CHAPTER 5

SPANNING THE INTERNET DIVIDE TO DRIVE DEVELOPMENT

Contributed by the International Telecommunication Union

Abstract: *Information and Communication Technologies (ICTs) are key building blocks of the digital economy, to facilitate trade and drive e-commerce. Strong growth in ICT infrastructure, connectivity, access and use promise great development opportunities but the full potential of the Internet remains untapped, as over half the world's population remains offline. Unless policy-makers address infrastructure, affordability but also broader socio-economic challenges outside the ICT ecosystem, the Internet is liable to reinforce existing inequalities, instead of addressing them. This chapter analyses progress but also the gaps that exist in developing countries—and in particular the least developed countries—in terms of infrastructure, connectivity and quality of service, particularly for mobile and fixed-broadband Internet. It addresses some key connectivity bottlenecks and points to recommendations to overcome these. The chapter looks at fixed- and mobile- broadband prices, and the affordability of services in developed and developing regions. In addition to addressing supply-side barriers, it examines demand-side barriers outside the ICT ecosystem, including broader socio-economic inequalities, digital and analogue skills, and the availability of relevant local content.*

INTRODUCTION[1]

An increasingly ubiquitous, open, fast and content-rich Internet has changed the way many people live, communicate and do business. Internet uptake has been found to bring great benefits for people, governments, organizations and the private sector. It has opened up new communication channels, provided access to information and services, increased productivity and fostered innovation, and it facilitates trade in goods and services. Information and communications connectivity and use are key building blocks of the digital economy, and indispensable drivers of e-commerce.

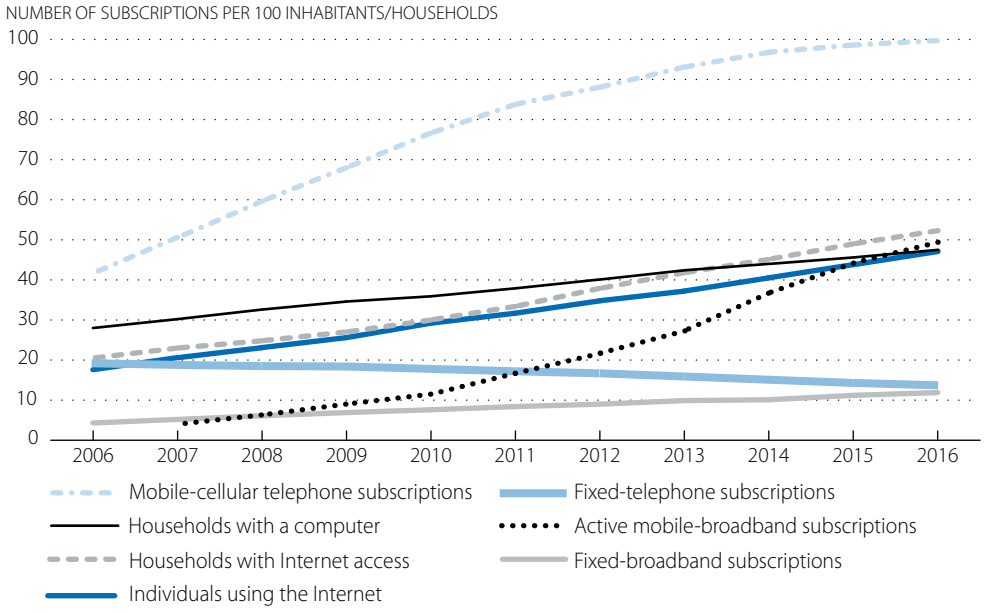
The importance of infrastructure and connectivity is recognized by Sustainable Development Goal (SDG) 9, on industry, innovation and infrastructure. It issues a call to "significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020" (SDG Target 9c, UN 2016).[2]

This chapter analyses the gaps that exist in developing countries—and in particular the least developed countries (LDCs)—in terms of infrastructure, connectivity and quality of service, particularly for mobile and fixed-broadband Internet.[3] It addresses some key connectivity bottlenecks and points to recommendations to overcome these. The chapter looks at fixed- and mobile- broadband prices, and the affordability of services in developed and developing regions. In addition to addressing supply-side barriers, it examines demand-side barriers outside the ICT ecosystem, including broader socio-economic inequalities, digital and analogue skills, and the availability of relevant local content.

Global trends show rapid growth—as well as gaps—in the use of information and communications technology

The rapid growth in access to and use of information and communications technology (ICT) throughout the world is illustrated by Figure 5.1. The steep rise in mobile-cellular subscriptions worldwide, which began early in this century, is tailing off as the global penetration rate approaches 100 subscriptions per 100 inhabitants. At the same time, there has been a gradual decline in the penetration rate for fixed-telephone subscriptions, owing to the tendency for new users to prefer mobile over fixed lines.

Figure 5.1. Global changes in levels of ICT uptake, 2006-16



Note: The figures for 2016 are ITU estimates.

Source: ITU (2016b), *Measuring the Information Society Report 2016.*

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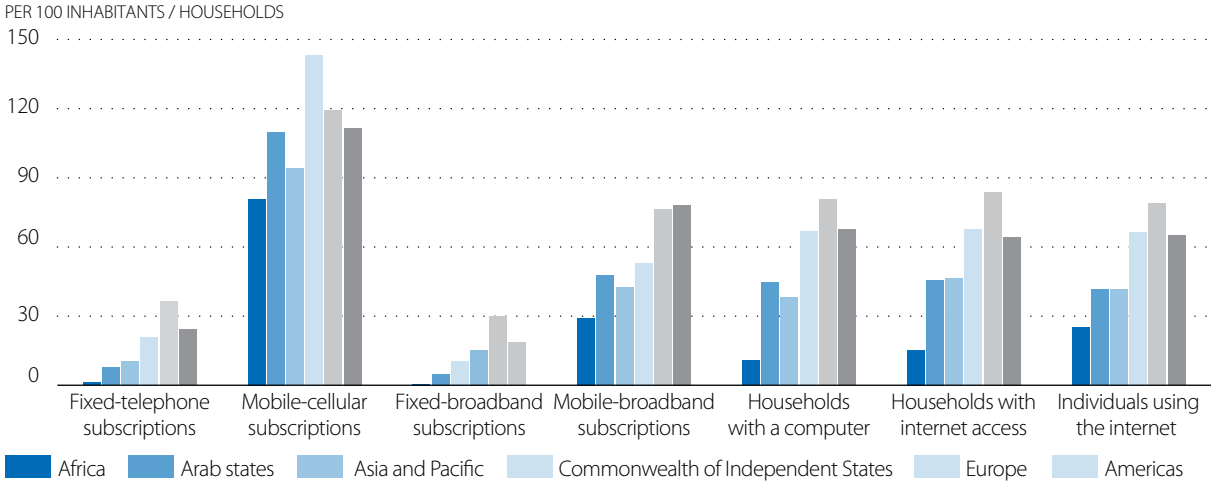
The benefits of the Internet are still unavailable to over half the world's population

Nonetheless, many people still do not—or do not fully—benefit from the rapid expansion of the digital economy and the opportunities it offers. Global figures mask substantial differences in connectivity and access levels, which vary greatly between and within countries, especially in terms of high-speed broadband access and Internet use.

Globally, 3.9 billion people, constituting more than half the world's total population, are still offline. The majority of these people live in the world's most vulnerable countries. In many developing countries—in particular the LDCs, the land-locked developing countries (LLDCs) and small island developing states (SIDS)—development challenges also hamper the spread of ICTs. These challenges include limited and costly access to national and international connectivity in small and isolated communities, difficulties in the rollout of terrestrial communication infrastructure across large land areas, and lack or limited direct access to the sea.

Figure 5.2 compares the 2016 figures for key ICT penetration indicators in the International Telecommunication Union's (ITU) six geographic regions. Figure 5.4 compares the figures for developed countries, developing countries and least developed countries. These comparisons highlight that developing countries, and in particular the LDCs, lag behind developed countries in terms of fixed-broadband penetration, household access to ICTs and Internet uptake (Box 5.1). While mobile-cellular penetration has reached over 70% in the world's LDCs, mobile-broadband penetration stands at just below 20%, compared to close to 50% globally and 90% in the world's developed countries.

Figure 5.2. ICT penetration levels by geographic region, 2016



Note: ITU estimates.

Source: ITU (2016b), *Measuring the Information Society Report 2016.*

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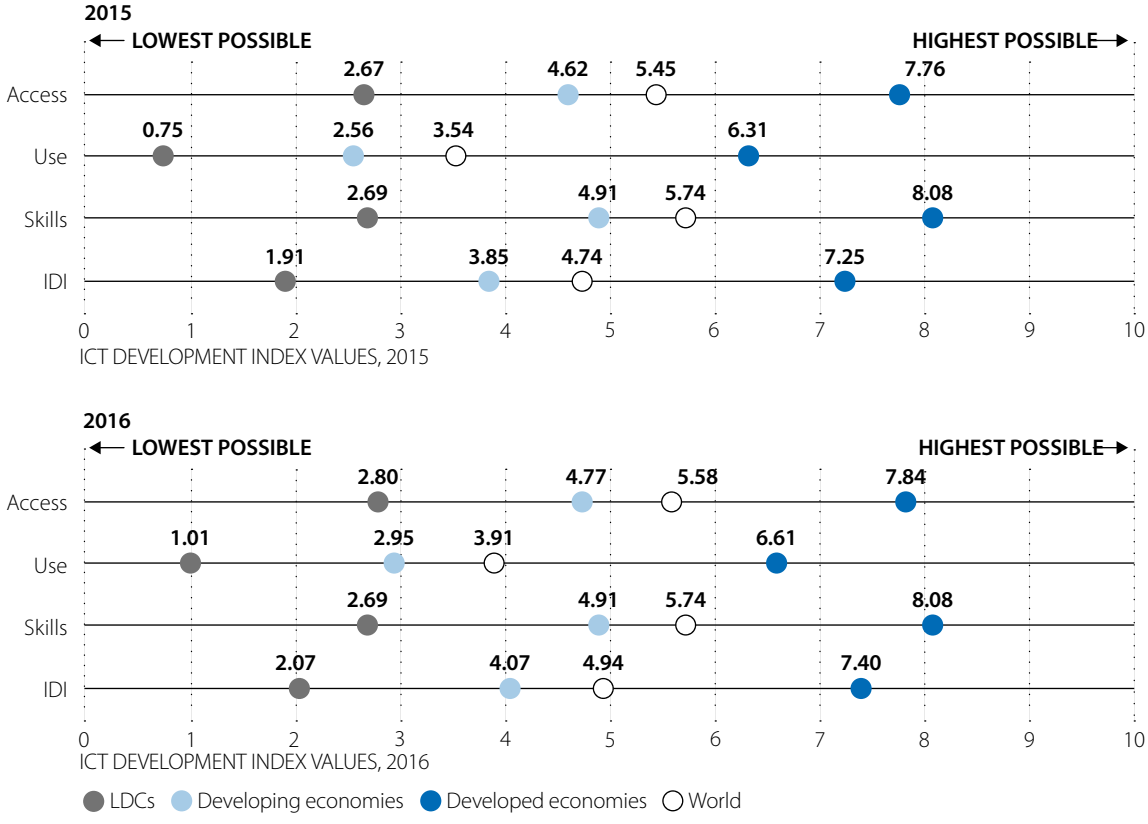
Box 5.1. The least developed countries and the ICT Development Index

The 2016 ICT Development Index (IDI), published by the ITU, is a composite index that combines 11 indicators for ICT access, use and skills into one benchmarking measure to highlight progress for 175 economies. Comparison of the rankings suggests that LDCs are not catching up fast enough in terms of ICT development. All of the bottom 27-ranked countries are LDCs. The highest ranking LDC is Bhutan, in 117th place. This is of particular concern given the potential role of ICTs in facilitating sustainable development.

Figure 5.3 compares the IDI performance of LDCs with that of developed countries, developing countries and the global average in the period 2015-16. The overall performance of LDCs during this period follows the trend of the previous period (2010-15), remaining below that of the higher- and middle-income developing countries. The LDCs record an average improvement in their IDI value: 0.16 points between 2015 and 2016, as compared to 0.22 points for all developing countries (including the LDCs) and 0.24 points for developing countries other than LDCs.

Figure 5.3. IDI values for the LDCs compared with all developing countries and global values



Source: ITU (2016b), *Measuring the Information Society Report 2016.*

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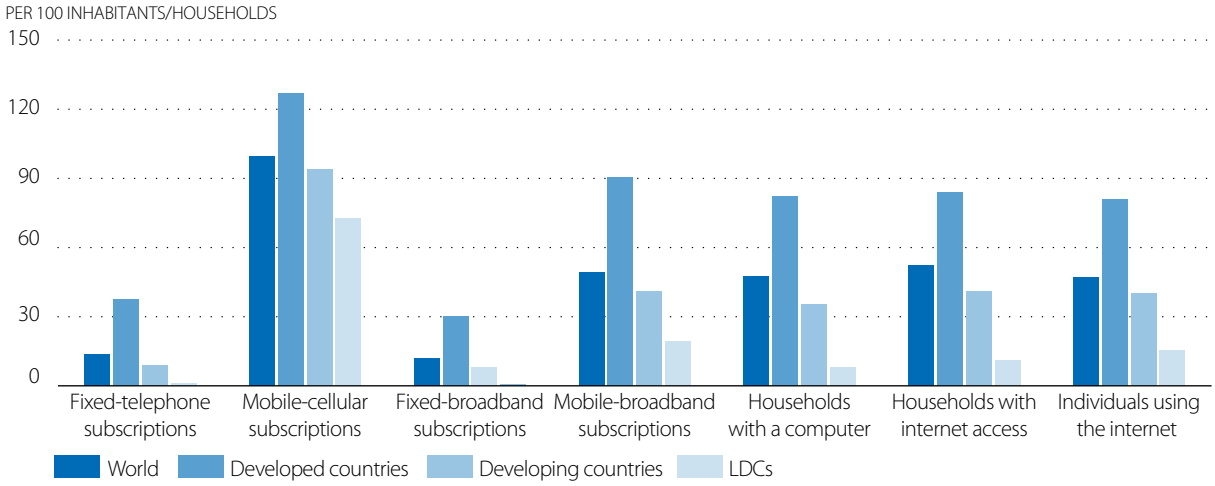
Figure 5.4. ICT penetration levels by level of development, 2016



Note: ITU estimates.

