The State of Broadband:
Broadband catalyzing sustainable development

September 2016

BROADBAND COMMISSION
FOR SUSTAINABLE DEVELOPMENT

THE STATE OF BROADBAND 2016: BROADBAND CATALYZING SUSTAINABLE DEVELOPMENT

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- Sunil Bharti Mittal, Chairman, Bharti Airtel Limited (Bharti Airtel);
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Executive Summary

In September 2015, UN Member States and the UN General Assembly formally agreed on the Sustainable Development Goals (SDGs) and set out a global agenda for development based on economic prosperity, social inclusion and environmental sustainability, known as the '*2030 Agenda for Sustainable Development*'.

The *ITU/UNESCO Broadband Commission for Sustainable Development* is united in its belief that broadband can play a vital role in achieving the SDGs. The Broadband Commission presents this report to explore the role that broadband plays in underpinning inclusive and sustainable development, and the necessary framework conditions to enable affordable, universal and available Internet access to be achieved.

However, in order for this to happen, key framework conditions need to be met. According to the latest ITU estimates, there will be 3.5 billion people online by the end of 2016, but more than half the world's population (some 3.9 billion people) will still be offline, and unable to connect regularly, if at all. But in the 48 UN-designated Least Developed Countries (LDCs), still only around one in seven people will be online at the end of 2016. Pushing basic connectivity out beyond major urban centres to more remote areas continues to prove a major challenge. Even where people have access to the Internet, access has to be accompanied by a range of relevant services and content to help improve individuals' personal awareness, education and hygiene, as well as development outcomes in health and education at the national level.

The introductory **Chapter 1** to this report gives an overview of **broadband for sustainable development**. It concludes that the SDGs are aspirational and can be realized, but require urgent efforts and greater progress in the speed, degree and equality of development, for which broadband is critical. **Chapter 2** reviews **current global trends** in broadband, and developments in the next generations of mobile broadband (5G), fixed broadband and satellite broadband systems. The global market for broadband shows strong growth. Globally, the total number of active mobile-broadband subscriptions is expected to exceed 3.6 billion by end 2016, up from 3.2 billion at end 2015. Almost half of all mobile phone subscriptions are now broadband-enabled. Strong growth in broadband markets is being driven by rapid innovation in next-generation mobile broadband (5G), fixed broadband and next-generation satellite systems, and the report overviews some of the exciting developments in these fields, that will help mobile phones become a portal to a range of vital online services.

Chapter 3 explores progress towards achieving the **Broadband Commission's targets** for broadband, first established in 2011, with an initial end-date of 2015. Progress towards meeting these targets has been mixed, with some targets not yet achieved over the initial timeframe, although there has been good progress towards the first target (on National Broadband Plans and policy-making) and second target (promoting affordability of broadband access). The third target on household Internet access will have been achieved by the end of 2016, as will the target for Internet access in LDCs, which are expected to have an average of 15.2 Internet users per capita by the end of this year.

However, the target for Internet penetration for developing countries has not been achieved in the original timeframe. Regrettably, progress towards gender equality in access to broadband (the Commission's fifth target) has stalled, with the global online gender gap in fact widening slightly. 'Business as Usual' will not produce the results needed to connect the remaining offline populations, who are now found in more remote, rural areas, and consisting disproportionately of poorer, minority, less educated, and often female, members of society.

Chapter 4 explores promising new uses and applications of **ICTs for development**

(ICT4D), including mobile, satellite and the Internet of Things (IoT). Mobile broadband currently offers some of the best prospects for putting information and empowering apps into the hands of individual people, but satellite offers universal coverage and good reliability for connecting communities, schools and remote areas. Connected sensors and Machine-to-Machine (M2M) connectivity may represent the next frontier in the ICT4D story, in the emerging 'Internet of Things'. This is a major development, which promises to change ways of doing things through better information in real-time and improved learning opportunities. The report explores the exciting new applications made possible by sensors and Wireless Sensor Networks (WSN) for monitoring and improving agricultural yields, water irrigation, fires and tsunamis.

Chapter 5 by UNESCO focuses on cities, in light of *Habitat III*, the UN Conference on Housing and Sustainable Urban Development taking place in October 2016. It explores the implications of 'city smartening' processes for turning major urban centres into smart cities or '**knowledge cities**'. Broadband connectivity and ICTs have the potential to transform our urban lives by generating greater economic, energy, governance and mobility efficiency in our cities. However, their rationale goes far beyond increasing efficiency. Indeed, these new digital technologies could represent a crucial milestone in the building of knowledge cities by boosting urban democratic processes through greater inclusion and participation, rendering education accessible to all, empowering women and girls, and promoting cultural diversity and creativity.

Technology in itself cannot be the solution to sustainable development – countries need to create an enabling environment for digital technologies. If countries overlook the 'soft components' of the ICT roll-out (such as skills, education, local content, inclusive policies, participation and institutional accountability), the impacts of the digital revolution will fall short and its benefits will not be fully realized. Broadband infrastructure and content need to be conceived and developed jointly, to ensure future human-centred, sustainable development.

Chapter 6 concludes by making a number of **policy recommendations** to promote broadband for catalyzing sustainable development:

- 6.1 Review and update regulatory frameworks for broadband
- 6.2 Improve policy frameworks for IoT
- 6.3 Encourage investment by both the public and private sectors
- 6.4 Make full use of Universal Service Obligations (USOs)
- 6.5 Consider infrastructure-sharing and open access approaches to infrastructure
- 6.6 Consider measures to make broadband more affordable
- 6.7 Reduce taxes and import duties on telecom/ICT equipment & services
- 6.8 Promote training and measures to stimulate demand
- 6.9 Encourage local content and the local hosting of content
- 6.10 Promote free flows of information
- 6.11 Promote advanced market commitments for rural broadband access
- 6.12 Benchmark and monitor ICT developments

1 Introduction

Since its establishment in 2010 by ITU and UNESCO, the *Broadband Commission* has sought to promote the adoption of effective and inclusive broadband policies and practices in countries around the world, with a view to promoting development and empowering each and every individual and society through the benefits of broadband.

In September 2015, UN Member States and the UN General Assembly formally agreed on the new Sustainable Development Goals (SDGs) and set out a global agenda for development based on economic prosperity, social inclusion and environmental sustainability known as the '*2030 Agenda for Sustainable Development*' (or '*2030 Agenda*'). They acknowledged that 'the spread of ICT and global interconnectedness has great potential to accelerate human progress[1]. The Agenda refers to ICT infrastructure as a cross-cutting 'Means of Implementation' (MoI). The SDGs build on the foundations established by the Millennium Development Goals (MDGs), but extend them in several important ways. The *2030 Agenda* emphasizes the growing urgency of inclusive development efforts, and puts environmental sustainability centre-stage as a vital priority which we ignore at our peril. The 2030 Agenda applies directly to all UN Member States, developed and developing countries alike.

The SDGs for education, gender equality, and infrastructure include bold targets for ICT. Technology also plays a role in the goal relating to global partnerships for sustainable development. The SDGs are aspirational and achievable, but require urgent efforts and progress in the speed, degree and equality of development – indeed, there is an explicit goal recognizing the urgent need to reduce inequities and calling for more even progress in development, which can be realized through broadband (Figure 1).

A large body of economic evidence has amassed for the role of affordable and effective broadband connectivity as a vital enabler of economic growth[2], social inclusion[3] and environmental protection[4]. Various arguments are advanced for the benefits of broadband, including:

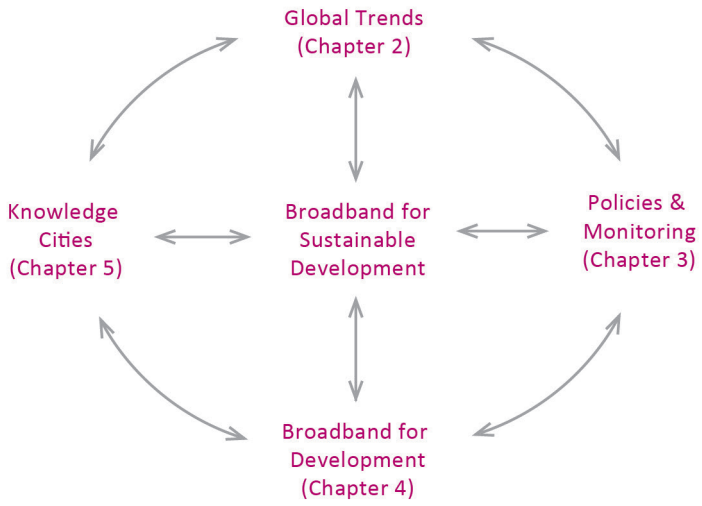
- **Macroeconomic arguments**[5]: for example, emphasizing the size of the ICT sector in its own right or by adding to total GDP (e.g. research by the World Bank, 2009[6]); the role of broadband to promote innovation in new products and services; the productivity gains achievable through broadband-enabled solutions across the economy (Booz & Company, 2009[7]); or the potential of broadband to improve access to new markets. This is the area where the bulk of economic research has tended to focus, although some more recent research has found more nuanced results with respect to the economic impact of broadband, however – the *World Development Report 2016* (World Bank, 2016[8]) and *World Employment & Social*

Outlook 2016 (ILO, 2016[9]) offer more cautious viewpoints with regard to the economic impact of Internet access on job creation, with the WDR 2016 examining the 'displacement' of jobs between different sectors.

- **Microeconomic arguments** at the firm level: through productivity gains from more efficient working methods, the automation of simpler tasks, more informed decision-making by firms and/or reduced production costs. However, most studies demonstrating this tend to focus on North America and Europe, with less evidence available for the impact of technology on firms in developing countries.

- **Individual empowerment**: through access to improved information about new methods, entitlements and/or rights to resources. A body of development literature has focused on this area, although many studies focus on the potential of ICTs, rather than actual impact. Indeed, ICTs offer a powerful platform for achieving the SDGs, accessible to around half the total global population when associated with appropriate services, skills and content (Viewpoint 1).

Figure 1: The Structure of this Report



Source: The Broadband Commission for Sustainable Development.

Viewpoint 1: ICTs offer an incredible platform for achieving the SDGs

Digital transformation is enabling rapid change in every industry and across every aspect of our lives. As a direct result of three fundamental ICT forces—mobility, broadband and the cloud—a new service economy is emerging. Value chains are being reshaped, business models are becoming digitalized, distance is being overcome and, increasingly, people can share goods and services instead of buying and owning them. These are all examples of how the digital age is unleashing innovative new business models and changing lives.

As innovation transforms the world around us, business is changing too. Among the most significant demonstrations of this is the way companies like Ericsson are working with others to achieve shared societal goals and collectively tackle global challenges. This year, Ericsson celebrates its 140th anniversary. During our history, we have transformed many times, from enabling infrastructure which connected places with fixed phones, to connecting people through mobile telephony, to envisioning the architecture for today's Networked Society, where everyone and everything is connected. But we have always been driven by the same objective—using communication to improve people's lives. In the late 1890s, our founding father, Lars Magnus Ericsson, observed that "access to communication is a basic human need". Today, this principle underpins our vision of being a relevant and responsible driver of positive change by using Technology for Good.

As an industry leader, our ideas, technology and people have had real impact, helping to transform lives, industries and society as a whole. As the world embarks on the ambitious journey of achieving the 17 SDGs, it is our responsibility to work with other stakeholders to extend the benefits of communication by ensuring they are affordable and accessible to all.

ICTs offer an incredible platform for achieving the SDGs. Every goal—from ending poverty and halting climate change to fighting injustice and inequality—can be positively impacted by ICT. The digital revolution currently underway is paving the way for an Age of Sustainable Development—a profound transformation of society where technology is a key contributor to human and planetary wellbeing. The benefits of broadband as a tool for sustainable development are widely known. When the MDGs were set in 2000, broadband was in its infancy, with just 750 million mobile subscriptions worldwide. The latest *Ericsson Mobility Report* shows that there are now over 7.4 billion mobile subscriptions globally and that over 90% of the world´s population will be covered by mobile broadband networks by 2021.

Universal connectivity offers a powerful platform to deliver essential services like e-governance, education, health, energy and financial inclusion and ensure that no-one is left behind. Our recent report, "*How ICTs can Accelerate Action on the Sustainable Development Goals*", builds on the work of the Broadband Commission for Sustainable Development, a forum with which Ericsson has been deeply engaged since its launch in 2010.

ICTs are key to accelerating achievement of the SDGs. By embracing broadband as a critical infrastructure for the 21st century, governments are creating the foundations for unprecedented global social and economic progress. Strong partnerships underline the type of engagement needed to reach the Goals. Together, we can demonstrate that realizing significant long-term economic rewards goes hand-in-hand with helping to achieve the SDGs by 2030.

Source: Hans Vestberg, President and CEO, 2010-2016, Ericsson, based on "How ICT can Accelerate Action on the SDGs", Ericsson & Earth Institute (2016), at: www.ericsson.com/res/docs/2016/ict-sdg.pdf.

However, even as mobile technology becomes more widespread, the digital divide is also shifting, with attention focused on the remaining 3.9 billion people who are still offline, many of whom are disproportionately poor, rural, old and female[10]. In Least Developed Countries (LDCs), only around one in seven people are online. The ITU *Connect 2020* targets call for 60% of the world's population to be online by 2020, equivalent to bringing another 1.2 billion people online between now and then.

Indeed, the countries where offline populations are concentrated are surprisingly few, with just three countries accounting for 45% of the total global offline population in 2013 (India, China and Indonesia), and a total of six countries accounting for 55% of the total offline population (adding in Pakistan, Bangladesh and Nigeria, according to McKinsey, 2014[11]). The World Bank points out that many of these offline populations share common characteristics – they are predominantly rural, low-educated, with lower incomes, and a large number are women and girls (World Bank WDR, 2016[12]). Among the 3.9 billion people who are not online, many people may be unaware of the Internet's potential, or cannot use it because they lack the necessary skills or because there is little or no useful content in their native language, on top of facing other barriers to Internet access, including unreliable power supplies and/or sparse network coverage.

Even once progress is achieved in improving connectivity, discrepancies in access to and use of different services are likely to come to the forefront. It is vital to improve the availability and awareness of Internet content in languages that are not well-represented online. Larger investments are also needed in Natural Language Processing Technologies – governments can promote collaboration between the technical community and vertical sectors to develop natural language processing and machine translation applications, particularly in areas such as justice, education or health, which are critical to achieving the SDGs (examples of this strategy include the Spanish National Plan for Language Processing Technologies or the 'Connecting Europe Facility' implemented by the European Commission).

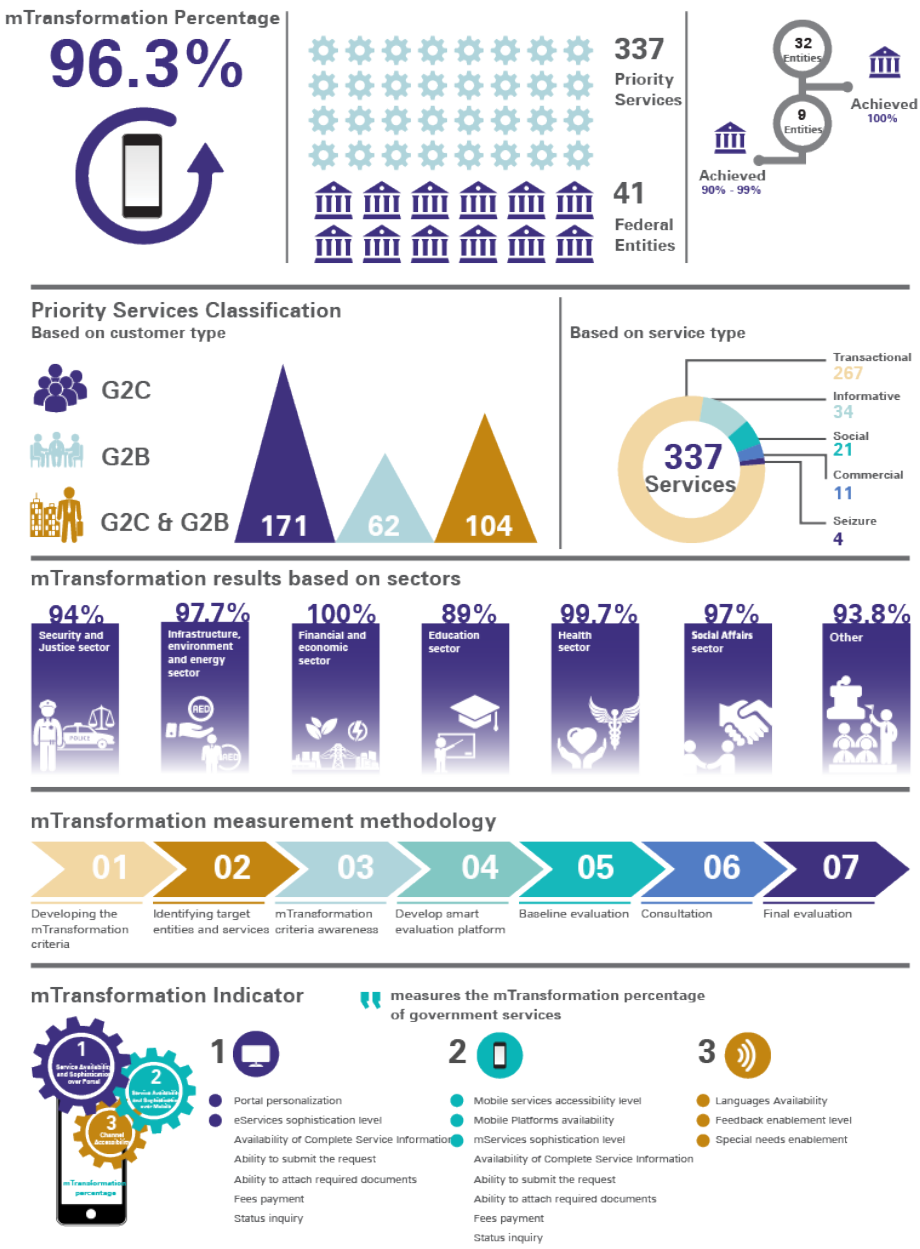
There are a number of factors driving the explosion in the use of ICTs. New technologies are shrinking the size of devices or in some cases, disappearing into the embedded environment. ICTs and devices are gaining in functionality, contextual awareness and performance, while costs are falling rapidly, and new services and business models are being introduced. The 'digital transformation' is being experienced in:

- improving existing use cases (e.g. enhancing or supplementing existing services such as driving with connected cars or delivering remote, long-distance diagnosis);
- the digitization of existing products or services (e.g. e-books, online purchases or reservations);
- introducing altogether new services (e.g. real-time tracking services); and/or
- adopting new business models within the ICT ecosystem that can help to bring more people online and make the Internet more affordable to individuals or communities without access (e.g. partnerships between content providers and mobile operators).

All in all, digital transformation is proceeding rapidly in many different sectors, including the digital economy, education and government services, among others (Figure 2), with far-reaching consequences for both national development and international approaches to development. Viewpoint 2 details how mTransformation is changing the fields of government and smart government in the United Arab Emirates (UAE). This report seeks to offer some insights into the present state of broadband globally, how broadband roll-outs are proceeding, and how broadband is being used to advance development globally.

Viewpoint 2: mTransformation in the United Arab Emirates

The United Arab Emirates (UAE) has gained noteworthy progress in the field of mGovernment and smart government, with many government entities now offering their services through multiple platforms including mobile devices. Under the directives of His Highness Sheikh Mohammed bin Rashid Al Makhtoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, the UAE Mobile Government Initiative was launched in May 2013. At the launch of the initiative, His Highness instructed 41 government entities to provide 337 priority services through mobile phones, and set a deadline of two years for this transformation (mTransformation). The UAE's mTransformation efforts resulted in 96.3% of overall transformation.



Source: Telecommunications Regulatory Authority (TRA) of the United Arab Emirates.

Figure 2: Digital Transformation is Advancing Rapidly – a Chronometer of Different Internet Services

Demand for Internet

Coverage Is there fixed or wireless coverage and a service provider in the area?	**Platforms and devices** Are devices and services affordable and easy to use?	**Awareness** How much do stakeholders know about Inernet and its benefits?	**Affordability** Is Internet a worthwhile purchase compared to alternatives?	**Adoption**

Source: World Bank.

ICT Regulatory Enabling Environment

1G Regulated public monopolies command & control	**2G** Partial liberalization & privatization	**3G** Enabling investment innovation & access	**4G** Flexible & integrated regulation	**5G** Collaborative regulation

Source: ITU.

Value Chain of the Digital Economy

Content Creation Regulated public monopolies command & control	**Applications** Partial liberalization & privatization	**Equipment** Enabling investment innovation & access	**Transport** Flexible & integrated regulation	**Devices** Content transport to the user's device

Source: ITU.

ICT Integration in Education, Learning and Teaching

Emerging Applying productivity tools, improving awareness	**Infusing** Enhancing traditional learning & teaching methods	**Applying** Facilitating learning using 'multi-modal instruction'	**Transforming** Creating & managing innovative & open learning environments

Source: UNESCO.

Maturity of Government Services

Stage 1 Emerging Information Services (e.g. web presence)	**Stage 2** Enhanced Information Services (e.g. portals, open data)	**Stage 3** Transactional services (e.g. tax forms, social security forms)	**Stage 4** Proactive / interactive services (pooled between agencies)

Source: UN-DESA.

Firm level adoption of Internet

Content creation	Application development Comms applications	E-commerce & E-invoices, E-supply chain management	ERP & CRM Data storage & Cloud Computing	Disaster recovery

Source: World Bank.

This year has also seen a number of major international connectivity initiatives, including the *Global Connect initiative*, recently launched by the U.S. Department of State in partnership with a number of governments and stakeholders (Viewpoint 3). On 24 June 2016, the *Global Connect initiative* was instituted into US law via the 'Executive Order on Global Entrepreneurship', institutionalizing Global Connect for the next five years. Going forward, major organizations such as the World Bank will host *Global Connect* Stakeholder conferences at future meetings, with the support of certain other governments and stakeholders.

Viewpoint 3: The Global Connect Initiative for Accelerating Global Internet Adoption

In early 2015, the global Internet passed a critical threshold of three billion Internet users. This year, Internet adoption will grow from just over 3.2 billion at the end of 2015 to almost 3.5 billion by the end of 2016. While this growth is to be applauded, much more effort is needed to ensure that the benefits of the Internet spread to the remaining 3.9 billion people without Internet access. It is by now well-established that Internet connectivity is one of the most important drivers of economic growth and opportunity.

To spur more action to close this digital divide, the U.S. Government, led by the U.S State Department, launched the multi-stakeholder *Global Connect Initiative* in 2015 aiming to bring an additional 1.5 billion new Internet users online by 2020. This initiative has three inter-related goals: first, to encourage governments to make Internet access central to all development and growth initiatives. And second, to work in cooperation with multilateral development institutions to double public and private lending for connectivity and digital technologies. And finally, to harness the knowledge, skills and resources of the technical community to implement solutions for high-speed, affordable broadband access. In doing this, we recognize that building Internet infrastructure is only one step towards digital inclusion. Creating a policy environment that sustains a healthy Internet by encouraging investment and innovation is critical for long-term success.

In April 2016, over 150 participants, including representatives from over 30 countries, as well as civil society, the tech industry, international organizations and multilateral development banks joined U.S. Secretary of State John Kerry and World Bank President Jim Kim in Washington, D.C., in support of the *Global Connect Initiative* and its objectives. Stakeholders announced over 65 new and ongoing initiatives in support of connectivity by governments, international organizations and multilateral lending institutions, industry and civil society. They highlighted their planned and recent investments in connectivity valued at over US$20 billion, in many cases leveraging public investment to support larger private sector investments in connectivity infrastructure.

In addition to these efforts, many other countries and private sector companies have committed to accelerating the expansion of Internet infrastructure and increasing adoption through demand side activities (such as skills training and the development of locally relevant content). As with the rapid adoption of mobile technologies, the majority of investment will continue to come from the private sector. Targeted multi-stakeholder efforts, such as the *Global Connect Initiative*, can help to tackle barriers to access and unlock latent resources, accelerating the diffusion of the Internet's benefits to those who currently remain unconnected.

Source: Catherine A. Novelli, Under Secretary of State for Economic Growth, Energy and the Environment, U.S. Department of State.

Endnotes

1 Paragraph 15, 'Transforming our world: The 2030 Agenda for Sustainable Development', available at: https://sustainabledevelopment.un.org/content/documents/7891TRANSFORMING%20OUR%20WORLD.pdf

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3 "Technology Broadband and Education: Advancing the Education for All Agenda, 2013", available at: www.broadbandcommission.org/publications/Pages/bb-and-education.aspx

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2 Maximizing the Benefits of our Connected Future

2.1 Continuing Growth in Broadband

Broadband and ICTs have a unique potential to support countries to meet the SDGs by 2030. However, fulfilling this potential needs continued investments in the necessary networks and services to expand access to broadband for all. A range of broadband technologies are available to achieve the SDGs, including mobile broadband, licensed cellular and unlicensed Wi-Fi technologies in the access network, supported by fixed broadband or satellite backhaul networks. At the global level, the total number of mobile cellular subscriptions will reach 7.4 billion by the end of 2016, according to the latest ITU estimates, with almost half of these subscriptions for mobile broadband (excluding cellular Machine-to-Machine or M2M connections).

GSMA (2016) estimates that there were 4.7 billion unique mobile subscribers worldwide by the end of 2015, equivalent to 63% of the global population[1]. Some observers have interpreted this as an indication that the digital divide in mobile may soon be bridged. Last year's "*The State of Broadband*" report found that mobile broadband is likely to be the fastest-growing ICT in human history[2].

Most outlooks for **telecom and Information Technology (IT) revenues and spending** remain relatively buoyant in most economies, despite uncertain economic prospects. Analysys Mason (2015) estimates that the global telecom services market will be worth an estimated US$1.79 trillion in 2019, up from US$1.68 trillion in 2014[3]. Infonetics puts total global telecom service revenues higher, at around US$2.1 trillion by 2017[4].

The International Data Corporation (IDC) forecasts that global IT spending will rise from US$2.46 trillion to US$2.8 trillion globally from 2015 through 2019, despite any prospects of recession[5]. According to IDC, equipment sales will remain relatively healthy – IDC forecasts that the market for hardware, networking equipment, and basic element/systems management software generated revenues of over US$2 billion in Q4 2015 alone, representing a year-over-year increase of 6.7%[6]. GSMA Intelligence's CAPEX forecast project that operators will invest US$900 billion in mobile network infrastructure over the next five years, representing on average 16% of total global mobile revenues each year[7].

Reviewing the industry, Technalysis Research suggests that 2016 is seeing:

- **Expected declines in tablets and PCs**[8] – for example, Gartner predicts that PC shipments are expected to decline by 1.5% on last year[9]. However, IDC estimates a double-digit rate of decline year-on-year[10];
- **A flattening in the smartphone market** – for example, Gartner predicts that smartphone sales will grow by only 7%

to 1.5 billion units in 2016 from 2015, down from 14% growth, due to more incremental upgrades, longer replacement cycles and market maturity[11]. Gartner forecasts that spending on PCs, mobile phones, tablets and printers is also expected to decline 3.7% to US$626 billion, due to saturation in many markets[12];

- Overall modest uptake for wearables and other new hardware categories;
- The first integrated prototypes of foldable/bendable displays – and maybe even the finished products themselves.

The mobile market will continue to grow, albeit more slowly. In 2015, there were just under five billion unique mobile subscribers according to GSMA Intelligence and Ericsson (Figure 3 and Table 2), and GSMA Intelligence forecasts that by 2020, there will be 5.6 billion unique mobile subscribers globally – more than the number of people with electricity at home (5.3 billion), bank accounts (4.5 billion) or running water (3.5 billion)[13]. The vast majority of new subscriber additions will come from developing markets, with GSMA Intelligence putting this figure as high as 93%. GSMA (2016) estimates that the high growth rate in unique mobile subscribers of 7.7% CAGR between 2010 and 2015 is set to slow to 4% from 2016[14].

Many developed markets are now approaching saturation, with over 90% unique subscriber penetration, meaning the vast majority of people already subscribe to mobile services. According to Ovum, total mobile subscriptions will grow to 8.5 billion by the end of 2019[15], with GSMA Intelligence and Ericsson forecasting this will grow to 9 billion by 2021, of which 85% will be mobile broadband subscriptions and over two thirds will be smartphone subscriptions[16] (Figure 3 and Table 2). ITU forecasts that the total number of mobile-broadband subscriptions will reach 3.6 billion by end 2016[17], suggesting almost half of all mobile subscriptions may be broadband-enabled.

4G roll-outs are proceeding more rapidly than 3G. GSMA Intelligence estimates that as of June 2016, 503 operators had commercially launched 4G networks across 165 ITU Member States, and forecasts that the number of 4G operators will increase by almost 50% by 2020, when 4G networks will cover over two thirds (69%) of the global population. GSMA Intelligence (GSMAi) expects Long-Term Evolution (LTE) connections to increase by two billion worldwide over the next five years (excluding M2M), reaching over three billion LTE connections by 2020 from one billion in 2015[18]. Strategy Analytics forecasts that the number of user-linked 4G subscriptions (i.e. handsets, modems, tablets and connected devices, but excluding M2M connections) will increase from 1.1 billion at the start of 2016 to 1.9 billion by the end of 2016[19].

GSMAi estimates that, by Q2 2016, 165 countries had deployed 4G networks, with steady growth in 4G/LTE networks since 2011 (Figure 4). Last year, Europe was home to around 30% of all 4G networks deployed worldwide (Figure 4). In terms of number of countries, 4G roll-outs are proceeding more rapidly than 3G roll-outs – four years after the first launch of 4G (in 2009), nearly 100 countries had launched 4G, compared with only around fifty countries having launched 3G four years after its launch at the end of 2001.

