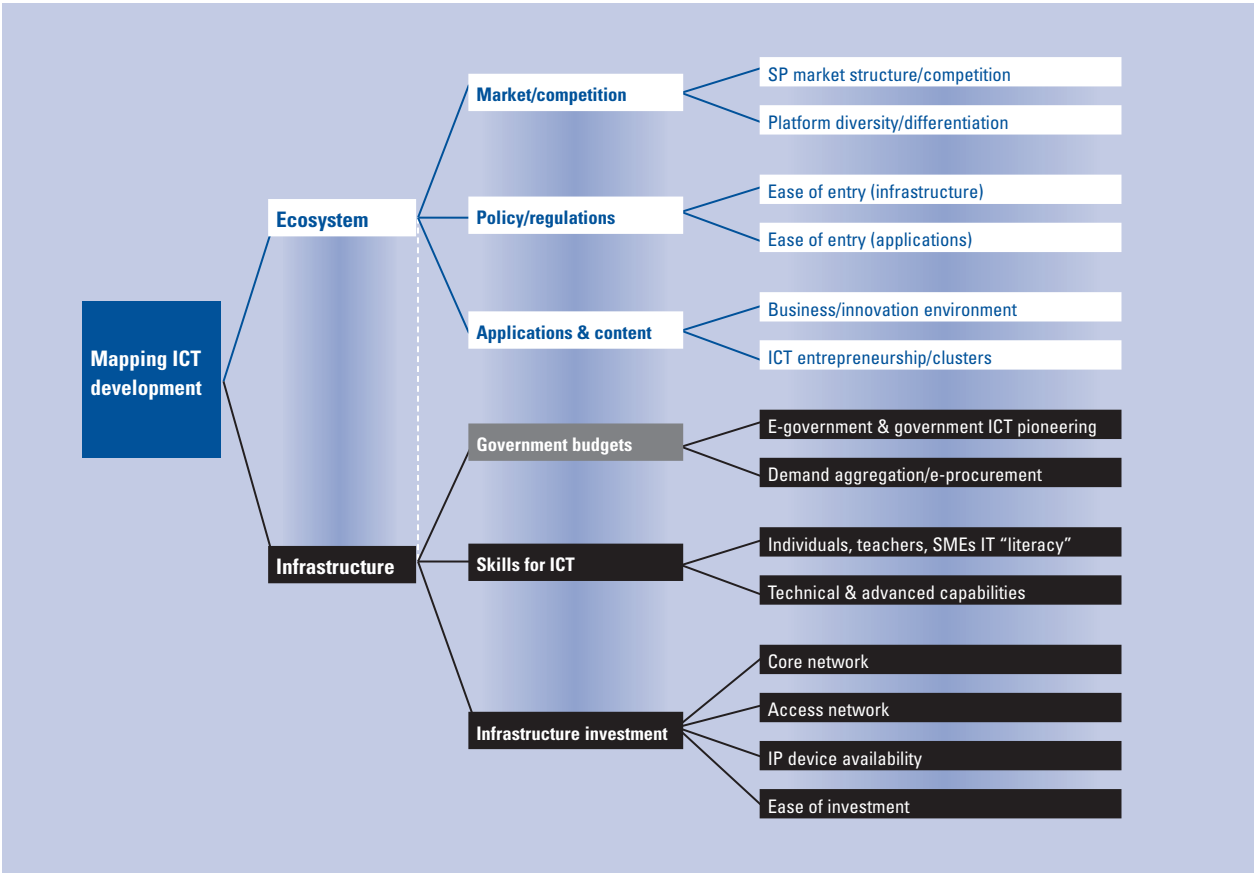
- *Coordinate infrastructure design and implementation.* It is much cheaper to lay cables alongside roads as they are being built than to return later, dig a ditch, and lay cables. Even if roads are being built with no network on the horizon, they can be designed with empty ducts beneath or easily assessable trenches so cable and fiber can be added later at a fraction of the cost. Infrastructure process coordination is an excellent alternative for municipal and regional governments, since there is no need for a federal decree to make coordination happen.

- *Sequencing.* Governments can greatly improve cost effectiveness by considering the importance of effect sequence. For instance, many lower-stage countries would do well to focus on improving their PC-to-citizen ratio as they develop and execute investment programs for broadband expansion.

To envisage the range of possible interventions in the formulation of a Net Strategy, we need now to go into another level of detail beyond our six keystones and consider 14 action areas or levers to which governments —depending on their specific circumstances—can resort (Figure 9).

Going into the details in each of the 14 areas shown on the right side of Figure 9 is beyond the scope of this chapter, but under each of these headings a number of promising practices are taking shape. Matching the assessment of bottlenecks in the 14 intervention areas with a catalog of best practices can quickly

Figure 9: A Net Strategy Framework



provide the components of a sound Net Strategy and lead a country to derive the immense benefits that the intensive use stage of the Internet offers.

