

Broadband, Inevitable Innovation, and Development

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It is an interesting phenomenon that many inventions have been made two or more times by different inventors, each working without knowledge of the other's research.

—Ogburn and Thomas, 1922.

Thus starts a delightful and fascinating 1922 paper entitled 'Are Inventions Inevitable? A Note on Social Evolution', authored by William F. Ogburn and Dorothy Thomas.¹ In the subsequent pages, the authors cite case after case of the world's most significant inventions that appear to have emerged independently and almost simultaneously, sometimes on completely different sides of the world. In the appendix, they offer a preliminary list of 148 such cases chosen from the fields of mathematics, astronomy, chemistry, physics, medicine, biology, psychology, and mechanics. And they assert that there are surely many more examples that could be found with additional research.

On the basis of this evidence, the authors ask the obvious question: 'What does this mean?' They seek to develop tentative answers to the question of whether inventions are inevitable. They begin with a simple rhetorical question: if certain inventors had died in infancy, would somebody else not have shortly invented the same thing and overall human progress continued? Their conclusion is, of course, 'Yes'. In other words, the numerous parallel occurrences of essentially the same invention suggest that it is not so much the genius of specific individuals that is important as the set of enabling knowledge and conditions at a period in time that enables an invention to emerge. To put it

simply, nobody can invent the river steamboat without the prior invention of both boats and the steam engine. But once both exist, their combined emergence is not only likely, but also *simply inevitable*.

A more recent and powerful example can be cited for the invention of the worldwide web. Dave Raggett of the World Wide Consortium, in his description of the history of the invention of the Web by Sir Tim Berners-Lee, starts with the observation: 'The time was ripe for Tim's invention'.² He states:

The fact that the Web was invented in the early 1990s was no coincidence. Developments in communications technology during that time meant that, sooner or later, something like the Web was bound to happen. For a start, hypertext was coming into vogue and being used on computers. Also, Internet users were gaining in the number of users on the system: there was an increasing audience for distributed information. Last, but not least, the new domain name system had made it much easier to address a machine on the Internet.

Indeed, with hindsight, most innovations can be qualified as inevitable. Rare is the disruptive breakthrough that comes out of nowhere—most are incremental changes built on the underpinnings of other knowledge, technologies, or platforms. What is important for most innovations to occur is a set of enabling conditions that triggers somebody with the right knowledge

and skills to recognize (even serendipitously) an incremental step that can be taken at that moment in time.

Along any evolutionary path, there are always set points where an underlying direction becomes clearer and trend signs get stronger. This chapter argues that we are entering an era of *inevitable innovation* enabled by information and communication technologies (ICTs). This will be the beneficial consequence of putting the knowledge, technologies, and platforms that ICTs bring into the reach of billions of new users, many of whom will come from developing countries. In turn, these users will produce many new innovations that will directly benefit and empower those in developing countries.

To make this point and identify ways in which countries at various levels of development can best benefit from ICT-based innovation, we shall successively consider the following four areas: (1) the changing ICT landscape and the contribution of ICTs to innovation, (2) the advent of broadband as a platform for inevitable innovation, (3) how to maximize the innovation benefits of ICTs, and (4) what steps should be taken to trigger inevitable innovation.

The changing ICT landscape

What is happening in the global ICT landscape? What are the key trends over time and across economies? To answer these questions, the International Telecommunication Union (ITU) gathers statistics as inputs into its *ICT Development Index* (IDI), a composite index combining 11 indicators into a single benchmark measure to monitor and compare developments in ICTs across countries. Elements of the IDI (ICT access and use) are used as inputs into the Global Innovation Index.

Data gathered for the IDI show that, over the past 10 years, we have witnessed an extraordinary transition. We have moved from a world where most people did not have access to even basic telecommunications to one with over 6 billion mobile subscriptions and an estimated 2.4 billion people using the Internet at the end of 2011.³

Figure 1 demonstrates that the most successful technology by a wide margin is mobile, with subscription numbers reaching 87% of the world's population at the end of 2011. The figure also shows that about 35% of the world population is using the Internet. This compares with penetration rates of 17% for mobile-broadband subscriptions, 16.6% for fixed-telephone lines, and 8.5% for wired-broadband subscriptions.

To fully appreciate the implications of these numbers and their predicted impact on innovation, it is helpful to drill down further into the nature and extent of Internet and mobile penetration around the globe.