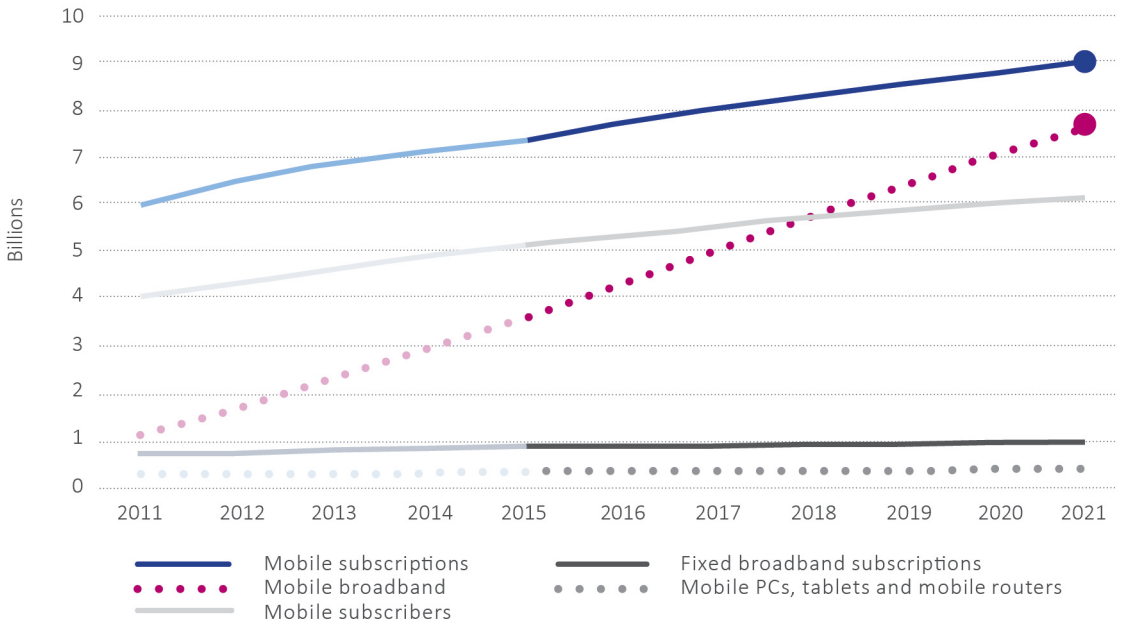
Improved performance is a clear driver of 4G. 4G will increase download speeds and upload speeds significantly. For example, in the UK in mid-2014, a comparison of the performance of 3G networks with 4G revealed that, in practice[20]:

- 4G download speeds were over twice as fast as 3G.
- 4G upload speeds were seven times faster than 3G.
- Web browsing was much faster on 4G (0.78 to load a webpage, versus 1.06s).
- 4G networks have lower latency than 3G.

The ascendancy of 4G may not spell an end to 2G. GSMA Intelligence estimates that, in 2015, just over half (52%) of mobile connections were running on 2G networks by end of 2015. In Europe (and elsewhere) operators have started shutting down 2G and/or 3G networks, and in Europe, 3G might be shut down before 2G[21]. According to the research consultancy Tolaga Research, almost one-third of the world's mobile subscriptions are currently 3G, while only 15% are 4G. However, by 2020, 4G could still only account for just over a third (37%) of subscriptions[22]. Indeed, some experts suggest that legacy 2G infrastructure elements may persist in mobile networks long after 2G and 3G networks are decommissioned[23].

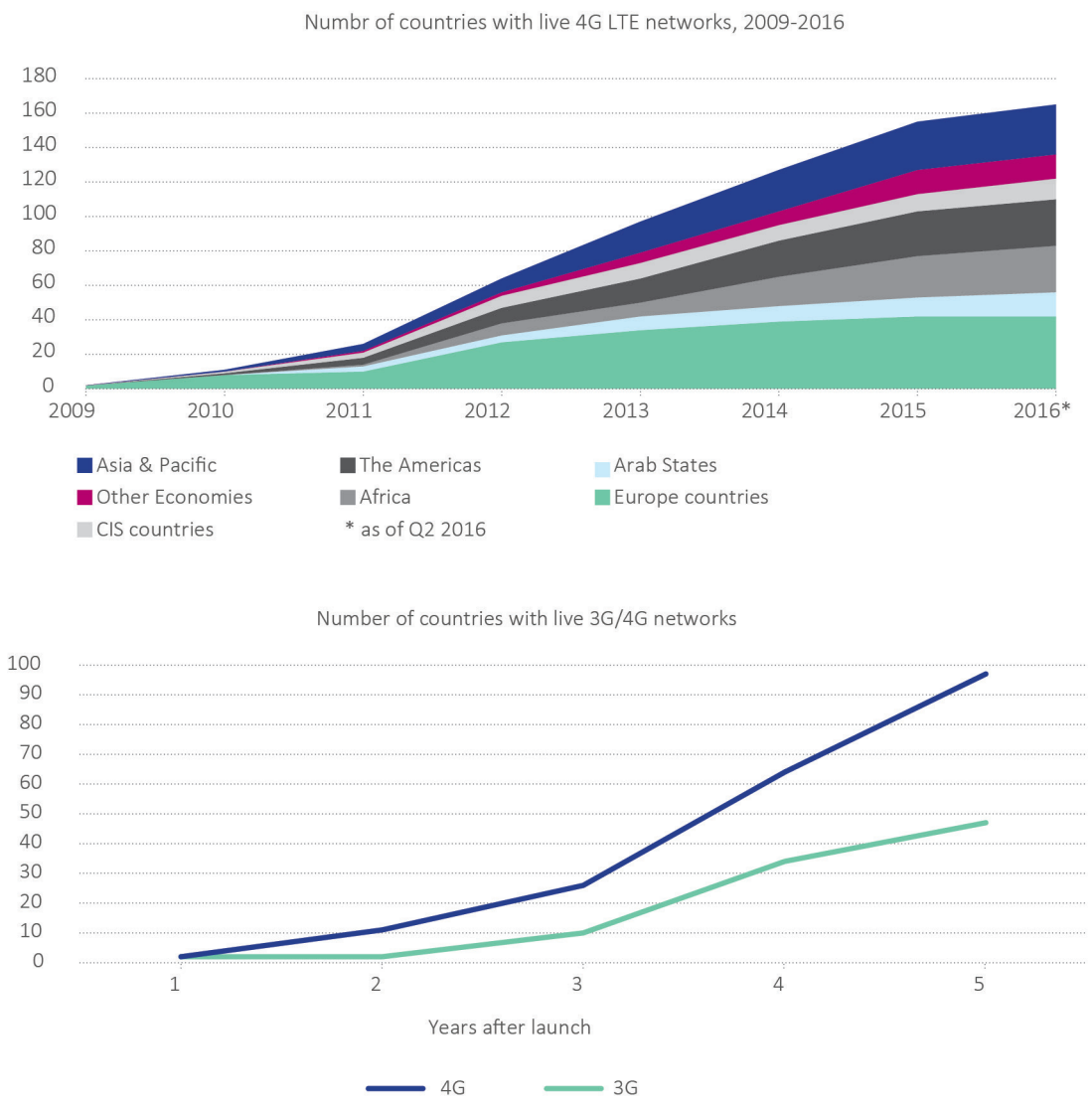
4G deployments are proceeding apace in large and small developing countries alike. For example, India is engaged in one of the biggest 4G deployments in the world, aiming to connect 800 million people with 4G access by 2018, and 1.2 billion people by 2020 – see Viewpoint 4 for more detail as to how Bharti Airtel is providing mobile broadband in India. Visiongain estimates that China alone added some 100 million LTE subscriptions in 2014[24].

Figure 3: Subscriptions/Lines and Subscribers, 2011-2021



Source: Ericsson Mobility Report June 2016, available at: www.ericsson.com/res/docs/2016/ericsson-mobility-report-2016.pdf.

Figure 4: The Growth of 4G



Source: GSMA Intelligence (top); ITU (bottom).

Viewpoint 4: The "Next Big Frontier" of the Digital World – How Bharti Airtel is Providing Broadband Connectivity in India

Over the last two years, mobile broadband subscriptions (including 3G/4G) in India have grown by nearly 2.5 times. But with just 137 million customers and a broadband penetration rate of just 13%, compared with a mobile penetration rate of 80%, India's digital leap is just starting. Given the massive opportunity to expand broadband connectivity in the country, India is truly the "next big frontier" of the digital world.

To realize this massive digital opportunity, the Indian Government is currently implementing a transformational rural connectivity programme – 'Digital India' – which aims to connect 2.5 million panchayats (village councils) through broadband. Operators are also in the midst of a massive network expansion programme to strengthen their 3G and 4G coverage. As the largest mobile operator in the country and the only one with pan-India 4G and 3G reach, Bharti Airtel has been at the forefront of this expansion drive. With over 36 million mobile broadband customers, besides over 1.8 million fixed

broadband customers, it has the largest broadband customer base in the country. While it already has a pan-Indian 3G footprint, its 4G services have been launched in over 300 cities.

Airtel has acquired spectrum worth US$13 billion in auctions and its cumulative investments in mobile business is US$ 30 billion till date. Currently Airtel is executing a comprehensive three-year network transformation initiative, "Project Leap" necessitating capex investments of around US$ 9 billion. The Company will be adding 80,000 new broadband-enabled base stations under the initiative to its current base of 120,000 broadband sites.

After expanding its mobile broadband coverage to all towns and over 250,000 villages by March 2016, Airtel is committed to offer mobile broadband to over 500,000 villages over the next three years. It will cumulatively deploy more than 550,000 km of domestic & international fibre to create a powerful, future-ready Internet backbone.

Connecting homes and small businesses is a major priority for Airtel. Alongside its mobile network upgrades, the Company is also modernizing its fixed broadband networks, which will enable it to offer 50 Mbps speed from its current 16 Mbps. Rapid scaling up in connectivity speed is a critical focus area for Airtel. Recently, Airtel became the first operator in India to commercially deploy carrier aggregation technology to deliver mobile data speed of 135 Mbps. The Company is also planning to deploy fibre to the home, which can offer up to 100 Mbps speed.

Broadband networks are the highways of tomorrow. In India, they also constitute a critical driver of economic growth and inclusion. These networks not only bring the government to the citizens' doors through e-governance modules but help link producers and consumers to the marketplace as well. Banking, education and healthcare can ride networks to reach citizens in the most remote regions.

India's Broadband Dream – 'Extending access to the next billion' – will be driven primarily by growth in wireless, requiring both massive investment by operators but a supportive regulatory environment as well. The Government needs to address relevant policy and operational issues proactively (such as Right of Way) and, most importantly, to keep in perspective the long-term financial health of the sector while deciding on pricing of spectrum, the lifeblood of mobility.

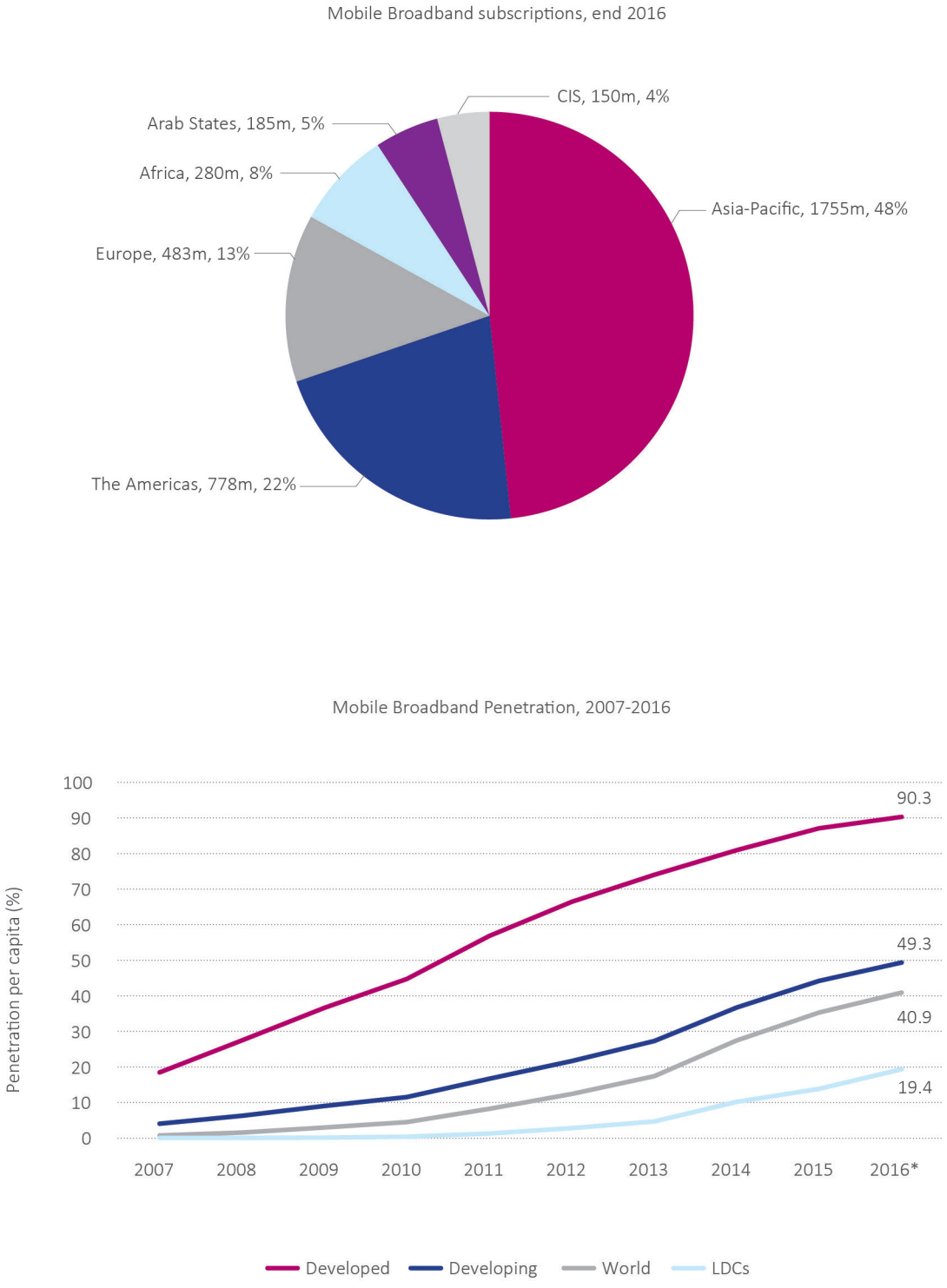
Source: Sunil Bharti Mittal, Chairman, Bharti Airtel Limited.

Regional markets continue to grow strongly in mobile broadband. The total number of mobile-broadband subscriptions is expected to reach 3.6 billion by end 2016, compared with 3.2 billion at end 2015. Despite absolute increases in the number of unique subscribers, Asia-Pacific's and Europe's regional shares actually declined slightly, due to Africa, where mobile penetration grew by 54% over 2015, increasing its regional share from 5% to 8%. Indeed, Africa's average mobile broadband penetration in 2016 is ahead of Europe's for 2009 or the Americas' for 2010. The Americas, Arab States and the CIS retained the same regional share, year on year (Figure 5).

Smartphones continue as the access medium of choice. The smartphone market has reached 90% penetration in mature markets in North America, Europe, and the mature markets in Asia-Pacific, leaving little room for future growth. In the United States, China and EU countries, the pool of first-time buyers for smartphones is shrinking rapidly, with most smartphone sales now deriving mainly from phone upgrades. Deloitte (2015) forecasts that smartphone upgrades will surpass 1.5 billion in 2016. According to Business Intelligence (2016), emerging markets should still see robust shipment growth, with India and Indonesia, in particular, driving shipment growth within the global smartphone market over the next few years[25]. Gartner agrees, but notes that users in mature markets are not replacing or upgrading their smartphones as

Figure 5: Status of Mobile Broadband subscriptions, end 2016

Distribution of mobile broadband subscriptions by region (top), evolution of mobile broadband, 2007-2016 (bottom).



*Source: ITU. * denotes estimate.*

Table 1: Estimates of the Global Market: 2015, 2016, 2020 and 2021

	2015	2016	2020	2021	2022
Mobile cellular subscriptions	7.09 bn (ITU) 7.3 bn (GSMA)	7.6 bn (GSMA) 7.4 bn (E)[31]	8.7 bn (GSMA) 9.2 bn (E)	9.0 bn (GSMA) 9.0 bn (E)	9.1 bn (GSMA)
Unique mobile phone users	4.7 bn (GSMA)[31] 4.9 bn (E)	4.9 bn (GSMA) 5.0 bn (E)[31]	5.6 bn (GSMA) 5.4 bn (Cisco)[31]	--/--	
LTE Subscriptions	1.1 bn (GSMA) 1.1 bn (E) 1.37 bn (ABI Research) [32] 1.068 bn (GSA)	1.6 bn (GSMA) 1.2 bn (E)[33] 2 bn (Strategy Analytics[33])	3.2 bn (GSMA); 3.5 bn (ABI); 3.7 bn (E)	3.6 bn (GSMA) 4.3 bn (E)	4.0 bn (GSMA) 5.6 bn (Strategy Analytics)
5G subscriptions	--/--	-/-	2 million	150 million (E)	116 m (Strategy Analytics)
Mobile broadband subscriptions	3.41 bn (GSMA) 3.46 bn (ITU); 48.8% of mobile subscriptions	4.0 bn (GSMA) 3.7 bn (E)[34]	6.2 bn (GSMA) 7.7 bn; 85% of all subscriptions (E)	6.7 bn (GSMA) 7.7 bn (E)	7.1 bn (GSMA)
Smartphone subscriptions	3.3 bn[34] (GSMA) 45% global subscriptions; 40% total mobile subscriptions (E)	3.9 bn (GSMA) 3.4 bn (E)[35]	5.8 bn (GSMA) 6.1 bn subscriptions (E) 70% world's population (E)	6.2 bn (GSMA) 6.3 bn (E)	6.5 bn (GSMA)
Fixed broadband (ITU)	794m	884m (ITU)	1 bn by 2019		
Internet users (ITU)	3.17 bn (ITU)	3.5 bn (ITU)	4 bn by 2019 (Facebook)	4.67 bn (ITU)	
Facebook users	1.59 bn MAU 1.04 bn DAU[35] (Dec 2015)	1.65 bn MAU[36] 1.09 bn DAU*	1.23 bn (EST)	2.39 bn (EST)	
Smartphone stock Smartphone shipments	2.2 bn (Del); Q1/15 - 75% of all mobile phones (E)	2.5 bn (GSMA)	2.1 bn (BI)[36]		

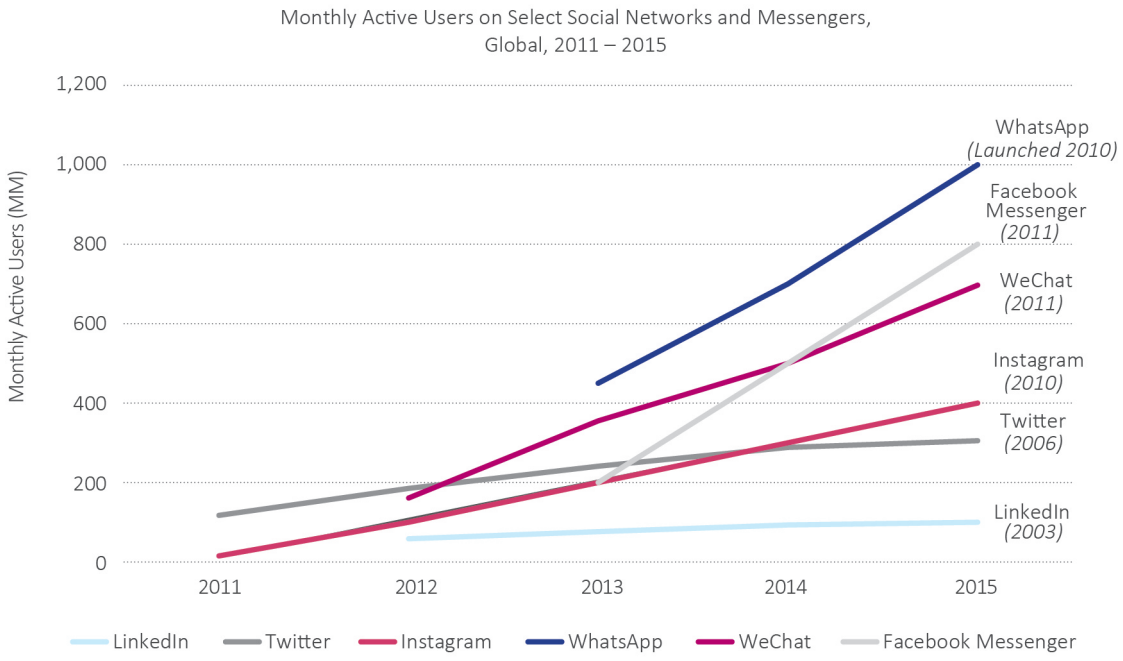
*Source: Various. EST = Estimate. MM = Mary Meeker. Del = Deloitte; Facebook, E = Ericsson Mobility June 2016 report at: https://www.ericsson.com/res/docs/2016/ericsson-mobility-report-2016.pdf 2021 forecasts from Ericsson November 2015 Mobility report at: www.ericsson.com/res/docs/2015/mobility-report/ericsson-mobility-report-nov-2015.pdfFor Facebook figures, MAU = monthly average users; DAU = daily average users. * Q1 2016 figures. **Q2 2016 figures. *** Facebook's State of Connectivity 2015 report.*

often as before – indeed, in these markets, Gartner estimates that the phone replacement cycle for premium phone users has extended to 2.5 years[26]. Deloitte (2016) observes a sharp increase in the size of the market for used smartphones[27].

Indeed, GSMA (2015) notes that India overtook the U.S. in Q1 2016 as the second largest market in the world for smartphones (with over 260 million smartphones[28]). Mary Meeker (2016) notes that India has overtaken the U.S. in number of Internet users (with an estimated 277 million Internet users) as the second largest Internet market, second only to China[29]. WeAreSocial/Internet World Stats forecasts that mobile will help push **Internet penetration** beyond 50% of the world's population during late 2016, with 2.7 billion added smartphone "connections" worldwide (it is unclear whether this refers to subscriptions or actively used phones)[30].

This increase in connections and devices is accompanied by an increase in registered users in online services. The milestone of one billion WhatsApp users was passed in February 2016[37]. Meanwhile, Google has just reached one billion Gmail monthly active users at end 2015. According to Facebook, there were 1.13 billion daily active users on average by June 2016, of which 91% access Facebook via mobile. Some 84.5% of these daily active users resided outside the US and Canada. There were 1.71 billion monthly active users by June 2016, adding 60 million subscribers each quarter (for Q1 and Q2 2016)[38]. Figure 6 shows growth in monthly average users for selected

Figure 6: Growth in Social Media Users



Source: Slide 99, "Internet Trends 2016", Mary Meeker presentation http://www.kpcb.com/internet-trends.

social media services, which varies significantly by service. A virtuous circle can be established with relevant content, services and apps driving further Internet adoption.

There has recently also been an increase in innovative private sector partnerships for the deployment of telecommunication network infrastructure, including core infrastructure, such as ducts and submarine cables, as well as access technologies. Viewpoint 5 describes one innovative private partnership aimed at boosting investment and developing infrastructure. Another example is the Telecom Infra Project (TIP), an engineering-focused foundation driven by various telecom operators, infrastructure providers, system integrators, and other tech companies that aims to reinvent the traditional approach to building and deploying infrastructure[39] by exploring new approaches and technologies to deploy backhaul and faster mobile networks at lower costs.

Viewpoint 5: Innovative partnerships aimed at infrastructure investment and development

Tech companies have been branching out to specific infrastructure partnerships with key telcos. In May 2016, Facebook and Microsoft announced a partnership that will lay a new start-of-the-art 6,600 km submarine cable across the Atlantic (called MAREA). Telefonica's Telxius is also a partner of the cable project and will manage the system, and sell off capacity of the cable to other companies interested in high-speed connections. MAREA will stretch from Virginia Beach in Virginia, United States, to Bilbao in Spain, offering speeds of up to 160 Terabytes per second. Construction will start in August 2016 and should be completed by October 2017. The aim is to address the growing customer demand for high-speed, reliable connections for cloud and online services for Microsoft, Facebook and their customers[40].

Box Figure: The route of the MAREA submarine cable funded by Microsoft and Facebook

Source: https://blogs.technet.microsoft.com/server-cloud/2016/05/26/microsoft-and-facebook-to-build-subsea-cable-across-atlantic/

2.2 Towards the Next Generation of Mobile

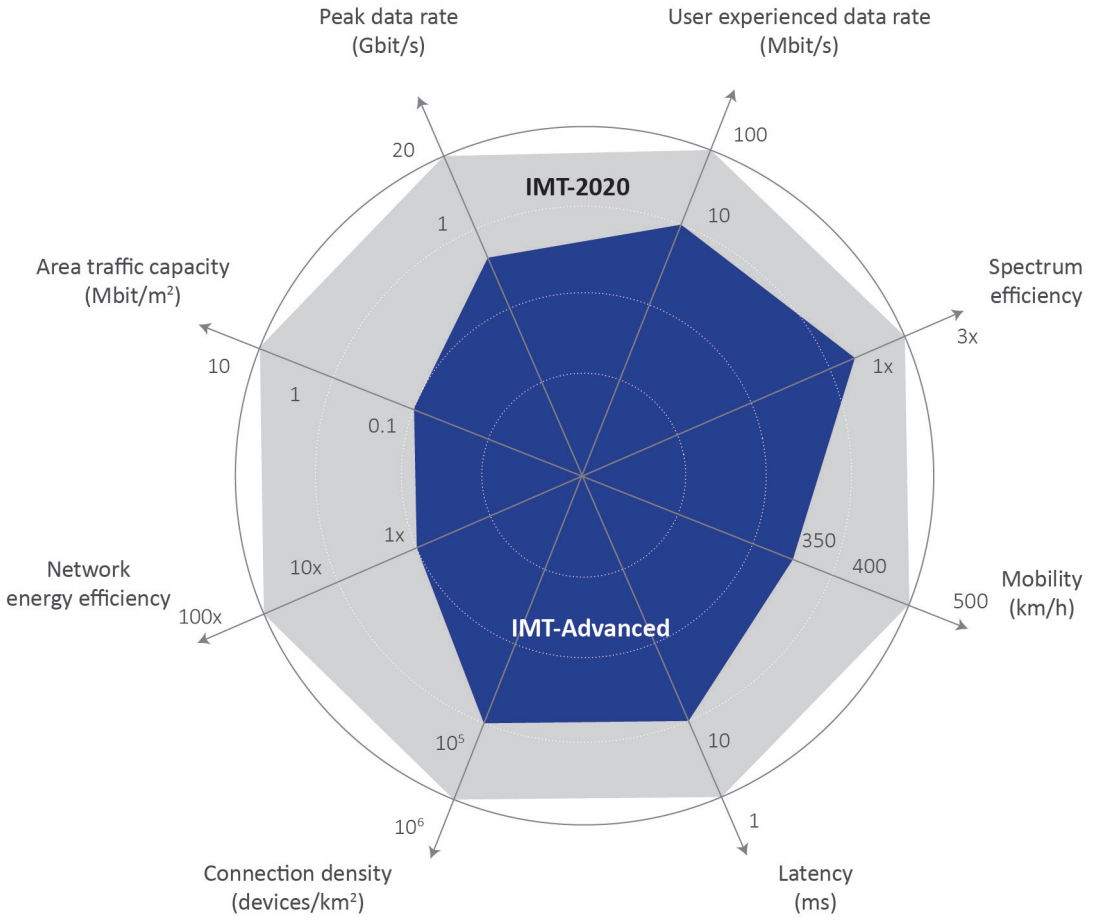
There is currently great excitement about the development of 5G. One key difference between 5G and previous generations of mobile systems is the diversity of applications that 5G networks will be supporting. Various visions have been presented for 5G, including 'infinite Internet', '4G on steroids', 'massive connectivity' for billions of IoT devices in a 'hyperconnected world', and highly reliable, virtually zero-latency communications. Many observers see 5G as facilitating the arrival of the Internet of Things (IoT) or even the Internet of Everything (IoE) with the vision of a seamlessly connected intelligent environment for smart homes, smart cities, connected cars and connected vertical use cases as well.

Companies are engaged in trialling 5G technologies for International Mobile Telecommunication (IMT) systems, with some operators already planning early deployments in the 2018 timeframe, although widespread adoption of 5G is not expected to occur before 2020, after the spectrum allocations are finalized by the ITU's WRC-2019 and the IMT-2020 standard (which covers the 5G specifications) is finalized by ITU-R Study Group 5.

Indeed, the arrival of 5G will not be without challenges and obstacles, including: spectrum fragmentation, standards development, coverage range, device availability, the necessary capex investments, and use cases that ensure profitable outcomes from 5G. Additionally, regulatory frameworks are likely to need to be updated to accommodate changes required to support 5G developments. The need to identify additional spectrum for IMT and machine-type communications will be addressed at the ITU's World Radiocommunication Conference (WRC) in 2019.

Work is already underway on 5G, with a long wish-list of potential requirements. Figure 7 presents one view comparing the tentative preliminary technical specifications for 5G with the specifications for 4G. Standardization

Figure 7: Comparison of the Technical Specifications for 4G and 5G (Tentative)



Source: ITU Recommendation M2083-03.

work is immensely challenging[41], as it involves forecasting future demand and future use cases five to ten years from now, already a long time horizon in a fast-changing industry.

Stakeholders are already calling for: ubiquity; higher capacity; 'uniformity' across cell-sites; high levels of reliability and low latency (for use by emergency services or telehealth); interoperability and 'seamless' integration across different types of networks. 5G should support multiple critical applications functioning in a 'live' environment.

ABI Research predicts that mobile broadband operators will reap 5G revenues of US$247 billion in 2025 with North America, Asia-Pacific, and Western Europe being the top markets[42]. Based on experience with 4G, 5G roll-outs are likely to proceed even more rapidly than preceding generations, while technology migration over the next few years will mean the continued decline – but not the immediate disappearance – of 2G and 3G. 4G will continue to grow in many markets, but 5G will generate new use cases and market revenues.

Many use cases for 5G will likely be closely connected with the IoT. Discussions on 5G almost invariably involve discussion of vertical use cases in health, education, smart cities, the industrial Internet, and connected cars, as we move from the IoT to an 'Internet of Everything'. A recently published Gartner report predicts IoT devices will encompass more than 6.4 billion connected objects in use by 2016, a 30% rise on 2015, with that number forecast to explode to 20.8 billion things by 2020[43]. Ericsson puts this figure considerably higher, with IoT making up close to 16 billion of a total forecast 28 billion

connected devices by 2021[44]. IoT use cases to be achieved through 5G are still under evaluation and development, with the mobile industry, standardization bodies and the verticals working to define the use cases, the relevant business models and the best way of interworking of these industries.