Examples of promising interventions include the following:

- The national regulator set Greece's broadband market on the path to fair network access and more competition. The two key events in 2006 were the adoption of the European Union (EU) framework for Electronic Communications into Greek law and new regulations on Local Loop Unbundling (LLU). As a result, broadband connections accelerated and Greece no longer occupies the last place in the EU broadband penetration ranking.

- France implemented a bold regulatory framework that has led to a very competitive market. Free Ilyad and Neuf-Cegetel are among the most successful challengers in the world. Both have crafted business plans that focus on fiber deployment and innovative convergent services. In response to this competition, France Telecom has become one of the most innovative incumbents in the world.

- Ireland launched a licensing scheme for local area broadband fixed wireless access services. Under this scheme, licenses are offered in two frequency bands, 10 GHz and 26 GHz. The licenses are awarded on a first-come, first-served basis and issued for up to 2x28 MHz of spectrum for use in a location of the applicant's choice. The licensing initiative is also expected to extend to the 3.5 GHz frequency band at a later stage for service to rural and suburban areas.

- Korean broadband Internet service was classified as a value-added service, not as an infrastructure communications service. Hence it was largely free from strict government regulations and interventions. As a result, the entry barrier into the market was low and pricing competition was free—quite the opposite of the heavily regulated phone market.

- South Africa's regulatory authority announced in November 2008 that it had decided to convert all value-added network service licenses to network infrastructure licenses under the Electronic Communications Act. The move is expected to open South Africa's telecommunications industry to new infrastructure investors able to inject competition and expand services into the market.

Beyond the intensive use stage: Ubiquity

Ubiquity, everywhere and personal, is predicated on three things: the wide availability of a core network that takes fixed broadband as far as feasible; a diverse system of "capillaries," including wireless broadband that extends the core to "the last mile"; and a variety and abundance of Internet-enabled devices that meet the income, literacy, business, and personal needs of users.

For countries that are at or close to the intensive use stage, there are a number of factors to consider in developing a plan of action toward ubiquity.

Core network. Access to ubiquitous wireless networks assumes that broadband core fiber optic networks can reach every part of the country. The core network or backbone can also be thought of as the arteries and veins that handle the heavy flow of traffic, while wireless and other capillary systems provide access beyond the core and create the network's outer reaches. An important role of the government is to ensure that high-speed robust core backbone networks are available across their country to enable the availability of broadband everywhere. In many cases, a clear and predictable regulatory environment will attract private capital to build core broadband networks, if these are not already done; in others, public investment in the basic layer may be required to generate the externalities that core networks offer.

Spectrum. Wireless spectrum is, in many countries, an untapped asset. There are many policy enablers available to spread wireless broadband, but none is more effective than making radio spectrum available over large geographic areas. The good news is that the migration from analog to digital television's broadcast is opening up a broad swath of the radio spectrum that is ideal for wireless broadband networks. Virtually all governments control radio spectrum within their borders and therefore can license to broadband providers reclaimed spectrum, at wavelengths that are particularly well suited to deliver the signal over the topography of many emerging countries.

Good spectrum policy can do the same thing for broadband that it did for mobile telephony—leapfrog fixed networks and extend service to large swath of underserved and un-served areas and people.

Finally, spectrum policy to enable the expansion of wireless broadband will lead to new capabilities, such as mobility, that are simply unavailable on fixed networks and open the door for competition to fixed network broadband—driving investment, service innovation, lower prices, and, as a result, greater adoption.

Not all spectrum are created equal: spectrum at lower frequencies travel further with the same amount of energy and do not require line of sight. That is why emphasis on the 700 to 800 megahertz bands—which travel at long distances at lower power—as part of what the ITU calls the *International Mobile Telecommunications Bands,*[4] and on technologies such as WiMAX offers great potential for widespread broadband and ubiquitous Internet.

In order for wireless broadband to become a reality and have the impact that mobile telephony has enjoyed, multiple large swaths of spectrum (of 20 MHz or preferably 30 MHz each) need to be dedicated to wireless broadband. Migrating analog TV spectrum to digital broadband service offers an important "digital dividend." The United States has already acted, with the recent auction of 700 MHz spectrum; other countries are moving in the same direction, with the European Union (EU) planning a 2010–12 rollout. Some countries, such as Chile and India, have never used these 700 MHz band for television and therefore can move even faster to deploy these frequencies for wireless broadband.

Finally, to properly service the "last mile," countries will have to open up spectrum to build ultra-broadband, high-speed, symmetric, robust, intelligent networks. This strategy will promote whole new classes of applications, including high-resolution virtual meetings, such as telepresence systems; more effective and robust remote medical treatment; new forms of entertainment and multiplayer games; and visual and video-based educational opportunities—a particularly important advance for rural and agricultural uses. In countries with many languages and cultural groups, video, visual, and audio communications enabled by wireless broadband can be used to overcome literacy gaps and language barriers to provide education, health care, and government services as well as to expand social interaction.