The nature of the Internet as an enabling platform for innovation

Figure 2 shows that the Internet has seen its number of users more than double over the past five years to about 2.4 billion users worldwide at the end of 2011. Growth rates in developing countries are high, with absolute numbers driven by large countries such as Brazil, China, India, Nigeria, and the Russian Federation. In developed countries, around 74% of the population is online, but this figure drops to 26% in developing countries. Globally, at the end of 2011, roughly 35% of the world's population was online—up from 12% in 2003 and 6% in 2000.

Although the Internet entered the public domain only 20 years ago, the inhabitants of the developed

world can take for granted the enormous benefits that it has brought. The Internet has been an extraordinary enabling platform that has facilitated numerous innovations, from e-banking to social media, online travel booking to e-government, free telephony to instant messaging—the changes it has brought to the way we work and play are immense. This has largely been possible because it is an open platform on top of which anyone can build a new service or application.

However, it is sobering to realize that 65% of the world's population (and 74% in developing countries) is not yet using the Internet. Clearly much work needs to be done to make the benefits of the Internet more broadly available on a global scale.

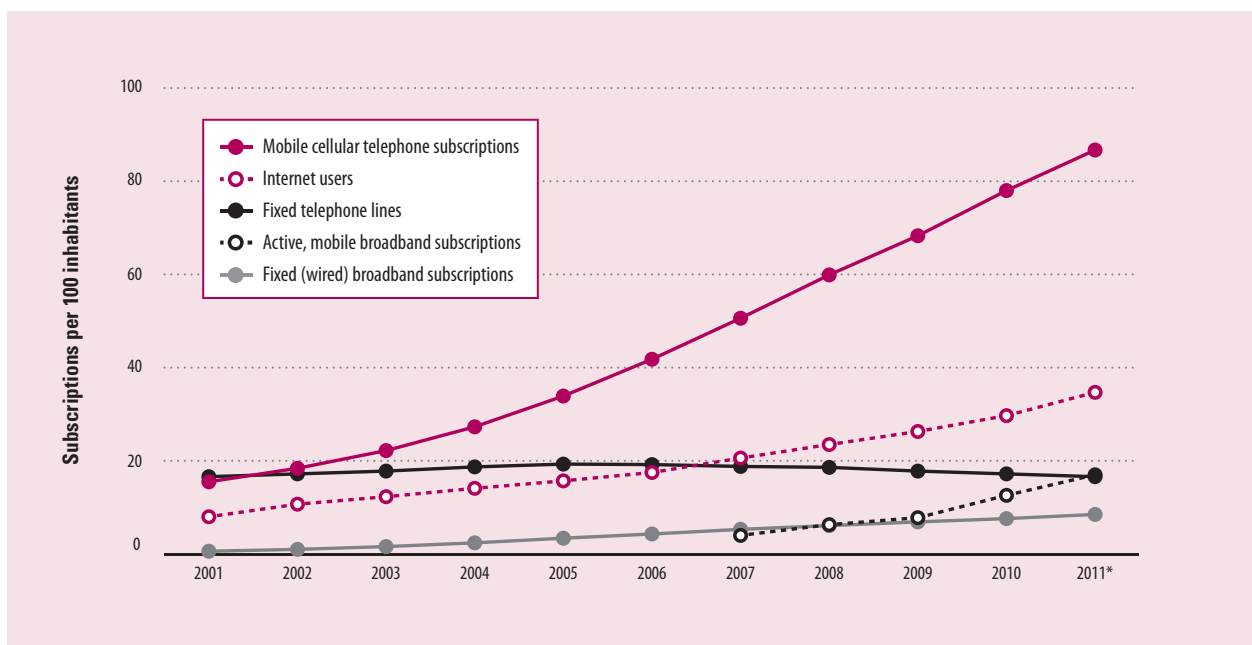
For the majority of the world population, the true ICT revolution has not been the Internet, but rather mobile telephony

Although ICTs have conquered the globe and brought basic communications within reach of almost everyone, the most prevalent technology, particularly in developing countries, is mobile. In many countries, mobile telephony growth has appeared to reach saturation levels, recording penetration rates of over 100%. In fact, more than 90 countries have a larger number of mobile subscriptions than their population. This 'mobile miracle' has occurred against the backdrop of the ongoing decline, which began in 2005, of fixed telephony lines—which now represents only a 16.6% penetration rate of the global population (see Figure 1).