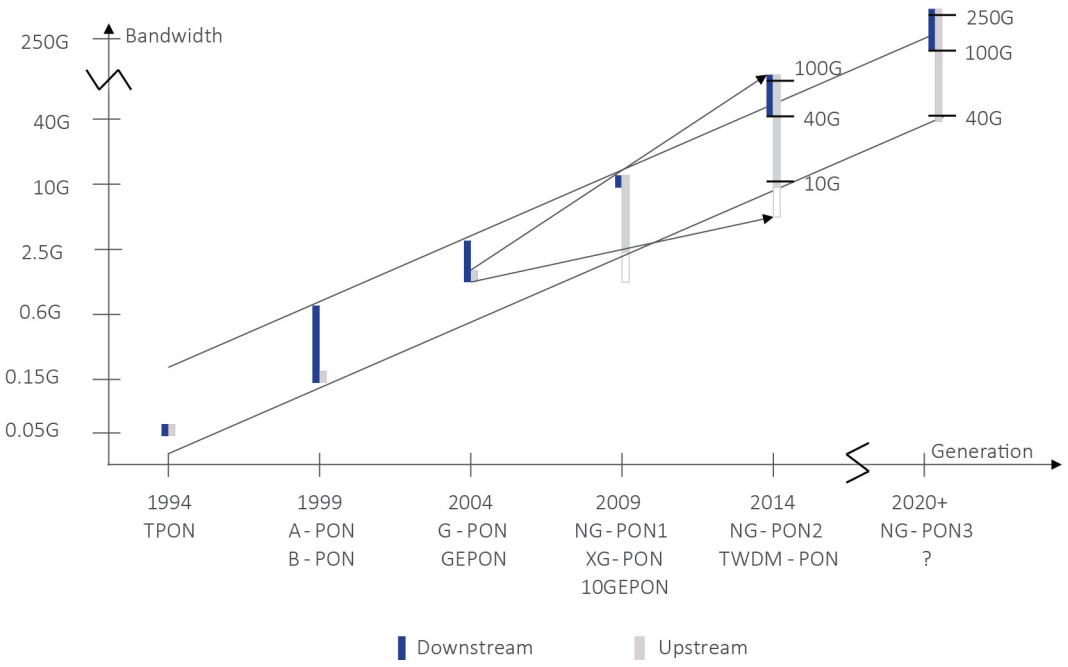
The demand for radio-frequency spectrum to support fixed, mobile and satellite broadband access will only grow, both for communications between people and increasingly for machine-type communications. To meet this growth in demand, a range of regulatory approaches will be required, coupled with efficient procedures for access to suitable radio-frequencies, while ensuring adequate protection for existing systems. To the maximum extent possible, globally harmonized solutions should be sought within international frameworks for spectrum management through standardization activities and ITU World Radiocommunication Conferences.

2.3 Next-Generation Networks in Fixed Broadband

Fixed technologies will still play a vital role in providing connectivity and mobile backhaul. ITU estimates that there will be 884 million fixed broadband subscriptions by end 2016, up 8% on the previous year, which ended with 820 million fixed broadband subscriptions[45]. Point Topic's estimates are somewhat lower, putting the total number of fixed broadband subscribers at around 751 million by end 2015[46]. Ovum forecast that global fixed broadband subscriptions will achieve 920 million by 2019[47], while IHS/Infonetics Research estimated that fixed broadband will reach 1 billion worldwide in 2019, driven by growth in South Asia and key emerging markets[48].

Growth in fixed broadband subscriptions roughly matches growth in overall Internet usage, with fixed broadband continuing to maintain its overall share in Internet usage over the last four years, despite the explosion of mobile broadband. The speed and capacity of passive optical networks continue to increase steadily, helping promote quality of experience (QoE) in new services and applications (Figure 8).

Figure 8: Capacity Trend for Passive Optical Networks (PON)



Source: ITU Telecommunication Standardization Bureau.

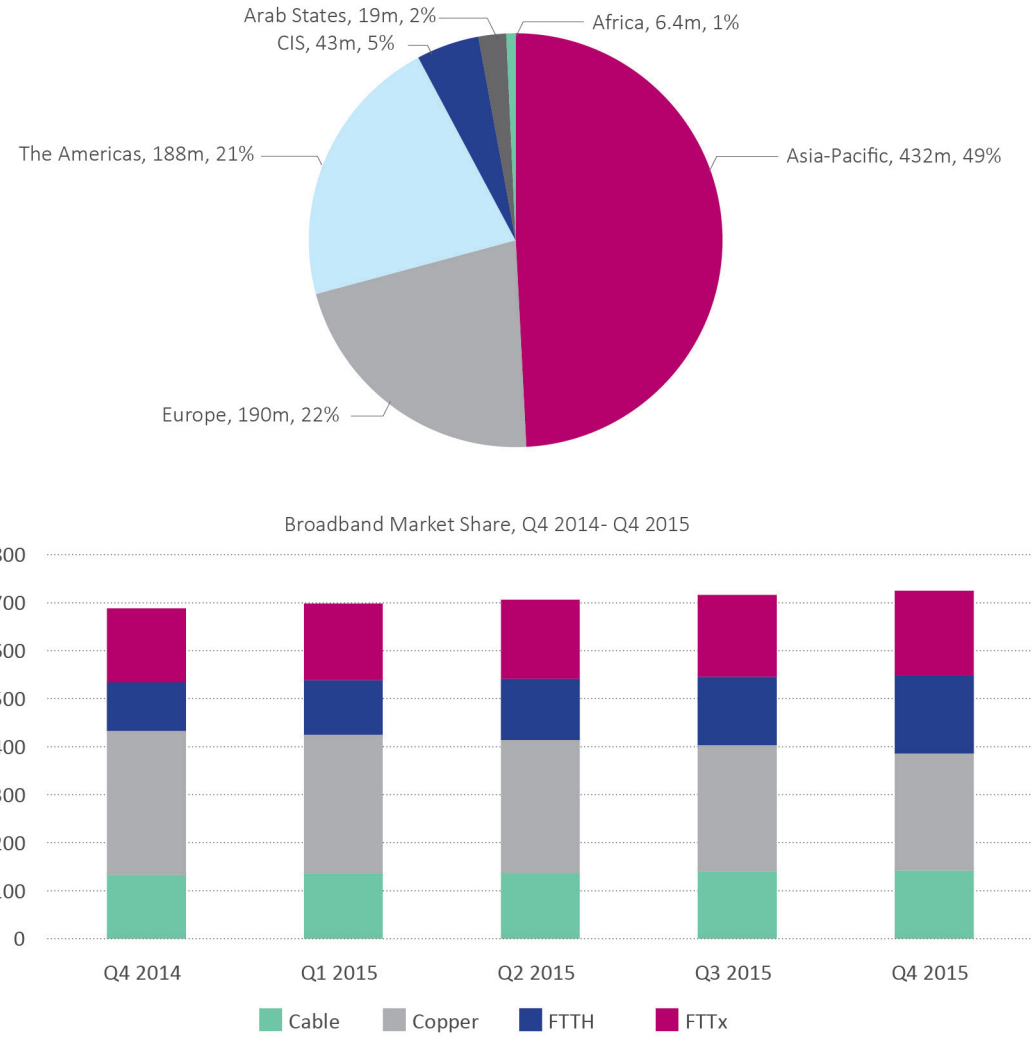
Some interesting trends are evident from the regional analysis, with growth in fixed broadband driven mostly by parts of Asia, Europe and North America. Asia-Pacific accounts for nearly half of all fixed broadband subscriptions globally, and increased its share of the total global market for fixed broadband again, from 44.4% to 46.6% from 2014-2015, and again to 49% in 2016 (Figure 9, top chart). This means that Europe and the Americas experienced declines in regional shares, although they saw growth in absolute numbers, driven by consumer demand for Internet at increasing speeds and the growing number of Internet-connected devices in homes and at work.

Fibre deployments (FTTH and FTTx) are growing fast in both developed and developing countries. Pure copper-based technologies in the local loop (DSL, ADSL and ADSL2+) no longer hold the dominant share worldwide. According to Point Topic (2016), there are now more connections with fibre in the local loop (FTTx – Fibre To The x) than pure end-to-end copper connections[49] (Figure 9, bottom chart). Operators are now using a mix of copper and fibre technologies (e.g. Vectoring, G.fast) to increase the speeds, service quality, shorten time-to-market and optimize investments.

An important recent development in fixed broadband has been the progress made in

Figure 9: Status of Fixed Broadband Subscriptions, 2016

Distribution of fixed broadband subscriptions by region, 2016 (top); Evolution of fixed broadband subscriptions by technology, Q4 2014-Q4 2015 (bottom).



Source: ITU (top); Point Topic (bottom).

G.fast, a new technique to achieve fibre-equivalent speeds of up to 1Gbps reusing traditional telephone lines in the last mile. The standards for G.fast were approved by ITU-T Study Group 15 in 2014 and 2015. Major G.fast trials are now underway in Australia, Panama, Brazil, Croatia, the Rep. of Korea, Norway, UK and US[50], in both developed and developing countries. G.fast can be used in combination with coaxial cable to give maximum speeds of 750/750 Mbps. In Switzerland, Swisscom will extend G.fast deployments to all its FTTB and FTTS connections in mid-2016 to give speeds of up to 500 Mbps[51]. For example, in Austria, A1 is deploying a mix of VDSL2 and G.fast to deliver on the national broadband initiative goal of connecting 99% of homes at 100Mbps. Today, already half of Austria's population has access to broadband service at 100Mbps.

Recently, rapid adoption of new technologies, such as Software-Defined Networking (SDN), network function virtualization (NFV) and new wireless network technologies and solutions are helping change how we use ICTs. The SDN enables instant re-configurations of networks, without the involvement of engineers. NFV replaces specialized network devices (such as routers, firewalls, switches) with software analogues, reducing the number of physical components in the network.

2.4 Towards the Next Generation of Satellite Broadband

New satellite systems are being developed, which are overturning old assumptions about speed, capacity, and latency. High Throughput Satellite (HTS) systems use multiple spot beams and sophisticated ground infrastructure to provide network speed and capacity rivalling, or surpassing, terrestrial technologies in many instances. Recently deployed and upcoming non-geostationary satellite orbit (NGSO) systems in low-Earth or mid-Earth orbit provide low-latency connectivity capable of supporting a wide range of applications. And advances in satellite construction and competitive pressures are reducing the costs of these services for users.

In 2018, a new generation of HTS satellites (named Quantum) will provide Internet services to mobile users and allocate the power of the satellite on the basis of the users' needs[52]. Eutelsat Quantum will be the first satellite with full in-orbit reprogrammable features which will set a new standard in flexibility to address fast-moving or mobile markets.

Satellite connectivity already performs favourably with terrestrial wired solutions in many developed and developing country environments. Several HTS and other advanced systems have recently been launched or are planned for the near future, which are ushering in a new age of affordable, high-capacity, satellite connectivity. As the technology and market continue to evolve, satellite capabilities will continue to improve while the cost of satellite services will fall exponentially, bringing satellite services in line with terrestrial solutions (Figure 10).

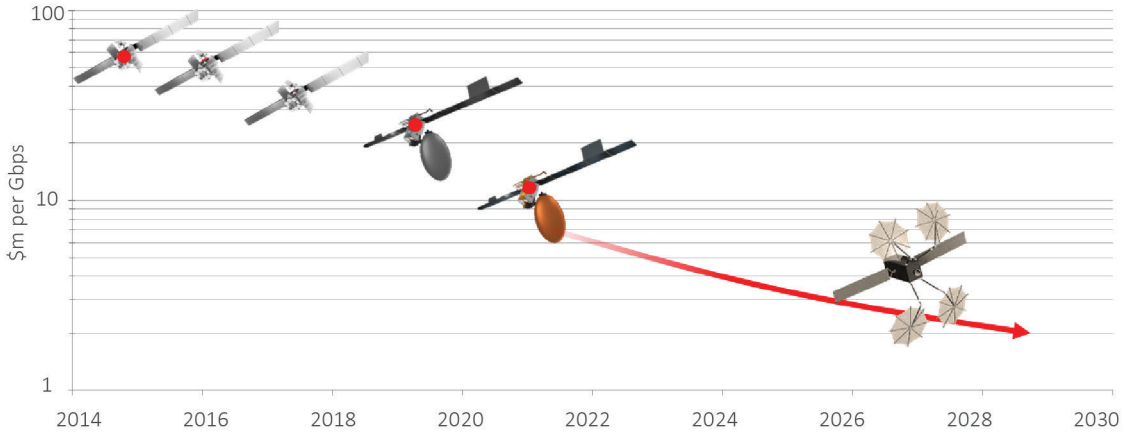
Satellite technology offers many unique capabilities that will make it essential to 5G deployment. 5G networks may well evolve to include software networking/network virtualization across satellite and terrestrial interfaces, providing seamless integration of satellite and terrestrial network elements. Satellite connectivity can also underpin the Internet of Things platforms as part of these 5G systems.

In terms of coverage, satellites will continue to be an effective means for reaching remote and rural areas beyond commercially effective terrestrial coverage (as well as for passengers in mobile environments including vehicles, trains, aircrafts and ships). In addition to extending the range of terrestrial networks, integrating satellite connectivity into terrestrial systems can help improve the quality of experience (QoE) by intelligently routing traffic with different demands for speed and latency between the delivery systems.

Satellite networks will also continue to evolve to increase throughput (in Tbps) utilizing more powerful spacecraft and use of higher frequencies (such as Q/V bands), thereby reducing the cost per bit of data communications. Satellite technology can

Figure 10: Impact of the development of satellite technology on Cost per Gbps

Reduction in Cost per Gbps for Different Generations of Satellite Technology



Source: Inmarsat Intelligence.

also help relieve congestion and overloading of networks and, when integrated into 5G systems, can support a resilient 5G network and ensure connectivity in times or areas where terrestrial networks are unavailable. Additionally, lower frequency band satellite services (such as L-band 1518 to 1559 MHz) are ideal for high-reliability and mobility applications including safety services.

Satellite systems should be given full consideration as solutions for next-generation broadband network deployments in rural and remote areas, as well as in diverse environments and deployment scenarios.

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3 Evaluating Global Growth Using the Commission's Targets

The Broadband Commission first launched its targets in 2011, at the Broadband Leadership Summit, with an initial end-date foreseen for 2015. Today, in mid-2016, progress in the growth of Internet towards meeting these targets has been mixed, with most targets not yet achieved over the initial timeframe. The third target and target 4 (for LDCs) will be achieved by 2016, with good progress in the first and second targets. The fourth target has not been achieved in the original timeframe (except for LDCs). Regrettably, there seems to be backwards progress in the fifth target calling for gender equality in access to broadband Internet.

3.1 Advocacy Target 1: Making broadband policy universal

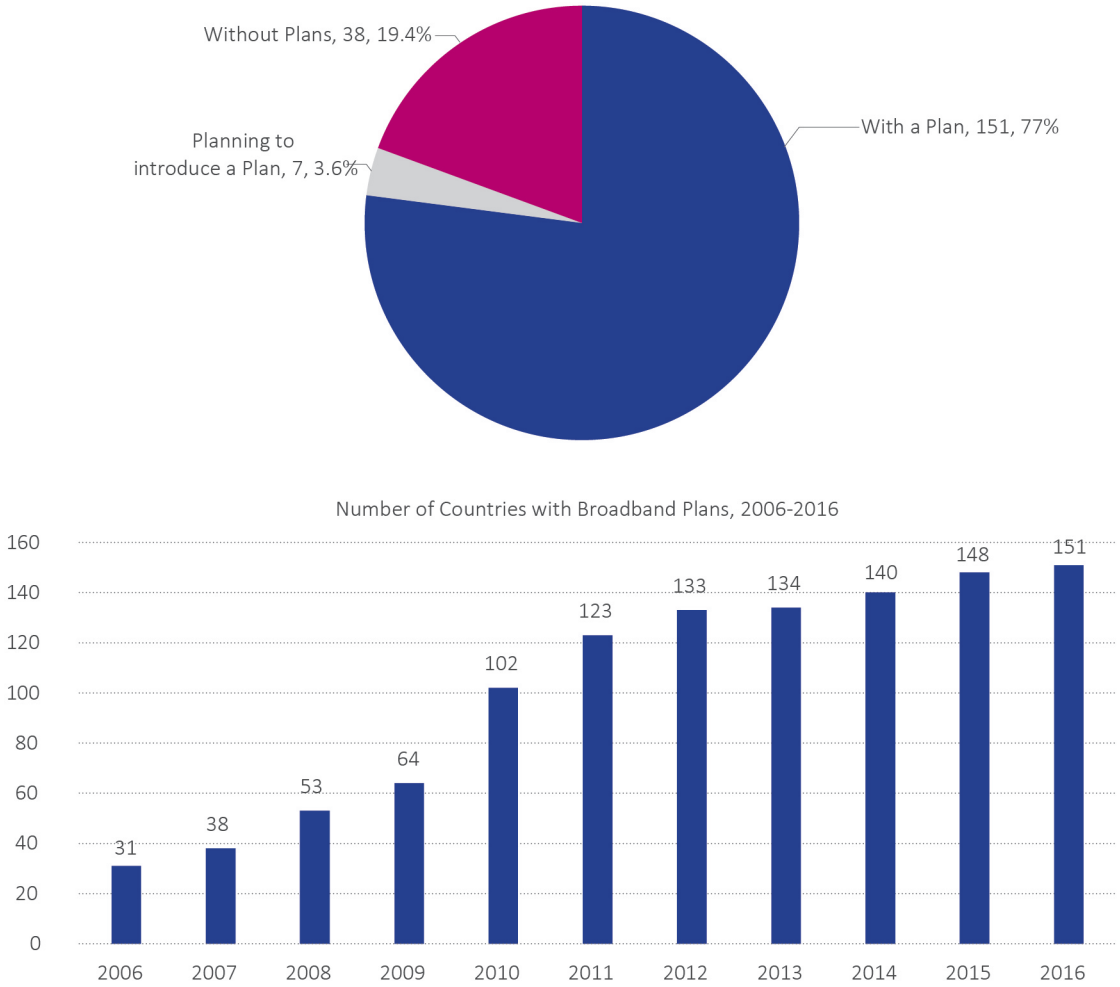
All countries should have a National Broadband Plan or strategy or include broadband in their UAS definitions. Growth in the number of countries with National Broadband Plans (NBPs) has shown good progress over an eight-year period, but has effectively stabilized over the past three years (Figure 11, top). The number of countries with a NBP currently stands at 151, with 38 without (Figure 11, bottom). According to ITU data, the country which has approved a National Plan most recently is Azerbaijan (Appendix 1). A further seven countries are planning to introduce a National Broadband Plan (Cape Verde, Cuba, Dominica, Iraq, Solomon Islands, Saint Lucia and Togo).

Although the Commission's target on NBPs has not been fully achieved, there has been steady progress in the number of countries that have introduced a Plan (Figure 11). Even once a National Plan is approved, it may be subject to a constant process of revision and refinement in many countries. A number of countries are now regularly reviewing their previous NBP – for example, the UK has followed up its 'Digital Britain' Plan with a 'Digital Communications Infrastructure Strategy'. The Philippines is pulling together a number of relevant institutions as it looks to usher in an interim broadband plan[1], while the US has engaged in a flurry of policy activity around broadband, and several Bills have been proposed in Congress to further stimulate progress towards broadband deployment, and additional regulations for broadband and privacy.

In Switzerland, the Swiss Federal Council adopted its new 'Digital Switzerland Strategy' on 20 April 2016, building on the previous Strategy of the Federal Council for an Information Society from 2012. The new 'Digital Switzerland Strategy'[2] is defined as an umbrella strategy intended to co-ordinate the numerous activities and existing expert groups already in place. All measures by departments or federal authorities in relation to the implementation of the strategy are summarized in an action plan. It is intended

Figure 11: Policy Leadership in National Broadband Plans, 2006-2016

Number of countries that have adopted a Plan or Strategy, planning to adopt or without (top chart); Growth in National Broadband Plans, 2006-2016 (bottom chart).



Source: ITU. Note: Bottom chart based on data for 196 countries. National Broadband Plan or strategy includes: a plan, strategy or policy specific to broadband; digital plan, agenda, strategy or policy; ICT plan, strategy, or policy; or a communication plan, strategy, or policy.

that this action plan will be updated annually, and will be continuously developed in dialogue with representatives from the economy, science, research and civil society. Accompanying the new strategy is a structured dialogue on Digital Switzerland, in which all relevant stakeholders are invited to take part.

Policy-makers and the industry may sometimes have different priorities. For instance, in Latin America, GSMA Intelligence notes that a number of governments in this region are aiming to increase mobile broadband coverage to ubiquitous levels[3], while mobile operators are focusing on improving network capacity to meet the growing demand for data resulting from the increasing use of mobile broadband. In this region, governments and regulators may attach onerous coverage obligations to new licenses, but may also fine mobile operators for failing to adhere to strict QoS expectations. There may also be restrictive planning laws on the deploying new infrastructure in rural areas (to improve coverage) and cities (to improve capacity and QoS).

For example, the Brazilian Ministry of Communications has published guidelines to be followed by the National Telecommunications Agency (ANATEL) when reviewing the current regulatory model for telecom services[4]. According to Telesemana, the Ministry recommends that 'public authorities should promote access to broadband services at affordable costs and levels'. Objectives include the expansion of transport networks and FTTH infrastructure in urban areas, in keeping with the Ministry's National Broadband Programme published in November 2014. In addition, the Ministry aims to use mobile broadband technologies to improve Internet coverage in smaller towns and for public sector applications (such as education and health).

There is some evidence that adopting a NBP increases both mobile and fixed broadband penetration[5], but debates continue as to the efficiency and effectiveness of NBPs in some cases. In a recent study, Nokia/ Diffraction Analysis explored the key policy measures that were commonly found in NBPs and investigated the difference in average broadband penetration for countries with and without these five policies. Infrastructure-sharing, public investment in both backbone and access networks and inclusive offers for poorer customers were all found to be helpful in spurring broadband adoption (Viewpoint 6). Viewpoint 7 details the Kingdom of Saudi Arabia's Vision 2030 for building a more prosperous and sustainable economic future through digital transformation.

Viewpoint 6: Government Broadband Plans – Effective Policy Measures

Broadband policies aim for broad adoption of quality broadband, and may focus on availability, affordability or quality of broadband. These policies focus mostly on supply (trying to ensure market offers go in the right direction), although some countries have prioritized demand stimulation as well. A recent joint report by Nokia/Diffraction Analysis published in early 2016 examined the NBPs of 35 countries and explored key policy measures most likely to impact broadband availability:

1. **Public investment in backbone and aggregation (15 Plans): lack of open backbone capacity is a major hurdle to broadband development, especially in emerging markets and/or rural areas. Governments can invest public money (through investments, subsidies or any other financial mechanism) in open access aggregation and/or backbone networks to make broadband more broadly available, increase competition (through equal access to a shared infrastructure) and lower prices for end-users.**

2. **Public investment in access networks (13 Plans): In countries where an open aggregation and backbone network already exists, but where a fixed access network is lacking, governments have directed initiatives and public money toward access networks to boost availability of fixed network access, and increase the quality of broadband infrastructure.**

3. Regulatory framework for infrastructure sharing (21 Plans): In many countries, the incumbent's fixed infrastructure is forced open to create competition in the access network, from resale of bitstream wholesale products to full structural separation. Infrastructure sharing can drive competition, lower prices (affordability) and boost innovation (quality).

4. Inclusive/social offers (9 Plans): Inclusive or social offers aim at providing those who cannot afford broadband with some connectivity, either under licenses or financed by government.

5. Regulatory framework facilitating FTTx roll-out (11 Plans). They can be combined with public funding in access networks, but also include measures designed to reduce the cost of deployment or eliminate hurdles (rights of ways, building consent, etc.).

The report found that:

- Countries that included **public investment in backbone and aggregation** in NBPs have seen prices drop by 4% of GNI per capita in 4 years versus 1% for countries that had not invested.

- Countries that invested **public money in fixed access** saw a marked surge in fixed broadband subscriptions of 30% higher growth over 4 years than countries that had not invested.

- Countries that put in place a framework for **infrastructure-sharing** see the proportion of households with Internet access increase significantly from an initial gap of 2% in year zero to a gap of nearly 10% in year 3 in households with Internet (Figure 16).

- **Subsidies** – countries with inclusive or social offers in their NBPS saw subscriptions grow significantly faster than those without. From an equivalent starting point, growth in Internet usage is 18% in Year 4 for countries with subsidies, versus 10% growth for countries without.

- The impact of **frameworks for FTTH development** was difficult to quantify. However, country case studies (for South Africa and Qatar) suggest this is still a very important factor.

Source: "Government broadband plans: 5 key policy measures that proved to make a difference", Nokia/Diffraction Analysis (2016).

Viewpoint 7: Saudi Arabia's Vision 2030

Saudi Arabia's Vision 2030 is an ambitious blueprint for digital transformation for a prosperous and sustainable economic future, which expresses the Kingdom's long-term goals and reflects its strengths and capabilities. One of its important goals is for nationwide digital transformation, with public-private partnerships (PPPs) driving innovative new business models and solutions in the Digital Economy. Vision 2030 calls for developing the digital infrastructure in order to activate economic sectors and support industries and private sector entities.

With a view to achieving the 2030 Vision, the Kingdom launched its Transformation Program 2020. Among its many goals, in the domain of ICT, the Transformation Program 2020 identified 10 Strategic Goals and 19 initiatives, as well as assets that may be invested to support digital transformation, including these targets:

- Increasing penetration of high-speed broadband access by promoting investment in fibre optic roll-out in the Kingdom to achieve 80% coverage in densely populated urban areas and 55% in other urban zones by 2020.

- Increase the maturity of government services transformation in e-services from 44% to 85%.
- Increase the e-government transformation measurement (Qyas) from 50 to 80%.
- Raise KSA's rank in the UN index for the development of e-government from 36th to 25th.
- Increase FTTH coverage in densely populated urban areas from 44% to 80%.
- Increase Internet user penetration in KSA from 63.7% to 85%.
- Increase the retained value for the information technology industry from 20% to 40%.
- Increase the IT industry's contribution in the non-oil GDP from 1.12% to 2.24%.
- Supporting adoption of e-commerce, and increasing ICT skills to meet future work needs.

In line with the *2030 Vision*, the implementation of PPPs with leading technology companies has already begun. As a result, Internet user penetration has grown rapidly from 41% in 2010 to reach 70.4% by Q1 2016, for some 22.3 million total Internet users. Fixed broadband subscriptions have grown to around 3.9 million subscriptions by March 2016. The total number of mobile broadband subscriptions reached around 28 million by Q1 2016, equivalent to a penetration rate of 88.5%. The mobile broadband market continues to gain momentum, driven by the launch of 4G services and a dramatic increase in the number of users, and demand for data traffic over portable devices.

Source: Government of Saudi Arabia.

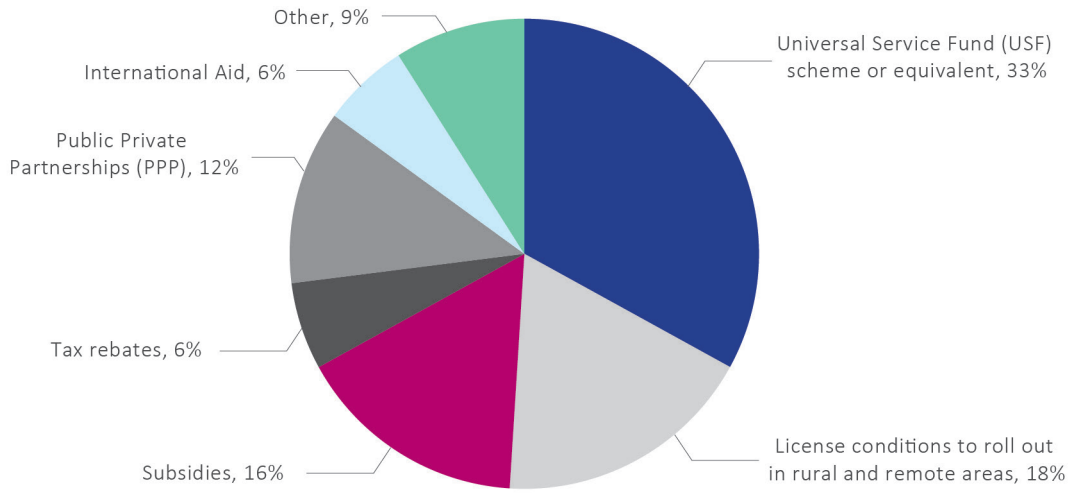
There are of course other policy options open to policy-makers in bridging the national digital divide or urban/rural divide, in addition to a National Broadband Plan. Universal Service Obligations (USOs) or a Universal Service Fund (USF), subsidies, tax rebates, the optimization of new business models, and PPPs are all options that countries can use when seeking to increase broadband penetration and access. In fact, USFs still seem the most popular mechanism with 33% of ITU Member States, followed by license conditions or USOs (18%) and subsidies or inclusive offers (16%) – Figure 12. However, the question of the obligations linked to broadband universal service and appropriate policy measures is an ongoing debate. The future role of broadband within universal service will be part of the forthcoming telecoms review in EU, expected in the second half of 2016. Currently Finland, Malta and Spain provide for a minimum broadband speed in their national law.[6]

Today, the next generation of policy frameworks are coming to fruition. A number of countries are starting to introduce legislation for the Internet of Things (IoT) and smart cities. ITU notes around ten countries have introduced an IoT roadmap and Plan. In the US, the NTIA has just issued a request for comments on "The benefits, challenges, and potential roles for the Government in fostering the advancement of the Internet of Things"[7].

The IoT has policy implications across many areas, including licensing, spectrum management, standards, competition, security, cross-border data flows and privacy – only some of which are the familiar territory of telecom regulators, compared to other domains where non-telecom regulators often take the lead. Maximizing the benefits of the IoT requires more coordinated regulation across sectors, with telecom/ICT regulators working with counterparts in data protection and competition, but also with emergency services, health and highway authorities.

The experience of broadband deployment in Russia provides a good example of national policy-making that has resulted in a relatively high fibre penetration per capita (Viewpoint 8).