Source: ITU (2016b), *Measuring the Information Society Report 2016.*

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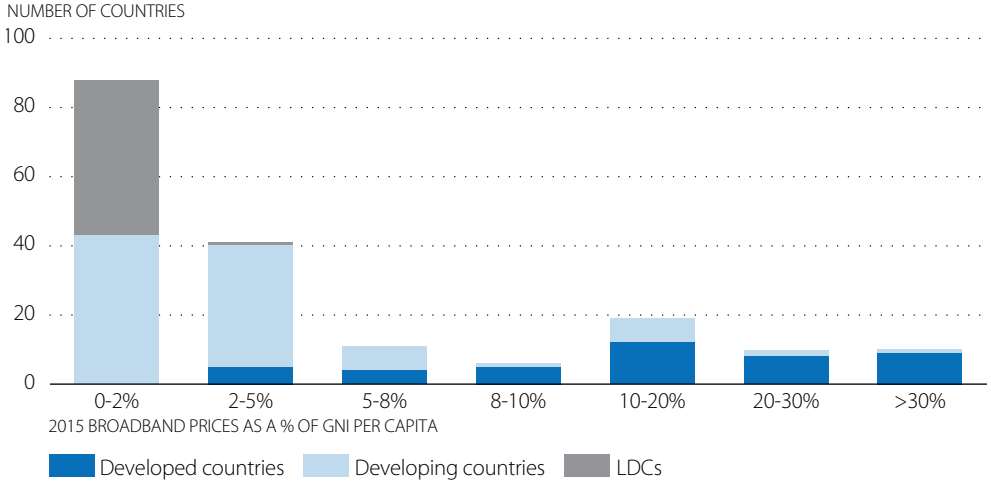
There is evidence that for many people in the developing countries, and especially the LDCs, ICTs remain unaffordable and thus out of reach. The relatively high cost of ICT services, in particular broadband services, compared to low income levels remains a major barrier to wider ICT access and use.

Making broadband affordable is a development target

In 2010, the Broadband Commission for Digital Development, an initiative led by ITU and UNESCO to increase awareness of the importance of broadband for achieving international development goals, identified four specific ICT targets: broadband strategies, affordability, connectivity and use. Target 2 is about making broadband affordable: "By 2015, entry-level broadband services should be made affordable (less than 5% of average monthly income) in developing countries through adequate regulation and market forces" (Broadband Commission for Sustainable Development, 2015). By the end of 2015, this target had been achieved in all developed and 83 developing countries, but only in 5 LDCs (Figure 5.5).

Figure 5.5. Number of countries that achieved the Broadband Commission target to make broadband affordable, 2015



Source: ITU (2016a), *Facts and Figures 2016.*

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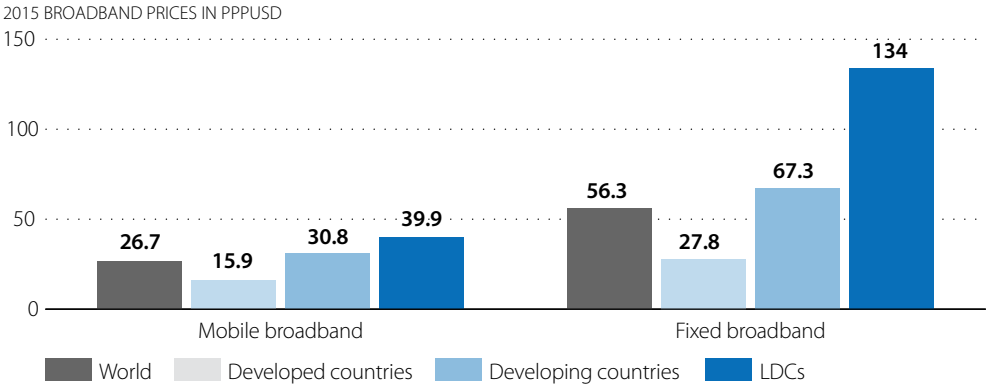
A comparison of fixed- and mobile-broadband prices for 185 economies worldwide highlights the fact that mobile-broadband services tend to be cheaper, with more countries achieving the affordability target in terms of mobile- than fixed-broadband prices. The available data also show that the global average price of a basic fixed-broadband plan (56.3 PPPUSD) is twice as high as the average price of a comparable mobile-broadband plan (26.7 PPPUSD). In the LDCs, the average monthly fixed-broadband price is more than three times higher than the average monthly mobile-broadband price (Figure 5.6).

Figure 5.6. Fixed- and mobile-broadband prices, 2015



Source: ITU (2016a), *Facts and Figures 2016.*

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ICT INFRASTRUCTURE, CONNECTIVITY AND QUALITY OF SERVICE VARY GREATLY

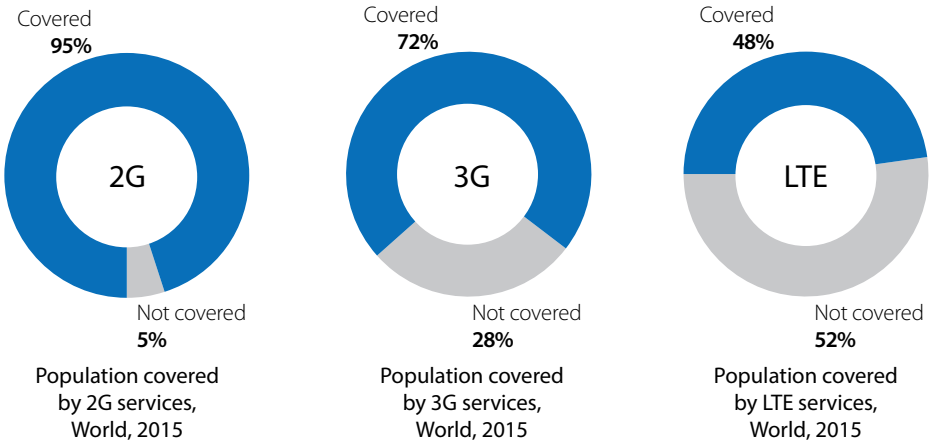
High-speed affordable broadband connectivity to the Internet holds widely recognized promise for social and economic development. Technological advances in areas such as the Internet of Things and artificial intelligence, combined with hyper-connectivity, are leading to an increasing variety of services and applications that can serve economic, social, and entertainment needs. Advances in mobile networks have made connectivity, including to high-speed broadband communication networks, potentially ubiquitous.

Local access networks highlight the importance of mobile broadband in addressing the digital divide

Mobile-cellular services have spread much faster than anticipated, allowing people living in previously unconnected areas to join the global information society. As of 2016, second generation (2G) mobile telephony is quasi ubiquitous, with 95% of the world's population and 85% of people living in the LDCs covered by a mobile-cellular signal. Mobile-cellular penetration rates have reached 99.7% globally and 72.6% in the LDCs. It should be noted, however, that this does not signify that almost everyone owns or uses a mobile phone; available data suggest that mobile-cellular penetration usually far exceeds mobile-phone use or ownership. It does testify, nonetheless, to the growth in mobile services, and the potential they have to address the digital divide.

This is true especially as mobile-networks evolve and deliver not only basic voice services, but also data and high-speed access to the Internet. Third-generation (3G) mobile coverage, which delivers higher speed access to the Internet as well as ICT services and applications to drive smartphone use and uptake, stood at 72% globally in 2016 (Figure 5.7). Yet in rural areas, only 29% of the population was covered, highlighting the limited access to mobile broadband that continues to characterise many rural and remote parts of the world. In the meantime, the next generation of mobile networks—LTE (long term evolution, also referred to as 4G)—is spreading rapidly, bringing even higher speeds and improving the mobile-broadband experience. By the end of 2016, ITU estimates that almost half the world's population lived within reach of an LTE network.

Figure 5.7. Global population covered by at least a 2G, 3G, and LTE network



Note: These are population-weighted figures.

Source: Based on ITU (2015b), *Facts and Figures 2015* and *Facts and Figures 2016*.

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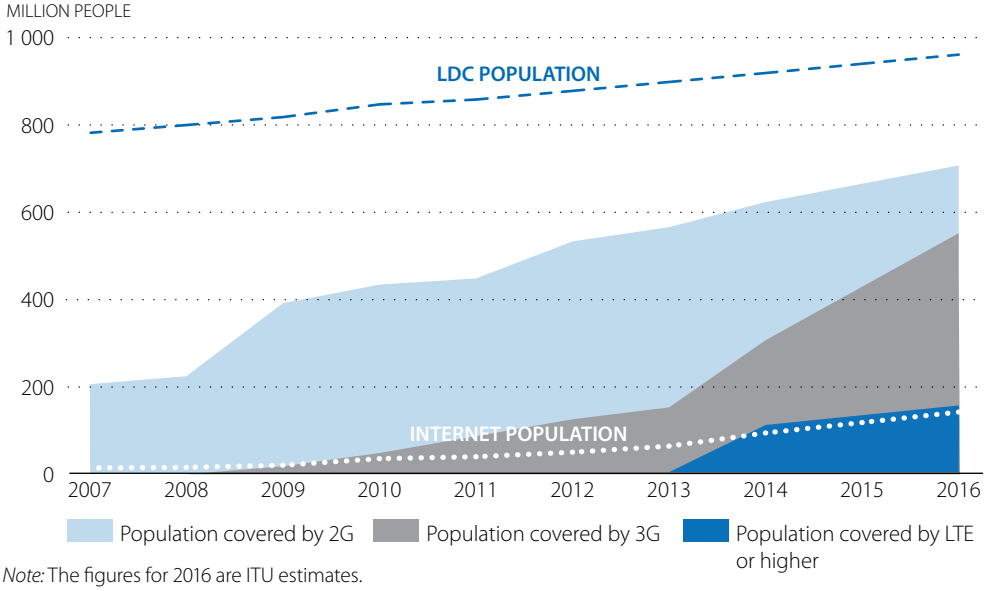
Mobile-broadband coverage has also spread rapidly in the LDCs. Almost all LDCs have launched 3G mobile-broadband services. Over 50% of the population in the LDCs were covered by a mobile-broadband network. LTE services have been launched in about 15 LDCs and while coverage remains limited, these services are growing rapidly, in particular in urban areas (Figure 5.8).

Figure 5.8. Mobile network coverage and evolving technologies in the LDCs



Note: The figures for 2016 are ITU estimates.

Source: ITU (2016a), *Facts and Figures 2016*.

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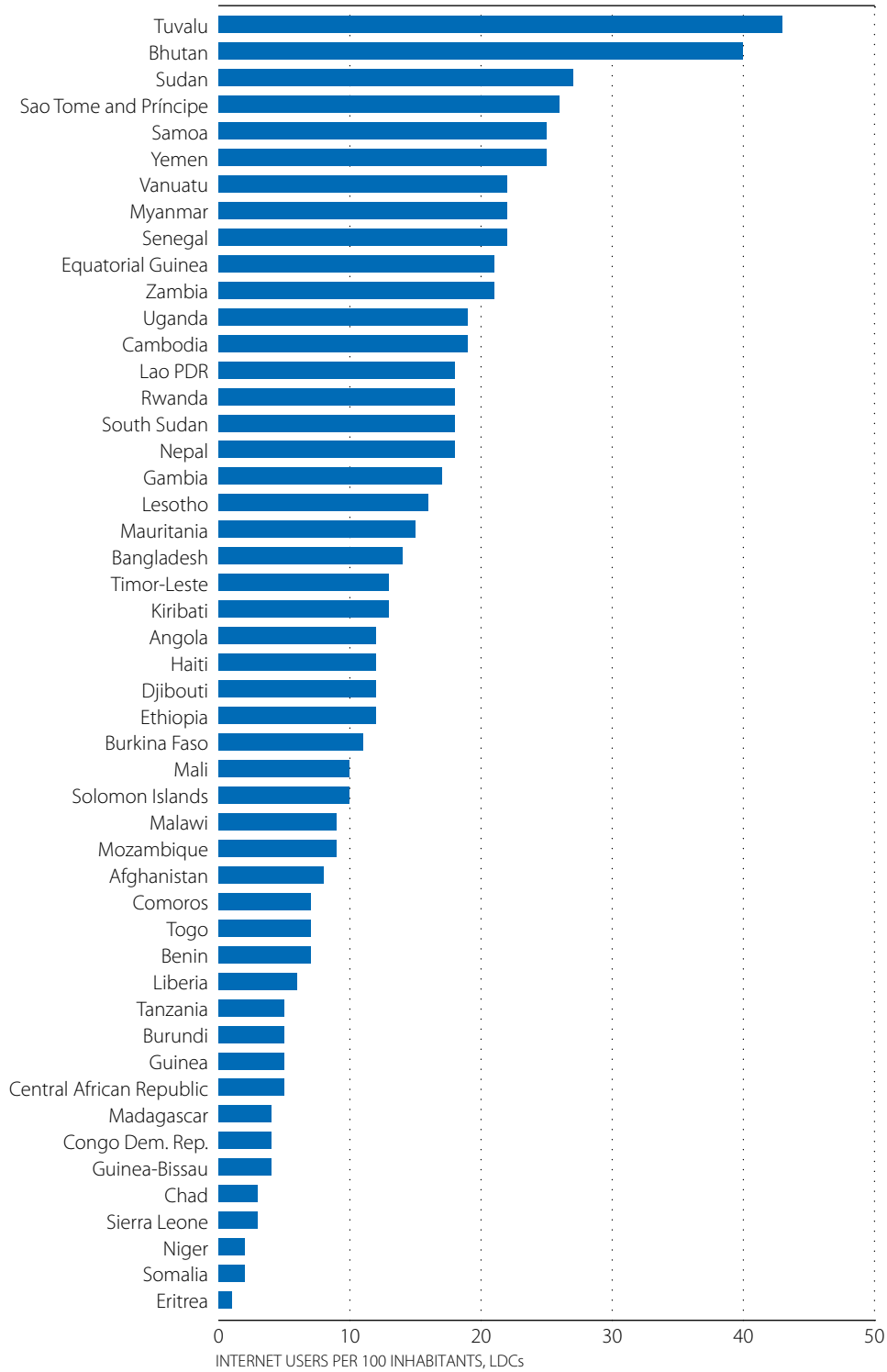
Mobile population coverage is a very useful indicator of ICT development and access, as it is relatively easy to measure (by data provided from mobile operators). It is also convenient as it allows countries to set and track targets. Yet it is important to compare coverage to actual ICT use. As of 2016, for example, more than 50% of the population in the LDCs was covered in terms of mobile-broadband signal, and thus at least in theory had access to the Internet at high speed. Yet only 15% of the people in the LDCs were actually using the Internet. Penetration rates also vary considerably from country to country. For example, countries such as Tuvalu and Bhutan have around 40% Internet penetration rates, but rates in a number of the African LDCs are much lower—below 5% (Figure 5.9).

This paradox of connectivity versus use suggests that connectivity remains only one of the barriers to Internet use; it is important to take into account the affordability of services, but also socio-economic factors, as will be discussed later in this chapter.