The contribution of ICTs to innovation

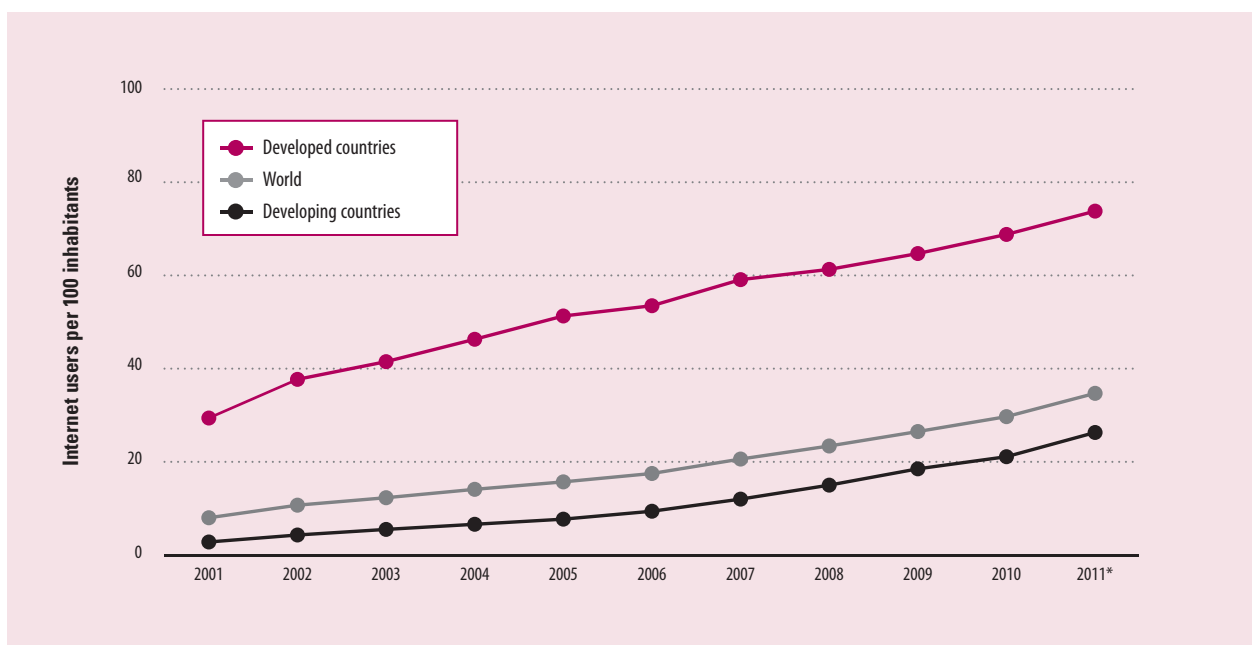
Generally, the contribution of the ICTs to innovation can be seen in at least three domains:

Figure 1: Global ICT developments, penetration (2000–11)



Source: ITU World Telecommunication / ICT Indicators database.
* Estimate.

Figure 2: Global Internet growth, penetration (2000–11)



Source: ITU World Telecommunication / ICT Indicators database.
Note: The developed/developing country classifications are based on the UN M.49 (the standard used by the United Nations for statistical purposes); see <http://www.itu.int/ITU-D/ict/definitions/regions/index.html>.
* Estimate.

Box 1: Simpa Networks

Simpa Networks is an innovative for-profit start-up that supplies pay-as-you-go solar energy systems in developing countries for households without access to the electricity grid. Consumers are able to purchase and install, at a minimal up-front cost, a solar energy system and pre-pay for electricity using a mobile text-based payment scheme.

Each payment contributes towards the total purchase price of the solar energy system. When full payment has been made, users receive a code that unlocks the device and delivers free electricity for the expected 10-year life of the product.

Simpa Networks provides a green energy solution that has cleverly adopted a mobile pre-paid business paradigm in an innovative way to deliver a solution for energy needs in rural areas. Although the company has developed its mobile payment engine, it is now in talks with a major mobile provider in India about directly using that provider's payment gateway.

SOURCE: simpanetworks.com.

- First, ICTs enable access to a global platform of knowledge (Wikipedia represents one well-known example of a knowledge source) that accelerates and enables further inventions and innovations. Knowledge about the best and brightest ideas can now quickly be made available to billions of people around the globe on a scale never before seen in human history. It is a new phenomenon of collective 'global knowledge bootstrapping'.
- Second, ICTs exponentially increase the ability of people to create, exchange, and debate ideas and knowledge—the

mental building blocks of invention and innovation. Discussion and debate on new ideas and paradigms can spread around the globe in days—and be quickly adapted to local circumstances and needs. ICTs do this both by connecting people, whether individually or in groups or communities, and by facilitating the 'viral' spread of the best views and ideas.