Devices. Ubiquity and personalization also require a range of highly functional devices, including low-cost, robust, and easy-to-use ones. Laptops, of course, are the penultimate take-along Internet device, but for a great percentage of the world's population, laptops are still unaffordable. Mobile phones, in theory, are Internet devices, but aside from texting, they provide very limited connectivity. A wide range of new "smart" phones qualify as true Internet devices, but these are costly and have limitations. Other devices, such as the many variations emerging under the generic term of *netbooks,* offer promise, but accelerating their proliferation will be key.

Although the market is already providing more functional, smart, low-cost devices, public-private partnerships, nongovernmental organizations, and governments can help promote the widespread adoption of these devices to low-income and other disadvantaged populations. Countries ranging from Egypt to Saudi Arabia and Korea are easing or facilitating the adoption of PCs among low-income groups. Many schools in the intensive use stage countries have developed school curricula that rely on PCs and other Internet-enabled devices, and ensuring that these opportunities are open to all is a critical goal.

Conclusion

A new era has dawned as Internet use crosses critical-mass thresholds across the world and technology expands the range of connectivity options. Broadband networks offer productivity increases for businesses, greater inclusion and opportunity to individuals, and the potential for a competitiveness leap-forward for countries that seize the moment.

Mobile telephony is a great example on how emerging countries have leapfrogged more developed countries, and wireless broadband offers similar potential. No one ever believed that telephone service could reach the level of ubiquity that it has since its inception. Ubiquitous, high-speed Internet connectivity opens the door to the enormous potential of Internet-enabled pervasive communication and multifaceted collaboration.

The world is getting smaller. Telephones and Internet-connected computers started that process, and now ubiquitous broadband will explode the potential for connectivity, bringing us all closer together and changing the nature of our interactions in ways we are just beginning to imagine.

Notes

1 See Morrison et al. 2008.

2 It is noteworthy that the thresholds between the moderate and good categories are more significant than those between poor and moderate and, particularly, between good and best practice.

3 ITU 2007a.

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Appendix A: Definitions and Technical Notes

Broadband definition. The source for broadband data is the International Telecommunication Union (ITU), which defines broadband as 256 kb/s or higher (http://www.itu.int/ITU-D/ICTEYE/Indicators/WTI_Technotes.pdf). This definition is under scrutiny and likely to be revised in the future—to at least 1 mb/s.

Countries included in the five stages to ubiquity. The 157 countries generally overlap with the 134 economies included in the NRI this year, with the following exceptions (driven by data availability or size—we used a floor of 300,000 people for the stages): 6 economies are included in the NRI but not in the stages (Barbados, Burundi, The Gambia, Mongolia, Montenegro, and Puerto Rico) and 29 countries are included in the stages but not in the NRI (Afghanistan, Angola, Belarus, Belize, Bhutan, Cape Verde, Central African Republic, Comoros, Democratic Republic of Congo, Djibouti, Equatorial Guinea, Eritrea, Fiji, Gabon, Guinea, Haiti, Lao People's Democratic Republic, Lebanon, Liberia, Maldives, Myanmar, Niger, Republic of Congo, Rwanda, Solomon Islands, Swaziland, Bahamas, Togo, and Uzbekistan).

Household penetration ratios. The subscriber data, again as reported by the ITU, are in terms of subscriptions per 100 inhabitants and, thus, combine quite different magnitudes: the numerator shows total number of lines, accounts, or subscriptions and the denominator shows the total population. This ignores the fact that a significant number of the lines/accounts/subscriptions are used by businesses and that household sizes vary across countries. For the purposes of the stages, we have found it more meaningful to consider businesses and households separately. When referring to household penetration in this chapter, we are relying on a conversion of Internet and broadband subscriber ratios. Our estimates are based on the model:

$$\text{Household Penetration} = \frac{\text{Total Lines} - \text{Total Businesses}}{\text{Total Households}}$$

We get the estimates with two simple steps: (1) using average household sizes to estimate number of households per country that serves as denominator; and (2) deducting from the numerator an estimate of business subscriptions (based on extrapolation of business registration data and on the evidence from the city research, mentioned in the chapter, that all urban businesses above the micro size tend to have connections).

Explaining variation in broadband penetration—beyond income. Regression analysis of the GDP per capita 2007 (nominal, from the IMF) for 127 countries (those for which we were able to estimate ecosystem and infrastructure ratings from the NRI components) underscores the role that income plays (including through its effect on infrastructure). As we expand the model specification, the analysis also clearly shows that ecosystem factors are very significant determinants of broadband penetration, adding 12 percentage points in explanatory value; the gap between ecosystem and infrastructure ratings (indicative of distance from the balanced "diagonal") is similarly significant, adding a further 6 percentage points of explanatory value; and, finally, urbanization rates are also a significant explanatory factor (see Table A).

Table A: Factors in broadband penetration

	Explanatory (independent) variables (all significant at 97.5% level)				
Dependent variable	**Income** (per capita GDP, nominal)	**Ecosystem** (authors' rating based on NRI components)	**Balance gap** (difference in ecosystem, infrastructure percentiles)	**Urbanization** (share of urban population in country's total)	R^2 (%)
Broadband penetration (% of population)	X				**65**
	X	X			**77**
	X	X	X		**83**
	X	X		X	**79**