Figure 12: Strategies Adopted to Achieve the Targets for Rural & Remote Areas, 2015



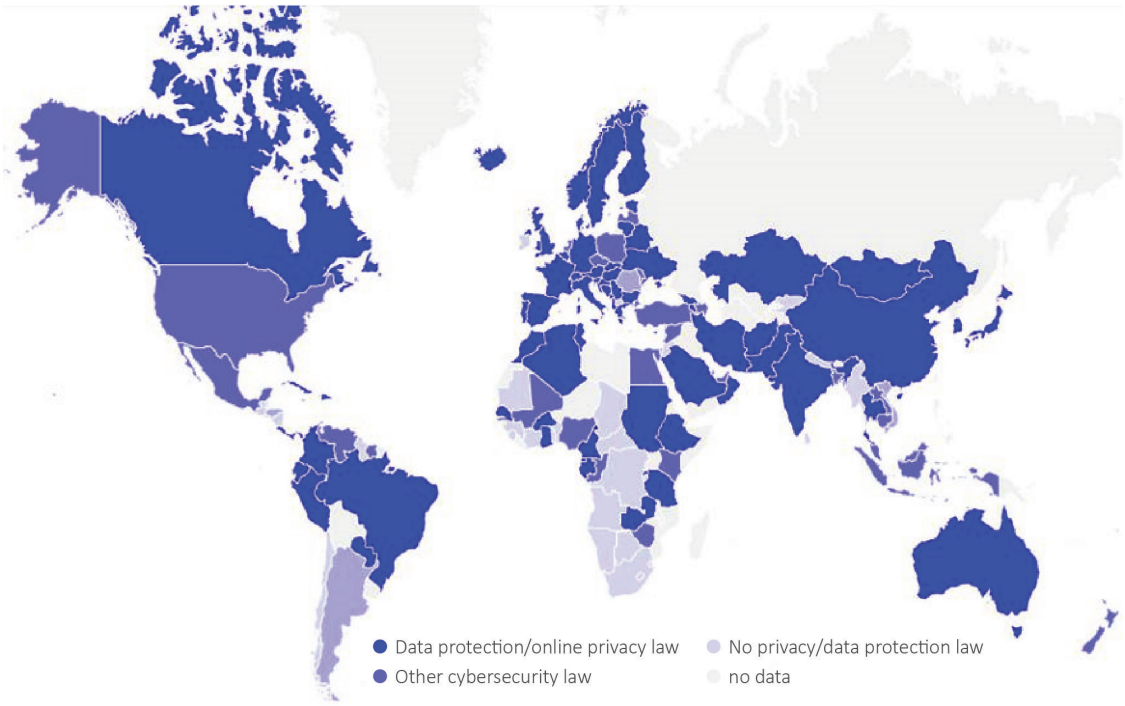
Source: ITU-D Study Group 1, Q5/1; responses were received from 42 ITU Member States.
Note: Multiple responses were possible, so this pie chart shows proportions of total responses.

Viewpoint 8: Broadband Infrastructure Development in Russia

With the aim of bridging the digital divide between the cities and scarcely populated and hard-to-reach regions, the Ministry of Telecom and Mass Communications of the Russian Federation has been consistently implementing measures to ensure Internet accessibility through advanced communication technologies. Russia is currently implementing a project which is unique in its complexity, scale (215,000 km of fibre optic links) and investment, aimed at development of broadband infrastructure to offer advanced communication services to all citizens. To connect remote areas to the telecom networks of the Russian Federation, the Ministry has been supporting projects to build submarine fibre optic links for remote mainland areas along the Magadan-Sakhalin-Kamchatka route, and during the second stage in 2018, it is planned to connect telecom networks of the Kuril Islands to the uniform telecom network of the Russian Federation. The length of the two submarine fibre optic cables will be 2,740 km with throughput of 440 Gbit/s. Universal broadband services will be provided in 1,757 access points (105% to the Plan), and 2,215 healthcare facilities and schools. Approx. 30,000 km from 215,000 km of planned fibre optic links for delivery of UBB services have been constructed (i.e. more than 14% of the total required length). The total service area of access points provides free access to over 2,000 additional sites of Russian Federation Government bodies, Government budgetary agencies and the Common Government Services Portal of the Russian Federation through wireless networks. A major feature of this project is its social orientation. Firstly, it is intended for people living in small villages and towns with populations of up to 250-500 people, which will benefit from low tariffs established by the Russian Government. 10Mbit/s Internet access with unlimited incoming and outgoing traffic will cost just 45 rubles per month (70 US cents). This project aims to achieve social affordability of public communication services in Russia compared with many other countries. Due to the activities of the Ministry, Internet penetration among adults reached 69% or 80.5 million people by end 2015 (Public Opinion Foundation survey, April 2016).

Source: Ministry of Telecom and Mass Communications of the Russian Federation.

Figure 13: Data Protection and Privacy Legislation Worldwide, 2015



Source: ITU Regulatory Survey, www.itu.int/icteye.

Progress in the IoT brings with it greater potential, however, for recording information, generating data or monitoring people's behaviour, both individually and over a group or population. The introduction of ICTs in many different realms of life also raises many issues with respect to trade-offs between privacy, confidentiality and ownership of data for the sake of greater protection, security, safety, better services and efficiency (see Chapter 5 for a discussion of some of the issues regarding data and smart cities). Accompanying this growth in IoT policy-making, a growing number of countries are therefore also introducing data protection legislation.

According to ITU, at the national level, by 2015, 110 countries had introduced some kind of cyber-security legislation, of which 83 have adopted specific arrangements to secure the protection of data and privacy at the national level (including 64 developing or transition economies). However, in Asia and Africa, less than four out of every ten countries have introduced data protection and privacy laws. A large number of countries are in the process of introducing draft legislation, including Brazil, Egypt, Namibia and South Africa (Figure 13). Meanwhile, the United States' FCC recently introduced a Notice of Proposed Rulemaking (or NPRM) on "Protecting the Privacy of Customers of Broadband and Other Telecommunications Services"[8], debating whether to make data protection an opt-in or opt-out setting for ISPs.

Finally, another dimension of some National Broadband Plans is that some successful models are effectively being 'exported' and replicated abroad. Where projects have proven to be successful, and have helped boost broadband connectivity and services, best practices can be applied elsewhere to help improve broadband connectivity in other countries (Viewpoint 9).

Viewpoint 9: Global 'GiGA Island' Project Helps Transform Bangladesh into Digital Bangladesh

In an effort to bring 'broadband empowerment' to an unconnected part of the world, KT has been collaborating with the Government of Bangladesh, IOM and NGOs. This initiative is dedicated to enhancing quality of life through the high-speed GiGA network by improving public services and enhancing access to information in Moheshikhali Island, Bangladesh. KT and IOM with the Government of Bangladesh plan to provide ICT services to implement the success of the GiGA Island. The project aims to provide the benefits of high-speed Internet and to build a replicable national development model for developing countries.

The government-supported Bangladesh 'GiGA Island' Project, labelled 'Digital Island', is distinctive from the case of Rep. of Korea because: (1) It is a multi-party collaboration model involving numerous public and private sector stakeholders from both countries; (2) It is aligned with a national development strategy, 'Digital Bangladesh', which is a part of Bangladesh's 'Vision 2021'.

Vision 2021 is a national initiative to transform Bangladesh into a middle-income country by 2021. As part of this strategic vision, Bangladesh has committed itself to build a 'Digital Bangladesh' that is poverty-free, has healthy citizens and skilled human resources, all enabled by ICT. Among its key pillars, a contribution of at least 2% led by ICTs is expected to be achieved by 2017, calling for large-scale investment support and elevating the skillset of the young workforce.

The demographic profile of Bangladesh embodies a high propensity to achieve 'Digital Bangladesh': the younger generation (18-35) accounts for 65% of the population, while internet penetration and mobile penetration currently stand at 34% and 83%, respectively. Taking all this into consideration, the country is concentrating its efforts on developing a highly skilled IT workforce and building the supporting network infrastructure.

For choosing a site in Bangladesh, KT considered network feasibility, investment effectiveness, and societal value to satisfy relevant socio-economic needs and selected Moheshikhali Island, with a total population of 321,218 and population density of 900 people per kilometre squared. The average literacy rate is 30%, below the national average of 50%.

Beginning in November, KT plans to roll out network infrastructure; GiGA Wire (through existing copper lines), GiGA Microwave (over legacy microwave equipment) and GiGA WiFi in three districts in Moheshikhali Island. Each has high population density, concentrated public institutions and low access to network infrastructure, an ideal environment for expanding connectivity and maximizing the use of ICT solutions. Gradually, KT plans to expand the coverage to overall islands in cooperation with development organizations.

The 'GiGA Island' Project aims to empower residents of rural communities, using ICT technology. In collaboration with the Government of Bangladesh, KT identified four major social priorities in Moheshikhali: Education, Health, Information, and Agricultural Resilience Service. For each area, KT has assigned initiatives: A21, Teachers Portal, Learning & Earning, and Agricultural Centre. By facilitating these policies, the viability and sustainability of the project is to be achieved. Once the network is built, the project will start introducing relevant ICT solutions to the targeted government facilities and provide training to the service providers to ensure they can utilize the services.

The 'Digital Island' promotes the achievement of a number of the SDGs and shows how ICT can contribute to

achieving the SDGs, including: Goal 1 (End Poverty), Goal 2 (No Hunger), Goal 3 (Good Health and Well-Being), Goal 4 (Quality Education) and Goal 9 (Good Jobs and Economic Growth).

For instance, to combat poverty and hunger, 'Digital Island' provides IoT solutions, which help farmers by sensing and analysing salinity information to boost agricultural productivity, and enable efficient use of farming resources. To promote good health and well-being, the project provides access to health education, as well as diagnosis tools for early and remote detection and prevention of diseases. By providing distance learning programmes to students, the project expects to improve digital literacy, which ultimately acts as a powerful lever for achieving broader goals of good jobs and economic growth.

Source: Korea Telecom (KT).

3.2 Advocacy Target 2: Making broadband affordable

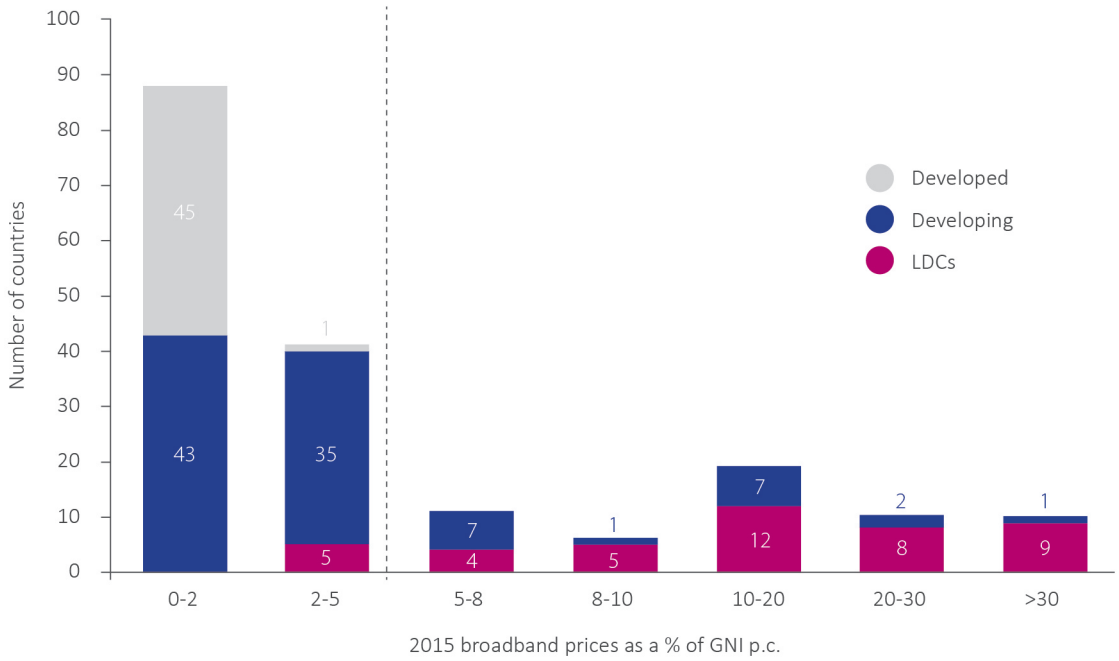
Entry-level broadband services should be made affordable in developing countries through adequate regulation and market forces. There are a number of key barriers to expanding connectivity, including lack of infrastructure, and awareness of the value and relevance of being online, but affordability is increasingly identified as critical in expanding access to broadband in developing countries, especially LDCs. Affordability describes both the price of services, as well as the cost of devices, relative to income. The good news is that new technologies and market forces have encouraged the launching of innovative business partnerships between key players in the ICT ecosystem, helping make broadband connectivity more affordable, accessible and valuable for unconnected people. New technologies such as those being developed by Facebook's Connectivity Lab, for example, can help provide a solution to these issues (see Viewpoint 10).

Fixed broadband services are becoming more affordable – over the past five years, fixed-broadband prices as a share of GNI per capita have dropped by some 65%[9]. By 2015, the majority of countries had reached the Commission's target of offering basic fixed-broadband services at <5% of monthly GNI per capita. 83 developing countries had achieved the Commission's affordability target, but only 5 LDCs. Broadband still remains unaffordable in much of the developing world.

Huge discrepancies in affordability persist. According to ITU's latest price research, a monthly fixed broadband package cost 1.7% of average income in developed countries, compared with 31% of average income in developing countries, and 64% of average income in Africa[10]. Mobile broadband cost 1-2% of monthly income in developed countries, compared with 11-25% of monthly average income in developing countries. The European Union performs well in terms of affordability, with all EU countries achieving an affordability threshold of below 2% of GNI per capita, instead of 5%, based on 2014 data. The calculation of affordability of broadband services is increasingly difficult, due to the bundling of broadband services with other audiovisual services (e.g. fixed phone, mobile phone and TV) in some markets[11], and the comparison of prices broadband services in standalone offers is complex. For transition economies, the World Bank notes that, when taking into consideration the distribution of income in countries, over 80% of the population in Kyrgyzstan, Armenia and Georgia would need to spend more than 10% of their household expenditure to afford a basic mobile plan.

Issues of affordability and access are especially crucial for Small Island Developing States (SIDS). Despite hard won gains, connectivity remains an obstacle for many, particularly for SIDS in the Pacific, where major gaps persist in access to reliable fibre-optic and satellite broadband services. Connectivity is a lifeline for remote islands, making development of ICT infrastructure and resources a high priority. Nonetheless, operational costs of networks in many SIDS are above world average, posing major challenges in the expansion of telecom services by both public and private operators.

Figure 14: Broadband sub-basket, 2015



Source: ITU.

Viewpoint 10: Facebook's Mission to Connect the World

Internet access can offer life-changing opportunities, information and experiences, but there are still nearly 4 billion people not connected to the Internet. Around 1.6 billion of these live in remote locations, and do not have access to broadband networks due to the costs associated in bringing conventional networks to those areas. Aiming at expanding connectivity worldwide and bridging barriers to digital inclusion, Facebook's Connectivity Lab is developing new technologies, including high-altitude unmanned aircrafts, lasers, satellites and terrestrial wireless system to provide connectivity to communities with different population densities.

Most recently, the Connectivity Lab announced a big milestone: the first full-scale test flight of Aquila, Facebook's high-altitude, long-endurance, unmanned solar-powered airplane. Aquila has a wingspan bigger than a Boeing 737 airplane but weighs much less than an electric car due to its design and carbon-fibre frame. It flies on solar power during the day and battery at night. When in operation, Aquila will be part of a fleet of aircraft beaming Internet access to people within a 60-mile diameter for up to three months at a time. It will fly above commercial air traffic and weather. It will use space laser communications as to communicate between aircraft, and e-band technology to beam connectivity from the airplane to the receivers on the ground. Aquila's first full-scale flight took place on 28 June 2016 in Yuma, Arizona. In future tests, the Connectivity Lab team will fly Aquila faster, higher and longer, eventually taking it above 60,000 feet.

This work is extremely important for Facebook and its mission to connect the world. New technologies such as Aquila have the potential to bring access, voice and opportunity to billions of people around the world, and may do so more rapidly, and more cost effectively, than has proved possible to date.

Source: Facebook.

3.3 Advocacy Target 3: Broadband homes

40% of households in developing countries should have Internet access (either fixed or mobile). Access to broadband or the Internet at home is one of the more inclusive ways of bringing people online. At home, household members may be able to access a household phone or connection, although socio-cultural norms may often still represent a major barrier to girls' and women's access to broadband and other ICTs in many regions of the world. In addition, home connectivity remains relevant, since it will be key to advance IoT solutions, which will be fundamental to advance the SDG agenda, in particular in the areas related with sustainable consumption and energy efficiency.

Household Internet access shows strong gains. Globally, 52% of total households will be connected to the Internet by the end of 2016, up from 49% in 2015 (Figure 15, top chart). Internet access for households in developed countries is close to saturation, with 84% or over four-fifths of households connected to the Internet. The proportion of households in developing countries with access to the Internet has increased from 37.6% in 2015 to 41.1% in 2016. This means that the Broadband Commission target of 40% has been achieved. However, this is a global average, which masks strong regional disparities in access (Figure 15, bottom chart).

Parks Associates estimates that broadband adoption will reach 84% of U.S. households and 79% of Western European households in 2016. Of these broadband households, ownership of smart home products increased from 16% to 19% of U.S. broadband households in 2015, with 44% of households without a smart home device planning to purchase one in 2016. By 2020, 50% of North American broadband households will have a smart home device, including wearables, smart fabrics, and virtual and augmented reality (AR)[12]. Boosting household Internet access remains a particular issue in Africa (Viewpoint 11). Huawei estimates that, for advanced broadband, approximately 1.1 billion homes remain unconnected, while some 400 million have slow connections and unreliable data speeds (Viewpoint 12).

Viewpoint 11: Boosting Household Internet Access in Africa

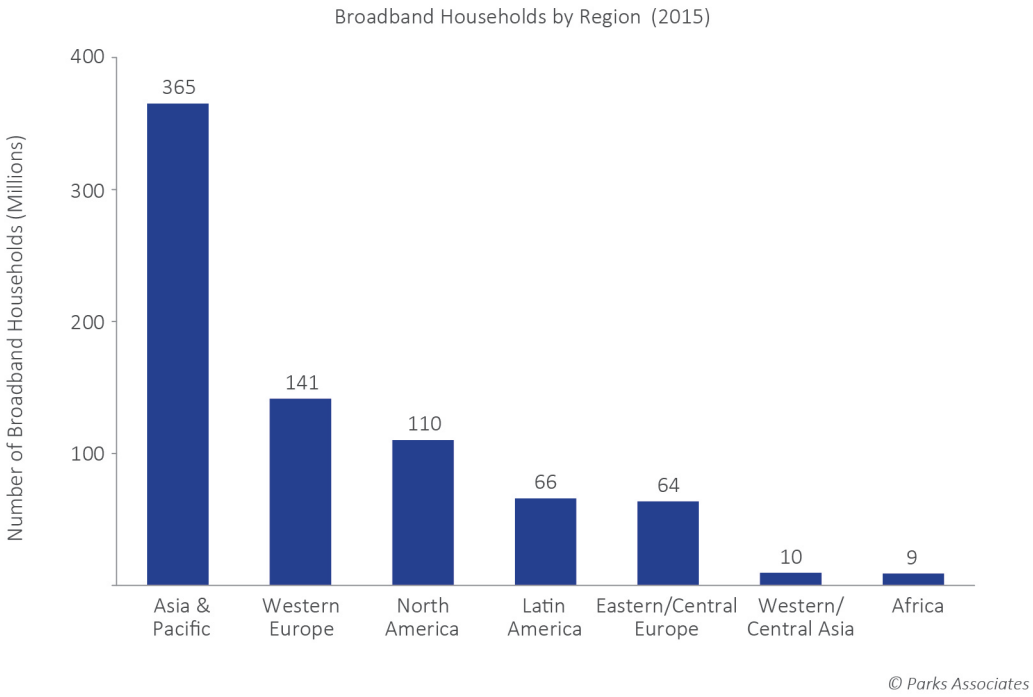
In Africa, the main focus is on means of owning a smart phone and accessing Internet through the smart phone. People in countries such as Rwanda, Kenya and Uganda are hoping that the various initiatives that have started to connect homes to the Internet will cover all parts of the countries in future, although in actual fact, Internet connections will take time to be fully implemented within households.

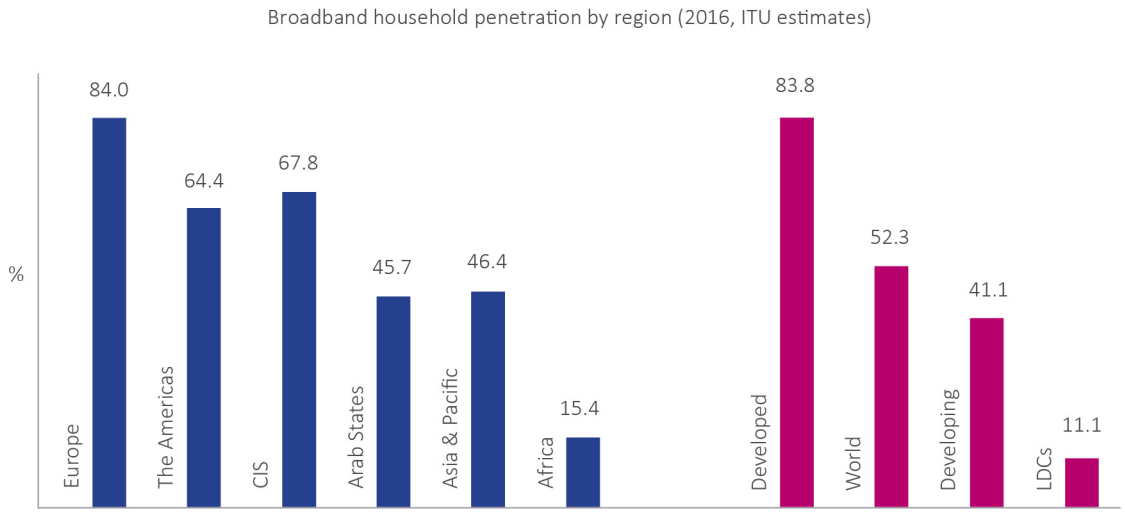
In Rwanda, Liquid Telecom has invested more than US$35 million in rolling out Rwanda's first FTTH network to homes and businesses in Kigali, offering speeds of up to 100Mbps[13]. Liquid Telecom recognizes Rwanda's role as an Internet services hub for East and Central Africa, and already Liquid operates a nationwide fibre network with cross-border connectivity into all four neighbouring countries (Burundi, Dem. Rep. of Congo, Tanzania and Uganda). It plans to continue its FTTH build in Kigali and expand to other cities in future.

In Kenya, Kenya Power has launched a twelve-month pilot project with Safaricom aiming to connect 12,000 homes in Nairobi with a fibre optic Internet network[14]. The ISP Liquid Telecom is spending US $1.07 million in 2016 to set up 200 free Wi-Fi hot spots in the country's major towns including Kisumu, Mombasa, Nakuru, Kajiado, Eldoret and Nyeri. The company has already connected 2,500 homes in Mlolongo and Runda and is working to connect 10,500 more homes by the end of 2016[15].

In Uganda, Oxfam is running the *Internet Now! Project* aiming to improve people's lives through Internet access in 100 communities in northern Uganda. Funded by the Dutch National Postcode lottery's Dream Fund, it aimed to connect 100 rural villages with high-speed fibre-optic connections and to have connected 200,000 people through visits to the Internet visitor centres[16].

Figure 15: Number of households with broadband access by region, 2015





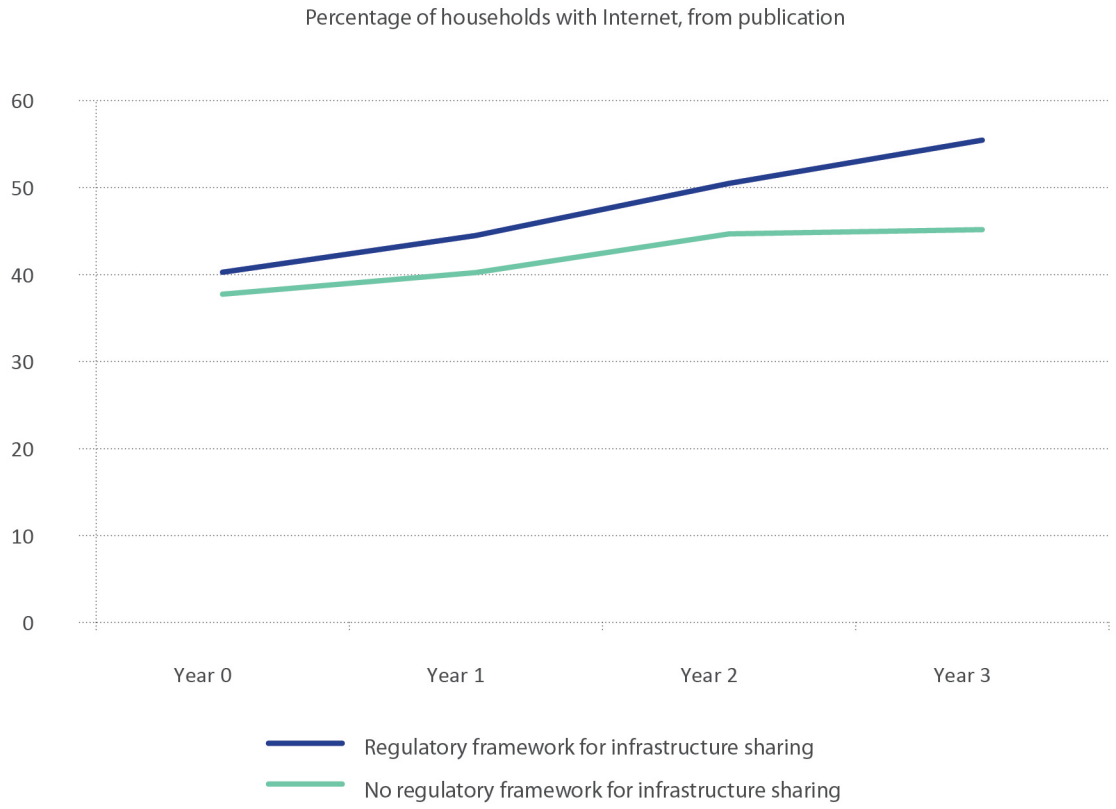
Source: Parks Associates (top); ITU World Telecommunication Development Indicators (bottom).

Meanwhile, the company Soliton has been laying fibre cables around Kampala in partnership with Google[17]. These many different projects illustrate the range of initiatives and investments underway to provide greater household Internet access in African countries.

Source: Dr. Speranza Ndege, Kenyatta University.

Nokia/Diffraction Analysis (2015) found that countries that put in place a framework for infrastructure-sharing generally benefit from a significantly higher proportion of households with Internet access, from an initial gap of 2% in year zero to a gap of nearly 10% in year 3 in households with Internet (Figure 16).

Figure 16: Impact of Framework for Infrastructure-Sharing on Percentage of Households with Internet Access



Source: Figure 6, "Government broadband plans: 5 key policy measures that proved to make a difference", Nokia/Diffraction Analysis (2016).

Viewpoint 12: Redefining Broadband for "Building A Better Connected World"

Huawei believes that broadband connectivity plays a major role and becomes a necessity for life (such as water, food and shelter). But the predicament is how to address the digital divide in the era of advanced broadband, where approximately 1.1 billion homes remain unconnected, while some 400 million have slow connections and unreliable data speeds?

Research shows that a 20% increase in ICT investment can lift a country's GDP by one percentage point, making national broadband networks a matter of strategic concern to governments around the world. Huawei supports the *ITU Connect 2020* and the SDGs with its slogan of "**Building a Better Connected World"** that embraces new applications, business models, industries and space where every heart and soul connects. **GigaBand** (over fiber, copper, coax) for last-mile connectivity, **ultra-high definition immersive video experience,** and network modernization, based on **a cloud strategy** that is essential for a win-win ecosystem in a connected world.

Huawei believes that Governments and regulators play an essential role in building and regulating National Broadband Network (NBN) ecosystems. Through well-planned and investment-friendly policies, Governments can address market failures, ensure optimal resource allocation and realize opportunities for advances in education, business, and healthcare. With deep industrial standing and long-standing research innovation, Huawei has

achieved GigaBand over last-mile media. GigaBand provides Giga capabilities as a last-mile solution and supports ultra-high definition video for immersive experience, Smart Home (for the indoor IoT) and smart provisioning for network modernization and 'cloudification' (meaning the greater and more robust availability of cloud infrastructure).

Operators, utilities and building companies must work together to provide fibre to the home. Governments can help by enacting supportive policies and regulatory frameworks that encourage investment and supply of necessary infrastructure. Telcos can reduce ICT costs and time by sharing municipal infrastructure (such as power-grid companies, gas, water and other utilities) and considering compensation for owners of non-telecom infrastructure. The ITU and the European Union (EU) advocate greater infrastructure sharing and coordination as a means of increasing access to high-speed broadband, and improving the efficiency of the civil engineering efforts needed to provide it.

For Greenfield sites, such policies would require or assume that buildings must be fibre-ready before occupancy or sale. For Brownfield sites, regulatory frameworks would provide incentives to encourage re-use of non-telecom ducts and conduits that, in return, help in reducing the cost of fibre broadband roll-out. Possible business models for such infrastructure-sharing could include:

- **Outsourcing,** where utility companies lay cables and are compensated by broadband providers;
- **Renting,** where the utility lays fibre and leases capacity to a telco (or offers broadband itself);
- **Build-and-sell,** where the utility lays the fibre and sells it to the broadband service provider.

Economic and ICT growth can be fuelled by investment-friendly regulations and hence, accelerate the national broadband support. High-speed and affordable broadband connectivity is the right of each citizen and the foundation stone of any developed society. **Broadband does not only mean simple connectivity,** but also the nation-wide infrastructure readiness covering (urban and rural reach) with minimum 25Mbps or higher speeds to GigaBand capabilities for supporting health, education and industrial automation fields and giving people a better quality of life.

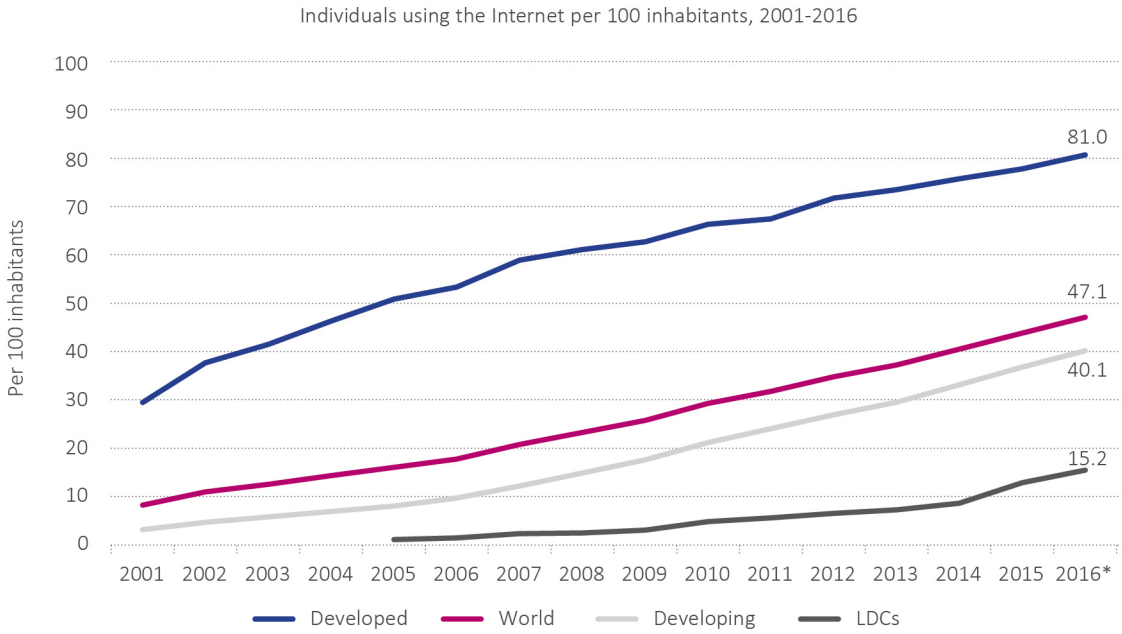
Source: Huawei.