Figure 5.9. Internet users per 100 inhabitants in the LDCs, 2015



Source: ITU.

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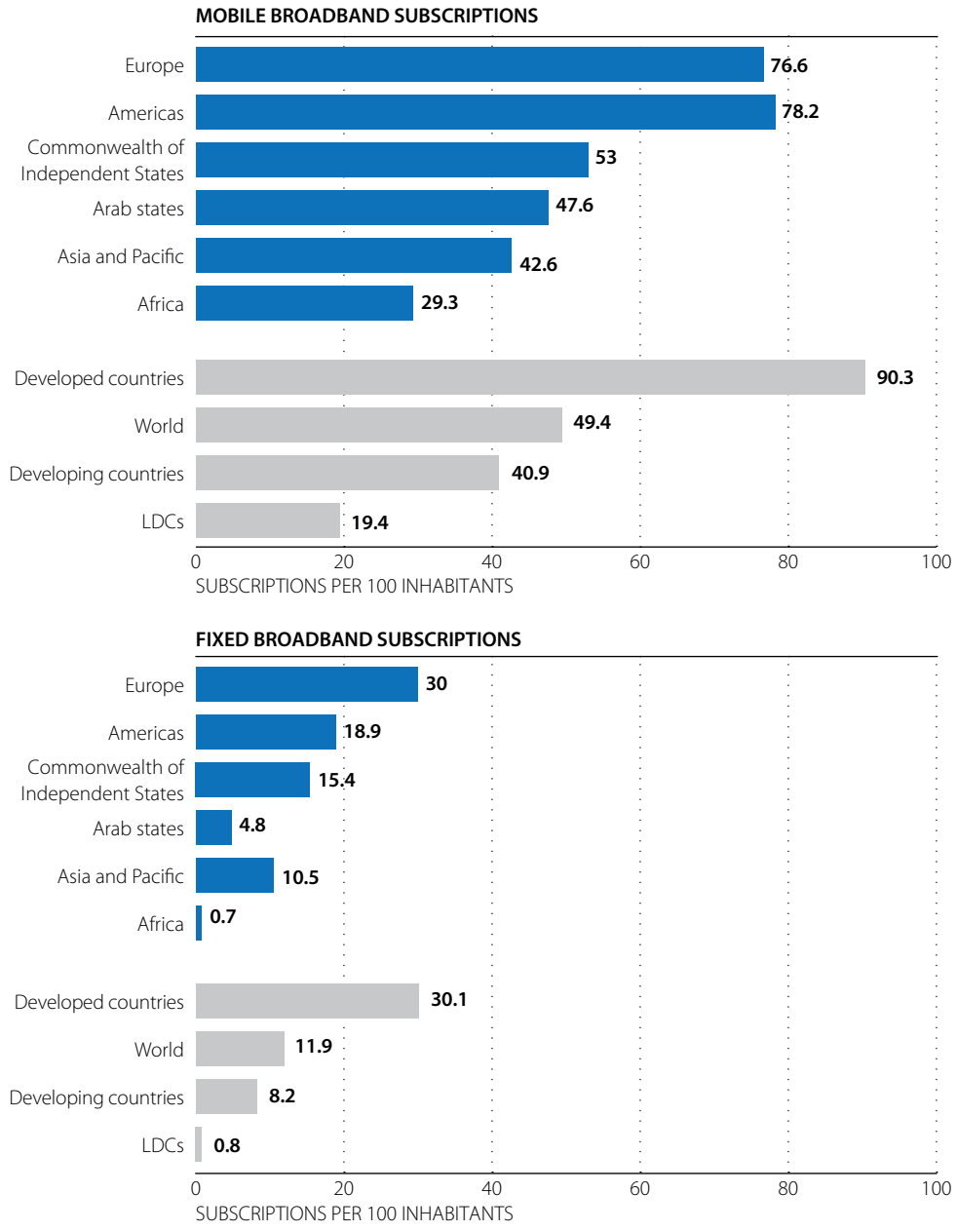
Advances in mobile-broadband networks, including greater coverage and a growing number of services and applications, have driven mobile-broadband penetration rates. Indeed, mobile broadband remains one of the fastest growing market segments. ITU estimates that by 2016, penetration reached close to 50% globally. Looking at specific country groups, mobile-broadband penetration is 90.3% in developed countries, 40.9% in developing countries and 19.4% in the LDCs. These figures highlight discrepancies, but they also show the that developing countries, and in particular the LDCs, have made progress in terms of mobile- compared to fixed-broadband penetration (Figure 5.10). Fixed-broadband penetration in local-access networks remains limited in nearly all developing regions and particularly in the LDCs; at the end of 2016 it had not reached 1%, compared to close to 12% globally and over 30% in the developed countries.

Figure 5.10. Mobile- and fixed-broadband penetration, 2016



Note: ITU estimates.

Source: ITU (2016a), *Facts and Figures 2016*.

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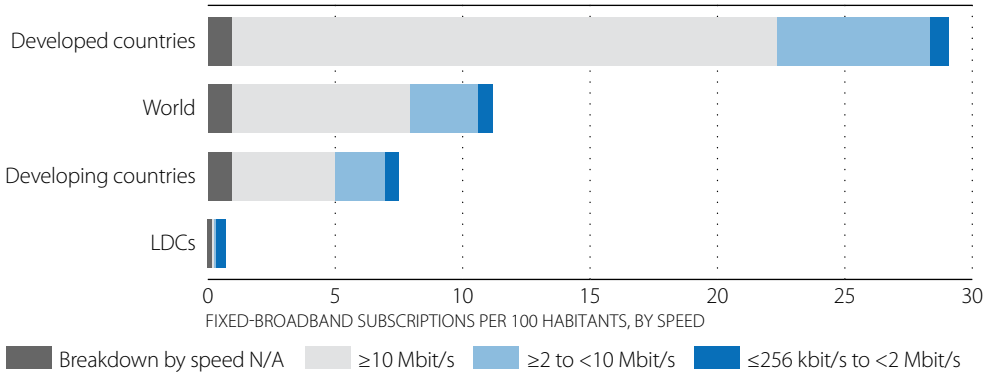
The marked divide between developed and developing economies in terms of fixed-broadband penetration is further compounded by the difference in speeds that subscriptions deliver. In early 2016, three out of four fixed-broadband subscriptions in the developed countries had advertised speeds of 10 mbit/s and above; two out of four in the developing countries reached these speeds. In the LDCs, overall fixed-broadband penetration remains very low: only 7% of fixed-broadband subscriptions are advertised at speeds above 10 mbit/s (Figure 5.11). This highlights the limits of fixed-broadband in connecting people and businesses in the LDCs.

Figure 5.11. Fixed-broadband penetration by speed, 2015



Source: ITU (2016a), *Facts and Figures 2016.*

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Country-level data, highlighted in Figure 5.12, further point to the major differences that exist in terms of the speed and quality of services that fixed-broadband subscriptions deliver in many developing countries. Although only limited country data are available for the LDCs, they suggest that fixed-broadband services remain negligible in low-income developing economies.

While the role of mobile-broadband is complementary to fixed-broadband in the more developed markets, it is increasingly predominant in many low-income developing economies, particularly the LDCs. This raises the question of whether mobile-broadband can replace fixed-broadband connectivity in terms of local access networks. This question is of particular interest to businesses, which often require relatively larger bandwidth, higher speed and greater quality of service to deliver online services (Box 5.2).

What is clear, however, is that fixed technologies will continue to play a vital role in providing backhaul networks to transfer data from both mobile and fixed networks. The increasing offload of mobile data traffic onto fixed networks highlights the growing integration of fixed and wireless networks: Cisco estimates that in 2015, 51% of total global mobile data traffic was offloaded onto fixed networks through Wi-Fi or femtocell (Cisco, 2016).

Box 5.2. Comparing fixed- to mobile-broadband networks

As highlighted in this chapter, developing countries, and in particular the LDCs, rely almost exclusively on mobile-broadband networks to deliver high-speed Internet access to end users, including many businesses. The question of how mobile-broadband networks compare to fixed-broadband networks is an important one, especially as mobile-broadband technologies evolve. Operators are already talking about the launch of IMT-2020 (5G), the next generation of mobile networks, which promises "lightning speed and ultra-reliable communications for broadband" (ITU, 2017a).

Today, 3G and LTE (or higher) mobile-broadband networks have reached unprecedented levels of population coverage and promise theoretical speeds comparable to that of the copper and coaxial cables used by DSL and cable operators. Nonetheless, their speed—or latency (the amount of time it takes for a data packet to traverse a network, which affects the quality of a connection)—is inferior to that of fibre broadband networks. This means that fixed-broadband access networks continue to provide a more reliable and often cheaper option for streaming videos, gaming and downloading large files. Furthermore, mobile-broadband services often are linked to usage caps, while fixed-broadband offers are frequently "unlimited".

IMT-2020 networks will address some of these issues and; they promise to reduce latency. Nonetheless, because spectrum, which refers to the radio frequencies allocated to the mobile operators and others for communication over airwaves, is a limited resource—used not only by mobile operators but also, for example, for broadcasting and satellite services—the effective capacity that mobile networks can deliver is also limited. The number of users on the same mobile network will continue to impact speeds, as well as the quality of service. Operators are looking into ways of optimizing services, including by increasing the amount of spectrum and by using complementary network technologies to offload data.

These differences between fixed- and mobile-broadband networks highlight two issues that need to be taken into account, especially in developing countries, where many users only have access to mobile networks:

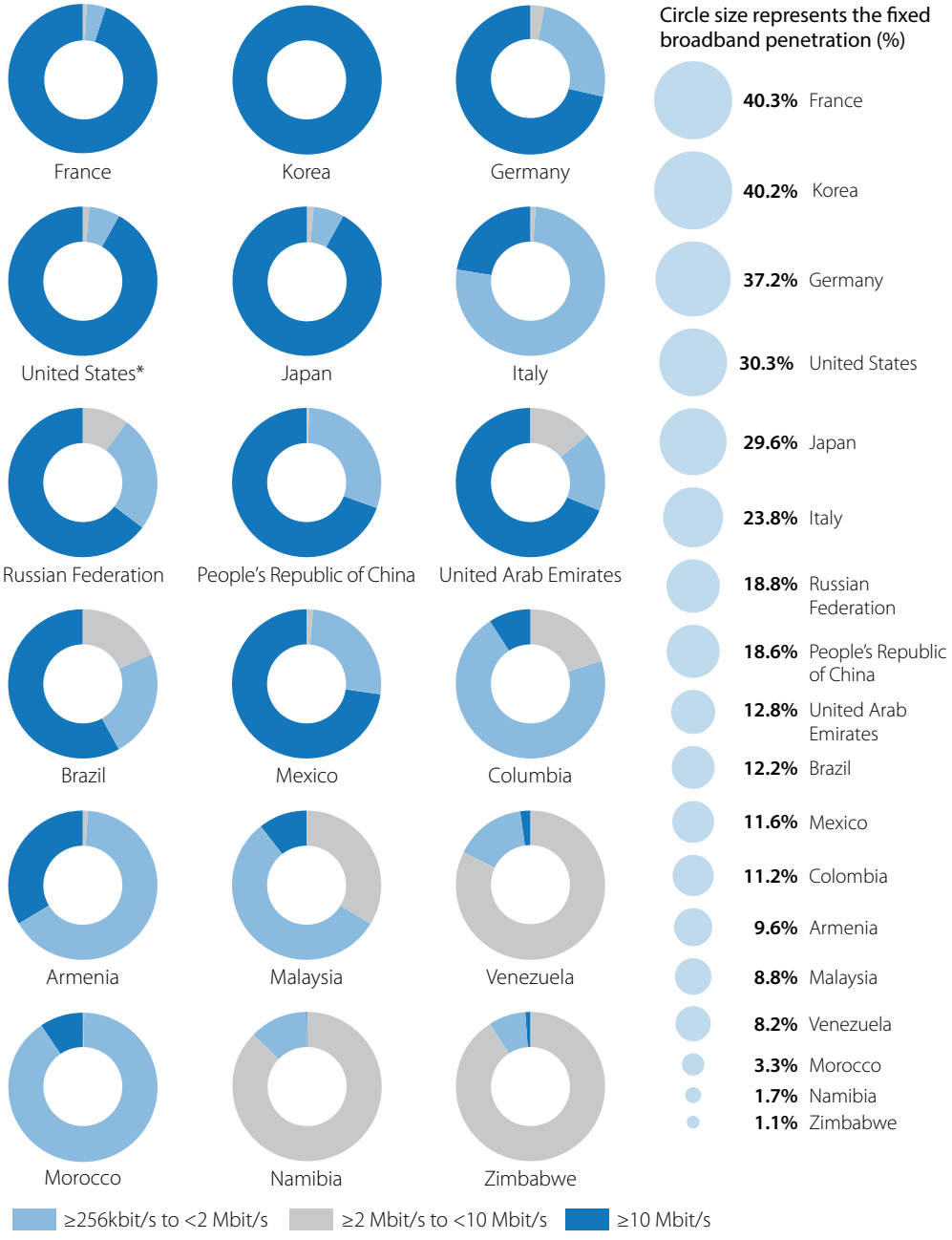
First, it is important for regulators to create the right regulatory environment and the incentives that will allow operators to launch the latest generation of high-speed mobile-broadband networks, including by making the necessary spectrum available. Almost all LDCs have launched 3G services, yet LTE services have been introduced in only about 15 LDCs.

Second, it is important to take advantage of technological advances and innovations that allow adaptation of and improvements in the existing networks. Small cells (low-powered cellular radio access nodes), for example, can increase capacity (and speed) in densely populated areas. Satellite networks can also be used to expand services to rural and remote areas.

At the same time, developing countries need to continue to invest in fixed-broadband infrastructure, both in terms of national backbone and of international connectivity. Mobile-broadband users can only benefit from high-speed services if the necessary backbone infrastructure is in place. By reducing the distance between end-users and the backbone infrastructure, mobile-broadband networks can be optimized. This will significantly increase the speed and the quality of mobile-broadband services, and allow the delivery of more data-intensive services and applications, including in rural and remote areas.

Finally, in areas where the speed and quality of Internet access remains limited, content providers must adapt services and applications, not only to the needs of end users, but also to the type of network.

Figure 5.12. Fixed-broadband subscriptions by speed in selected countries, 2015



*2014 data.