- Third, business paradigms that have proven to be successful in making ICTs available for billions of users in developing countries, such as prepaid subscriptions, can serve as business paradigms for addressing other critical developmental needs (see Box 1).

Not surprisingly, as both the Internet and mobile telephony have become more widespread in developing countries, we have seen a wave of innovations emanating from and focused on the needs of the developing world.⁴ Recognizing this, Brahima Sanou, the Director of ITU's Telecommunication Development Bureau, has identified innovation and its linkages to ICTs as one of his key focus areas. He foresees numerous opportunities for innovation in the developing world to empower individuals at a local level to fundamentally shape and improve their lives.

In fact, it is likely that history will demonstrate that the greatest contribution of ICTs to global development is that they provided an enabling platform that exponentially increased the ability of people to create and exchange ideas and knowledge.

Just as the wonders of the brain and human consciousness cannot be explained by studying neurons or how they are connected, the benefits of ICTs for socioeconomic development cannot be understood

by simply adding up the numbers of newly connected people. In fact, the collective social and intellectual behaviour that arises out of interconnected networks of people can make these networks perform like rapidly evolving organisms. This phenomenon is only just beginning to be understood in a new and emerging scientific discipline called 'network science' that seeks to understand the principles and behaviours governing networked behaviour.

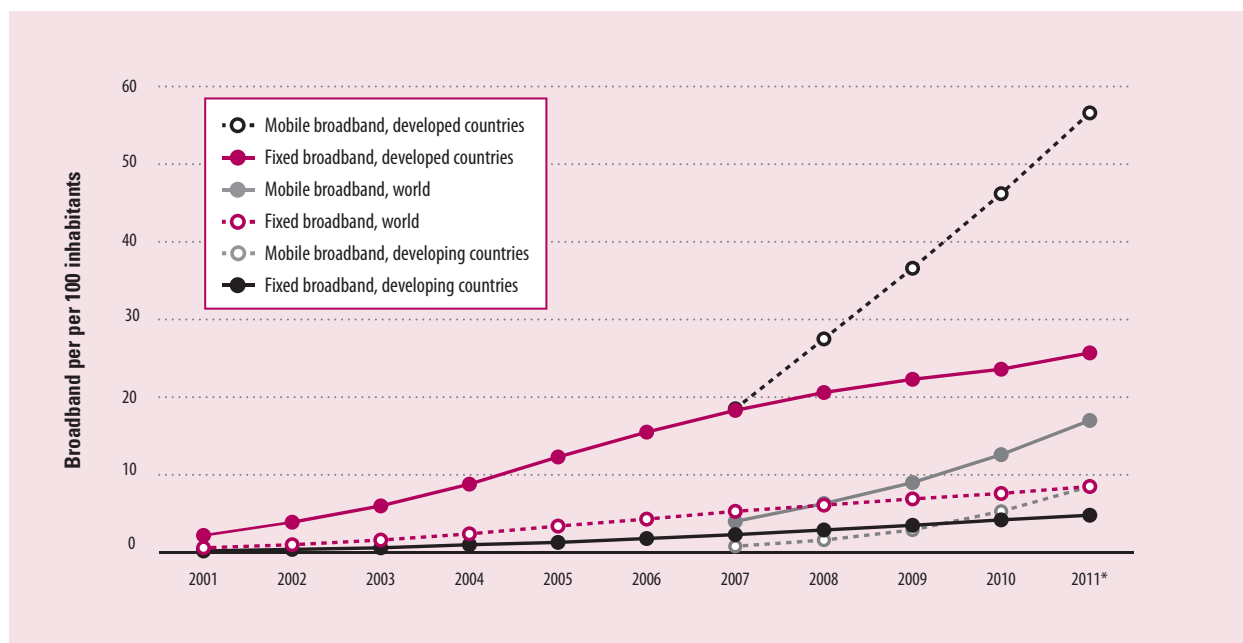
The advent of broadband: A platform for inevitable innovation

Government policy makers and investors are now directing considerable attention towards improving access to the Internet through broadband networks—whether these use wired or wireless connections. Although fixed broadband subscriptions have more than doubled in the past five years, Figure 3 shows that fixed broadband penetration in developed countries has risen to 26% at the end of 2011, but lags at less than 5% penetration in developing countries. Is there a solution on the horizon that could help? Mobile broadband seems to hold a large part of the answer.