3.4 Advocacy Target 4: Getting people online

Internet user penetration should reach 60% worldwide, 50% in developing countries and 15% in LDCs. By the end of 2016, some 3.5 billion people or 47.1% of the world's population will be online[18], up from 3.21 billion people in 2015 (equivalent to 43.8% penetration). The target of 60% Internet user penetration is unlikely to be achieved until 2021 at the earliest. In the developing world, Internet penetration will reach 40.1% by end 2016 (up from 24% five years earlier). However, the good news is that the LDC target of 15% should be achieved this year, with a projected penetration of 15.2% in LDCs by the end of 2016 (Figure 17).

In some ways, the question of where people are offline is just as interesting as the question of where people are online. According to McKinsey (2014), the top twenty countries with the largest offline populations (which includes the United States at number #15) account for around 75% of the total global offline population. The top three countries alone (India, China and Indonesia) account for 46%, while adding in Pakistan, Bangladesh and Nigeria accounts for 55%[19]. So global efforts to 'connect the unconnected' could in fact target a relatively small number of countries, based on their large offline populations.

Figure 17: Internet User Penetration, 2016



The developed/developing country classifications are based on the UN M49, see: http://www.itu.int/en/ITU-D/Statistics/Pages/definitions/regions.aspx.html

Note: denotes an estimate.*
Source: ITU World Telecommunication/ICT Indicators Database.

3.5 Advocacy Target 5: Achieving gender equality in access to broadband by 2020

Gender equality in access to ICTs and broadband is essential for empowering women and girls through access to information, learning, improved decision-making, better education, new digital skills and potentially better incomes, although there is some discussion about the impact and consequences of the Internet and web content on the perceived status of women[20]. Gender equality was recognized as a goal in both the MDGs and the SDGs as both a principle and a stand-alone goal (SDG #5), as well as being integrated into all other SDGs as a vital enabler of true and equitable development. Improving women's participation and empowering women has been recognized as a powerful enabler for improving their lives, as well as the lives of their families, in development projects in many different areas.

The ITU estimates that in fact, the overall global Internet user gender gap grew from 11% in 2013 to 12% in 2016. Internet user penetration rates are higher for men than for women in all regions of the world (Figure 18, top chart), with the smallest gaps observed for the Americas (<2%) and CIS (5%), and largest gaps found in Africa (23%), Arab States (20%) and Asia-Pacific (17%). The gap is also growing in the LDCs at 31%, up from almost 29% in 2013[21]. GSMA estimates that there was an overall gap of 202 million fewer women owning a mobile phone (Figure 18, bottom chart).

In 2015, ITU and UN Women (in collaboration with various partner countries and organizations) launched an 'Action Plan to Close the Digital Gender Gap'[22]. The Action Plan outlines a framework for key actions to foster and accelerate inclusive and sustainable development by closing the digital gender gap and harnessing the transformative potential of ICT for women's empowerment.

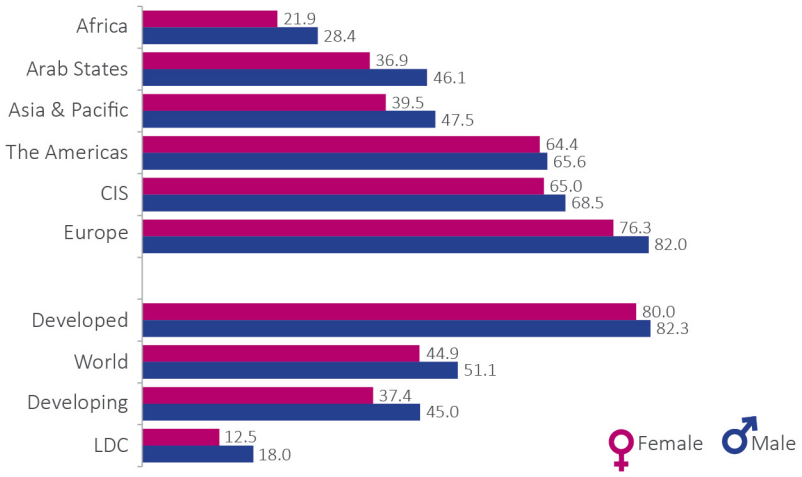
It is clear that these gaps limit the potential of ICTs for women and girls and perpetuate inequalities between boys and girls, which sometimes start from very early on. Some barriers may be obvious (such as affordability

or lack of access to or decision-making over money and resources or limitations over women's physical and social mobility); other barriers may be more subtle – such as prioritizing access by boys to available computers and phones or lack of access for girls and women to safe and women-friendly cyber-cafés and public spaces with ICT facilities.

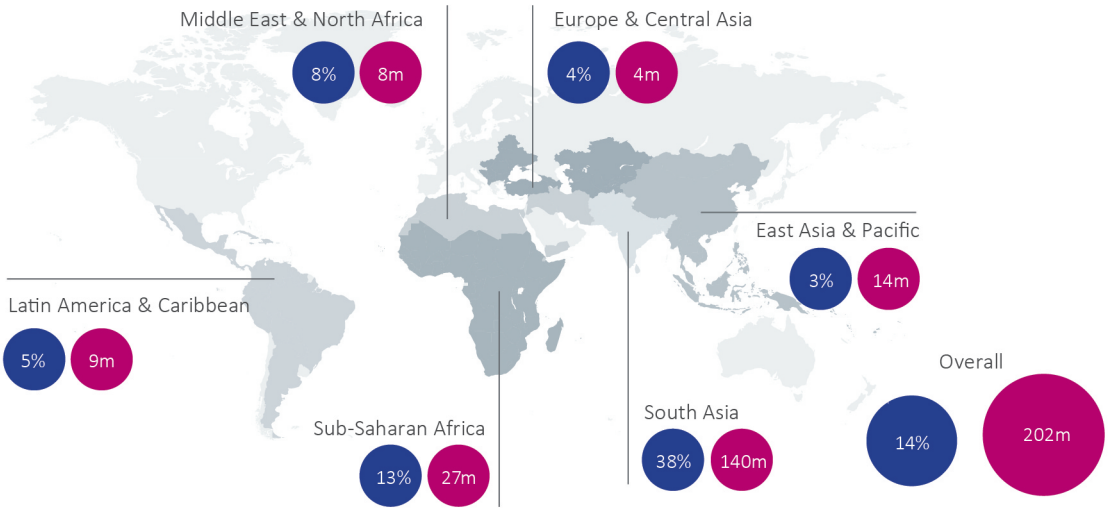
The bad news does not end there, however. It is vital that women and girls are involved both as consumers and makers of technology, but according to recent research from the OECD, despite concerted efforts by policy-makers, the gender gap between men/women in Science, Technology and Mathematics (STEM) careers is in fact widening in many European countries. The gender gap in STEM careers

Figure 18: Gender Gaps in Internet Usage and Mobile Phone Ownership

Internet penetration rates, different regions of the world (top); Female population & distribution of female mobile phone owners in low- and middle-income countries (bottom)



Gender gap in mobile phone ownership in low & middle-income countries
(by region, blue %, purple absolute number of females)



Source: ITU "Facts & Figures 2016" (top chart); GSMA (bottom chart), www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/02/Connected-Women-Gender-Gap.pdf
Note: Penetration rates in the top chart refer to the number of women/men that use the Internet, as a percentage of the respective total female/male population.

(measured by comparing the proportion of men and women in ICT careers around parity, reflecting the balance of men and women in the overall population) has actually increased in many European countries over the period 2004-2014.

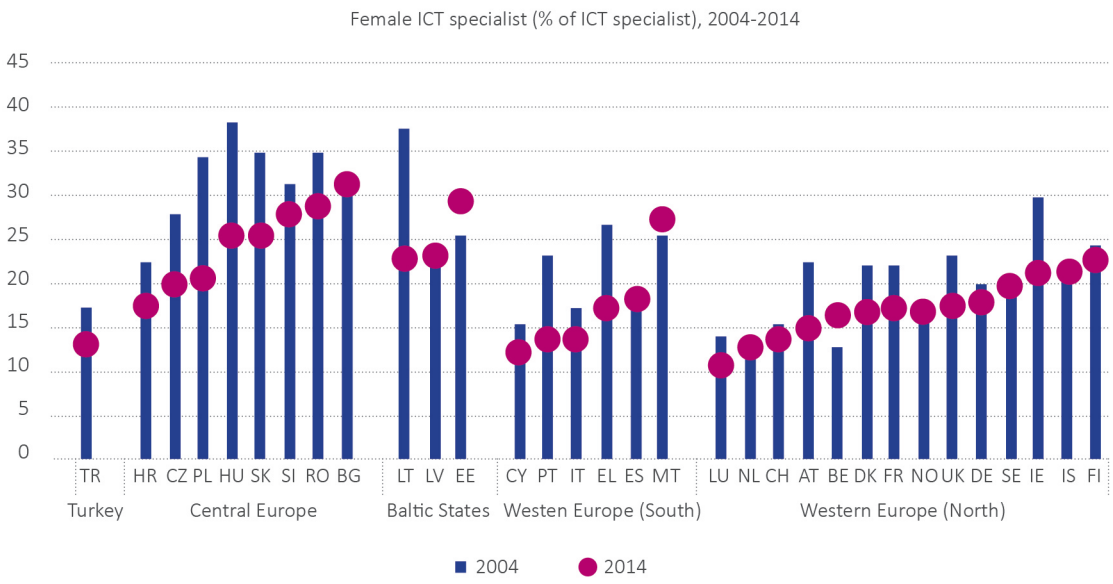
Significant falls in the proportion of women participating in ICT jobs (as one specific example of the STEM domain) are observed throughout nearly all countries in Central Europe reaching to 10 percentage points, with somewhat smaller falls of 3-5 percentage points in Austria, Denmark, France, UK & Ireland (Figure 19). The only European countries where the proportion of women in STEM has actually increased marginally are Estonia, Belgium and Malta.

Of course, connectivity and participation in tech jobs and designing and creating future technologies are important, but they are only part of the solution. In many ways, more subtle, but longer term differences arise in the content, knowledge and skills boys and girls are able to acquire through access to the Internet. If women and girls are less able to access relevant content, they will find themselves at a serious disadvantage in acquiring digital skills and literacy, learning about and exercising their rights, participating in public processes and accessing more skilled jobs, which generally tend to be better paid. Many of these disadvantages are very difficult to measure and evaluate, however.

ICTs have the potential to alleviate some of the barriers faced by women, including illiteracy, poverty, time scarcity, lack of mobility and/or other cultural and social norms, and limits on participation in decision-making. In some countries, cultural norms can include restrictions on access to ICTs or lack of availability of relevant content. In some countries, the pervasive presence of sexualized content and aggressive behaviour of a proportion of the online community can act as a deterrent or as barriers to women coming online. To achieve equality and combat these restraints, it is vital to find ways to empower girls and women to participate in designing, building and leading our shared digital future, including awareness raising and professional training. Viewpoint 13 outlines some of the actions being taken by Nokia in this regard.

Figure 19: Gender Gaps in ICT jobs are Large and Increasing, 2004-2014

Female ICT Specialists (as a percentage of total ICT specialists), 2004-2014



Source: OECD.

Viewpoint 13: Gender balance in ICT and the need for an urgent response

In September 2016, women are still under-represented in business, especially within the ICT sector. At Nokia, our ambition as a company is to have a gender balance that reflects the world around us and a workplace where both men and women have an equal opportunity to succeed in every function and at every level. Whereas some companies talk about wanting 30% of their employees being women, we talk about reflecting the world we live in, which ultimately is approximately 50% men and 50% women. Equality in opportunities is not something that we can make happen tomorrow, but any long-term aspiration short of that goal seems morally challenged.

The barriers to get there (as reported by the World Economic Forum[23]) are high and require the skills of policy-makers, the understanding of societies, and the commitment of leaders and managers to address them. Nokia is committed to:

- Challenge gender-based expectations for ICT roles and increase the number of women in R&D and sales;
- Increase Nokia's gender balance by enabling practices ensuring diversity among job candidates;
- Foster a gender-neutral culture through training for leaders and managers, and transforming our processes and communications to ensure that they are gender-neutral and inclusive;
- Build a long-term talent pipeline by helping to bring more girls into STEM;
- Bring the proportion of female leaders in every organization in line with the proportion of women in the workforce.

To level the playing field for talented women in leadership development, Nokia is launching two career development programmes for talented women, who will undergo one year's Sponsorship, Mentoring, and Executive Coaching, sponsored by an Executive-level leader in their same organization (indeed, I am sponsoring one of the nominees myself). In this way, Nokia will create female role models whom others in the company can look up to. Mentoring and sponsorship is one of many steps Nokia is taking in the right direction. We need to take more steps though, and we need to take them more quickly.

Therefore I appreciate the work that the Broadband Commission is undertaking on this important topic, bringing together actors who can make a change. Indeed, we can start with making a difference first within our own organizations. As leaders, we can contribute to levelling the playing field for women in our respective organizations. So let's invest the time and resources in mentoring and sponsoring high-potential women to ensure they fulfil their potential in rewarding leadership roles.

Source: Rajeev Suri, President and CEO, Nokia.

Endnotes

1 Telegeography Communications Update 22 April 2016.

2 https://www.bakom.admin.ch/bakom/en/homepage/digital-switzerland-and-internet/strategie-digitale-schweiz/strategy.html

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7 https://www.ntia.doc.gov/files/ntia/publications/fr_ntia_iot_notice_and_rfc.pdf

8 https://www.fcc.gov/document/fcc-releases-proposed-rules-protect-broadband-consumer-privacy

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16 https://www.oxfam.org/en/countries/connecting-villages-northern-uganda-internet-now

17 www.dignited.com/16190/fibre-internet-coming-to-homes-in-uganda/

18 ITU "ICT Facts & Figures: The World in 2015", at: www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx

19 McKinsey (2014) "Offline and falling behind – Barriers to Internet Adoption".

20 See report of the Working Group on Gender and violence, available from www.broadbandcommission.org/

21 ITU Measuring the Information Society Report 2015.

22 See http://www.itu.int/en/action/gender-equality/Documents/ActionPlan.pdf and http://www.itu.int/net/pressoffice/press_releases/2015/CM21.aspx

23 http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

4 Harnessing Broadband for Sustainable Development

A broad range of ICTs, including basic voice, mobile data services, Internet and Big Data analytics can now be used pervasively in global development projects in a field often known as ICT for Development (ICT4D). Many different stakeholders are involved in ICT4D projects on the ground to deliver services and improve development outcomes, including industry members, universities, NGOs and tech start-ups. Broadband is driving significant improvements to human wellbeing in healthcare, water, agriculture, natural resource management, resiliency to climate change and energy, as reflected in the UN's post-2015 sustainable development agenda.

Both the **actual use** of ICTs in development projects, and the **potential uses** of ICTs in development projects, have considerably expanded recently. For example, at Johns Hopkins University alone, as of May 2015, there were over 140 mHealth (mobile phone-enabled healthcare) projects across the developing world[1]. An April 2015 review at the World Bank identified at least thirty-two projects incorporating Big Data analytics[2]. Catholic Relief Services (CRS) identified 157 new development assistance projects started by CRS between 2014 and 2015 that incorporate ICTs (primarily mobile telephony).

ICT interventions in development are broader than just mobile, however. They can range from the very large-scale continental-sized coverage possible through satellites (Section 2.4) to the very small-sized sensors and devices enabled by the 'Internet of Things' (Section 4.3). Table 2 at the end of this chapter maps different examples of ICT interventions in development to the SDGs.

4.1 Mobiles and Sustainable Development

ICTs and mobiles are already highly integrated in many development projects. Impactful ICT interventions in development can improve efficiency (achieving similar levels of impact with fewer resources) and/or enhance effectiveness (increasing impact with similar levels of existing resources). ICT4D programmes are now helping to improve research, public policy, basic service delivery and the monitoring and evaluation of programmes across a range of different sectors.

Mobile networks are proving essential for the delivery of the SDGs (Viewpoint 14), due to the nearly ubiquitous coverage even in low-income countries, as well as the portability, ease and convenience of use of mobile phones. There are many interesting examples of use cases of broadband, and especially mobile broadband, in healthcare, education, water, agriculture and natural resource management. Viewpoint 15 presents one company's view on how mobile broadband can be used to achieve the SDGs.

Viewpoint 14: Connecting Everyone and Everything to a Better Future

Technology has always dictated how we live, communicate, shop, and, of course, bank. Today, we see that advances in mobile connectivity have driven successful mobiles services in many emerging markets. Of the more than 4.7 billion mobile subscribers active today, some 3.7 billion are located in low- and middle-income economies, with more than 560 million mobile subscribers in Africa alone. Mobile has become one of the most profound enablers of social and economic growth in our time and will underpin many of the solutions needed to address the world's most pressing development challenges, captured in the SDGs.

The SDGs have set us on an incredible path to solving the greatest challenges of our time. Mobile networks have the power to accelerate this journey in a way that no other technology can. We have already connected more than 4.7 billion people, enabling greater inclusion in vast cities and remote villages, transforming communities, delivering healthcare in ways never imagined, opening doors to education, employment and income opportunities, creating smarter cities, empowering people with the tools they need to thrive and driving a more sustainable planet. The goals are big, and so is the mobile industry's ambition – to connect everyone and everything to a better future.

Near-ubiquitous mobile technology brings the opportunities of the Internet directly to the fingertips of people everywhere. A farmer in a rural community can make payments to suppliers without having to travel miles. An urban entrepreneur can better achieve scale in his or her business through quick and secure mobile payments. A mother can conveniently pay her children's school fees. At the end of 2015, there were 271 mobile money services available across 93 countries, and 411 million registered mobile money accounts. By disrupting the "bricks and mortar" financial services previously inaccessible to so many, millions of people now have a pathway to financial inclusion.

The mobile Internet has made a huge impact on the global economy and has helped to lift millions out of poverty, contributing US$3.1 trillion to global GDP in 2015 alone. By the end of 2015, 2.3 billion individuals across the developing world were accessing the Internet through mobile devices, a figure set to increase by more than 3.6 billion by 2020.

However, despite all of this incredible progress, we have yet to see the full impact of mobile connectivity and the central role it will play in enabling the social and economic progress of those yet to come online. This opportunity is enormous, particularly when we consider the around 4 billion individuals who are not yet connected. Not surprisingly, the majority of people yet to come online live in markets that are still developing. Many of these citizens are on low incomes and have had less access to digital literacy skills training. Women are also disproportionately affected by these challenges and, globally, they represent the most excluded segment. This has a direct impact on both the growth of these markets and the social circumstances for these women and their families.

Connectivity is a global challenge, requiring a global solution that brings together the wider digital ecosystem, government, and non-government organisations to collaborate on four key areas: network coverage, affordability, digital skills and locally relevant content. While we have made significant progress, we must work together on these key areas to accelerate connectivity. As stated by the UN at the launch of the SDGs, the "spread of ICT and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide, and to develop knowledge societies". Continued investment from both the private sector and the philanthropic community will be required to drive the innovation and collaboration needed to expand the reach and strengthen the accessibility of essential services through mobile.

The mobile ecosystem, led by network operators, will continue to work with others to break down the barriers and foster digital, social and financial inclusion. As an industry, we have already connected billions, and we won't stop until we've connected the world.

Source: Mats Granryd, Director General, GSMA.

Viewpoint 15: How ICTs are unlocking opportunities to realize the SDGs

ICTs are unlocking new opportunities for economic growth, socio-economic development and the empowerment of individuals across the globe. VimpelCom sees three trends as fundamental to the transition towards digital societies, which form core elements of our strategy.

First, connectivity has increased rapidly and demand for faster data networks is high, particularly in emerging markets. Globally, mobile connectivity has increased rapidly; from only 34 mobile subscriptions per 100 people in 2005 to almost 97 ten years later. The digital divide between the developed and developing world is quite large with 81% mobile penetration in the developed world, versus 46% mobile penetration in the developing world, respectively. Research by GSMA shows demand for faster connectivity is high, particularly in emerging markets where the willingness to pay for 4G is often high. Continued investments in network infrastructure are required, including 4G roll-out.

Second, value is shifting away from connectivity towards a portfolio of mobile-enabled services, making a broad approach to connectivity necessary, with a focus on digital services. For many, mobile devices have become the primary interface with digital services, enabling access to news, financial services, healthcare, education and job opportunities. By moving into new service areas, operators face an increasingly complex policy environment. Regulations risk becoming outdated very quickly, creating uncertainty among operators and a reluctance to invest. Forward-looking, principles-based, broad regulation is a new approach that can significantly benefit the digital society.

Third, the role of businesses is changing, from profit maximizers into engaged corporate citizens. Companies need to look at the local

needs of the communities in which they operate, and by supporting entrepreneurship and start-ups, which are increasingly recognized as valuable contributors to both innovation and economic growth. In this way, large companies such as VimpelCom can serve as a platform, enabling individuals and entrepreneurs to be active participants rather than passive beneficiaries of the digital world.

VimpelCom is working to transform development challenges into opportunities. We continue to invest in our networks, including the roll-out of 4G as we see high demand for faster connections. For example, a year after the launch of 4G in Georgia, data use had increased seven-fold, while it has tripled in many other markets. This improved infrastructure forms the basis of our move into new service areas that allow us to contribute directly to the SDGs. VimpelCom's mobile financial services enable financial inclusion for over 30 million users; m-health apps provide information on diagnosing and treating the more common diseases in Kazakhstan, pre- and ante-natal care applications assist young mothers in Ukraine; and mobile-enabled services are helping farm workers in Bangladesh. Commercial interests and development goals can go hand-in-hand.

Connectivity and mobile networks are key enablers of socio-economic development. Together, we can have a profound positive impact on the communities in which we operate, and continue to realize the benefits of a digital society for everyone.

Source: VimpelCom.

Mobile broadband can be used to provide broad, general enabling services, such as taking existing banking remittance services online. Broader participation in the financial system through mbanking can reduce poverty and income inequality, boost job creation and directly help people better manage risks and absorb financial shocks. For example, Safaricom's M-Pesa mobile banking system assists Kilimo Salama in keeping index insurance premiums more affordable, helping transform smallholder farmers into a commercially viable market segment for insurance firms[3]. Viewpoint 16 details some of ITU's work on digital financial inclusion. Viewpoint 17 details the use of Internet cafés in Kenya, and the impact on savings and earning power.

Viewpoint 16: Promoting Digital Financial Inclusion

Digital financial services offer major benefits in "banking the unbanked" and empowering people through better management of their limited resources, or access to new sources of finance. The full potential of mobile money has yet to be achieved, however, with 2 billion people in developing countries still lacking access to financial services. 1.7 billion of these people have mobile phones, but the industry has found it challenging to launch and scale services for the unbanked due to limitations in the policy and regulatory environment. Developing countries face major challenges in attaining merchant acceptance of digital payments, including interoperability, consumer protection, competition issues, regulation for DFS, security of transaction, quality of service and digital identity.

In June 2014, ITU established a **Focus Group on Digital Financial Services** comprising 60 organizations from 30 countries to help bridge the gap between telecom and financial services regulators, and the private and public sectors. The Focus Group aims to:

- Create a framework for a more structured and regular dialogue and collaboration between telecom and financial services regulators who need to develop consistent policy and regulatory approaches to DFS; and

- Discuss some of the main policy and regulatory issues currently preventing the DFS from developing organically and reaching the poor.

FG DFS is developing a set of operational recommendations, tools and solutions that will fast-track policy reform to support developing countries in implementing financial inclusion and promoting DFS at scale. In June 2016, the Focus Group has published a series of thematic reports on Digital Financial Services, mapping the overall **digital financial services ecosystem**, considering ways to: **enable merchant payments acceptance in the digital financial ecosystem**; examining **National Identity Programmes (a report from the Evans School of Public Policy and Governance)** in 43 developing countries; and considering **QoS and QoE aspects of DFS**, including proposed Key Performance Indicators (KPIs). The Group's recommendations are due to be published in January 2017.

Source: ITU Focus Group on Digital Financial Services.

Viewpoint 17: The Economic Impact of Affordable Broadband in Matanya, Kenya

Affordable broadband came to Matanya, Kenya, in 2014 when Mawingu launched low-cost license-exempt wireless technologies, with cloud-based management architecture and solar power to deliver affordable broadband in rural areas. Matanya is an important trading post with several small businesses and a large market serving farmers in the surrounding area, covering an area of 121 km^2 and 14,848 people in 4,095 households. Mawingu charges users 300 KSh or US$3 a month for unmetered, unlimited Internet access.

Previously, Internet access was available only in two Internet cafés via metered 3G services, with only limited cellular coverage and a weak signal for voice and data. Internet users had to make trips to the town of Nanyuki 10 km away to use the Internet there – at a cost of 300KSh one-way (nearly twice the average daily income of 172 KSh).

In mid-2015, Mawingu replaced the 3G connections in the Internet cafés with license-exempt wireless. Six months later, 85% now used Matanya's cyber café. The proprietor of the cyber-café improved the speed of his offering and halved the price to 1 KSH per minute. Mawingu has now expanded to over 100 hotspots and is continuing to expand, with 11% of the population or some 1,500 people now direct users[4] or users of the cyber-café. Users can now access rich media (such as video and pictures). This is especially important in Kenya, where literacy was around 72% in 2012[5] and is lower in rural areas. Residents of Matanya are now making use of high-bandwidth connections to conduct business, improve agriculture, and access government services and information.

A Mawingu user saves 8,684 KSh (US$87) on average annually. For 200 Mawingu subscribers, the total costs saved by these customers could amount to US$17,000. The 650 cyber-users in Matanya, each save roughly 4,472 KSh (US$45) annually, equivalent to some 2.9 million KSh (US$29,000) in total. The total cost savings amount to US$46,000 or 0.6% of the total GDP of Matanya.

The savings for Mawingu users are greater than average household spend on either cooking fuel, transport, lighting or water. The saving to Mawingu users is 4% of average annual income, the saving to cyber users is roughly 2% of annual income[6] - savings which can now be used to consume or invest. This change in Internet usage patterns means that the population of Matanya is able to take advantage of the benefits of Internet connectivity to improve education and business.

Source: Microsoft.

Another example is more widespread and timely availability of weather information via mobiles which farmers and fishermen can use to help protect and save lives, as well as crops. Internet-connected weather stations are being used in Syngenta's Kilimo Salama ("Safe Farming") project to monitor the weather and provide a much-needed safety net for farmers while promoting agricultural investment and improved livelihoods.

Mobile broadband can be used for specific purposes in specific sectors. For example, mobile broadband is being used to improve health and wellbeing through greater efficiency and improved care in existing healthcare settings. It can enable greater use of remote telehealth provision, and enabling individuals to monitor their own health day-to-day, improve wellbeing and better manage their conditions, diagnose medical conditions more quickly and promote treatment regimes. Over 2014-2015, mobile technologies were used to address immediate challenges in humanitarian response, including tracking the migration and treatment of people during the Ebola outbreak in West Africa[7].

M-learning apps, and e-learning more generally, can help people learn at any stage of their lives (from primary school pupils to students and retirees), learn basic skills or follow supplementary courses to enhance their knowledge, skills and experience, improve their basic literacy and numeracy skills or convert knowledge into actively acquired skills. E-learning could also help significantly improve access to education for people with special needs, reducing physical barriers. The shift towards e-learning also helps students tailor their own learning to their personal needs or make learning more enjoyable (e.g. through games and apps). Meanwhile, learning can be made more interactive and less onerous, through more responsive student feedback and personalized syllabuses and courses which are more accessible, regardless of income.

4.2 Satellite & Sustainable Development

Satellite technologies can also be used extensively to enhance and improve development outcomes, distinguished mainly by their universal coverage, instant coverage, high reliability and low marginal costs of connectivity. Satellite systems have two major attributes – universality and reliability. Satellite operators have put in place an infrastructure that already covers the whole world, with huge reach over massive areas, including remote and rural areas or oceans. Satellite is the only broadband technology that provides full coverage in metropolitan as well as in rural or most remote areas, including mountainous regions, oceans and islands, as well as the skies.

Satellite broadband connections can be set up immediately without large investment in terrestrial infrastructure. With only a modem, an antenna and electricity, satellite broadband access is available at any location in the satellite coverage area and the service quality is independent of geographical factors[8]. The broad reach of satellite systems can also ensure interoperability across borders and different regions.

Satellite technologies can be used to monitor, survey, increase, protect, and optimize crop production, as well as improve the storage and distribution of food. Growth in agricultural productivity over the last fifty years has been slowing in many regions of the world. Satellites can be used to gather and utilize local weather data, a critical aspect of farming. Traditional weather monitoring equipment is large and capital-intensive, but use of satellite technologies can help predict weather patterns and provide feedback for agricultural schemes.

New systems are coming online soon bringing substantial additional capacity at lower cost, making satellite broadband a competitive alternative to terrestrial technologies for connecting the unconnected, and can be used to provide connectivity for critical services such as education, hospitals and clinics (Viewpoint 18). Many analysts are now trying to model the risks and vulnerabilities raised by climate change. For example, climate models

and disaster risk models can now be combined with satellite imagery of human settlements (such as night-time lights) to estimate economic exposure to risk[9]. Viewpoint 19 details Inmarsat's work to achieve the SDGs.

Viewpoint 18: Satellite Networks are Vital in the Delivery of the SDGs

Satellite technology's reliability ensures that mission critical services (such as emergency aid and first response, smart assets, utility networks, transportation systems, border control and security, etc.) function continuously, regardless of the circumstances. This is why satellite broadband becomes crucial in cases of natural disasters or other humanitarian needs when terrestrial infrastructures may not be available, to coordinate crisis management in field units.