Source: ITU (2016a), *Facts and Figures 2016.*

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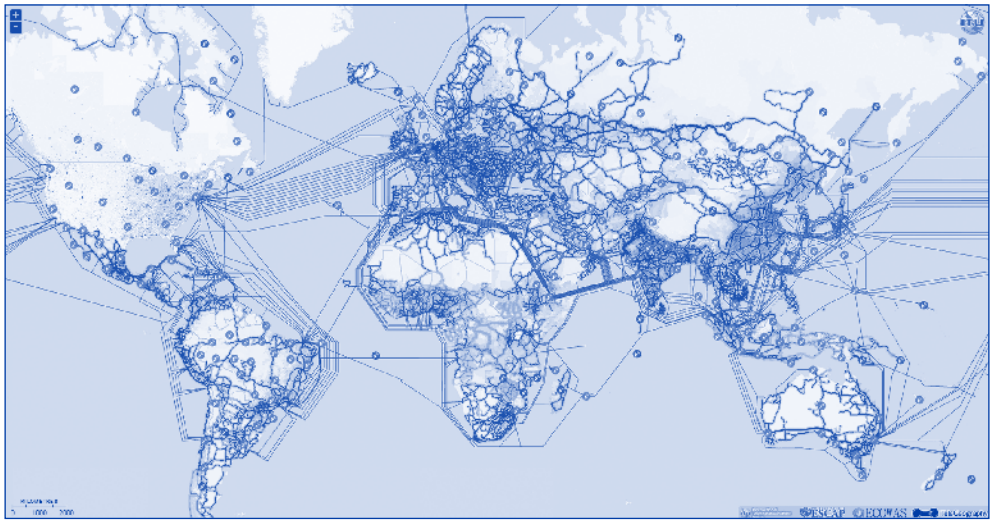
National and international backbone infrastructure is critical to broadband access and use

National backbone infrastructure and international Internet connectivity are critical building blocks to drive broadband demand, access, and use. Growth in broadband subscriptions is accompanied by continuous growth in national backbone capacities and international Internet bandwidth. Indeed, without growth in deployment of backbone infrastructure, service providers are unable to expand their markets to previously underserved regions, and to deliver high-speed and high quality services to customers.

Data collected by ITU on the deployment of ICT transmission capacity shows that by the end of 2016, more than 10.1 billion km of fibre and microwave backbone transmission networks from 378 operators was available worldwide (Figure 5.13). While this data does not cover all operators or countries, it highlights the important expansion of and investments in international backbone infrastructure.

Figure 5.13. ICT backbone transmission networks



Note: This map includes fibre and microwave backbone transmission networks as reported by 378 operators worldwide. The map, which continues to be updated, does not cover all operators or countries.

Source: ITU Interactive Transmission Maps, http://itu.int/go/Maps (accessed 10 April 2017)

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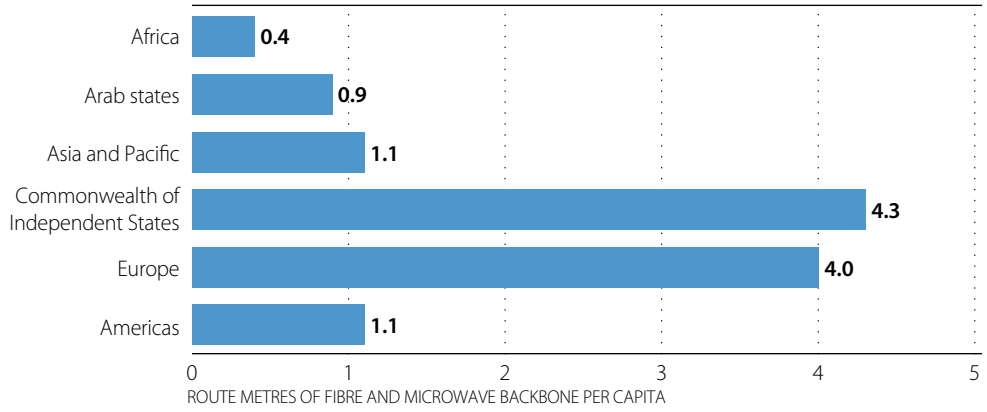
At the same time, major differences exist among regions and countries. As highlighted in Figure 5.14, the route metres of fibre and microwave backbone networks per capita remain below one in the Arab States and Africa; they are highest in Europe. Tracking the population that lives within a range of up to 10, 25 and 50km of an operational fibre transmission network also gives a measure of access. Populations living more than 50km away from a network are considered to be out of reach. In 2016, about 20% of Africa's population lived within a range of 10km; 36.3% lived out of reach.

Figure 5.14. Route metres of fibre and microwave backbone per capita by region, 2016



Source: ITU.

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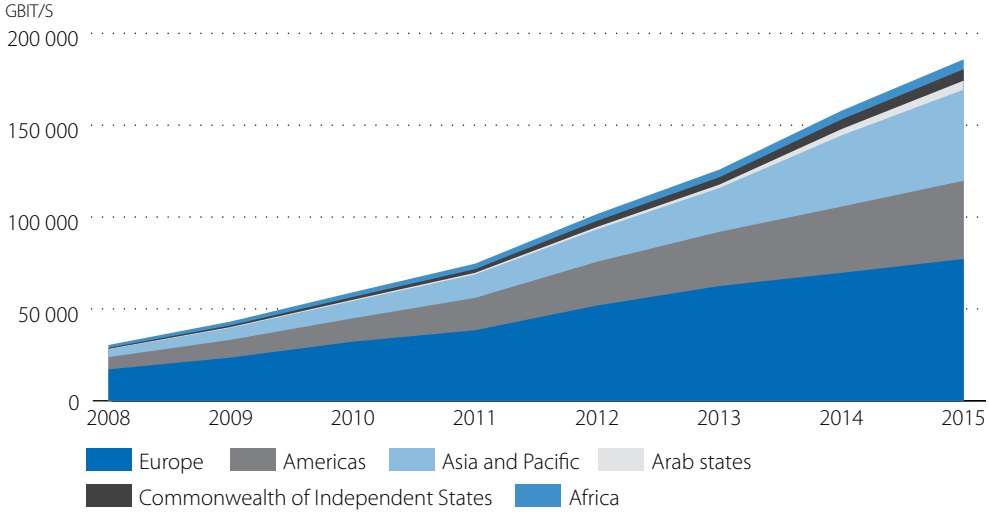
The amount of international Internet bandwidth available in a country or region provides important insights into the quality and speed of networks and is another key indicator of the readiness of countries to become information societies. International Internet bandwidth is a key building block for delivering data-intensive applications and services through high-speed networks. While national fibre transmission networks are essential infrastructure for access to high-speed networks, information on bandwidth is also required to gauge the actual quality and speed available.

Over the past decade, total international Internet bandwidth has climbed sharply, from around 35 000 gbit/s in 2008 to 100 000 gbit/s in 2012 and 185 000 gbit/s in 2015. This strong growth reflects the significant investment that has been made in backbone infrastructure—in particular in important submarine cable projects—in all parts of the world. The growth in international bandwidth has been strong in all regions. The developing country share of total international bandwidth increased from around 11% in 2005 to almost 40% in 2015. Europe leads by far, accounting for more than 40% of total international Internet bandwidth in 2015; in the same year, Africa's share was less than 3% (Figure 5.15).

Figure 5.15. Share of total international Internet bandwidth, by region



Note: 2016 data are ITU estimates.

Source: ITU (2016a), *Facts and Figures 2016*.

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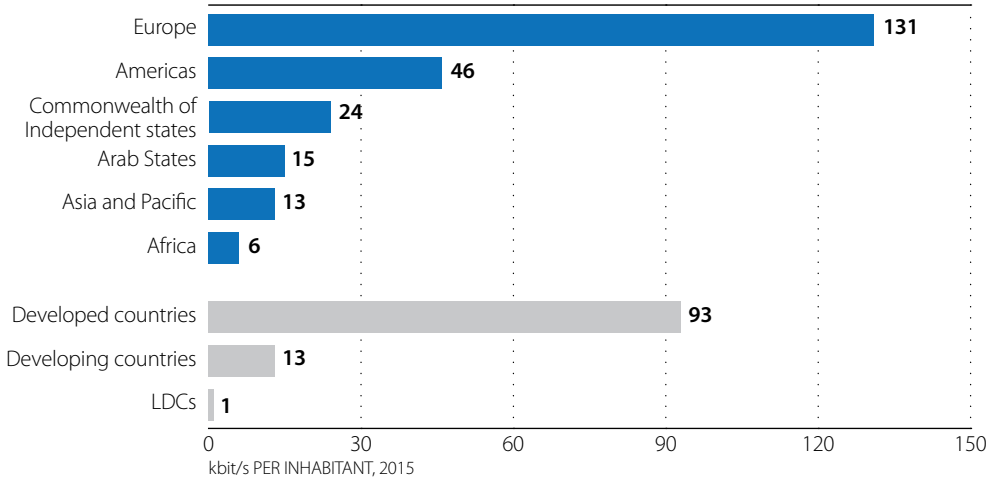
The impact of available international bandwidth on Internet use differs widely across regions and countries. Bandwidth per inhabitant has increased significantly over the past decade, yet there are huge differences between developed and developing regions: there is more than seven times as much international bandwidth per inhabitant (93 kbit/s versus 13 kbit/s) available in the former than in the latter (Figure 5.16). International Internet bandwidth per inhabitant remains particularly low in the LDCs, suggesting that the lack of international connectivity remains a major bottleneck in the Internet infrastructure of these countries.

Looking at regional differences, Europe stands out with around 160 000 bit/s per inhabitant in 2013, compared to the global average of 52 000 bit/s per inhabitant; it is followed by the Americas, with 54 000 bit/s per inhabitant.

Europe's leadership in international Internet bandwidth is explained by the advanced level of broadband adoption and use in the region. Also, Europe's composition—made up of countries that are relatively small in geographic size and depend on international connections to reach the global Internet—is an important factor. The Internet backbone network in the European region is interlinked by several Internet exchange points (IXPs), physical locations that connect national networks, allowing Internet traffic to be exchanged and giving them access to the global Internet. IXPs are an important part of the Internet ecosystem and can help increase the quality of service and make it more affordable.

Figure 5.16. International Internet bandwidth per inhabitant, by region, 2015



Source: ITU (2016a), *Facts and Figures 2016.*

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Some of the world's largest IXPs are located in Europe and have an international reach, for instance the German Commercial Internet Exchange, the Amsterdam Internet Exchange and the London Internet Exchange.[4] Many countries, however, do not have any IXPs, which limits the quality of their Internet services and adds to connectivity fees, thus increasing the price to consumers. Indeed, Figure 5.13 shows that only 16 of the 48 LDCs—one-third—had IXPs in 2016. This suggests that there is clear room for progress.

Box 5.3. Generations of ICT regulation

The ITU's Telecommunication Development Bureau annually collects self-reported data on the regulatory environment of 186 member countries. Data for 2007 through 2015 are coded giving each country and each year a score (between 0 and 100), which is associated with a generation of regulation. Five generations of regulation have been identified. This begins with the command-and-control approach of the first generation, eventually reaching the fifth generation characterised by harmonized collaboration across sectors (Figure 4.2).

The ICT Regulatory Tracker traces the transition of countries from generation one through to four (G1 to G4; Figure 5.17). The indicators correspond closely to the guiding principles outlined in the ITU Best Practice Guidelines of the Global Symposiums for Regulators (GSR), adopted annually by the global community of ICT regulators (ITU, 2016c). The Best Practice Guidelines are at the core of modern ICT regulation. They represent the collective wisdom of the current bodies in charge of ICT regulation.

Figure 5.17. Generations of regulation

Source: ITU (2017b), *Global ICT Regulatory Outlook*..

Box 5.4. Winning formulas for fixed and mobile-broadband markets

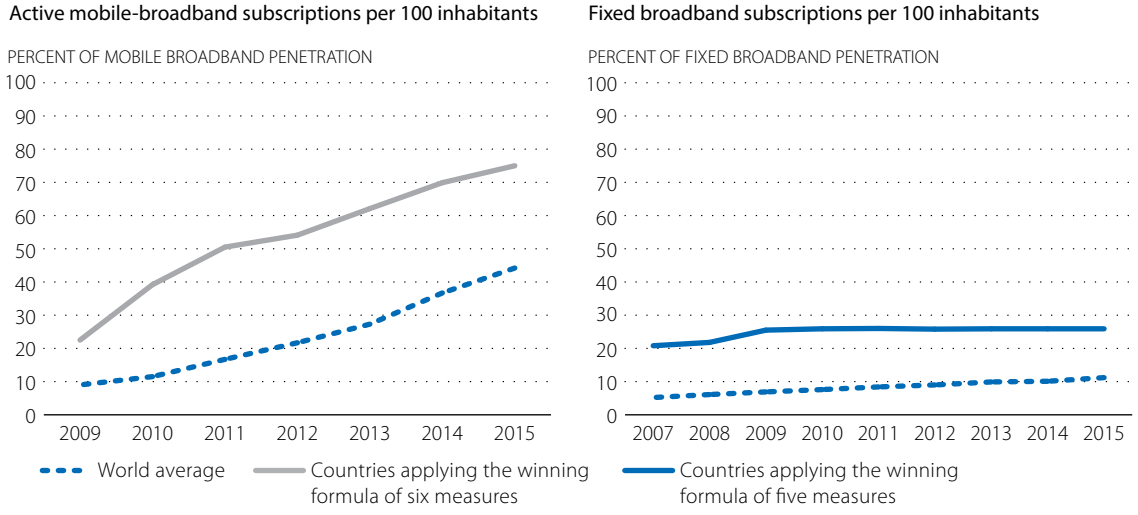
It is widely recognized that good regulation is key for the development of vibrant digital economies. Based on evidence produced using the ICT Regulatory Tracker, the choice of regulatory interventions appears to be equally important in promoting market growth.

There are many areas that require regulatory oversight and the focus on these might be significant differences in their focus across countries, analysis based on the ICT Regulatory Tracker demonstrates that a handful of key regulations can unlock the potential of an ICT market and turn it into a mass market in a short period of time.

ITU produced an evidence-based "recipe for success" comprising six policy and regulatory measures, which has helped 58 countries achieve 75% mobile-broadband penetration. Further, their markets have skyrocketed: penetration is 70% higher than the world average in 2015, and is significantly outpacing most other countries (Figure 5.18, left). Although there are multiple factors at work, for these countries regulation has made a significant difference.

With regards to fixed-broadband services, adopting a similar recipe for success—comprising five measures—40 countries have achieved a considerably higher level of fixed-broadband service adoption (Figure 5.18, right). The average fixed-broadband penetration of countries deploying the five measures was 26% in 2015, 15% higher than the global average of 11%. Although it is difficult to statistically establish direct causality, this nevertheless implies that regulation can facilitate market growth.