Figure 3 shows the growth of mobile broadband over the last five years, which can only be characterized as a success story. Even having entered the ICT landscape so recently, globally mobile broadband has already surpassed twice the penetration of fixed broadband subscriptions. Remarkably, in just a few years, it has surpassed (at 17%) the global penetration of fixed telephone lines (at 16.6%), which was built up over more than 100 years.

The growth of mobile broadband comes at the same time that a number of studies demonstrate that mobile technologies, particularly

Figure 3: Global fixed and mobile broadband growth, 2000–11 (penetration)



Source: ITU World Telecommunication /ICT Indicators database.

Note: The developed/developing country classifications are based on the UN M.49 (the standard used by the United Nations for statistical purposes); see <http://www.itu.int/ITU-D/ict/definitions/regions/index.html>.

* Estimate.

in developing countries, can boost socio-economic development and, in particular, improve development outcomes in fields such as health, education, agriculture, employment, crisis prevention, and the environment.⁵

In other words, even with the relatively low-tech, low-bandwidth, and low-cost handsets widely used in developing countries, mobile technologies have acted as a platform for innovation. For example, Africa's rapid embracement of mobile—with more than 430 million subscriptions (36 times its number of fixed telephone lines)—has created an enabling platform that was sorely needed. With other infrastructure systems lacking, innovators have been quick to build out new services such as mobile banking, agricultural news sharing, and m-health applications. If this can occur with

simple infrastructure and rudimentary access to the Internet, it is not too difficult to imagine what the impact of ubiquitous mobile broadband access to the Internet would be through the next generation of ever-more-affordable smartphones, phablets,⁶ and tablets.

How to maximize the innovation benefits of ICTs

Because they cut across so many areas of social and economic policies, ICTs have been at the convergence of a complex array of commercial, political, and diplomatic strategies and actions. Maximizing the positive impact of ICTs for fostering innovation for development needs will therefore require deliberate and concerted efforts to ensure that all relevant players, private and public, are brought to the same table.

An example of recent efforts of that kind can be found in the area of broadband communications. To proactively address the 'broadband gap', ITU and UNESCO recently set up the *Broadband Commission for Digital Development* in response to UN Secretary-General Ban Ki-Moon's call to step up UN efforts to meet the Millennium Development Goals (MDGs).⁷ The Commission was established in May 2010, five years after the World Summit on the Information Society (WSIS) and ten years after the launch of the MDGs. The Commission is attempting to boost the importance of broadband on the international policy agenda and believes that expanding broadband access in every country is key to accelerating progress towards the MDG targets of 2015. It is outlining practical ways in which countries—at all stages of development—can

Box 2: The targets of the Broadband Commission

In its report *Broadband for the Global Good*, issued in conjunction with the Broadband Leadership Summit in October 2011, the Broadband Commission issued a set of four targets that countries around the world should strive to meet in order to ensure that their populations fully participate in tomorrow's emerging knowledge societies:

1. **Making broadband policy universal:** By 2015, all countries should have a national broadband plan or strategy or include broadband in their Universal Access Service Definitions.
2. **Making broadband affordable:** By 2015, entry-level broadband services should be made affordable in developing countries through adequate regulation and market forces (for example, amounting to less than 5% of average monthly income).
3. **Connecting homes to broadband:** By 2015, 40% of households in developing countries should have Internet access.
4. **Bringing more people online:** By 2015, Internet user penetration should reach 60% worldwide, 50% in developing countries, and 15% in Least Developed Countries (LDCs).

SOURCE: Broadband Commission, 2011.

improve their broadband infrastructure in cooperation with the private sector.

It is clear that a broadband revolution will not arrive by itself. It must be accompanied by enlightened policies and concerted efforts to bridge the gap for the 74% of people in developing countries who have

yet to use the Internet. The international targets proposed recently by the Broadband Commission in its *Broadband for the Global Good* report (Box 2) suggest practical reference points to make the broadband revolution truly global.⁸

What about the money?