As such, satellite broadband should be regarded as part of a country's critical national infrastructure. Satellite technology can provide broadband connectivity to rural and remote areas, satellite technology also contributes to economic growth, notably for SMEs in rural, remote and scarcely populated areas. There have been several developments of satellite broadband that will prove useful in connecting rural and remote regions. For example:

- The African mobile operator Vodacom has partnered with Intelsat to extend service to over 700 rural sites in the Democratic Republic of Congo[10].

- Eutelsat Communications and Facebook are teaming up to leverage satellite technologies to get more Africans online. With Spacecom, the two companies will utilize the entire broadband payload on the future AMOS-satellite to be launched in 2016, and Eutelsat will develop its capacities for Africa with a new-generation HTS covering nearly all Sub-Saharan Africa[11].

Satellites can be used to support development objectives and goals – for example, in the fields of:

- **eLearning/mLearning:** Satellite communications can bring educational resources and Internet connectivity to drive educational initiatives in remote and highly vulnerable communities. Satellite-connected mobile learning centres can ensure that even children in refugee camps, displaced by events outside their control, can access educational resources.

- **Telemedicine/eHealth**: Portable satellite broadband services power crucial connectivity to allow specialist doctors to remotely monitor the health of patients in villages and flag early detections of conditions such as diabetes, hypothermia and high blood pressure. For example, satellite mobile broadband services bring ultrasound technology and expert support to isolated communities, allowing them to obtain medical help without long or difficult journeys.

- **Environment**: Satellite services can help capture critical data on climate change and other environmental changes. Through sensors tracking environmental changes, connectivity to researchers in remote areas, and buoy systems monitoring movements of whales, and endangered sea life, satellite solutions can help us better understand the changing world.

- **Disaster Response**: Mobile and portable satellite communications are often the only connectivity options available in the critical hours and days immediately after a major disaster. Where terrestrial facilities are incapacitated, relief workers, public safety, and military personnel rely upon satellite communications to re-establish relief operations and save lives.

We are now fully dependent on space capabilities and satellite technologies and communications. Broadcasting, navigation and positioning, remote sensing, earth observation, satellite weather and climate monitoring have now become essential components of our lives. Through these and similar means, satellite technologies are significant contributors to the achievement of each and every SDG.

Source: Christian Roisse (EUTELSAT IGO) and Jose Toscano (ITSO).

Viewpoint 19: How Satellite Communications will Help Achieve the SDGs

Satellite communication systems are unique due to their global coverage and unparalleled reliability and resiliency, making them a critical connectivity component to the achievement of the SDGs. For example, eHealth solutions—technology-enabled healthcare applications coupled with Internet connectivity—are pivotal to achieving the SDGs in health. A telemedicine initiative launched in Benin, West Africa, uses Inmarsat connectivity to bring remote healthcare for the benefit of around 1,346 children and their families. The charity SOS Children's Villages in Benin works with clinics in Abomey and Dassa-Zoumé, gathering patients' medical information on smart tablets, and sending it in real-time via Inmarsat's broadband data service to a secure server allowing urban doctors to monitor and evaluate the villagers' health and to bring medical attention to individuals as soon as possible.

High-capacity broadband satellite solutions can also bring resources and Internet connectivity to drive educational initiatives in highly vulnerable communities. In one such initiative, a mobile learning centre powered by Inmarsat's broadband data service has enabled children in the refugee camp at Baharka in Iraq, to access educational resources via the Internet. Inmarsat also works around the world supplying secure satellite data services to support local economies through encrypted satellite services, which connect banks to remote and temporary branches securely. In 2015, Inmarsat worked in partnership with the Equity Bank Group to deliver financial services to the unbanked and unconnected in 200 sites across Kenya, in some of its most remote regions. Using Inmarsat, local agents in each village have reliable access to Internet banking services to drive economic growth.

Inmarsat takes its role in delivering solutions to promote sustainable development seriously. It has launched a public service commitment, "Seeking to Serve all Areas Where There is a Need for Mobile Satellite Communication", which provides services to rural and remote areas of developing countries. Today, part of our mission is to power global connectivity by enabling the deployment of advanced digital technologies in regions where lack of terrestrial infrastructure is holding back development.

Due to their universality and reliability, satellite communications are essential to making substantial progress on all the SDGs. Inmarsat has long embraced its role in sustainable development, and looks forward to continuing its work in this area, supporting the important work of the *Broadband Commission for Sustainable Development*, and working in continued partnership with numerous organizations around the world committed to improving the quality of life for all people.

Source: Rupert Pearce, CEO, Inmarsat.

4.3 Internet of Things for Development[12]

Connected sensors and M2M connectivity represent the next frontier in the ICT4D story, in the emerging 'Internet of Things'. This is a major development, which promises to change ways of doing things through better information in real-time and improved learning opportunities. IoT is closely related to concepts of M2M and Wireless Sensor Networks (WSN) in connectivity, and to Big Data in terms of content outcomes

In health, sensors are being used to monitor the 'cold chain' delivery of vaccines, particularly to remote and rural areas, where keeping the cold chain up and running to avoid vaccine spoilage is a major challenge. Nearly one-fifth of children in the developing world go unvaccinated each year. A major hurdle for healthcare providers is vaccine spoilage, as many vaccines need to be stored between 2-8 degrees Celsius. For example, Nexleaf's ColdTrace system monitors and records fridge temperatures and send out SMS alerts beyond critical thresholds[13].

For managing water, sensors are also being used to help collect hydrological data in developing countries where local data on river flow and levels may not be regularly collected. These sensors can also provide early warning of floods. For example, in Honduras, the Hidrosónico is a water stream gauge that uses a sonar range sensor to measure rainfall and flood levels[14]. In Jiangsu, China, IoT sensor devices are being used to monitor water usage and flow rates[15]. RFID tags are being used more broadly for monitoring agriculture and livestock. WSNs are being utilized to monitor soil moisture, minerals and pH levels in tea plantations in Sri Lanka and Rwanda[16].

Of course, IoT deployments are by now increasingly widespread in both high- and low-income countries. And IoT deployments are also being used in conjunction with mobile broadband to enhance the benefits for development (Viewpoint 20).

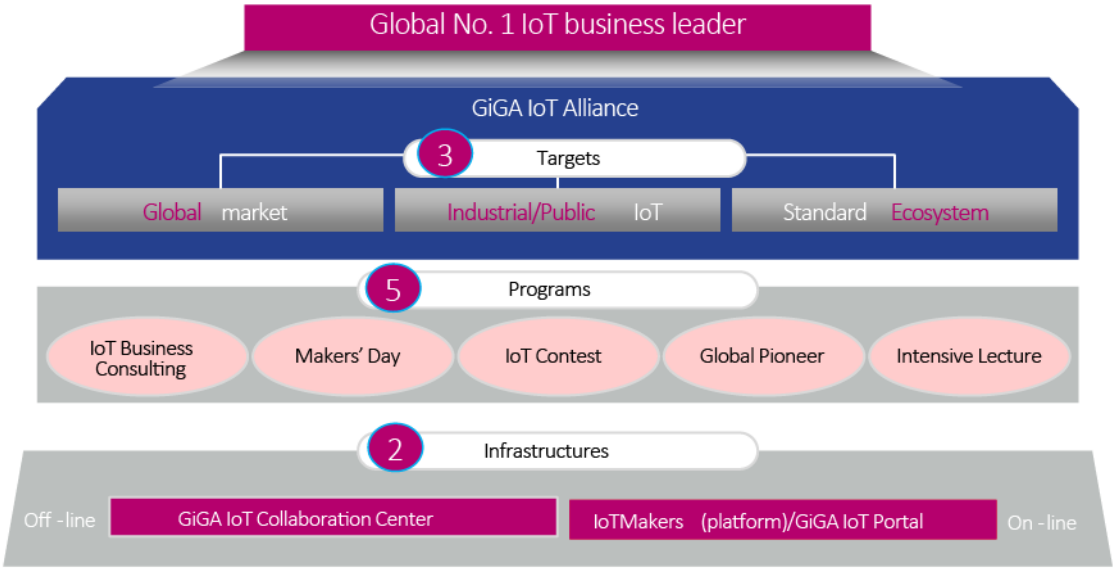
Viewpoint 20: 'Internet of Small Things' to Enhance Mobile Broadband and Development

The 'Internet of Small Things' (IoST) is a major trend in industry and technology with many industries and businesses collaborating to create the IoT and create a growing number of connections among products, where seamless and efficient networks are needed. Korea Telecom (KT) has established a nationwide network specialized for IoST to boost connectivity and uses of mobile broadband. In an era of abundant IoT devices, infrastructure that supports the transfer of smaller amounts of data efficiently is essential. In March 2016, KT commercialized a nationwide IoT network called LTE-M, which is the first low-power, low-bandwidth network to serve IoT devices and services. KT is planning to commercialize narrowband IoT technology in 2017 with an investment of US$128.8 million in IoT technology connecting over 4 million IoST devices and sensors by 2018.

To increase participation and to expedite the growth of IoT business, KT has been proactively engaged in national and global network standardization activities. KT pursues the primary network as LTE-M, the 3GPP network standard, with a plan to evolve into narrowband IoT. Furthermore, in collaboration with GSMA and other telcos, KT actively participated in the IoT Data Ecosystem (IDE) project to lead IoT global data standardization.

IoT services are also expanding into the industrial sectors, such as manufacturing, construction, and automotives. Utilizing GPS and sensors, it will be the operators' job to discover new areas in which to apply these core functions, increasing IoT market size and boosting mobile connectivity. For sustainable growth in its IoT business, significant efforts have been made relating to the creation and revitalization of the IoT ecosystem. First, KT has teamed with about 100 domestic and foreign firms to launch a strategic alliance for IoT business. The 'GiGA IoT Alliance' (including China

Box Figure: GiGA IoT Ecosystem



Source: Korea Telecom.

Mobile, Samsung Electronics, Nokia and Microsoft) will help local ventures and software engineers develop business ideas into products and make inroads into the global market.

KT has also created an open platform, 'IoT Makers', enabling users to develop applications by registering IoT devices on its webpage by following basic instructions. Developers can design IoT solutions with ease by connecting sensors and electronic components with PCs, and customizing functions and services through a PC screen. To date, 1,000 developers have developed new services on the platform with 0.1 million devices connected.

To enhance the IoT ecosystem, KT created the GiGA IoT Business Collaboration Center, which provides an onsite open collaboration lab for supporting business development and free equipment for verification, commercialization and authorization equipment to support start-ups in testing the latest wireless technology and demonstrate their products to clients. To help developers advance through the development process with ease, KT has supplied about 20 experts in IoT technology to the center. The era where mobile broadband is only used to connect people is over. Now, things are becoming connected on the mobile network, and these connections create value in people's lives. Amidst exponential growth of devices, the competitive network has become ever more important. KT, with its core asset, the LTE-M network, expects to globally create a better place to live and to create value across different industries.

Source: Korea Telecom.

Table 2: Examples of ICT interventions mapped to the SDGs

Area	SDG	Examples
Health, water, sanitation	SDG 3: Ensure healthy lives and promote well-being for all at all ages. SDG 6: Ensure availability and sustainable management of water and sanitation for all.	Sensor- and SMS-enabled village water pumps (Rwanda, Kenya); GSM-connected fridges for vaccines in the 'cold chain' (Global); sensor-enabled 'band aid' to monitor Ebola patients' data (W.Africa); water stream gauge with sensors to monitor river flow/depth (Honduras).
Agriculture & livelihoods	SDG 1: End poverty in all its forms. SDG 8: Promote sustained, inclusive & sustainable economic growth, full & productive employment & decent work for all. SDG 2: End hunger, achieve food security & improve nutrition & promote sustainable agriculture.	Connected micro-weather stations improving localized weather data and provision of crop failure insurance (Kenya); low-cost mobile-controlled micro irrigation pumps (India); soil-monitoring sensors used to improve tea plantations (Sri Lanka, Rwanda); RFID for tracking, theft prevention and vaccination of livestock (Botswana, Senegal & Namibia).
Education	SDG 4: Ensure inclusive and equitable quality education & promote lifelong learning opportunities for all.	Smart identity cards with biometric features for education (Nigeria); biometric clocking to improve teacher attendance (South Africa); Connected Schools Initiative (Spain). At Kenyatta University in Kenya, staff use identity cards to clock in/out of campus. Students use identity cards to clock in, borrow books & pay for food.
Environment & Conservation	SDG 12: Ensure sustainable consumption and production patterns. SDG 13: Take urgent action to combat climate change and its impacts. SDG 14: Conserve and sustainably use the oceans, seas & marine resources for sustainable development. SDG 15: Protect & promote sustainable use of terrestrial ecosystems, manage forests, combat desertification, reverse land degradation & halt biodiversity loss.	Radio-based cloud-connected devices to identify and track the presence of illegal fishermen (Timor-Leste); air pollution sensors to monitor urban outdoor air pollution (Benin); acoustic sensors to monitor sea bird populations (global); sensors and connectivity to protect game park perimeters and track animals (Africa); connected unmanned aerial vehicles monitor national parks and connecting images from camera traps (UAE); acoustic sensors in tropical rainforests 'listening' for illegal logging (Indonesia).
Resiliency, Infrastructure & Energy	SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all. SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, & foster innovation. SDG 11: Make cities and settlements inclusive, safe, resilient & sustainable.	National Plan for Smart Cities (Spain). VimpelCom has enabled donations via SMS for people struck by natural disasters in Georgia and Tajikistan.
Governance & Human Rights	SDG 10: Reduce inequality within and among countries. SDG 16: Promote peaceful and inclusive societies for sustainable development, access to justice & accountable, inclusive institutions.	Retinal scans used for ATMs providing secure biometric cash assistance to displaced refugees (Jordan).
Cross-cutting	SDG 5: Achieve gender equality and empower all women and girls. SDG 17: Strengthen the MoI and revitalize the global partnership for sustainable development.	ICTs can be used to enable girls and women to learn more about their rights online and to acquire skills. VimpelCom runs an m-Literacy program aimed at empowering (digitally) illiterate women in rural areas of Pakistan.

Source: ITU & Cisco Systems.

Endnotes

1 Keynote presentation by Dr. Carolyn Woo of Catholic Relief Services at the CRS ICT Conference 2015 at: http://schd.ws/hosted_files/crsict4dconference2015a/84/2015%20ICT4D%20Conference%20Welcome%20Presentation%20Final.pdf

2 Keynote presentation by Dr. Alain Labrique of Johns Hopkins University at the Catholic Relief Services 2015 ICT4Development Conference, Chicago, 27 May 2015.

3 "The Broadband Effect: Enhancing Market-based Solutions for the Base of the Pyramid", available at: https://publications.iadb.org/bitstream/handle/11319/6642/Opportunities_for_the_Majority_Report_The_Broadband_Effect.pdf.pdf?sequence=1

4 10.6% of the population as users of the cyber, as well as 2.6% having used Mawingu.

5 See http://www.unicef.org/infobycountry/kenya_statistics.html

6 In addition, time is saved by the users of a cyber from not having had to take a journey all the way into Nanyuki town.

7 "Harnessing the IoT for Sustainable Development", Cisco/ITU, available from: https://www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf

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15 www.chinamobileltd.com/en/ir/reports/ar2010/sd2010.pdf

16 Minuri Rajapaksa "IoT for Productive Tea Plantation", at: http://wireless.ictp.it/school_2015/presentations/CaseStudies/IoTforTeaPlantation-SriLanka-Minuri.pdf

5 Smart Ways to Promote Knowledge Cities

5.1 From Smart to Knowledge Cities

Today, over half the world's population lives in cities and this may increase to over 70% over the next thirty years. Sustainable urban development centred on people and the respect of human rights is therefore one of the major priorities and challenges of today's societies. Although cities occupy only 2% of total land surface, they account for 54% of the world population (World Bank, 2016[1]), 70% of GDP, 60% of global energy consumption, 70% of greenhouse gas emissions and 70% of global waste (UN-Habitat, 2016[2]). Habitat III, the UN Conference on Housing and Sustainable Urban Development taking place in October 2016, is pushing for urbanization to be understood as a strategy for development, rather than just an accumulation of problems (Habitat III's *New Urban Agenda*).

To solve urban problems, policy-makers and urban planners are seeking to harness broadband and ICTs for sustainable development. Among the four billion people living in urban areas in 2015, 89% have access to 3G mobile broadband (ITU, 2015[3]). Cities across the world are seeking to become "smart cities", in which ICTs play a key role in urban development by supporting cities to be more functional, efficient and competitive. ITU-T's Study Group 20 defines a smart city as "an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects"[4].

However, it is crucial for stakeholders to realize that broadband and ICTs have a role to play *beyond* greater efficiency in businesses, resource management and governance. Digital technologies can yield many benefits for urban dwellers, mainly when citizens are at the centre of "city smartening". Indeed, for smart cities to be truly sustainable, broadband and ICTs must serve people by facilitating people's access to knowledge and culture, fostering creativity, increasing citizens' decision-making power in governance and creating more inclusive cities.

Building on UNESCO's concept of open and inclusive Knowledge Societies and ITU's work on smart cities, countries around the world should now focus on moving towards inclusive knowledge cities, which put human needs and rights at the centre of their urban development, and which are grounded in principles of pluralism, inclusion, equity and openness, and guarantee freedom of expression, universal access to information and knowledge, cultural diversity and education for all. This is in line with Habitat III's *New Urban Agenda*, where urban development should "integrate all facets of sustainable development to promote equity, welfare and shared prosperity".

5.2 Beyond Greater Efficiency

The concept of a smart city often highlights the advantages of generating greater economic, energy, governance and mobility efficiency. However, 'knowledge cities' build on this concept by putting human beings explicitly at their centre, and focus on greater inclusion, pluralism, participation, education, diversity, creativity and human well-being.

Arguments for Greater Efficiency: the "raison d'être" of smart cities?

City authorities often embark on a "city smartening" process because they believe it will confer economic advantages, making them more efficient, competitive and productive. Thanks to broadband, transaction costs should fall and activities should become cheaper, faster, and more convenient, increasing productivity and efficiency.

Other central arguments for the development of smart cities are the improved energy efficiency and the reduction in greenhouse gas emissions through adoption of eco-friendly devices. Smart cities may create parks and green spaces to make cities more walkable, or put in place eco-friendly public transport and/or develop innovative waste management and recycling centres. Citizens can also take measures to reduce their own carbon footprint (such as smart thermostats in their homes or carbon-efficient start-stop systems in cars to conserve fuel).

Digital technologies can also result in increased efficiency in public administration. Thanks to ICTs, online public services can become more convenient, personalized, faster and less expensive. For example, smart cities may offer citizens the possibility to use the Internet to file complaints and claims, request certificates and reports, make payments and debits and participate in various activities. Governments may also employ digital technologies, such as video surveillance, to enhance the safety and security of their citizens and to reduce crime. Governments have to ensure, however, that at the same time, citizens' increased safety and security do not come at the expense of citizens' privacy and human liberties.

Finally, smart cities may seek to improve the travel experience of urban dwellers and make travelling more efficient, convenient and stress-free, thanks to real-time information about departure times, for example, or mobile applications showing the location of city bikes or the nearest available parking space.

Beyond Greater Efficiency: Towards a human-centred approach

Although greater efficiency is incredibly valuable for businesses and services in cities around the world, smart technologies are not the 'solution' to sustainable urban development. "Smart cities are not truly

sustainable unless they equip their citizens with the tools they need to contribute to civic life" (Hidalgo, 2015[5]). Women and men of different ages, cultures, locations and socio-economic backgrounds need to be included in the 'city smartening' process from the outset for the potential benefits of this process to be accessible to all. This is why knowledge cities places human beings at their centre and focus on greater inclusion, pluralism, participation, education, diversity, gender equality and creativity. Firstly, the role of ICTs in governance should not be confined to reducing the cost of administrative work, but should ensure that citizens have equitable and affordable access to information and knowledge and that their freedoms are protected, including their freedom of expression.

Indeed, the Internet can help overcome limitations imposed by geography, physical disabilities, wealth, gender or age by facilitating citizen communications. Citizens can receive important information influencing their daily decisions. Conversely, cities can use the Internet to give a voice and listen to their inhabitants through online platforms for citizen participation, electronic voting, online surveys and social networks. Active involvement may in turn may influence the decision-making of municipal governments and enhance the city's democratic processes. For example, Toronto is engaging its citizens through the TransformTO project which invites residents and businesses to imagine the transformative changes needed to create a more prosperous, healthy, equitable and sustainable city (City of Toronto, 2016[6]). Knowledge cities need to make communication fully interactive, rather than just two-way, to result in a win-win beneficial relationship.

ICTs have a vital role to play in quality education for all. ICTs have the potential to make education and learning more accessible, affordable, interactive and inclusive for girls and boys and men and women alike. This in turn will equip citizens with the necessary tools, skills and understanding to fully participate in their societies. The Beijing Declaration on Building Learning Cities (2013) defines a "learning city" as one which mobilizes its resources to enable individual empowerment and social cohesion, economic and cultural prosperity, and sustainable development. To encourage the growth of learning cities and lifelong learning, UNESCO has established the Global Network of Learning Cities (GNLC) encompassing one thousand cities and communities around the world (Box 1). For example, Massive Open Online Courses (MOOCs) can provide high quality education courses to wide audiences for free (although some suffer from high drop-out rates and low completion rates). Some cities offer final, certified exams for MOOCs which can be taken at universities in person, helping retain and motivate students throughout the learning process. Broadband and ICTs can also promote cultural diversity and enhance the creativity of urban inhabitants, which may help create a more pluralistic, tolerant and respectful environment to live in. Such a benevolent environment is key in order to nurture citizens' creativity and can catalyze innovation within the urban space[7].

For example, digital technologies can contribute to the broadcasting and preservation of cultural transmissions and heritage, while the Internet and online media can give voice to under-represented communities or ethnicities within a city. ICTs can also help enhance creativity, innovation and entrepreneurship by reducing the costs of information-sharing platforms. This democratization of information, knowledge and tools thanks to broadband and ICTs means that, with the right skills, many more people can now invent, create, and share culture and conversations with others, while reaching a wide audience. Box 1 details UNESCO's activities to promote knowledge cities; Box 2 details ITU's work on smart cities.

Spain's recent National Plan for Smart Cities and smart tourist destinations provides another example of policy-making. Introduced under the umbrella of the Spanish Digital Agenda, this Plan includes standards for intelligent solutions and projects encouraging cooperation between companies and local authorities, in order to favour the development of innovative solutions (Viewpoint 21).

Box 1: UNESCO's Activities for Promoting Knowledge Cities

Creative Cities Network - http://en.unesco.org/creative-cities/home

Building on culture and creativity within cities, the Creative Cities Network of UNESCO was created in 2004 to promote cooperation with and between cities. This network comprises 116 cities with a common objective: placing creativity and cultural industries at the heart of development plans, and cooperating actively at the international level. Cities commit to sharing their best practices and developing partnerships with the public and private sectors, as well as civil society, to:

- improve access to and participation in cultural life, in particular for marginalized or vulnerable groups and individuals; and
- develop hubs of creativity and innovation and broaden opportunities for creators and professionals in the cultural sector; and
- fully integrate culture and creativity into sustainable development plans.

Intergovernmental Information for All Programme (IFAP)

IFAP contributes to the development of and access to information and knowledge in the public domain. In Cartagena das Indias (Colombia), Cusco (Peru) and Quito (Ecuador), IFAP works with local governments to make information about citizen services available online, provide civil servants with Media and Information Literacy (MIL) skills, and provide electronic platforms to engage with citizens. Citizens have been empowered to engage with local government and exercise their rights and responsibilities by developing MIL skills through a range of adult literacy programmes, in particular considering the needs of vulnerable groups. A number of public Internet access points have been established. IFAP also established a Biblioteca Virtual – a repository of the youth policies of 14 Latin American countries – to inspire cooperation between governments and youth groups.

Cities Against Racism

The International Coalition of Cities against Racism is an initiative launched by UNESCO in March 2004 to establish a network of cities interested in sharing experiences in order to improve their policies to fight racism, discrimination, xenophobia and exclusion.

Source: www.unesco.org/new/en/social-and-human-sciences/themes/fight-against-discrimination/coalition-of-cities/

Global Network of Learning Cities (GNLC) - http://learningcities.uil.unesco.org/home

Cities differ in their cultural and ethnic composition, and in their heritage and social structures; however, many characteristics of a learning city are common. The Beijing Declaration on Building Learning Cities defines a learning city as one which: promotes inclusive learning from basic to higher education; revitalises learning in families and communities; facilitates learning for and in the workplace; extends the use of modern learning technologies; enhances quality and excellence in learning; and nurtures a culture of learning. A learning city should reinforce individual empowerment and social cohesion, economic and cultural prosperity, and sustainable development.

Source: UNESCO.

Box 2: ITU's activities for Promoting Smart Sustainable Cities

The sustainability of a smart city is based on four core themes:

1. **Economic:** The city must be able to thrive and generate jobs, income and employment for the livelihood of its inhabitants.

2. **Social:** The city must be able to provide for the welfare (safety, health, education) of its citizens equally.

3. **Environmental:** The city must be sustainable in its operations for present and future generations.

4. **Governance:** The city must be robust in its ability for administrating policies and pulling together the different elements.

Standards can play an essential role in enabling the interconnection and integrated management of city systems. Smart sustainable cities require trusted information infrastructure to support a huge volume and diversity of ICT applications and citizen-driven services. The ICT infrastructure of a smart sustainable city should be open and interoperable, which can be achieved through adherence to common standards.

ITU hosted a Focus Group on Smart Sustainable Cities (FG-SSC) I 2013, which published the development of 21 Technical Reports and Specifications which are encompassed in a flipbook on "Shaping smarter and more sustainable cities: Striving for sustainable development goals". Since 2015, ITU's Study Group 20 on IoT and its applications has developed various standards on smart cities and communities. Recommendation ITU-T L.1600 provides an overview of key performance indicators (KPIs) and indicators for a global framework of city indicators with reference to the UN Habitat´s City Prosperity Index. Recommendation ITU-T L.1601 defines these KPIs. Recommendation ITU-T L.1602 focuses on the sustainability impacts of ICT for smart sustainable cities. The new Recommendation ITU-T L.1603 being developed with the UN Economic Commission for Europe (UNECE) will consider the urban development targets of the SDGs.

ITU and UNECE launched the United for Smart Sustainable Cities (U4SSC) global initiative in May 2016 to advocate for public policy to encourage the use of ICTs in enabling the transition to smart sustainable cities. This initiative will focus on the integration of ICTs in urban operations, building on existing standards and KPIs, to assist the response to SDG 11 to "Make cities and human settlements inclusive, safe, resilient and sustainable". In May 2016, ITU also organized a Pre-Conference to GSR-16 in partnership with Bill and Melinda Gates Foundation on Global Dialogue on Digital Financial Inclusion in Egypt, which recognized Collaborative Guiding Measures for Inclusive Digital Financial Services. In July 2016, ITU, UNECE and Habitat III organized an expert management group meeting on "Driving Smart Sustainable Cities Worldwide" to promote discussions about smart sustainable cities.

Source: ITU.

Viewpoint 21: Spain's National Plan for Smart Cities

Spain has good and growing access to high-speed broadband networks – 76% of Spaniards have 4G mobile broadband coverage and 61% of Spaniards have access to 100Mbps broadband[8], an increase of five percentage points on 2014 thanks to the growth of fibre-optic networks. Access to superfast broadband networks is almost guaranteed in urban areas.

To continue this good progress in broadband uptake, in 2015, the Government of Spain introduced its National Plan for Smart Cities[9]. The key measures of National Plan for Smart Cities are:

- Aid programmes for smart city projects and smart tourist destinations.
- Promotion of standards to ensure interoperability between intelligent solutions.
- Innovative catapults and support for R&D around smart cities and industry promotion.
- Projects to encourage cooperation between companies and local authorities and favour the development of innovative solutions for cities.
- Aids the development of new business models based on efficiency and technology use;
- Foster the internationalization of Spanish companies involved in managing smart cities.

The National Plan for Smart Cities includes the development of a pioneer governance framework incorporating key players and coordinated by an Advisory Council. It promotes the exchange of best practices and seeks the commitment of the parties to ensure progress in achieving the Plan's objectives. Various organizations are involved, including the public administrations, the universities, the private sector (including SMEs) and the Spanish Association for Standardization and Certification (AENOR). The public sector is represented by SETSI, red.es, the State Society for the Management of Innovation and Tourism Technologies (SEGITUR), the Institute for Diversification and Saving of Energy (IDAE), the School of Industrial Organization (EOI) and City Halls.

Source: Secretary of State of Telecommunications and Information Society, Ministry of Industry, Government of Spain.

5.3 ICT-driven Urban Development: Challenges and Recommendations

Although broadband and ICTs can yield numerous benefits for urban dwellers, these technologies also pose a number of challenges and potential risks that need to be addressed. By rendering the use of ICTs unavoidable in many aspects of every day urban life, smart cities may in fact widen disparities. Women and girls in particular may be affected by existing digital and knowledge divides. Better educated, best connected and more capable individuals may be able to access many of the benefits of the 'city smartening' process, while those who live in remote areas and/or lack the skills or means or physical capacity to access the Internet, may be even further marginalized and excluded from the city's economic, political, social and cultural spheres of life, introducing new digital gaps. To help make the Internet more inclusive, UNESCO has adopted the 'Internet Universality concept' linked to four fundamental principles (which can be summarized in the acronym, R.O.A.M.): the Internet should be (i) human Rights-based (ii) Open, (iii) Accessible to all, and (iv) nurtured by Multi-stakeholder participation.

As explained above, one of the major rationales behind starting a "city smartening" process is to make the city more efficient and competitive. However, this may lead to dangerous distinctions between 'valuable'

Box 3: Skills, Participation, Access and Gender

Skills: providing people with the necessary skills to use the Internet

- Ensure that all urban residents are provided with the know-how to access information online, understand it and finally convert it into actionable knowledge to improve their quality of life.
- Put special emphasis on providing women and girls with ICT skills in order to bridge the digital gender divide.

Participatory approach: adapt 'city smartening' processes to the specific urban context

- Adopt a participatory approach in the design of smart cities and knowledge cities.
- Create local content for policy development and implementation in languages understood by all the city's inhabitants.
- Collaborate with all stakeholders to make sure urban planning responds to specific local needs.
- Use strategic planning and understanding current and future digital trends at the government and municipal levels to inform decision- and policy-makers.

Accessibility: ensuring people's access to affordable Internet

- Put in place Wi-Fi hotspots extending Internet to all citizens, and ensure that women and girls, people with disabilities and disadvantaged groups are able to access and use these facilities.
- Provide public spaces with available computers and Internet access.
- Ensure that women and girls are able to use these facilities.