Figure 5.18. Winning formulas: regulatory recipes for successful ICT adoption



Winning formula for mobile broadband

1. Competition in mobile broadband
2. Competition in international gateways
3. Mobile number portability enabled (implemented, available to consumers)
4. Band migration allowed
5. Infrastructure sharing for mobile operators permitted, including Mobile Virtual Network Operators
6. National broadband plan adopted

Winning formula for fixed broadband

1. Competition in DSL/cable supported
2. Fixed number portability enabled (implemented, available to consumers)
3. Infrastructure sharing/ co-location and site sharing for fixed mandated
4. Converged licensing framework in place
5. National broadband plan adopted

Source: ITU (2017b), *Global ICT Regulatory Outlook.*

StatLink http://dx.doi.org/10.1787/888933526367

Winning formulas can address the broadband divide through improved regulation

As the ICT market undergoes profound change, the role of ICT regulation becomes increasingly important for addressing the many challenges to connectivity. The biggest among these the creation of open markets where regulation encourages the growth of networks, the provision of services and the diffusion of content and applications in an affordable, competitive and safe way. This is especially important for the LDCs.

Expectations for ICT regulation have grown over the past decade. In a world in which more than half the world's population is not using the Internet, regulators have to reinvent the rules of the game to extend adoption and use of ICTs, align them with wider social and economic goals and set about to connect the unconnected. There are a number of important steps that governments, and in particular the LDCs, can take to address the broadband divide and to overcome infrastructure bottlenecks, in particular by creating an enabling regulatory environment.

Globally, more and more countries are working on fine-tuning their regulatory frameworks. They are moving towards the fourth and fifth generation of ICT regulation, which entails integrated and collaborative regulation to define the platforms and mechanisms for working with other sectors (see Box 5.3). On a very positive note, a third of LDCs have reached the third generation of ICT regulation, among them Burkina Faso, Malawi and Tanzania. One country—Uganda—has even attained the fourth generation, joining the club of some of the most advanced countries in terms of ICT regulation. However, two-thirds of all LDCs are still in either the first or the second generation of regulation and need to urgently carry out basic reforms, including for privatization, liberalization and intra-platform competition.

Among other important reforms many LDCs need to undertake is the removal of barriers to foreign ownership and investment. When private investment is not sufficient, solutions such as direct government investment and public-private partnerships can be explored. Universal service funds and obligations can also help to bring services to areas that provide limited business opportunities, providing tax incentives for investments. ITU, through its ICT Regulatory Tracker, helps countries identify the winning formulas and regulatory steps that can drive ICT investment, use and uptake (Box 5.4).

Within reasonable limitations, therefore, quantitative evidence suggests that best-practice regulation does matter. It also shows that for broadband markets to thrive, both the design and the effective enforcement of regulatory frameworks are essential. Good regulation has impact. Regulators need to ensure that market opportunities outweigh challenges, while protecting consumer interests.

Box 5.5. The impact of taxation on broadband services deployment and adoption

With regards to broadband services, which are a critical platform to deliver information and ensure economic growth, taxation tends to reduce the level of capital investment for the development of infrastructure, which is fundamental for the provision of services everywhere.

On the other hand, it is important to note that broadband penetration faces an affordability barrier in terms of service adoption, especially by consumers in developing countries, where the price of services is relatively higher. In general, it is considered that a broadband consumption tax increases the cost of ownership, thereby reducing the adoption of this services by the population. In reverse lower subscription prices generated by tax reduction, imply higher demand.

Considering the impact of digital technologies on the economy, by increasing the efficiency of production processes, facilitating the circulation of goods and creating new businesses, the taxation of digital goods and services should be approached with care, preventing any erosion of their spill-over contribution to GDP growth. It has been shown that excessive taxing of digital goods and services could limit adoption, restricting the positive contribution to GDP. Thus, the tax collected is outweighed by tax foregone on "lost" GDP. In this sense, in developing fiscal policies, Governments need to consider the trade-offs between revenue generation and the potential negative impact of the development of the digital sector.

Source: ITU, GSR15 Discussion Paper Taxation in the digital economy, http://www.itu.int/en/ITU-D/Conferences/GSR/Pages/GSR2015/GSR15-discussion-paper.aspx

The LDCs can build on these winning formulas to come up with their own balanced mix of regulatory incentives and obligations, deliver on regulatory goals and open the way to investment, innovation and market growth. As LDC markets become more complex and their interplay with regulation more open, ICT regulators will need to stay pro-active, to demonstrate leadership, skill-up and reach out to new actors. While no single regulatory model is perfect, the guiding imperative is to integrate ICT regulation with other sectors in order to leverage on synergies and create efficiencies--thus speeding up the success in bridging the broadband divide.

Increasing numbers of ICT regulators around the world are teaming up with regulators from other sectors to address multi-sector issues. Such collaborative regulation brings all parties to the table to share sector-specific expertise as well as the responsibility for decision-making. Transparent and practical co-operation, coupled with communication across sectors and key players—including regulators, policy-makers and other stakeholders—are essential to ensure that regulation responds to market realities, stakeholder needs and consumer demand. Equipped with this collaborative, problem-solving attitude, regulators in the LDCs can better harness and maintain the growth of ICT markets while making progress towards broader development goals, such as the Sustainable Development Goals.

PRICES ARE HOLDING BACK ACCESS TO THE GLOBAL INFORMATION SOCIETY

The relatively high cost of ICT services remains one of the main barriers to ICT uptake, excluding many people from the global information society. Monitoring of prices for services, as well as the costs of end-user devices, is critical for developing policies that will make ICT services affordable to all.

Fixed-broadband prices have dropped, but remain unaffordable in the poorest countries

The price of fixed-broadband services globally has dropped substantially, making these much more affordable. The price of a basic fixed-broadband connection, as measured by the ITU fixed-broadband sub-basket, fell from around USD 80 in 2008, to USD 25 in 2015. Relative to average GNI per capita, this represents a drop from over 90% to 14%. In developing countries, prices fell from around USD 200 to USD 26, impacting the global figures considerably.

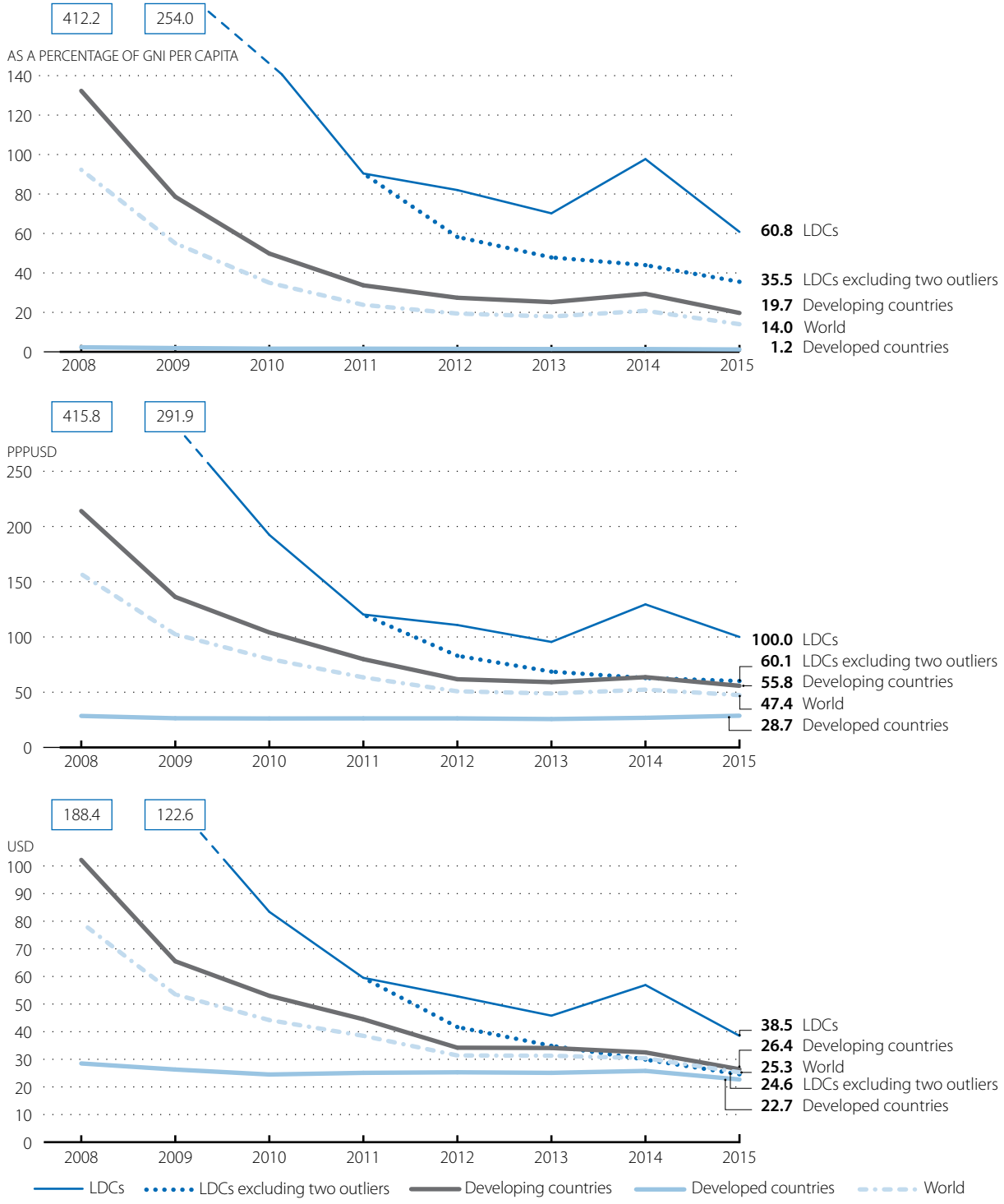
Although the USD price of broadband services is approaching similar levels across developed and developing regions, these services nonetheless remain unaffordable for large parts of the population of the LDCs. In terms of PPP-adjusted prices, the PPPUSD cost is almost twice as high in the LDCs as it is in the developing countries as a whole.[5]

Recent trends in fixed-broadband prices confirm that these services remain unaffordable in the LDCs

Figure 5.19 reveals some interesting trends in broadband service prices. In 2014, for instance, average fixed-broadband prices became less affordable. Yet this price hike resulted mainly from increases in a small number of countries and stagnating or zero price drops in many others.[6] In 2015, there was a renewed and significant drop in the price of fixed-broadband services. A price comparison in terms of USD and PPP-adjusted prices and as a percentage of GNI per capita highlights the following trends:

- **Percentage of GNI per capita** (Figure 5.19, top). At end 2015, fixed-broadband was more affordable than at end 2014, in both developed and developing regions. At 1.2% of GNI per capita, these services were very affordable in developed countries, yet they were still relatively expensive in developing countries, where the monthly subscription to an entry-level service corresponded to close to 20% of GNI per capita.

Figure 5.19. Fixed-broadband sub-basket, as a percentage of GNI per capita, in PPPUSD and in USD, 2008-15



Note: Simple averages based on 144 economies for which data on fixed-broadband prices were available for the years 2008-15. The 2014 price hike in the LDCs is mainly the result of very substantial price increases in two countries (Uganda and Rwanda), which had a sizeable impact on the LDC average (especially because complete price data for the period 2008-2015 are only available for 25 LDCs). The dotted line shows the evolution of the average in the LDCs excluding these two countries.

Source: ITU (2016b), *Measuring the Information Society Report 2016*.

StatLink http://dx.doi.org/10.1787/888933526386

Globally, the average price of an entry-level fixed-broadband subscription as a percentage of GNI per capita fell from close to 21% in 2014 to 14% in 2015. Prices dropped by one-third in the LDCs and other developing countries, while in developed countries they decreased at a lower rate. However, by end 2015 an entry-level fixed-broadband subscription still represented close to 61% of GNI per capita in the LDCs, making it unaffordable for a large portion of the population.

- **Purchasing power parity** (Figure 5.19, middle). Although PPP-adjusted prices in the LDCs dropped from a high of PPPUSD 130 in 2014 to PPPUSD 100 in 2015, broadband services still remained on average more expensive than in 2013. The average for the LDCs was significantly influenced by very high prices in two countries, Rwanda and Uganda. When these two countries are excluded from the other LDCs included in the price comparison, the average for 2015 was PPPUSD 60; there was also a slight but sustained decrease between 2013 and 2015 (8% and 4%, respectively). At the global level, PPP-adjusted prices fell by about 10% from 2014 to 2015, the same percentage decrease as in the developing countries as a whole.
- **USD prices** (Figure 5.19, bottom). Between 2014 and 2015, USD prices for fixed-broadband services decreased in developed and developing regions, and most strongly in the LDCs, thus reducing differences in the absolute USD price. By 2015, the average price of a fixed-broadband service stood at USD 23 and USD 26 in developed and developing regions, respectively, compared to USD 38 in the LDCs. Differences in USD terms compared to PPPUSD and GNI per capita prices are relatively small and would be even smaller in the case of the LDCs if the two outliers were not included in the average.