Is there conclusive and quantitative proof that economic benefits will directly result from broadband rollout? This is a question that offers a number of challenges for researchers. First, the deployment of broadband has happened over a very short time scale. As a consequence, the time series data for broadband adoption are much shorter than for other technologies, such as voice communications. Second, only a few countries focused early on the potential economic impact of the Internet and broadband and began to collect statistics, so the data available for worldwide comparison are sparse. Third, since broadband is essentially an access technology for data communications, it has demonstrable economic effect only in combination with the broader adoption and use of ICTs and the subsequent implementation of organizational or process changes in enterprises or governments that follow. In sum, although a number of studies suggest broadband's positive correlation with economic growth, it is also difficult to unequivocally argue that broadband is not itself a side benefit of overall development.⁹

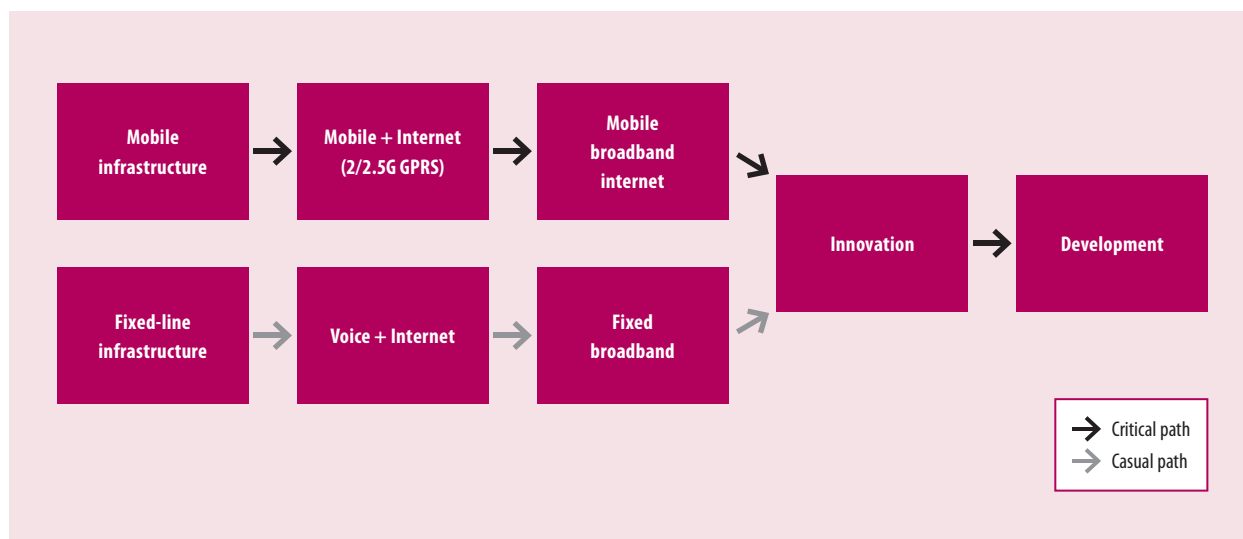
A more compelling case can be made that broadband is critical as an enabling platform for innovation and development. This is just beginning to be more widely understood in the context of supporting developmental needs and access to knowledge. For example, a 2010 Ministerial Report on the OECD Innovation Strategy observed:

Today, high-speed communication networks support innovation throughout the economy much as electricity and transport networks spurred innovation in the past. Governments should promote information and communication technologies (ICTs) as general-purpose platforms for innovation and knowledge sharing by upholding the open, free, decentralized and dynamic nature of the Internet.¹⁰

Some preliminary studies of the correlation of broadband with innovation are emerging, with case studies demonstrating how broadband has triggered entrepreneurial activities in developing countries and fulfilled developmental needs.¹¹ But the real innovation revolution is yet to come. This revolution will be based on mobile broadband, which holds the key to convergence between the two major communications revolutions whose genesis was in the early 1990s: the Internet and the mobile phone.

Triggering inevitable innovation: A basis for action

The beginning of this chapter considered how most innovations are incremental and built on foundations of other knowledge, technologies, or platforms. As noted, the numerous parallel occurrences of essentially the same invention suggests that what is really important is a set of enabling knowledge and conditions at a period in history that enables incremental innovations to emerge. Also discussed was how both the Internet and mobile phones have acted as enabling platforms for innovation and how mobile has impacted the developing world. It is therefore logical to reflect on how the convergence of Internet and mobile telephony technologies will occur in developing countries and what it may mean for innovation for development.