Source: UNESCO, based on CSTD (2016), "Committee of Digital and Knowledge-based Cities of UCLG" (2012) and World Bank (2016).

and 'non-valuable' jobs, 'valuable' and 'non-valuable' workers, and ultimately, 'valuable' and 'non-valuable' citizens (Benedikt, 2016[10]). Jobs may be considered non-valuable because they are difficult, dangerous, dirty and/or repetitive, and may be subject to replacement by machines and technological systems. The automation of low-skilled jobs may eventually lead to significant job losses and/or increased social polarization with "knowledge workers" separated from the uneducated, poor local population (Hollands, 2008[11]; Vanolo, 2014[12]).

However, low-skilled jobs are not the only jobs susceptible of being lost to automation. Mid-skill jobs and white-collar jobs also increasingly risk replacement by machines and robots, which today are sophisticated enough to perform not only manual tasks but cognitive ones as well. In financial journalism, for example, many financial articles are now written by computers (Podolny, 2015[13]). The results of a 2015 Bank of England study suggest that almost half of those employed in the UK are threatened by automation, with administrative, clerical and production tasks most at risk (Elliott, 2015[14]). There could be a risk of large-scale un- or under-employment, where possibilities of 'skilling up' are no longer available, with a considerable impact on city life. Considering office and administrative jobs are overwhelmingly female-dominated, women are disproportionately at risk. Furthermore, the wages of those occupying

skilled positions could increase dramatically, widening wage differentials and increasing social polarization.

These alarming prospects by some authors need to be put into perspective on the global scale. The OECD has suggested that "automation and digitalisation are unlikely to destroy large numbers of jobs", stating that on average, across the 21 OECD countries, 9% of jobs are automatable (Arntz et al., 2016[15]). The World Economic Forum (2016) predicts that 5.1 million jobs could be lost between 2015-2020 due to disruptive labour market changes[16], with two thirds of these in the 'Office and Administrative' job family (the survey covered 15 economies, accounting for 1.86 billion workers and 65% of global total workforce).

The introduction of ICTs in different realms of life raises significant issues with respect to trade-offs between privacy, confidentiality and ownership of data. ICT regulations may overlook problems of ownership and privacy for the sake of security and safety. For example, discussions with regard to self-driving cars have tended to focus mainly on people's physical security and have rarely mentioned the data ownership and privacy problems associated with the collection, use, storage and dissemination of data gathered from autonomous vehicle use (Goodman, 2016[17]). Indeed, such data can reveal intimate and commercially valuable information, including geolocation and/or driving habits. Some car sensors are able to determine whether a child is on board – data which brokers can use to entice parents off the road for child-friendly offers (Goodman, 2016[18]).

Overall, there is no international standard regarding, for example, the use and protection of data collected by online service providers. These transnational companies tend to have their own approach in interacting with countries, each with their own regulatory environment and legislation. In addition, the creation of new policies and regulations tends to be slower than the fast pace of technological development, leading to the need for innovation in policy-making and regulatory tools.

Another issue is the preservation of the digital heritage. Whenever there is a software upgrade or device purchase/replacement, there is a risk of data loss or incompatible physical or digital formats. Obsolescence and limited preservation of digital heritage can have a significant impact on our lives, but more generally for science, education, culture, for economic and social development and our histories. Assuring the continuity of formats and access over time is becoming a serious problem.

Broadband connectivity and ICTs have the potential to transform our urban lives by generating greater economic, energy, governance and mobility efficiency in our cities. However, the 'knowledge cities' vision goes far beyond increasing efficiency. Indeed, these new digital technologies could and should help boost urban governance processes through greater inclusion and participation. This would help render education accessible to all, empower women and girls, and promote cultural diversity and creativity.

Smart technologies in themselves are not the 'solution' to sustainable development – countries and cities need to create an enabling environment for digital technologies. If countries overlook the soft components of the ICT roll-out such as skills, education, local content, inclusive policies, participation and institutional accountability, the impacts of the digital revolution will fall short. In the spirit of inclusive knowledge cities, broadband infrastructure and soft-components need to be conceived and rolled out jointly, to ensure a future human-centred, sustainable city development.

Box 4: Providing, Retaining and Attracting Skills & Fostering Institutional Capacity

Education

- Conduct skill gap analysis with regard to skills required for design, development and management of smart and knowledge cities and infrastructure.
- Adapt the educational offer to the demands of the market and local needs, including for the well-being of citizens. Although automation may lead to loss of jobs, smart and knowledge cities will lead to the creation of jobs in IT, data analysis, research and in the socio-cultural and environmental sectors.
- Focus on digital, media and information literacy to close the digital and knowledge divides. Provide digital training to teachers with ICT competencies for teaching and learning, and motivate individuals to take a proactive approach to their own lifelong learning.

E-learning

- Maximize the potential of virtual education: reduced costs, flexible hours, easy access.

R&D

- Develop infrastructure, support emerging sectors, encourage R&D and innovation.

Fostering creativity

- Provide support for entrepreneurship – governments can support creative citizens with access to financing and an enabling environment to help them put their ideas into action.

Employment

- Ensure that those who risk to have their jobs replaced by new technologies receive adequate training and skills in order to re-insert themselves in the labour market. Businesses need to take an active role in supporting their workforce through this upskilling and reskilling process.

Enhanced Policies, Legislation and Regulations

- Put in place public policies that facilitate the implementation of smart and knowledge city strategies as well as an enabling policy framework (incentives, regulations…);
- Implement the guidelines of the 2003 UNESCO Charter on preservation of digital heritage;
- Implement regulatory frameworks for data privacy, security and sharing.

Improving Accountability

- Establish mechanisms to monitor and hold public and private sectors accountable.

Source: UNESCO.

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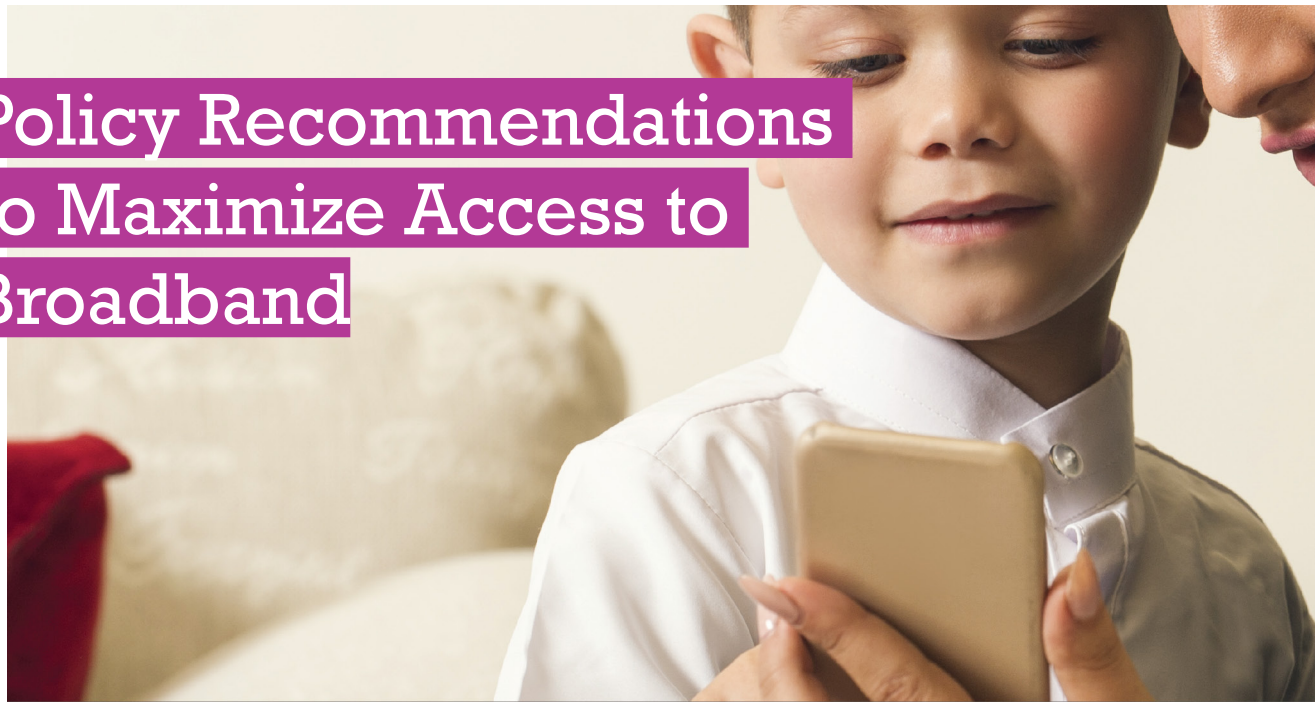
Policy Recommendations to Maximize Access to Broadband



A range of policy options are available to maximize access to broadband, and to maximize its benefits. These policy options can broadly be divided into broad framework conditions to improve the telecom sector more generally, and measures to improve broadband coverage more specifically (although a comprehensive and effective NBP would typically cover both).

General **framework conditions** are conditions which facilitate broadband as a whole. These may include the well-known framework conditions of:

- Market liberalization: including privatization and competition;
- An independent and transparent regulator, which engages in regular consultations & benchmarking, with an open approach encouraging the adoption of new technologies.
- 'Light-touch approach' to telecom/ICT policy and regulations that encourages competition and enables the entrance of new players in the ICT ecosystem, while permitting the promotion of innovative business models.
- Flexible financing models, involving both industry and/or other sources of finance (such as PPPs, BTOs and BOTs etc.)
- A progressive approach to work on potential issues ex post, and not ex ante, with the aim of addressing the issues as they arise (which vary significantly depending on the country or region, but may include for example, roaming fees, convergence, FDI, interconnection and/or taxation).

These framework conditions are well-known, and by now, a large majority of countries have moved to engage with market liberalization measures in their telecommunication sector. For example, by 2016, 151 countries had allowed private sector participation in their fixed-line sector, at least 147 countries had allowed private sector participation in their mobile (spectrum-based) operators, and there are now 164 regulatory authorities worldwide by 2016. VoIP has been fully legalized in over 130 countries.

Viewpoint 22: Effective Policy Measures to Improve Broadband Coverage

1. **Governments should accelerate the pace of regulatory reforms** to make it viable for the ICT industry operating on a commercial basis to invest in ICT infrastructure to connect the remaining 3.9 billion people. Today, as an operator, Zain spends 16% of its annual revenues on capex, and it could prove challenging to

spend more to extend coverage to rural areas against a backdrop of declines in revenue and profits for the industry overall. Areas requiring reforms include:

- Accelerate the adoption of national broadband policies;
- Lower costs for acquisition of spectrum and lower mobile-related taxes (e.g., sales taxes, VAT, import duty, etc.).
- Encourage and ease active network sharing and spectrum pooling to improve flexibility in the use of frequencies (e.g. India) and motivate existing players to redirect capex savings into extending coverage to rural areas and developing digital ecosystems to enhance innovation.
- Regularly review spectrum assignment allocations;
- Accelerate reforms on cloud-based technologies to promote cross-border usage and to encourage investments in data centre infrastructure, content delivery networks, etc.;
- Define standards for new housing developments to be built with high-speed connections (e.g. UK).
- Define standards for deployment of network elements to be shared by all operators such as ducts or in-building fibre (e.g. France).
- Impose USOs on operators, which can often be enhanced through PPPs.

2. Make **affordable personal, enterprise and IoT devices a reality:** Partnerships amongst participants in the digital ecosystem (e.g. manufacturers, operators and governments) should introduce targeted measures to lower device costs for specific social groups or for energy, water or sanitation.

3. Enhance **data collection to track progress of the SDGs:**

- Accelerate e-Government initiatives to incentivize the population to provide data relevant for SDG progress tracking.
- Stimulate innovations in big data to assist national statistics offices to analyze large data sets and establish patterns for decision-making.

Source: Zain Group.

With respect to improving **broadband coverage**, (Viewpoint 22), specific examples include:

- Infrastructure-sharing of network infrastructure to reduce prices;
- Fostering co-deployment with and access to non-telecom infrastructure (including addressing key obstacles such as limits on access and rights of way).
- Regularly reviewing spectrum assignment and trading arrangements.
- Focusing on expanding network coverage (e.g. via coverage obligations, rather than on spectrum proceeds).
- Developing effective technical standards to achieve economies of scale and enhance interoperability and QoS.
- Collaboration between the different government bodies to ease and reduce the administrative burdens of the broadband infrastructure deployment – especially for rights of way and other permits granted by municipalities (Viewpoint 23).

Viewpoint 23: Municipalities and government coordination for better network deployment in Spain

One of the major problems that network operators find when deploying high-speed electronic communications networks in the different territories of a given country is the wide range of licenses and application procedures to be completed in different municipalities. When a level playing-field is not found in any of the phases of high-speed electronic communications network deployment due to administrative burdens, additional costs for operators are created, as market unity is broken, raising final user prices. Infrastructure investment is also hampered. Nevertheless, municipalities need to take decisions concerning urban planning to minimize the impact of the network deployment on towns and respect homogeneous spatial planning.

In order to coordinate these interests, Spain's General Telecommunications Law of 2014 includes instruments allowing competent authorities to assess the urban management measures affecting electronic communications network infrastructures. These instruments require municipalities to obtain a report from the Ministry of Industry on their urban planning instruments. The Ministry of Industry studies the reports, and submits a final binding report within one month. In the case of an unfavourable conclusion, the municipality is not allowed to approve urban planning, although it can restart the process with a new dossier.

Since the entry into force of this coordination mechanism in March 2014, over 1,350 reports have been issued, of which 23% proved unfavourable in first round. After the second round, only seven unfavourable final reports have been submitted. This suggests that these coordination instruments help harmonize the rules of the game in the different municipalities for deploying networks, and give simplicity to operators by removing administrative burdens and reducing costs.

Source: Secretary of State of Telecommunications and Information Society, Ministry of Industry, Government of Spain.

On the basis of this report, the *Broadband Commission* believes that policy-makers may wish to consider addressing the following key measures as a means of promoting broadband as a foundation for sustainable development.

6.1 Review and update regulatory frameworks for broadband

Governments and regulators should review and update their regulatory framework, including benchmarking and comparisons with international best practices and analysis of the regulatory options available. Timely, consistent and well-enforced regulation developed in consultation with industry and

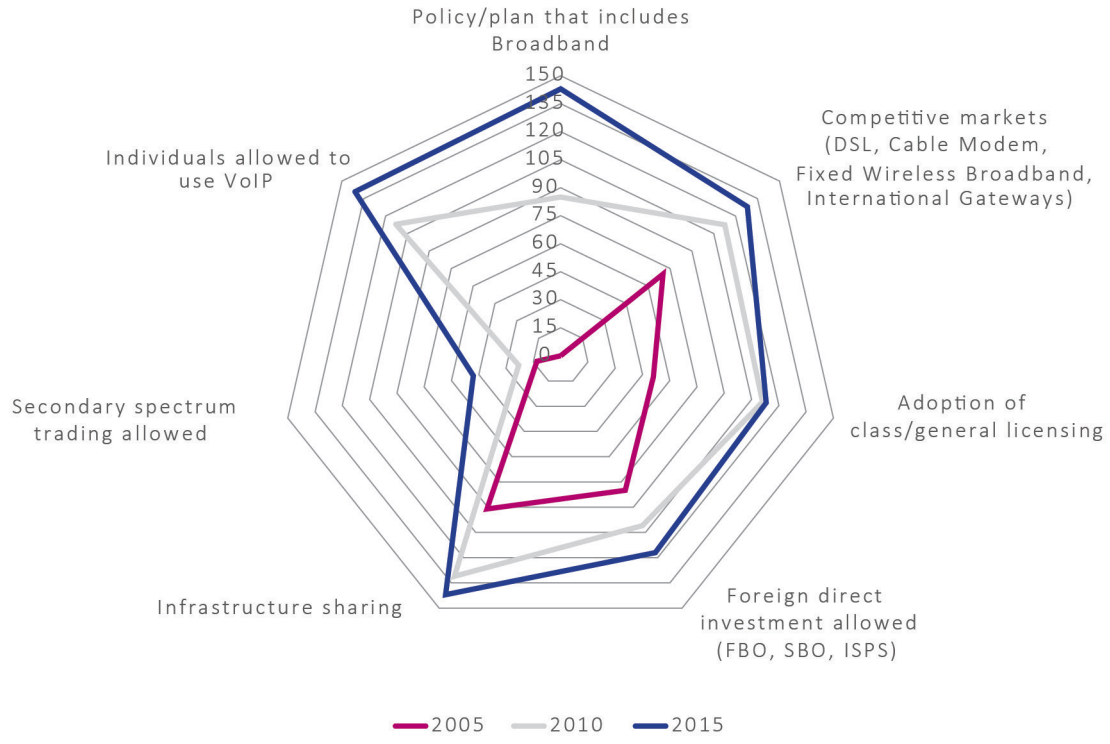
other stakeholders may generally benefit operators, consumers and the domestic economy. Policy-makers must regularly review and revise regulatory frameworks to encourage the development of broadband and ICTs. As explained in Chapter 3, today, regulatory frameworks should also include consideration of the emerging IoT, data privacy and protection.

According to ITU's *Trends in Telecommunication Reform Report 2015*, many countries have adopted or are in the process of adopting more flexible regulatory frameworks over the past decade (Figure 20). Analysis of countries' specific regulatory practices shows that a growing number of countries have adopted NBPs, and adopted general or class licensing. Meanwhile, secondary trading of radio spectrum is still only permitted in a small number of countries (Figure 20). ITU holds an annual *Global Symposium for Regulators* to debate the latest issues and review international best practices. ITU publishes its *Trends in Telecommunication Reform Report* annually to track regulatory developments around the world.

Historically, there were often calls for a 'level playing-field' among different actors in the ICT ecosystem to promote and maximize the investment capacity of different agents in the digital value chain, through adequate rules and the introduction of fair competition tools. Such calls usually referred to regulation of new entrants versus established incumbents, or mobile versus fixed operators. In a converged industry, competitive 'level playing-fields' between telecom operators and online service providers (OSPs), software or cloud computing players are difficult – if not impossible – to achieve due to their different backgrounds, modus operandi, size and scale.

In some countries, a mutually beneficial symbiotic relationship can develop (Viewpoint 24). In order to sustain momentum and further expand the ICT ecosystem and the value it generates, it is important that all agents continue to take advantage of their core competencies. It is necessary to reconsider the current regulatory frameworks governing incumbent telecom operators in order to unleash their ability to introduce new and innovative services that complement – and

Figure 20: Which regulations have shaped the ICT sector from 2005 to 2015?



Source: ITU's Trends in Telecommunication Regulatory Reform Report, 2015.

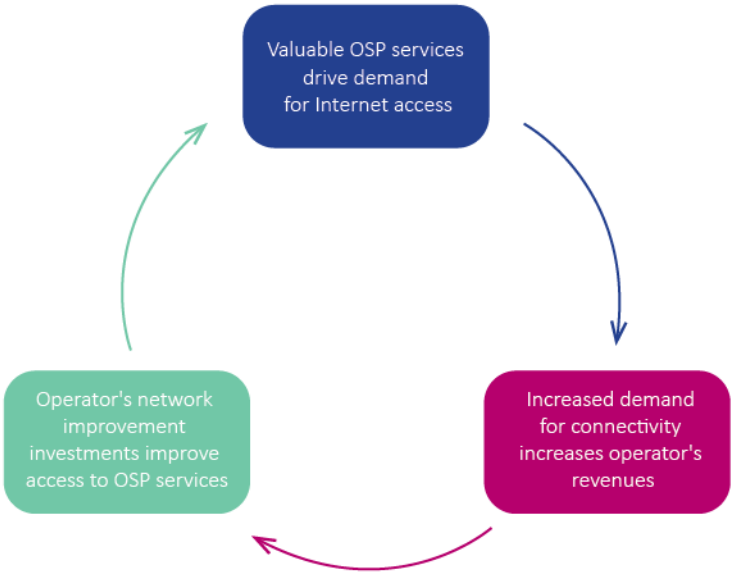
compete with – services provided by new entrants. Regulators must review their market carefully, and work closely with industry stakeholders to find regulatory approaches that respond to the needs of their market, while enabling and unlocking innovation to benefit consumers.

Viewpoint 24: The Symbiosis between Operators and OSPs

Operators and OSPs can benefit mutually from a symbiotic relationship that is driving the current wave of telecommunication players' revenue growth from access/data services (see Box Figure below).

- OSPs increase the value of the operators' networks by creating content that increases demand for broadband Internet access services, thereby increasing the value of broadband Internet access to end users. This increased value provides operators with the market power to reconfigure access pricing to leverage increased demand when appropriate and to the extent that the market will bear.
- Operators earn revenues from tariffs and fees paid by subscribers based on their use of data, typically on a tiered system based on speed or the amount of data used each month. As users increase consumption of online services' content and applications, they will move to a higher tier of service, thereby increasing operators' revenues.
- Revenues earned by operators are reinvested to improve access networks, including through increased capacity, expanded coverage, and optimization of existing resources. These investments make the telecom networks more attractive to current and potential customers, further driving usage of the Internet access network.

Box Figure: Operators and OSPs' symbiotic relationship



This cycle benefits both operators and OSPs, with the improvement and success of one actor driving benefits for the other. Policy-makers and regulation should enable this mutually beneficial dynamic, without unnecessary additional regulatory or financial obligations (e.g. taxes and fees). In particular,

regulators should avoid the temptation to impose new financial obligations on either party that could have unintended consequences (increasing service costs and/or necessitating a reduction in services) and resulting in reduced demand for Internet access. Similarly, unnecessary costs increase barriers to entry, decreasing the competition that drives service innovation and downward pricing pressure.

Source: Facebook.

6.2 Improve Policy Frameworks for the IoT and Smart Cities

Gartner forecasts that that there could be about 6.4 billion objects which are connected to the Internet in real-time, all the time. Cisco projects that, by 2020, there will be at least 25 billion smart objects connected to the Internet. The exponential growth in connected devices can be traced to the rising popularity of consumer applications in smart homes, autonomous vehicles and consumer wearables. This has propelled many to declare the IoT as the next frontier of ICT development. Many governments which wish to leverage exciting technological advances to improve the lives of their citizens, advance their economies and enhance public service delivery have done so by adopting 'smart city' agendas into their national ICT strategies. Viewpoint 25 details some of the policy considerations governments may wish to consider for adopting IoT.

Viewpoint 25: Policy Considerations for Adopting IoT

It is important that governments recognize the key role which IoT will play and the need for policy-makers to formulate enabling policies that will support the adoption of IoT-enabled innovations. They can do this by:

1. **Providing Strong, Robust and Ubiquitous Connectivity**

For IoT to grow, governments will need to partner with the industry to invest in and roll out the right ICT infrastructure that can provide strong and resilient broadband infrastructure required by smart, connected devices. Many countries, including Singapore, have already implemented a National Broadband Plan that is built on a high-speed fibre network. However, with other countries now jumping onto the Smart Cities bandwagon and with the proliferation of different smart devices in the daily lives of citizens, consumers would not only be looking for high-quality broadband, but would also expect ubiquitous connectivity. To this end, Singapore is currently exploring a Heterogeneous Network (HetNet) that will represent the next leap in Singapore's communications infrastructure. It will provide the underlying communication backbone for a pervasive and robust connectivity, allowing users to seamlessly switch between different networks, such as cellular and Wi-Fi networks.

2. **Maintain Efficient Spectrum Allocation**

Clearly the demand for radio-frequency spectrum to support fixed, mobile and satellite broadband access will continue to grow, for communications between people and things, as well as machine-type communications. Although there is currently no specific spectrum allocation for M2M connectivity around the world, the proliferation of IoT devices and the attendant exponential growth on mobile wireless data traffic will undoubtedly create a spectrum crunch. To meet this demand, a range of regulatory approaches are likely required, coupled with efficient procedures for access to suitable radio frequencies, while ensuring adequate protection for other existing systems.

3. **Ensuring Security in a Hyper-connected Environment**

With the increase of sensor-based services and smart systems solutions, comes the accompanying risk in cyber threat vulnerabilities. Ensuring the security, reliability, resilience, and stability of IoT devices is therefore critical to promoting trust and use of IoT devices. It will not be sufficient to leave it to enterprises alone to ensure that the IoT ecosystem is adequately secured and protected as security might not be foremost on their minds when developing devices or solutions. Mindful of this, the approach that Singapore has taken is that data should be anonymized so that the origin and source of the data cannot be traced. Security efforts also have to cut across the entire IoT spectrum, whether it is protecting devices, putting in access control measures, writing security code, or looking at security from the policy perspective.

4. **Harnessing the Benefits of IoT for All**

With the Internet today increasingly becoming a basic utility for individuals, households and organizations, some consumers may inevitably be lagging behind as businesses and governments leap forward in IoT adoption. Governments need to ensure that no segment of the community is excluded from the benefits that the Internet and IoT can bring. The key priority for policy-makers should always remain, first and foremost, on addressing the challenges and needs of their people and citizens.

Source: Mr. Leong Keng Thai, Deputy Chief Executive, IDA, Singapore.

6.3 Encourage Investment by Both the Public & Private Sectors

Investment-friendly regulations can help create a balance between investment and competition, while the social benefits of broadband availability are vital for economic revival and GDP growth. Preferential policies and offering subsidies often play an important role in national broadband development, depending on a country's circumstances. Governments can seek to promote competition to stimulate investment, and provide financial support for broadband investment through tax incentives schemes, subsidized loan plans, special grants and PPPs.

6.4 Make Full Use of USOs

There are a range of different policy options available to governments and policy-makers to achieve universal service. USOs were still a popular mechanism with 18% of all ITU Member States (Figure 12), second only to Universal Service Funds (with 33% or a third of all ITU Member States). Depending on the geography of a country and the number of operators, making use of USOs with the incumbent as well as other operators could help boost coverage requirements for more remote areas where service provision is less commercially viable. Policy-makers should review how license terms and conditions interact with USFs and other funds to ensure effective access can be provided to remote, underserved communities.

6.5 Consider infrastructure-sharing

Policy-makers may wish to consider infrastructure-sharing and open access approaches to infrastructure. This may include both price factors (such as the wholesale price of access to infrastructure) and non-price factors (such as product specifications and service level agreements). Examples of open access include Local Loop Unbundling

(LLU), wholesale broadband access, ducts and submarine cables.

Recent ITU research suggests that growth in services has happened most rapidly where regulatory enablers (e.g. industry consultations, infrastructure-sharing) have been put in place to leverage the latest innovations. Although various strategies for open access exist, it is vital that policy-makers ensure that access to new facilities is provided on fair, reasonable and equivalent terms. This can also include the implementation of 'Dig Once' policies.

6.6 Consider measures to make broadband more affordable

Although there is evidence that broadband prices are falling internationally, relating prices to income may mean that there are still large segments of the population for whom broadband Internet service costs far more than 5% of total household income, once their effective purchasing power is taken into account. Regulators and policy-makers may wish to evaluate and monitor the relative purchasing power of their population and consider introducing targeted subsidies or support measures for certain areas or specific socio-economic groups. In addressing this issue, regulators and policy-makers should consider innovative business models to users. Subsidies were still the third most popular option with ITU Member States for helping achieve universal service, in use by an eighth or around 16% of all ITU Member States (Figure 12). In some countries, operators are raising their broadband prices for premium services to recoup investments in their networks, as consumers bear more of the cost of universal service.

6.7 Reduce taxes and import duties on telecom/ ICT equipment and services

As part of the measures to make broadband more affordable, Governments may wish to consider reducing taxes, VAT and import duties on ICT equipment and services. There is evidence to suggest that the introduction of tax rebates and allowances (for operators and consumers) can make broadband more affordable, with positive results for broadband adoption and use. Unfortunately, in the prevailing difficult economic climate, tax reductions may be difficult for governments to achieve, and there are examples of some governments acting to introduce or raise taxes on broadband services.

Regulations and tax reduction programmes can also be implemented to transform SDN/ NFV-based broadband networks to enable faster recovery of ICT after natural disasters. For example, Japan's Ministry of Internal Affairs and Communications provides tax incentives based on an "Act on Temporary Measures Concerning Telecommunication Infrastructure Improvement". This Act states that a 10% reduction of Corporate Tax shall be made available for electrical communication facilities (servers, routers, switchers and emergency power generators).

6.8 Promote training and measures to stimulate demand

Increased awareness and the ability to use broadband services effectively are critical to bringing the next 1.5 billion people online and to stimulating the growth, take-up and use of the Internet by new consumers. Investments in awareness campaigns, training programmes and the development and hosting of local content, including in local languages, can help promote effective use of broadband services.

Last year, the Broadband Commission established two separate Working Groups on Demand and on the Digital Gender Divide. The Working Group on the Digital Gender Divide will advocate endorsement of these recommendations by other stakeholders as well as coordinated action by all stakeholders to close the digital gender gap, meet women's needs for broadband and fulfil the goals for gender equality set out in the *2030 Agenda* and other international agreements.

6.9 Encourage Local Innovation through Strategic Local Hosting

The 2015 GSMA Intelligence SIM Survey revealed that a lack of awareness and locally relevant content is the most important barrier to Internet adoption for non-users in Asia (72% of those surveyed), Sub-Saharan Africa (59%) and Latin America (51%). Locally relevant content is one of the key enablers of internet adoption. In recognition of this, mobile operators around the world are making efforts to stimulate the development of locally relevant content ecosystems. Operator groups with activities in developing world markets are investing in locally relevant content through various different types of initiatives: incubators or accelerators; competitions for local start-ups; open API platforms; and investment in local content companies.

In many developing countries, much of the content accessed by local users may be hosted overseas and can only be accessed by international links, raising transit costs and the cost of Internet access. Recently, in developing countries, there have been significant efforts to promote local innovation through strategic hosting of content via locally hosted data centres (managed by private or public entities) as part of efforts to develop the local Internet ecosystem (Viewpoint 26). The option to host data locally is different from the obligation or legal or regulatory requirement to host data locally, called 'data localization requirements', which can sometimes prove contentious.

Viewpoint 26: Data Centres & Hosting Content Locally

Data centres represent a synergy of ICT equipment and facilities necessary to enable the constant and stable functions of storing, processing and transmitting data. They can also prove a tool to promote innovation. It is necessary to take into account the costs and profits, as well as social and environmental benefits, while constructing the data centres. Deployment of data centres can deliver the following benefits:

- Carbon reduction when replacing the older ICT infrastructures;
- Energy savings when renovating obsolete ICT infrastructures;
- Increase in computational capabilities enabled by sharing computational resources;
- Protection of ICT infrastructure and data from destruction and theft/ intrusion by physical barriers, invasion detection sensors, machine guard systems, access control systems and authentication systems such as facial authentication protection;
- Protection of ICT infrastructure and data from natural disasters (e.g. earthquakes, hurricanes, or floods);
- Network latency and network workload reduction. The latest virtualization and centralized-management technologies such as cloud computing, SDN and NFV reduce use of hardware and reduce deployment time. Further, NFV allows moving most of the traffic between distinct network nodes inside the data centres, which can result in significant reductions in traffic latency;
- Overcome issues resulting from the lack of skilled ICT engineers by centralized management of these resources.
- Promotion of innovation and development of a creative economy that eventually boost the investment in the sector.