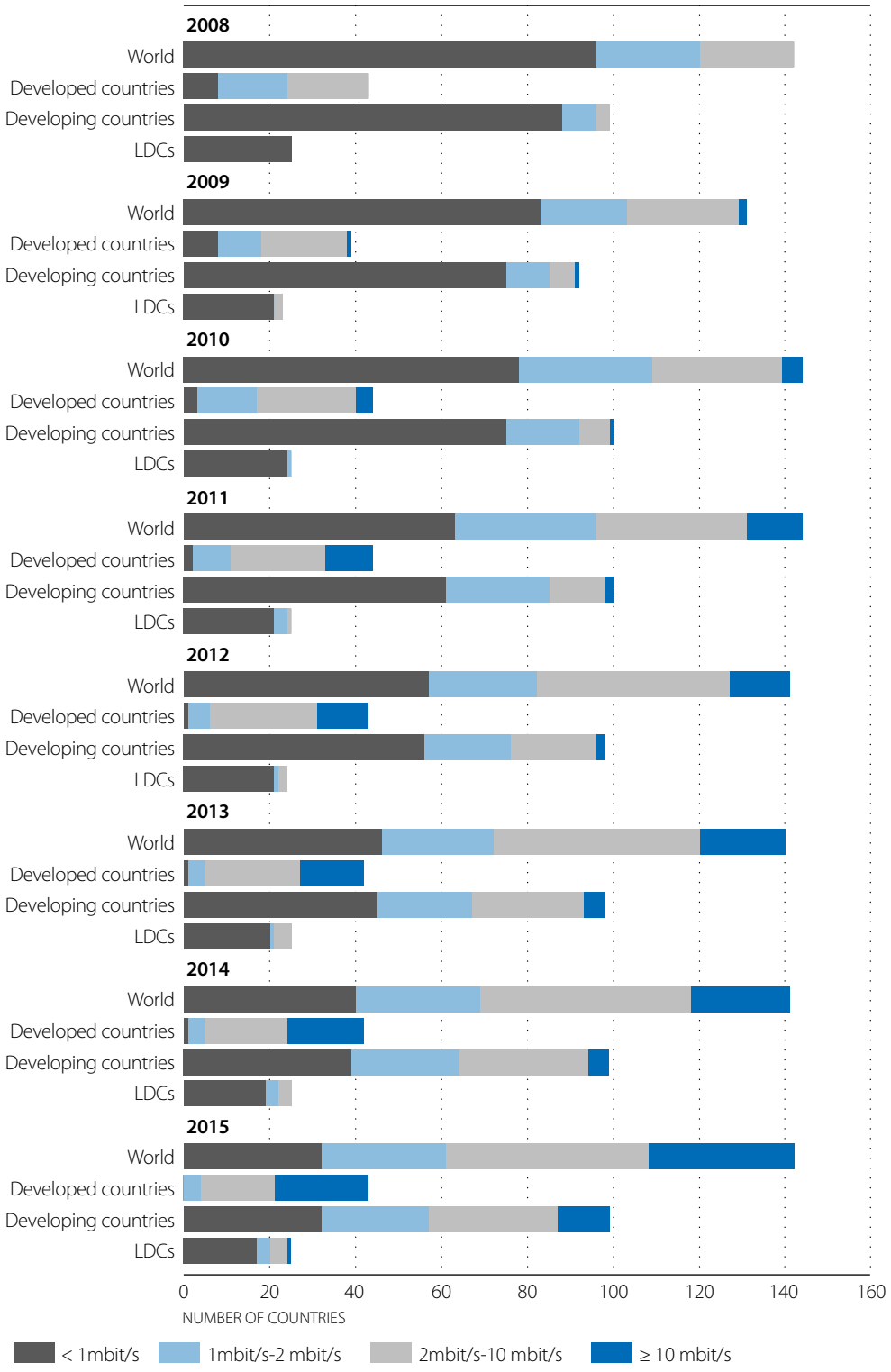
Entry-level broadband services are becoming faster, but not everywhere

So as to be able to make comparisons among countries, since 2008 ITU has collected data on entry-level fixed-broadband services, defined as an Internet connection of a minimum of 256 kbit/s with at least 1 GB of data included. While this benchmark has remained unchanged to date, a comparison of the speeds of entry-level fixed-broadband packages on offer today highlights the fact that minimum speeds have risen considerably over the past eight years. Providers offer higher speeds to meet the needs of Internet users, who access services and applications that require these speeds—and also result in increased data traffic.

While in 2008 only about 30% of all countries offered entry-level speeds above 1 mbit/s, by 2015 close to 80% offered entry-level speeds of 1 mbit/s or above. Indeed, by 2015 not a single developed country offered a connection with speeds below 1 mbit/s; the majority of plans advertised speeds of above 10 mbit/s. This indicates that while the price of connections has decreased, speeds have, on average, increased—although not equally for all subscribers (Figure 5.20).

Yet speeds have not increased equally in all countries and regions of the world. Developing countries are only gradually upgrading broadband infrastructure to deliver higher speeds. In 2012, over 50% of all countries were still offering services at speeds below 1 mbit/s; 10 mbit/s remained the exception for entry-level fixed-broadband packages. In 2015, more than 50% of countries continued to offer speeds of 2 mbit/s or less, and in the LDCs the large majority of entry-level plans offered speeds below 1 mbit/s.

Figure 5.20. Most common entry-level fixed-broadband speeds, globally and by level of development



Note: Based on 144 economies for which 2008-15 data on fixed-broadband prices were available.

Source: ITU (2016b), *Measuring the Information Society Report 2016*.

StatLink http://dx.doi.org/10.1787/888933526405

Some of the poorest countries continue to have the highest fixed-broadband prices

The highest entry-level fixed-broadband prices are found in developing countries, and in particular in the LDCs. By the end of 2015, a fixed-broadband plan with a minimum of 1 GB of data per month cost more than USD 80 per month in ten developing countries (Table 5.1). Eight of those countries were LDCs, in which the total household consumption expenditure per capita ranged from USD 18 to USD 58 per month.[7] This highlights how unaffordable fixed broadband is in these countries, especially considering international comparisons. The highest entry-level fixed-broadband prices in the developed world are recorded in Ireland, at USD 50 per month, which is significantly lower than in all the countries listed in Table 5.1, even though income in Ireland is much higher. Also, the entry-level plan in Ireland has a speed of 100 mbit/s, whereas in most LDCs the entry-level speed is 256 kbit/s.[8]

Table 5.1. Countries with the highest fixed-broadband prices in 2015

Economy	Fixed-broadband prices (USD/month)	Mobile-broadband (computer-based) prices (USD/month)	Total household expenditure** (USD per capita/month)	Development status
Chad	501	17	58	LDC
Central African Republic	489	N/A	32	LDC
Uganda	300	11	41	LDC
Solomon Islands	275	73	...	LDC
Kiribati	188	56	...	LDC
Cuba	180	N/A	308*	non-LDC
Equatorial Guinea	101	N/A	272	LDC
Rwanda	97	8	39	LDC
Burundi	83	N/A	18	LDC
Republic of the Congo	82	17	107	non-LDC

Notes:
"N/A" = service is not available.
"..." = information is not available.
* = 2014 data.
** = Total Household expenditure calculated by dividing the indicator "household final consumption expenditure (current USD)" by the population of the country.

Source: ITU (2016b), *Measuring the Information Society Report 2016*. Data on household final consumption expenditure from the World Bank.

Entry-level fixed-broadband plans cost less than USD 15 per month, nonetheless, in a number of LDCs, including Bangladesh, Bhutan, Ethiopia, Cambodia, Mauritania, Malawi, Lesotho, South Sudan and Sudan. Yet fixed-broadband uptake is also very low in these countries, with the exception of Bangladesh and Bhutan.[9]

The much higher prices in other LDCs must have specific supply-side causes which, if addressed, could significantly contribute to making fixed broadband more affordable in these countries. For example, in LDCs with very high fixed-broadband prices, operators often market fixed-broadband services as a premium or business service. For instance, Foris Telecom in Uganda and Airtel in the Republic of the Congo advertise fixed Internet for business customers, whereas households are only offered mobile-broadband services. In some cases, even when not specifically stated, some typical business broadband-service features are added by default to entry-level fixed-broadband plans; for example, a minimum guaranteed speed (Orange WiMAX offer in the Central African Republic) or low contention ratios (CBINET ADSL offer in Burundi).[10] Whereas normally operators would offer these extra features for a higher price, proposing basic plans to residential customers, in several LDCs they are added to basic fixed-broadband plans, making these unaffordable for residential customers.

Another element that may explain the high prices in some countries is the technology used in the fixed-broadband network. ADSL services rely on traditional fixed-line (copper wire) network, but this infrastructure has limited reach in most LDCs. As a result, ADSL plans are offered only by the incumbent operator (i.e. the operator having access to the legacy fixed-line infrastructure) and at very high prices (ITU, 2013). Fixed wireless technologies, such as fixed WiMAX, are often a more affordable alternative for extending the reach of the fixed-broadband network in countries with limited basic fixed-line infrastructure and reduced or sparse demand. Significant investment is needed in the LDCs to extend the basic wired-line infrastructure. Making the appropriate technological choice in each situation could help streamline limited investment flows allocated to fixed services.

Other infrastructure elements may have an impact on the underlying costs of fixed-broadband provision in the LDCs. These include limited and expensive international connectivity and backhaul connections, as well as deficiencies in the power grid. Yet these factors are—to a large extent—common in the broadband infrastructure chain, and therefore also affect mobile-broadband prices. Nonetheless, an analysis of mobile-broadband prices in countries with very high fixed-broadband prices reveals that mobile-broadband is much cheaper. This suggests that the infrastructure elements common to fixed and mobile broadband are not the main determinant of very high fixed-broadband prices. Instead, the regulatory challenges facing the fixed-broadband market, and the resulting limited competition in some LDCs (ITU, 2013), may better explain some of the differences in fixed and mobile-broadband prices.

Another distinct element in the LDCs that may have an impact on fixed-broadband prices is the way in which prices are communicated. Price information is not always available on operators' websites, but rather is communicated by phone, by e-mail or through paper advertisements. This makes information on prices more difficult to obtain, even for telecommunication regulators, and bespoke prices and/or one-off offers may be common. For instance, MTN Rwanda does not advertise fixed-broadband prices on the website, but the small alternative operator Hai advertises fibre-optic packages starting at USD 97 per month for 10 mbit/s. No one publishes prices for fixed-wireless broadband plans, although data from the Rwanda Utilities Regulatory Authority show that in 2014, most fixed-broadband subscriptions in the country relied on fixed-wireless technologies.

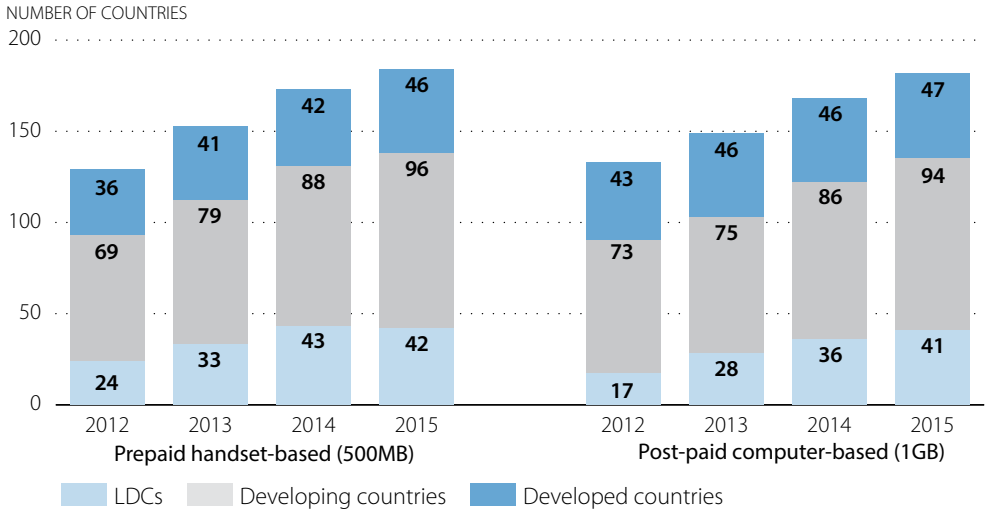
Fixed-broadband Internet access cannot always be replaced by mobile-broadband access, particularly for users requiring high capacity and high speed. Some of the most promising future ICT opportunities are linked to areas requiring high connectivity, such as big data analytics and the Internet of Things. Developing countries, and the LDCs in particular, are among those that could benefit the most from these ICT developments (ITU, 2015a; Cisco 2016). Therefore, policy-makers and regulators in these countries should not disregard the issue of very high fixed-broadband prices. Rather, they should address the concrete commercial and infrastructure-related problems mentioned above that make fixed broadband a premium service, unaffordable for residential customers and small/micro undertakings.

Availability and affordability of mobile-broadband services is growing in many countries

Mobile-broadband services are becoming more affordable and more available in more and more countries, including LDCs, where the availability of prepaid handset-based plans almost doubled in the period 2012-15, and tripled in the case of post-paid computer-based plans (Figure 5.21).

In addition to 3G, mobile-broadband networks based on LTE and other advanced technologies are now available in 70% of countries worldwide. However, the availability of LTE broadband networks varies across development levels. LTE technologies have been deployed only in 38% of the LDCs, as compared to 58% of developing countries as a whole and 91% of developed countries (GSMA, 2015). This suggests that the speed and capacity experienced by mobile-broadband users may differ significantly across countries.

Figure 5.21. Availability of mobile-broadband services by type of service and level of development, 2012-15



Note: A mobile-broadband service is counted as being available if it was advertised on the website of the dominant operator or if prices were provided to ITU through the ICT Price Basket Questionnaire, which is sent out annually to all ITU member states/national statistical contacts. Data on mobile-broadband prices were collected from 2010-14. Since 2015, data on mobile-broadband prices have been collected by ITU from operators' websites.

Source: ITU (2016b), *Measuring the Information Society Report 2016.*

StatLink http://dx.doi.org/10.1787/888933526424

For the least developed countries, affordability of mobile broadband is still an issue

A key factor for the growing uptake of mobile broadband, apart from the increasing availability of these services, has been the drop in prices. Globally, handset-based mobile-broadband prices, based on ITU price data, have fallen from an average of USD 23 in 2013 to USD 13 in 2015 (Figure 5.22).[11] In parallel, average prices for computer-based mobile-broadband services have decreased from USD 21 to USD 16. These reductions have been remarkable in the LDCs: handset-based prices have more than halved, in both USD and PPP terms, over the period 2012-15, while there has been a 40% reduction in computer-based prices.

The countries with the least affordable computer-based mobile broadband are mainly LDCs. Indeed, of the 19 countries in which computer-based mobile-broadband plans correspond to more than 20% of GNI per capita, 17 are LDCs. Most of these countries have in common very low income levels and a limited proportion of households with a computer (a prerequisite for using a computer-based mobile-broadband plan).[12] Even in some countries with higher income levels, such as Angola, Kiribati and Papua New Guinea, the high cost of computer-based mobile-broadband plans (more than USD 35 per month) makes them unaffordable for a majority of the population.

While in developing countries, handset-based mobile broadband is more affordable than computer-based mobile broadband (5.1% compared to 7.6%, on average, in 2015), prices still remain relatively high, especially for low-income populations (Figure 5.22). In nine LDCs, the cost of a handset-based mobile-broadband service corresponds to more than 20% of GNI per capita, thus making it unaffordable for most of the population. This is reflected in comparatively low mobile-broadband penetration in these countries.

On average, mobile broadband prices in the LDCs still represent 11% of GNI per capita for handset-based services and 17% for computer-based plans. This means that these services, and particularly computer-based mobile broadband, are still unaffordable for large segments of the population in the LDCs.