Figure 4: Evolution of ICT-innovation linkages in developing economies

Note: 'Mobile + Internet' refers to first-generation packet mobile data services with limited data rates; GPRS = general packet radio service.

As stated previously, along any evolutionary path, there are set points where an underlying direction becomes clearer and trend signs get stronger. One can clearly identify an emerging 'critical path' by which the ICT → Innovation → Development chain will be accelerated and trigger an era of *inevitable innovations* that will push forward the global development agenda (Figure 4). This is most likely to occur via mobile broadband, which can be logically anticipated from the enormous differences of penetration of mobile versus fixed telephony infrastructure in developing countries.

As an example, let us consider Africa at the end of 2011 to show why the future is mobile broadband. With a fixed line infrastructure of only 12 million lines and just 1 million broadband connections, future possibilities for fixed-line broadband growth are extremely limited. On the other hand, this can be contrasted with Africa's 433 million mobile subscriptions and 31 million mobile

broadband subscriptions. Clearly the critical path for ICT growth in developing countries appears to be through mobile broadband.

If this scenario is correct, it is highly probable that many inevitable innovations that support the global development agenda will flourish along the critical path emerging from mobile broadband. Many of these innovations may initially appear to be 'low-tech' in nature, but will likely become more sophisticated as available bandwidth slowly grows. Whatever their degree of technological sophistication, such innovations are likely to surface first in developing countries where mobile devices will be the primary enabling platform and development needs are the most acute.

Skills, skills, and skills

A common tendency among policy makers and researchers is to attempt to guide outcomes and foresee solutions that describe entire ecosystems of platforms, services, and

applications. But it would be wrong to try to 'over-engineer' the future of ICT-based or ICT-enabled innovations in emerging and developing economies. History has already demonstrated the remarkable creativity and surprising development-oriented innovations that have emerged once access to ICTs is made available. A more productive path would consist of (1) enabling innovative individuals to flourish, develop, and succeed locally; and (2) 'organize serendipity' by fostering multi-stakeholder and interdisciplinary approaches as often and in as many different areas as possible.

Clearly, pushing forward the broadband agenda is only one area in which a multi-stakeholder approach should be fostered. Enabling larger numbers of players to fully grasp the challenges and opportunities of emerging trends is paramount to maximizing global benefits from such trends. There are many new exciting areas that could be considered for such an approach in the

future, including cloud computing, open innovation, crowd-sourcing, and big data.

Enabling local knowledge and local brains to connect and mesh with the experience and talents of other countries, regions, traditions, and cultures will require steady efforts from the international community to encourage the development of innovation skill sets on a worldwide basis. ICTs can notably play a crucial role in allowing such skills to cross-fertilize, combine and re-combine, while enhancing their power to generate new innovations that will best address the local dimensions of development.

The relationship between ICTs and innovation and its foreseen positive impact on development suggests that policy debates about the importance of advancing the broadband agenda should shift from ‘pipes and plumbing’ to the critical importance of enabling an interconnected world of creativity, ideas, and knowledge that can trigger an age of inevitable innovations. Breaking with recent past and enabled by broadband access to ICTs and knowledge combined with local needs, many new innovations will emerge in developing countries. It is these bottom-up ideas that will bring exponential benefits and contribute more to the global development agenda than just about anything else we can do.

Notes

- 1 Ogburn and Thomas, 1922, p. 83.
- 2 Raggett et al., 1998.
- 3 ITU, 2011.

- 4 The ITU standards sector recently created a ‘Focus Group on Innovation’. Part of the mandate of this group is to highlight cases of ‘reverse innovation’, a term introduced by Professors Vijay Govindarajan and Chris Trimble of Dartmouth College and GE’s Jeffrey R. Immelt. Reverse innovation focuses on the needs and requirements for low-cost products and services in developing countries. In turn, these products and services may be made available in developed countries.
- 5 For an example of such a report, see UNDP, 2012.
- 6 ‘Phablet’ is a term formed from the words ‘phone + tablet’ coined to describe handheld devices that are larger than a smartphone but smaller than a conventional tablet computer.
- 7 Information about the Broadband Commission is available at <http://www.broadbandcommission.org>.
- 8 Broadband Commission, 2011.
- 9 See Katz, 2012, for a more detailed discussion of the economic impact of broadband.
- 10 OECD, 2010, p. 2.
- 11 An interesting ITU study on the relationship of broadband to innovation was presented at the last ITU Global Symposium for Regulators and can be found at Best and Taylor, 2011.

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