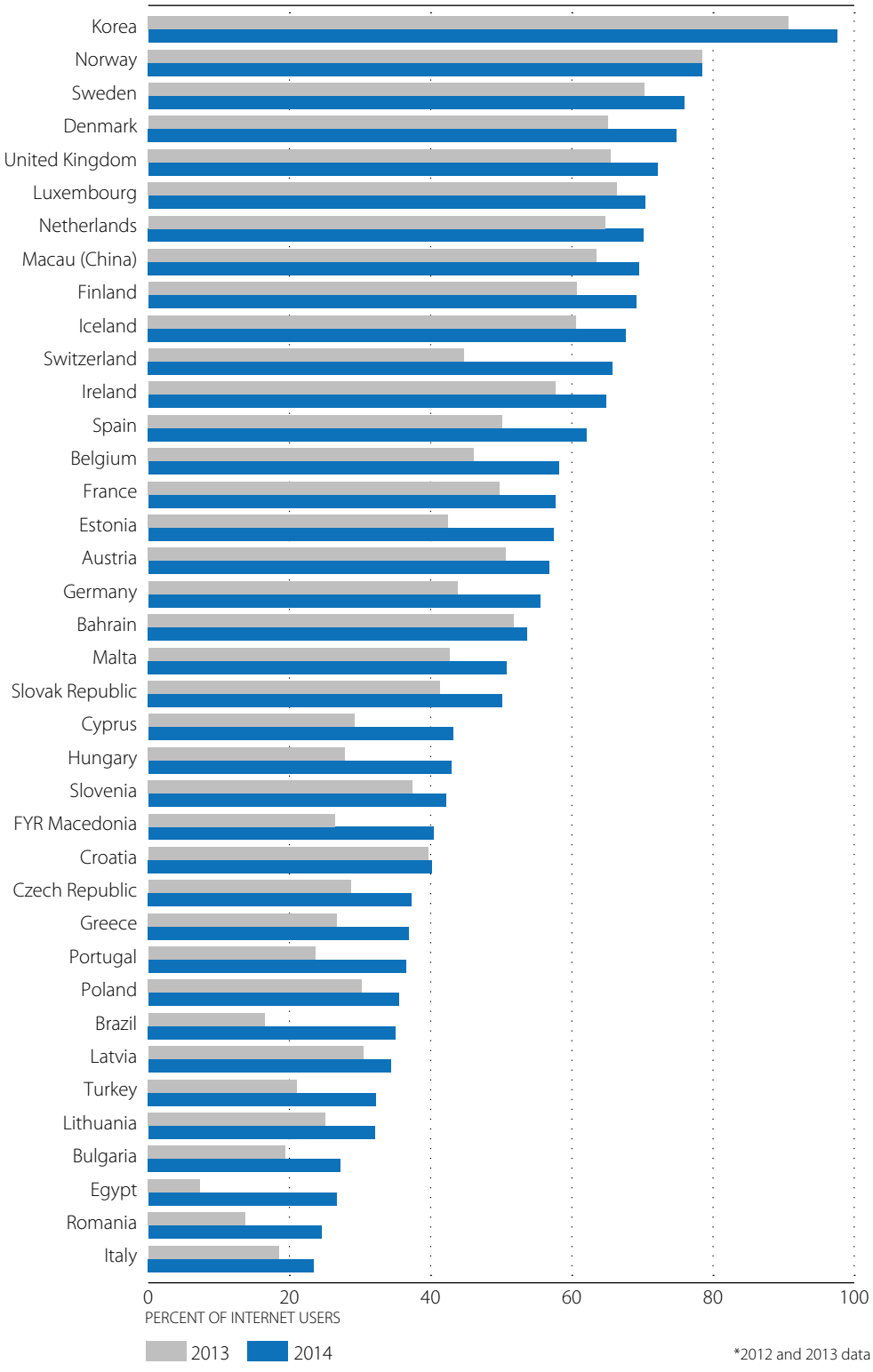
Figure 5.22. Mobile-broadband prices as a percentage of GNI per capita, in PPPUSD, and in USD, 2013-15

Note: Simple averages based on data on handset-based and computer-based mobile-broadband prices available for 153 and 147 economies, respectively.

Source: Adapted from ITU (2016b), *Measuring the Information Society Report 2016*.

StatLink http://dx.doi.org/10.1787/888933526443

Figure 5.23. Use of the Internet on the move in selected economies, 2013 and 2014



Note: "On the move" = Internet use via a mobile phone or other mobile access device, e.g. a laptop computer, tablet or other handheld device. For developing countries: Internet use through the above mentioned devices connected to a mobile phone network and at a location away from "home", "work", "place of education", "another person's home" and "community and commercial access facilities". For European countries: Internet use through the above-mentioned devices "away from home and work".

Source: ITU (2014) and Eurostat for European countries.

StatLink http://dx.doi.org/10.1787/888933526462

More and more people are connecting on the move

The increasing availability of mobile-broadband services, coupled with decreasing prices, is changing the way people access the Internet. Available data show that in a majority of developed countries, a growing number of Internet users are connecting to the Internet through mobile networks while on the move (Figure 5.23).[13] The limited data available from developing countries suggest that increases in the accessibility and drops in prices of mobile broadband may be having a strong impact on how people go online in the developing world as well. For example, the percentage of users accessing the Internet on the move tripled in Egypt between 2013 and 2014; it doubled in Brazil over the same period. As Internet usage continues to grow in developing countries, and in view of the low fixed-broadband subscription figures in most of these countries, a significant proportion of new Internet users may go online exclusively through mobile networks. This highlights the importance of affordability of mobile-broadband services to expand Internet use in the developing world.

Prepaid services also have driven uptake. In particular, affordable prepaid handset-based plans have been a major driver of uptake for mobile voice and SMS services; they could have a similar effect in promoting handset-based mobile-broadband services. It is important to note, however, that in addition to the price of the mobile-broadband service itself, other factors—such as the cost of a smartphone—may be decisive factors influencing uptake (OECD, 2013a; GSMA, 2016).

SOCIO-ECONOMIC BARRIERS KEEP MANY FROM JOINING THE INFORMATION SOCIETY

While limited access and high costs are important barriers to ICT uptake, research on Internet user behaviour suggests that socio-economic factors outside the ICT ecosystem keep many people from joining the information society.

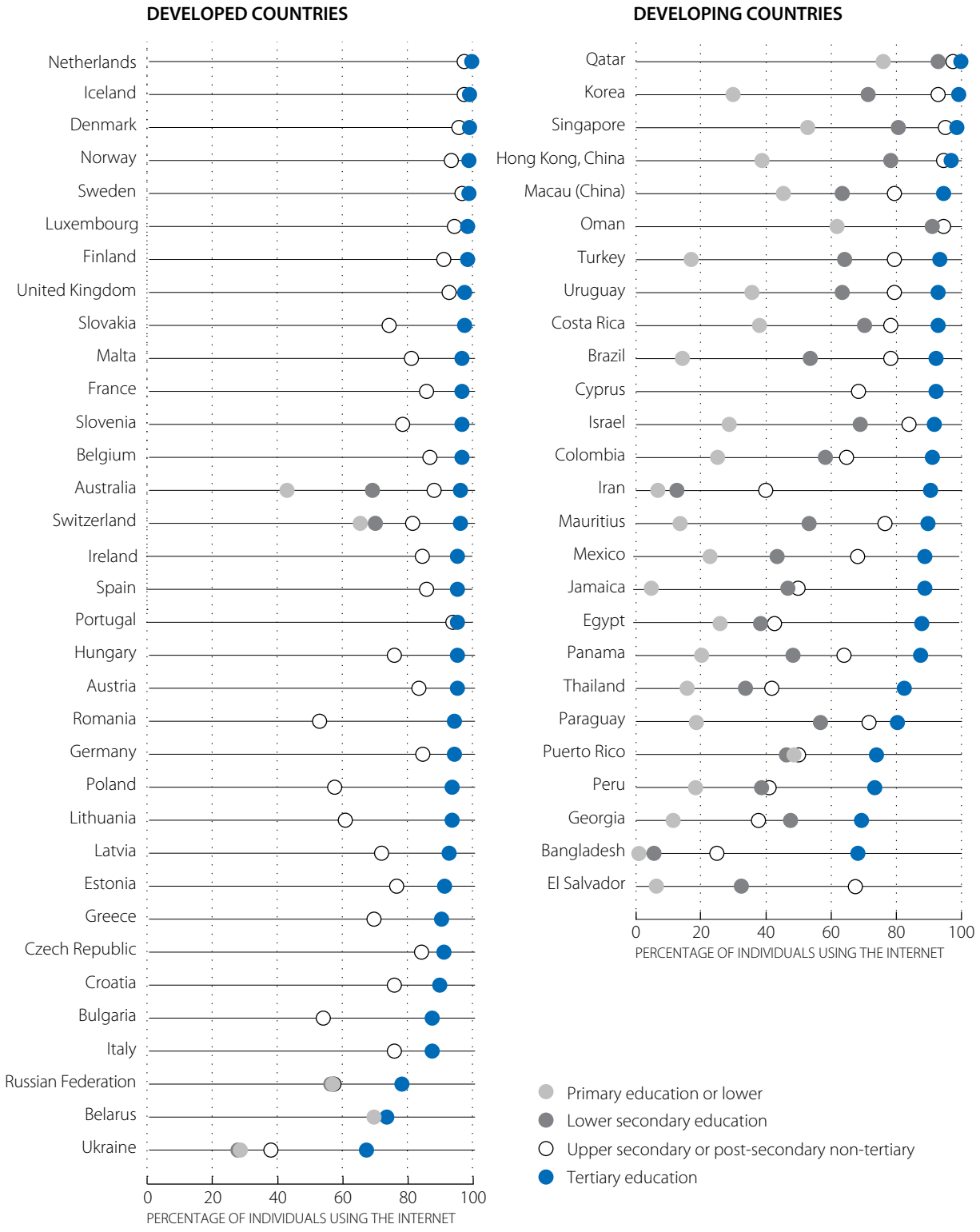
Available data show that the reasons households do not have Internet access at home differ across developed and developing countries. While the cost of services and equipment appears to be the key barrier in developed countries, people in developing countries face other challenges. The most often-cited response is that people "do not need the Internet". This suggests that non-users are either not aware of the information, services and applications available over the Internet, or that there is not sufficient content made available that is relevant for specific user groups. Lack of confidence, knowledge and skills is another important and often-cited barrier, pointing to the importance of raising levels of education to allow people to benefit from online opportunities.

Education matters, but so do income, gender and age

An analysis of Internet users and their activity points to a strong link between low levels of educational attainment and low Internet penetration rates (Figure 5.24). Indeed, ITU data show that education levels are one of the most important indicators of whether or not people are Internet users, in developing as well as developed countries. Internet use in most developed countries is almost universal among people with tertiary education, but a large proportion of citizens with lower educational attainment remain unconnected, despite having similar access to infrastructure and services.

Differences in educational levels also help explain other divides, such as income, gender and age. A number of studies suggest that the offline population remains disproportionately poor, rural, elderly, and female (Facebook, 2015; ITU, 2016b; McKinsey, 2014).

Figure 5.24. Internet use by level of education in developed and developing countries, 2013-15



Notes: Latest data available. ISCED = International Standard Classification of Education.

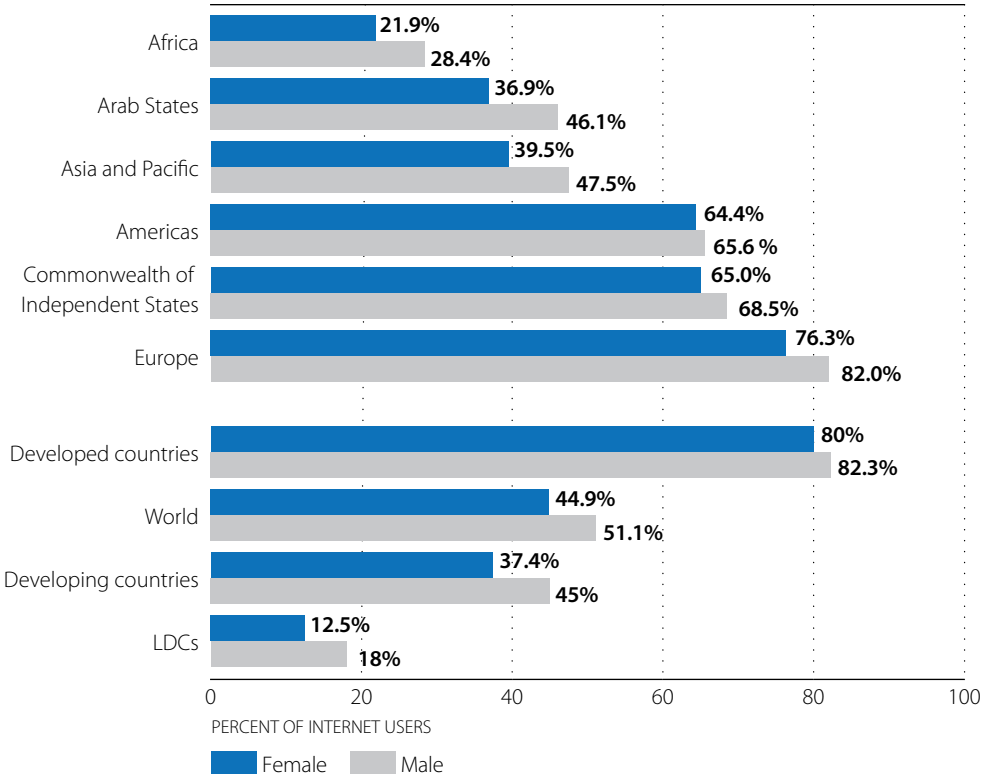
Source: ITU (2016b), *Measuring the Information Society Report 2016.*

StatLink http://dx.doi.org/10.1787/888933526481

The gender gap is particularly pronounced in the LDCs

Data on Internet use broken down by gender, for example, indicates a very clear gender divide. In the vast majority of countries, the proportion of men using the Internet is higher than the proportion of women (Figure 5.25). Only in selected countries, in Europe and the Americas in particular, are there more women than men online, proportionally. Data also point to significant differences between developed and developing countries; the gender gap is particularly pronounced in the LDCs. These findings are reflected at the global level, where ITU reports a 2016 Internet-user gender gap of 12.2% in 2016 (Figure 5.26).

Figure 5.25. Proportion of individuals using the Internet, by gender, 2016



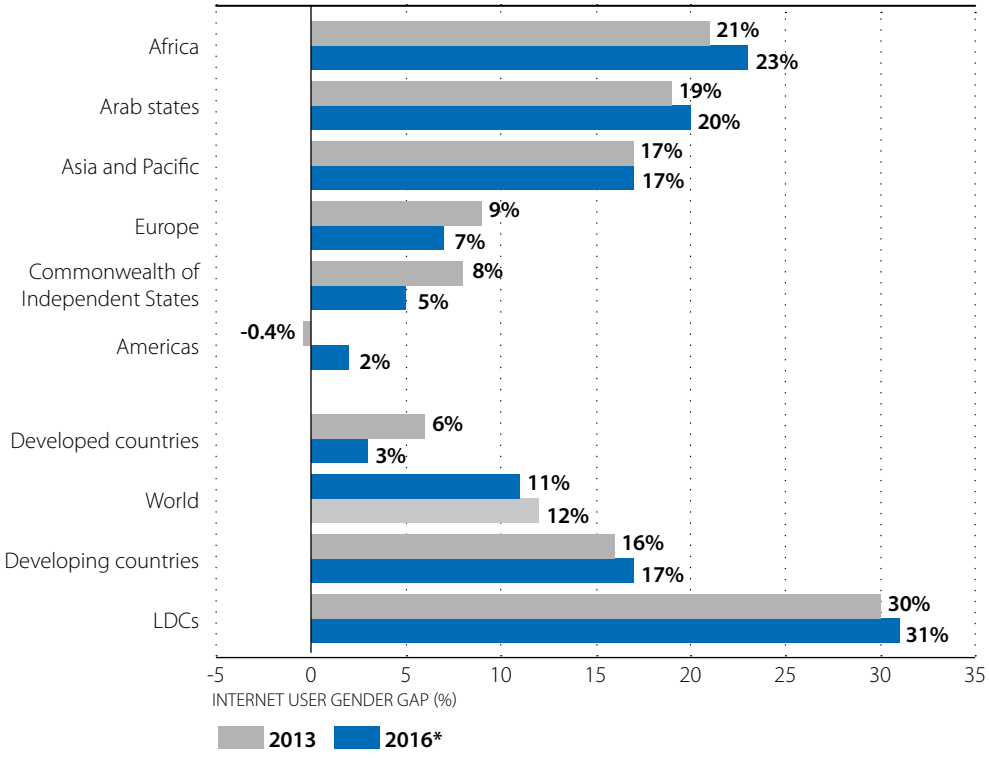
Note: Estimates.

Source: ITU (2016a), *Facts and Figures 2016.*

StatLink http://dx.doi.org/10.1787/888933526500

Differences in levels of education and school enrolment, and in tertiary education levels, could be important factors explaining why more men than women use the Internet. Some of the countries in which more women than men are Internet users are also countries that do well on the gender parity index (GPI), which measures parity between girls and boys in terms of school enrolment ratios. Gender equality in these countries is also reflected by a high proportion of women in the labour force.

Figure 5.26. Internet user gender gap, 2013 and 2016



*Estimates.

Notes: The gender gap represents the difference between the Internet user penetration rates for males and females relative to the Internet user penetration rate for males, expressed as a percentage.

Source: ITU (2016a), *Facts and Figures 2016.*

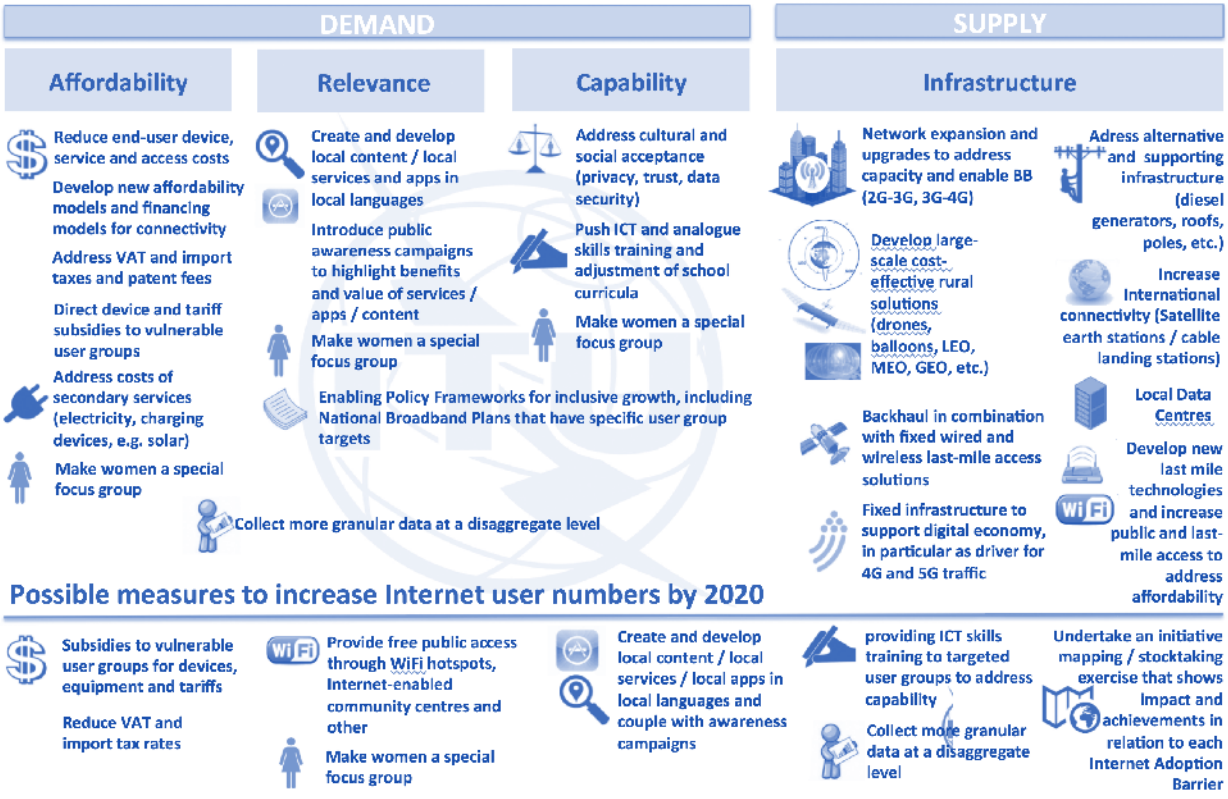
StatLink http://dx.doi.org/10.1787/888933526519

Tapping into the full potential of the Internet means addressing socio-economic inequalities

A recently published ITU discussion paper identifies similar barriers to greater ICT uptake and use. The paper states that "the key reasons for people not using the Internet are structural inequalities in income and education as well as the lack of infrastructure, relevant online content and services and high relative costs of access and usage." (ITU, 2017c). It provides an overview of possible measures that could help to increase the number of Internet users, both from the demand and the supply side. These include measures such as creating and developing local content—in local languages; addressing cultural and social acceptance; providing training; and making women a special focus group. On the supply side, suggested measures include developing large-scale cost-effective rural solutions to expand networks, and building fixed infrastructure to support the digital economy (Figure 5.27).

ITU research also finds that among the online population, important differences exist in terms of the types of online activity Internet users engage in. Education levels seem to influence the type of activity in which users engage, with implications for their potential gains. Many Internet users, in particular those with lower levels of education and income, make very limited use of the Internet and are not able to exploit its full potential. In developing countries, the Internet is still mainly used for communication and entertainment purposes. In developed countries, citizens use the Internet to a greater degree for reading newspapers, magazines, and books, interacting with government, and performing banking and e-commerce services.

Figure 5.27. Demand- and supply-side measures to increase internet use



Source: ITU (2017c), *Connecting the Unconnected Working together to Achieve Connect 2020 Agenda Targets.*

Similar findings are observed among children and adolescents. An OECD study shows that wealthier students are more likely to use the Internet for educationally advantageous activities, such as gathering information and reading the news, while poorer students are more likely to use it for communication and playing games (OECD, 2016). The same study suggests that even in countries with almost universal Internet access, the lack of knowledge and familiarity with the use of the Internet to find information can hamper young people in their studies and job-finding prospects. The study shows that traditional education is critical to increasing the ability of students to use ICT tools for learning purposes. Reading content on the Internet requires the same skills as reading a book or newspaper. While it is important to integrate the Internet into education, results from the OECD Programme for International Student Assessment (PISA) show that the highest-performing students in digital reading were "not more exposed to the Internet at school than are students in other OECD countries" (OECD, 2015).[14]

These findings suggest that the Internet can reinforce existing inequalities, leaving the most vulnerable population groups even further behind. The mobile phone has rightly been hailed as a development enabler that provides crucial communication channels. Yet for large population groups, including the poor and less privileged, access to information and new services—and therefore to the full potential of the Internet—remains largely untapped.

To turn the Internet into a truly universal tool for development, policy-makers must tackle not only the supply-side challenges of the Internet, including infrastructure deficiencies and high prices, but also the demand-side barriers that exist outside the ICT ecosystem. This means addressing broader socio-economic inequalities. Above all, people need to acquire not only the necessary digital skills, but also analogue skills—such as basic literacy and numeracy—in order to exploit the full potential of the Internet. ICT policy-makers must act within the context of a larger Internet ecosystem if they are to empower people and make Internet content easily accessible to disadvantaged groups. ICT policies must be linked to investments in education in order to develop the necessary human skills and raise education levels to bring more people online and make them more effective as online users.

CONCLUSIONS

This chapter has highlighted the rapid growth in ICT access and use, and the evolution towards the promise of a global information society that delivers new opportunities for development to everyone. Despite this progress, however, major differences continue to exist in ICT access, use, and affordability, in particular in terms of broadband Internet access and use.

ICT infrastructure, connectivity and quality of service in the least developed countries are lagging behind the rest of the world. Policy makers must make sure they address and overcome important infrastructure bottlenecks, in terms of both national backbones and international Internet connectivity. Similarly, fixed- and mobile-broadband prices remain high for the world's poorest countries, and unaffordable for low-income population groups.

This chapter identifies and number of important steps governments, and in particular the LDCs, can take to create an enabling regulatory environment that will help to stimulate investment and increase ICT access and use. Two-thirds of all LDCs are still in either the first or the second generation of regulation and need to urgently perform basic reforms, including to promote privatization, liberalization, and intra-platform competition. Other important reforms for many LDCs include the removal of entry barriers to foreign ownership and investment. When private investment is not sufficient, it is possible to look into direct government investment, take advantage of public-private partnerships, use universal service funds and obligations to bring services to areas that provide limited business opportunities, and provide tax incentives for investments.

Yet while Internet infrastructure, access and quality of service remain important barriers to uptake, more people have access to Internet services than actually use them. To bring more people online, broader socio-economic factors, not related to ICT, need to be addressed. Education levels, in particular, are strong determinants of whether or not, and how, people use the Internet. Citizens need both digital and analogue skills to fully benefit from the opportunities of the information society. ■

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NOTES

1. This chapter is based on the data and analysis of the ITU Measuring the Information Society Report 2016, and on data from the ITU World Telecommunication/ICT Indicators database.
2. The indicator used to track SDG Target 9c is the "proportion of the population covered by a mobile network, by technology". This can be considered as a minimum indicator for ICT access since it provides people with the possibility to subscribe to and use mobile-cellular services. By including the breakdown "by technology", the indicator provides flexibility in terms of technological developments. As technologies evolve and as more and more countries deploy and commercialize more advanced mobile-broadband networks (4G, 5G etc.), the indicator will be able to reflect and capture these.
3. Among the 48 LDCs, nine are SIDS, and 17 are LLDCs.
4. For information on Internet Exchange Points, see: www.datacentermap.com/ixps.html, https://en.wikipedia.org/wiki/List_of_Internet_exchange_points_by_size and www.telegeography.com/telecom-resources/internet-exchange-map/
5. To monitor fixed-broadband prices, ITU uses the "fixed-broadband sub-basket": the price of a monthly subscription to an entry-level fixed-broadband plan. It is calculated as a percentage of a country's average monthly GNI per capita, and also presented in USD and PPPUSD. For comparability reasons, the fixed-broadband sub-basket is based on a monthly data use of minimum 1 Gigabyte (GB). For plans that limit the monthly amount of data transferred by including data volume caps below 1 GB, the cost for the additional bytes is added to the sub-basket. The minimum speed of a broadband connection is 256 kbit/s.
6. It should be noted that in 2014, the price of fixed-broadband services fell in six LDCs, remained the same in more than half of all LDCs, increased slightly in two LDCs, and increased substantially in two LDCs (Uganda and Rwanda). The high prices in the latter two countries had a sizeable impact on the average, especially since complete price data for the period 2008-2015 are only available for 25 LDCs. In the remaining LDCs, fixed-broadband services were not available or not advertised during one or more years during that period. While in 2015 prices remained high in Uganda, they dropped substantially in Rwanda as well as in a number of other countries, including Zambia and Mali.
7. The only exception was oil-rich Equatorial Guinea, in which the household final consumption expenditure per capita was USD 272 per month in 2015. Household final consumption expenditure is an indicator produced in the context of national accounts and therefore does not reflect income and consumption inequalities. As a result, depending on the distribution of income/consumption within the population, the actual economic wealth of most households may be significantly lower than the average value derived from the national accounts. Data from household income and expenditure surveys provide better indicators to measure household economic wealth, but data availability is limited in developing countries. For more information, see, (ITU, 2014), pp. 140-146.
8. Measured in terms of household final consumption expenditure per capita, income levels are seven times higher in Ireland than in Equatorial Guinea, the LDC with the highest household final consumption expenditure per capita (among all those for which data is available).
9. Of the 44 LDCs with data available on fixed-broadband prices in 2015, 37 had a fixed-broadband penetration rate below one subscription per 100 inhabitants. Bangladesh recorded 2.4 fixed-broadband subscriptions per 100 inhabitants, and Bhutan 3.6.

10. In Burundi, CBINET offers contention ratios for ADSL services of 1:4. Contention ratios for common residential fixed-broadband plans are around 1:15 in most countries.

11. To monitor mobile-broadband prices, ITU collects data on (a) prepaid handset-based mobile-broadband plans with a data allowance of 500 MB per month, and (b) post-paid computer-based mobile-broadband plans with a data allowance of 1 GB per month. The plan selected in each country for each service is not necessarily the one with the cap closest to 500 MB or 1 GB, but the one from the dominant operator that is cheapest, while including a minimum of 500 MB/1 GB. The validity period considered for the plans is 30 days or four weeks.

12. ITU's definition of "computer" includes desktop computers, laptop (portable) computers and tablets (or similar handheld computers). Smartphones are not considered computers.

13. "On the move" is defined as the use of the Internet via a mobile cellular telephone or other mobile access devices, for example a laptop computer, tablet or other handheld device. For developing countries, it refers to Internet use through the above-mentioned devices connected to a mobile phone network when the location is away from "home", "work", "place of education", "another person's home" and "community and commercial access facilities". For European countries, it refers to Internet use through the above mentioned devices "away from home and work". For more information on the definitions of Internet use by location, see page 55 in *Manual for Measuring ICT Access and Use by Households and Individuals 2014* available at: www.itu.int/en/ITU-D/Statistics/Pages/publications/manual2014.aspx.

14. In the 2009 and 2012 PISA assessments, OECD assessed reading digital media separately from reading printed text (OECD, 2013b).