Data centres can help reduce backbone traffic and improve user experience through storing the content closer to the content consumers. Reduction in latency can also result in increased Internet usage. In Rwanda, for example, most content on commercial websites was located abroad, introducing high traffic costs and long latencies. Content

developers could save up to US$111 a year by hosting overseas, but this resulted in Rwandan ISPs carrying approximately US$13,500 in transit costs to deliver content from abroad to local users. After moving the content inside the country, locally hosted content resulted in positive impact on Internet usage – within two months, usage increased by 80%.

Source: Antonio Garcia-Zaballos (IADB) and Natalija Gelvanovska (World Bank).

6.10 Promote Free Flows of Information

Governments may wish to consider adopting policies that enhance data centre infrastructure but which do not force investors to build infrastructure locally as prerequisite to trade and operation. In an era of Big Data, policy-makers should work to facilitate the movement of cross-border data flows. Restricting international data flows with the intent of protecting access to data or ensuring security is ineffective and inefficient, and could slow the expansion of trade in Internet-dependent services and cloud services. Establishing strong and binding policies for cross-border data flow ensures that service suppliers, or customers of those suppliers, can access and move data more freely, while preserving important safeguards (such as privacy regulations). These commitments preserve the free flow of global information and data that drive the Internet and the digital economy. Unrestricted cross-border data flow will continue Internet innovation and the benefits of a globally connected digital economy.

6.11 Promote Advanced Market Commitments for Rural Broadband Access

In areas where there is little commercial interest, the development sector could unite to aggregate demand and help provide market commitments to extend broadband services to rural areas. "Advanced market commitments" similar to financing for vaccine production could be explored for rural broadband access. The UN has proposed a Technology Financing Mechanism, linked with the 2030 Agenda.

The importance of effective partnerships is recognized in SDG 17. The Global Partnerships Forum is developing a Partnerships Portal (SDGsOnline.org) to serve as an interactive database of projects focused on the SDGs. It will provide access to information and lessons learned on social impact projects globally to enable sharing of success stories, best practices and non-financial resources to facilitate better decision-making, and measure progress towards the SDGs. The portal will provide a potential crowd-funding platform for social projects and a mechanism for donors and investors to make capital available to prospective NGOs and entrepreneurs.

6.12 Benchmark and Monitor Developments in Telecom and ICT

Policy choices can be informed and improved on the basis of reliable data and indicators on ICT developments in countries. Statistical indicators are also essential to assess the impact of broadband policies and to track progress towards broadband goals and targets, such as the SDGs. Indicators should be identified to monitor broadband infrastructure and access, prices and affordability, and usage of services by consumers and institutions (e.g. schools and libraries and hospitals). Data collected nationally should be based on international standards and definitions, such as those developed by ITU. A number of international organizations now run surveys. ITU hosts an annual *World Telecommunication/ICT Indicators Symposium* for progress in the definition and collection of reliable and consistent data. The Broadband Commission for Sustainable Development is working on a set of National Digital Scorecards to evaluate digitization in different countries across the globe.

Annex 1: Target 1 – List of National Broadband Policies

Economy	POLICY AVAILABLE?	YEAR POLICY WAS ADOPTED	TITLE/DETAILS
Afghanistan	yes	2011	Optic Fiber Network Backbone Expansion Project (BBEP)- 2011-2013
Albania	yes	2013	National broadband plan
Algeria	yes	2008	E-Algérie 2013
Andorra	no		
Angola	yes	2013	White Book of Information and Communication Technologies, Livro branco das Tecnologias da Informação e Comunicação – LBTIC, Information Society National Plan 2013-2017
Antigua & Barbuda	yes	2012	GATE 2012
Argentina	yes	2010	Plan Nacional de Telecomunicaciones-Argentina Conectada
Armenia	yes	2008	Governmental Decree on Approving the Information Technology Sector Development Conception of the Republic of Armenia
Australia	yes	2009	The National Broadband Network (NBN)
Austria	yes	2013	Broadband strategy 2020-Breit Bandstrategie bbs2020
Azerbaijan	yes	2015	National Broaband Network Project I- Azerbaijan's 2020
Bahamas	yes	2014	Electronic Communications Sector Policy 2014
Bahrain	yes	2010	National Broadband Network for the Kingdom of Bahrain
Bangladesh	yes	2009	Broadband National Policy 2009, 'Digital Bangladesh'- Bangladesh's 'Vision 2021'
Barbados	yes	2010	National Information and Communication Technologies Strategic Plan of Barbados 2010-2015
Belarus	yes	2011	National programme on accelerated development of services in the field of information and communication technologies for 2011–2015
Belgium	yes	2009	La Belgique : Coeur de l'Europe numérique 2010-2015
Belize	yes	2011	ICT National Strategy
Benin	yes	2014	Projet de Développement des Infrastructures et des TIC
Bhutan	yes	2008	National Broadband Master Plan Implementation Project (NBMIP)
Bolivia	no		
Bosnia and Herzegovina	yes	2008	Decision On The Telecommunication Sector Policy Of Bosnia and Herzegovina For The Period 2008 – 2012
Botswana	yes	2014	Botswana's National Broadband Strategy
Brazil	yes	2014	National Broadband Plan 2.0 "Broadband for All"
Brunei Darussalam	yes	2014	National Broadband Policy 2014-2017
Bulgaria	yes	2011	National Strategy for Development of Broadband Access
Burkina Faso	yes	2013	Le Backbone National en Fibre Optique
Burundi	yes	2011	Burundi/ ICT: National Projects for Broadband Connectivity Burundi Community Telecentre Network (BCTN)
Cambodia	yes	2014	Cambodia's ICT Master Plan 2020
Cameroon	no		
Canada	yes	2014	Digital Canada
	***IoT**	***2016***	***The Internet of Things: An introduction to privacy issues with a focus on the retail and home environments; Research paper***
Cape Verde	yes	2005	Programme Stratégique pour la Société de l'Information (PESI) accompagné du Plan d'Action pour la Société de l'Information (PAGE) ; ICT Policy
Central African Rep.	yes	2006	Politique, Stratégies et plan d'actions de l'édification de la Société de l'Information en République Centrafricaine
Chad	yes	2007	Plan de développement des technologies de l'Information et de la Communication au Tchad or (PLAN NICI)
Chile	yes	2014	Agenda Digital Imagina Chile; PlanNacional de Infraestructura de Telecomunicaciones
China	yes	2011	Telecom Industry Development Plan 2011-2015
	***IoT**	***2016***	***EU-China Joint White Paper on The Internet of Things; White paper***
Colombia	yes	2014	Plan Vive Digital 2014-2018
Comoros	yes	2014	Loi N°14-031/AU du 17 Mars 2014, relative aux communications électroniques et Décret N°08-019/PR
Congo	yes	2011	Projet de Couverture Nationale (PCN), Projet West Africa Cable System (WACS), Projet back bone national en fibre optique
Congo (Dem. Rep.)	no		

Economy	POLICY AVAILABLE?	YEAR POLICY WAS ADOPTED	TITLE/DETAILS
Costa Rica	yes	2015	Estrategia Nacional de Banda Ancha 2012-2017; Costa Rica Digital 2015-2021
Côte d'Ivoire	yes	2016	Le Réseau National Haut Débit (RNHD) 2016. Objectifs Strategiques du Government de Côte dÍvore en Matiere de Telecommunications et de TIC 2010
Croatia	yes	2011	National broadband development strategy in the Republic of Croatia 2011-2015
Cuba	Planning		
Cyprus	yes	2012	Digital Strategy for Cyprus 2012-2020
Czech Republic	yes	2013	State policy in electronic communication: Digital Czech republic v.2.0
D.P.R. Korea	no		
Denmark	yes	2010	Digital work programme by the Minister of Science, Technology and Innovation
Djibouti	yes	2004	Plan d'action national pour l'exploitation des TIC en République
Dominica	planning		
Dominican Rep.	yes	2016	Digital Agenda of Dominican Rep. 2016-2020; Plan Bienal de Proyectos 2014-2015 INDOTEL and US/A Policy
Ecuador	yes	2011	Plan Nacional de Desarollo de Banda Ancha 2011-2016
Egypt	yes	2012	eMisr National Broadband Plan
El Salvador	no		
Equatorial Guinea	yes	2012	Nuevas Tecnologias: national project aimed at the popularization of technologies Information and communication (TICGE) 2012-2020
Eritrea	no		
Estonia	yes	2006	Information Society Development Plan 2013
Ethiopia	yes	2013	National Broadband Master Plan
Fiji	yes	2011	National Broadband Policy
Finland	yes	2005	Broadband 2015 Project Kainuu Information Society Strategy 2007-2015
France	yes	2010	Plan France Très Haut Débit
Gabon	yes	2011	Digital Gabon- Gabon Industriel, Gabon vert et Gabon des Services
Gambia	yes	2008	The Gambian ICT4D-2012 Plan
Georgia	yes	2015	ICT Development- Harmonisation of Laws and Acceleration of Broadband Roll-out (EBRD project)
Germany	yes	2009	Breitbandstrategie der Bundesregierung
	***IoT**	***2014***	***'INDUSTRIE 4.0 Smart Manufacturing for the Future'; policy proposal***
Ghana	yes	2010	Broadband Wireless Access
Greece	yes	2014	National NGA Plan and National Strategy for Digital Growth
Grenada	yes	2006	Information and Communication Technology (ICT) 2006-2010 / A Strategy And Action Plan for Grenada
Guatemala	no		
Guinea	yes	2009	Plan National de fréquences/Plan de développement de l'infrastructure nationale d'information et de communication de la République de Guinée 2001 – 2004
Guinea-Bissau	no		
Guyana	yes	2016	E-Guyana 2011, Telecommunications Amendment Bill 2016
Haiti	no		
Honduras	yes	2014	Agenda Digital Honduras 2014-2018, Resolución NROOS/IO
Hong Kong, China	yes	2008	2008 Digital 21 Strategy- Moving Ahead
Hungary	yes	2010	Digital Renewal Action Plan
Iceland	yes	2012	Telecom Policy Statement 2011-2014
India	yes	2011	National Telecom Policy 2012 and National Optical Fibre Network Plan
	***IoT**	***2014***	***IoT Policy Document; policy framework proposal***
Indonesia	yes	2014	Indonesia Broadband Plan 2014-2019; RPI: PELUNCURAN RENCANA PITALEBAR INDONESIA (INDONESIA BROADBAND PLAN) 2014-2019
Iran (I.R.)	yes	2011	National Information Network 2011-2015
Iraq	planning		
Ireland	yes	2008	National Broadband Scheme
Israel	yes	2012	The Communication Initiative: fiber-based national broadband network
Italy	yes	2014	Ultra Broadband Strategic Plan and Italian Digital Agenda

Economy	POLICY AVAILABLE?	YEAR POLICY WAS ADOPTED	TITLE/DETAILS
Jamaica	yes	2007	National ICT Strategy
Japan	yes	2014	Japan Revitalization Strategy
	***IoT**	***2015***	***IT Policy in Japan; policy framework proposal***
Jordan	yes	2007	National ICT Strategy of Jordan
Kazakhstan	yes	2010	Programme of ICT Development
Kenya	yes	2013	National Broadband Strategy- Vision 2030
Kiribati	no		
Korea (Rep.)	yes	2009	Ultra Broadband Convergence Network
	***IoT**	***2014***	***Master Plan for Building the Internet of Things (IoT); policy proposal paper***
Kuwait	no		
Kyrgyzstan	yes	2006	Regional Arrangement concerning the planning of the digital terrestrial broadcasting service and the digital Plan (GE06)
Lao P.D.R.	no		
Latvia	yes	2012	Next generation broadband development strategy for year 2013-2020
Lebanon	yes	2011	National ICT Strategy Action Plan 2011-2012
Lesotho	yes	2014	National Broadband Policy 2014-2018
Liberia	yes	2010	Policy for the Telecommunications and Information Communications Technology (ICT) 2010-2015
Libya	no		
Liechtenstein	yes	2006	Communications Act- Law on Electronic Communication
Lithuania	yes	2011	Lithuanian Information Society Development Program for 2011-2019
Luxembourg	yes	2010	Stratégie nationale pour les réseaux à “ultra-haut” débit “L’ultra-haut” débit pour tous
Macao, China	no		
Madagascar	yes	2014	Loi n° 2005-023 du 17 octobre 2005
Malawi	yes	2013	National ICT Policy
Malaysia	yes	2010	National Broadband Initiative
	***IoT**	***2015***	***National Internet of Things (IoT) Strategic Roadmap; policy paper proposal***
Maldives	no		
Mali	no		
Malta	yes	2012	Malta's Next Generation Broadband
Marshall Islands	yes	2011	National ICT Policy
Mauritania	no		
Mauritius	yes	2012	National Broadband Policy 2012- 2020 (NBP2012)
Mexico	yes	2013	Red Publica Compartida de Telecomunicaciones, Estrategia Digital Nacional 2013-2018
Micronesia	Planning		
Moldova	yes	2013	Digital Moldova 2020
Monaco	no		
Mongolia	yes	2011	National program on Broadband Network
Montenegro	yes	2012	Strategy for the Development of Information Society 2012-2016- Montenegro- Digital Society
Morocco	yes	2012	Plan national pour le développement du haut et très haut débit au Maroc
Mozambique	yes	2006	National ICT Policy Implementation Strategy 2002and 2006- Digital Inclusion in Mozambique
Myanmar	no		
Namibia	yes	2009	Telecommunications Policy for the Republic of Namibia
Nauru	yes	N/A	Nauru ICT Policy
Nepal	yes	2004	Telecommunication Policy, 2060 (2004)
Netherlands	yes	2010	Digital Agenda
New Zealand	yes	2015	Ultra fast broadband initiative, Five Point Government Action Plan for faster broadband
Nicaragua	planning		
Niger	yes	2005	Plan de développement des Technologies de l’Information et de la Communication au Niger / Plan NICI du Niger

Economy	POLICY AVAILABLE?	YEAR POLICY WAS ADOPTED	TITLE/DETAILS
Nigeria	yes	2013	National Broadband Plan 2013-2018
Norway	yes	2000	eNorway, Brodband requirements in Digital Divident Frequency Auction, Yearly national broadband
Oman	yes	2014	The National Broadband Strategy (2014-2018)
Pakistan	yes	2007	National Broadband Programme 2007
Panama	yes	2014	Plan Nacional de Banda Ancha (part of the National ICT Plan) 2014-2018
Papua New Guinea	yes	2013	National ICT Policy and PNG National Broadband Policy
Paraguay	yes	2011	Paraguay 2013 Conectado y Plan Nacional de Telecomunicaciones – PNT 2011-2015
Peru	yes	2011	Plan Nacional para el Desarrollo de la Banda Ancha en el Péru
Philippines	yes	2016	The Philippine Digital Strategy, Transformation 2.0: universal access fund (UAF) for broadband services.
Poland	yes	2014	Narodowy Plan Szeroko Pasmowy / National Broadband Plan
Puerto Rico	yes	2012	Puerto Rico Broadband Strategic Plan 2012
Portugal	yes	2012	Agenda Portugal Digital
Qatar	yes	2013	Qatar National Broadband Plan
Romania	yes	2015	National Strategy on the Digital Agenda for Romania 2020; National Plan for Next Generation Network Infrastructure Development
Russia	yes	2012	The Goals of the Ministry of Telecom and Mass Communications of the Russian Federation 2012–2018
Rwanda	yes	2006	Regional Connectivity Infrastructure Program (RCIP)
S. Tomé & Principe	no		
Samoa	yes	2010	Broadband Spectrum Plan
San Marino	no		
Saudi Arabia	yes	2012	Saudi Arabia's Vision 2030 National Communications and Information Technology Plan and E-Government Action Plan 2012–2016
Senegal	no		
Serbia	yes	2009	Broadband Access Development Strategy in the Republic of Serbia until year 2012: Стратегију развоја широкопојасног приступа у Републици Србији до 2012. године
Seychelles	no		
Sierra Leone	no data		
Singapore	yes	2005	Intelligent Nation 2015 (or iN2015)
Slovak Republic	yes	2006	Operačný Program Informatizácia Spoločnosti(Operational program-Information society)
Slovenia	yes	2008	Strategija razvoja širokopasovnih omrežij v Republiki Sloveniji
Solomon Islands	planning		
Somalia	no		
South Africa	yes	2013	National Broadband Policy
South Sudan	no		
Spain	yes	2013	Plan de Telecomunicaciones y Redes Ultra Rápidas
Sri Lanka	yes	2012	e- Sri Lanka
St. Kitts and Nevis	yes	2006	National Information and Communications Technology (ICT) Strategic Plan
St. Lucia	yes	2006	ICT Development Strategy for St. Lucia
St. Vincent and the Grenadines	yes	2010	National ICT Strategy and Action Plan 2010-2015
Sudan	yes	2012	Sudan's National Strategic Development Plan 2012-2016
Suriname	no		
Swaziland	no		
Sweden	yes	2009	Broadband Strategy for Sweden
Switzerland	yes	2016	Digital Switzerland Strategy
Syria	no		
Tajikistan	no		
Tanzania	yes	2004	National Information Communication and Technology Broadband Backbone (NICTBB)
TFYR Macedonia	yes	2005	National Strategy for the development of Electronic Communications with Information Technologies
Thailand	yes	2010	The National Broadband Policy

Economy	POLICY AVAILABLE?	YEAR POLICY WAS ADOPTED	TITLE/DETAILS
Timor-Leste	no		
Togo	planning		
Tonga	yes	2011	Tonga-Fiji Connectivity Project : Pacific Regional Connectivity Program (PRCP)
Trinidad & Tobago	yes	2014	SMART TT Plan, National ICT Plan 2014-2018
Tunisia	yes	2015	Tunisie Digitale 2018
Turkey	yes	2009	Strategy of Transport and Communications, Target 2023, 2009-2013 Strategic Ministerial Plan
Turkmenistan	no		
Tuvalu	no		
Uganda	yes	2009	Uganda Broadband Infrastructure Strategy National Position Paper
Ukraine	no		
United Arab Emirates	yes	2008	TRA Initiative- ICT Fund for ICT sector development
United Kingdom	yes	2016	Digital Communications Infrastructure Strategy
	***IoT**	***2014***	***The Internet of Things: making the most of the Second Digital Revolution; review***
United States	yes	2010	Connecting America:The National Broadband Plan
	***IoT**	***2016***	***Developing Innovation and Growing the Internet of Things Act; draft of the bill***
Uruguay	yes	2011	Agenda Digital ADU 2011-2015
Uzbekistan	no		
Vanuatu	yes	2013	National Information and Communications Policy
Vatican	no	2011	N/A
Venezuela	yes	2012	Fiber Deployment Project- La Compañía Anónima Nacional Teléfonos de Venezuela (Cantv)
Viet Nam	yes	2016	Programme for the development of the country's high speed telecoms infrastructure
Yemen	no		
Zambia	yes	2006	National Information and Communication Technology Policy
Zimbabwe	yes	2005	National ICT Policy

Number of countries with National Broadband Plans: 151
Number of countries planning on introducing a National Broadband Plan: 7
Number of countries without National Broadband Plans: 38

Annex 2: Fixed-Broadband Subscriptions per 100 inhabitants, 2015

Rank	Economy	Fixed-Broadband Subscriptions per 100 inhabitants
1	Monaco	47.47
2	Switzerland	44.79
3	Liechtenstein	42.71
4	Denmark	42.51
5	Netherlands	41.73
6	France	41.34
7	Korea (Rep.)	40.25
8	Norway	38.94
9	Andorra	37.92
10	Malta	37.85
11	United Kingdom	37.72
12	Germany	37.19
13	Iceland	36.95
14	Belgium	36.85
15	San Marino	36.60
16	Luxembourg	36.48
17	Canada	36.41
18	Sweden	36.07
19	Hong Kong, China	31.94
20	Finland	31.70
21	New Zealand	31.55
22	United States	31.53
23	Belarus	31.35
24	Greece	30.73
25	Japan	30.49
26	Portugal	29.62
27	St. Kitts and Nevis	29.57
28	Macao, China	29.05
29	Estonia	28.68
30	Austria	28.58
31	Spain	28.31
32	Czech Republic	27.90
33	Australia	27.85
34	Lithuania	27.79
35	Ireland	27.71
36	Slovenia	27.63
37	Israel	27.44
38	Hungary	27.43
39	Barbados	27.23
40	Singapore	26.45
41	Uruguay	26.27
42	Latvia	25.09
43	Italy	23.80
44	Slovakia	23.34
45	Croatia	23.18
46	Lebanon	22.76
47	Bulgaria	22.41
48	Cyprus	22.38
49	Bahamas	20.91
50	Dominica	20.86
51	Trinidad & Tobago	20.68
52	Romania	19.77
53	Azerbaijan	19.76
54	Poland	19.47
55	Russian Federation	18.77
56	Bahrain	18.61
57	China	18.56
58	Grenada	18.52
59	Montenegro	18.08
60	TFYR Macedonia	17.19
61	Serbia	16.75
62	Bosnia and Herzegovina	16.62
63	Argentina	16.08
64	Mauritius	15.74
65	Moldova	15.55
66	St. Vincent and the Grenadines	15.51
67	St. Lucia	15.37
68	Chile	15.17
69	Georgia	14.63
70	Seychelles	14.31
71	Antigua & Barbuda	13.07
72	Kazakhstan	13.05
73	United Arab Emirates	12.81
74	Turkey	12.39
75	Brazil	12.24
76	Saudi Arabia	12.01
77	Ukraine	11.81
78	Mexico	11.65
79	Costa Rica	11.17
80	Colombia	11.16
81	Iran (I.R.)	10.86
82	Tuvalu	10.08
83	Qatar	10.06
84	Armenia	9.58
85	Suriname	9.48
86	Thailand	9.24
87	Ecuador	9.17
88	Malaysia	8.95
89	Venezuela	8.24
90	Viet Nam	8.14
91	Brunei Darussalam	7.99
92	Panama	7.93
93	Albania	7.60
94	Mongolia	7.12
95	Guyana	6.65
96	Maldives	6.47
97	Dominican Rep.	6.44
98	Peru	6.42
99	Jamaica	5.83
100	Oman	5.61

Rank	Economy	Fixed-Broadband Subscriptions per 100 inhabitants
101	Algeria	5.57
102	El Salvador	5.49
103	South Africa	5.25
104	Egypt	4.52
105	Tunisia	4.34
106	Jordan	4.16
107	Kyrgyzstan	3.71
108	Uzbekistan	3.57
109	Bhutan	3.56
110	Philippines	3.40
111	Morocco	3.38
112	Syria	3.14
113	Paraguay	3.14
114	Micronesia	3.14
115	Sri Lanka	3.10
116	Cape Verde	2.99
117	Belize	2.88
118	Guatemala	2.83
119	Bangladesh	2.41
120	Honduras	2.34
121	Djibouti	2.33
122	Tonga	1.89
123	Marshall Islands	1.89
124	Nicaragua	1.86
125	Botswana	1.79
126	Namibia	1.72
127	Bolivia	1.64
128	Vanuatu	1.63
129	Yemen	1.55
130	Fiji	1.43
131	Kuwait	1.37
132	India	1.34
133	Samoa	1.10
134	Zimbabwe	1.09
135	Indonesia	1.09
136	Nepal	1.06
137	Libya	0.97
138	Pakistan	0.95
139	Togo	0.92
140	Somalia	0.74
141	Angola	0.67
142	Benin	0.67
143	Senegal	0.67
144	Ethiopia	0.66
145	Gabon	0.63
146	Cambodia	0.53
147	Lao P.D.R.	0.52
148	Côte d'Ivoire	0.52
149	S. Tomé & Principe	0.49
150	Equatorial Guinea	0.48
151	Swaziland	0.47
152	Myanmar	0.35
153	Uganda	0.32
154	Kenya	0.28
155	Ghana	0.28
156	Comoros	0.26
157	Solomon Islands	0.24
158	Mauritania	0.24
159	Tanzania	0.20
160	Papua New Guinea	0.20
161	Gambia	0.18
162	Rwanda	0.17
163	Liberia	0.16
164	Zambia	0.15
165	Kiribati	0.11
166	Lesotho	0.10
167	Timor-Leste	0.09
168	Chad	0.08
169	Mozambique	0.08
170	Cuba	0.07
171	Sudan	0.07
172	Tajikistan	0.07
173	Cameroon	0.07
174	Madagascar	0.07
175	Guinea-Bissau	0.06
176	Niger	0.06
177	Turkmenistan	0.06
178	Burkina Faso	0.04
179	Burundi	0.03
180	Mali	0.02
181	Guinea	0.01
182	Nigeria	0.01
183	Afghanistan	0.00
184	Malawi	0.00
185	Congo (Dem. Rep.)	0.00
186	South Sudan	0.00
187	Haiti	0.00
	Central African Rep.	n/a
	Congo (Rep.)	n/a
	D.P.R. Korea	n/a
	Eritrea	n/a
	Iraq	n/a
	Nauru	n/a
	Palestine*	n/a
	Sierra Leone	n/a
	Vatican	n/a

*Notes: The table includes ITU Member States. * Palestine is not an ITU Member State; the status of Palestine in ITU is the subject of Res. 99 (Rev., Busan 2014) of the ITU Plenipotentiary Conference. n/a – not available. Source: ITU World Telecommunication/ICT Indicators Database.*

Annex 3: Active Mobile-Broadband Subscriptions per 100 inhabitants, 2015

Rank	Economy	Mobile-broadband Subscriptions per 100 inhabitants
1	Finland	144.05
2	Singapore	142.20
3	Kuwait	139.31
4	Bahrain	131.78
5	Japan	126.44
6	Sweden	122.09
7	Denmark	116.80
8	Estonia	114.27
9	New Zealand	114.22
10	Australia	112.86
11	Saudi Arabia	111.67
12	Korea (Rep.)	109.67
13	United States	109.23
14	San Marino	108.87
15	Hong Kong, China	107.02
16	Liechtenstein	101.44
17	Switzerland	97.61
18	Costa Rica	95.52
19	Ireland	95.05
20	Iceland	93.43
21	Norway	92.83
22	United Arab Emirates	91.99
23	Malaysia	89.94
24	Brazil	88.62
25	United Kingdom	87.79
26	Luxembourg	83.33
27	Italy	82.14
28	Spain	82.06
29	Bulgaria	81.29
30	Qatar	80.03
31	Oman	78.26
32	Uruguay	77.71
33	Mongolia	76.02
34	Suriname	75.85
35	Croatia	75.42
36	Thailand	75.28
37	Germany	75.10
38	France	74.65
39	Lithuania	74.22
40	Cape Verde	72.93
41	Serbia	71.75
42	Russian Federation	71.29
43	St. Kitts and Nevis	71.02
44	Netherlands	70.54
45	Czech Republic	68.81
46	Austria	68.57
47	Slovakia	67.53
48	Botswana	67.31
49	Argentina	67.30
50	Latvia	67.04

Rank	Economy	Mobile-broadband Subscriptions per 100 inhabitants
51	Ghana	66.82
52	Belgium	66.59
53	Monaco	65.24
54	Maldives	63.64
55	Romania	63.53
56	Malta	63.17
57	Tunisia	62.63
58	Namibia	62.07
59	Belarus	61.83
60	Azerbaijan	60.92
61	Poland	60.18
62	Kazakhstan	59.97
63	South Africa	59.47
64	Chile	57.61
65	Bhutan	56.41
66	Canada	56.32
67	TFYR Macedonia	56.19
68	Israel	56.06
69	China	56.03
70	Barbados	54.86
71	Cyprus	54.81
72	Jamaica	53.51
73	Lebanon	53.43
74	Portugal	52.04
75	Slovenia	52.03
76	Moldova	51.94
77	Turkey	50.94
78	Egypt	50.66
79	Georgia	50.45
80	Mexico	50.36
81	Fiji	48.17
82	Greece	45.65
83	Montenegro	43.65
84	Venezuela	42.97
85	Cambodia	42.80
86	Dominica	42.20
87	Andorra	42.12
88	Indonesia	42.05
89	Philippines	41.58
90	Vanuatu	41.31
91	Armenia	41.29
92	Colombia	40.97
93	Albania	40.58
94	Côte d'Ivoire	40.39
95	Algeria	40.11
96	Hungary	39.80
97	Dominican Rep.	39.61
98	Morocco	39.28
99	Paraguay	39.23
100	Zimbabwe	39.03

Rank	Economy	Mobile-broadband Subscriptions per 100 inhabitants
101	St. Vincent and the Grenadines	39.01
102	Viet Nam	38.98
103	Lesotho	37.70
104	Timor-Leste	37.52
105	Mauritius	37.03
106	Peru	36.71
107	Jordan	35.58
108	Ecuador	35.09
109	Bolivia	33.85
110	Antigua & Barbuda	33.76
111	St. Lucia	33.63
112	Bosnia and Herzegovina	33.48
113	Gabon	33.12
114	Panama	32.66
115	Trinidad & Tobago	32.22
116	Kyrgyzstan	30.98
117	Belize	30.21
118	Myanmar	29.54
119	Tonga	29.52
120	Sudan	29.41
121	Grenada	28.76
122	Uzbekistan	28.69
123	Senegal	26.42
124	Rwanda	25.88
125	Mauritania	23.10
126	Nepal	21.10
127	Bahamas	21.06
128	Nigeria	20.95
129	Liberia	20.52
130	Iran (I.R.)	20.02
131	El Salvador	19.94
132	Angola	19.33
133	Seychelles	19.14
134	Mali	18.84
135	Uganda	18.31
136	Honduras	17.23
137	Swaziland	17.04
138	Malawi	16.59
139	Sri Lanka	15.77
140	Kenya	15.50
141	Burkina Faso	15.44
142	Sierra Leone	15.22
143	Lao P.D.R.	14.16
144	Guinea	13.93
145	Zambia	13.79
146	Bangladesh	13.45
147	Pakistan	13.02
148	Tajikistan	12.08
149	Ethiopia	11.95
150	Solomon Islands	11.41
151	Syria	10.38
152	Guatemala	10.08
153	Gambia	10.02
154	Samoa	9.63
155	Mozambique	9.37
156	India	9.36
157	Madagascar	9.01
158	Congo (Dem. Rep.)	8.47
159	Ukraine	8.10
160	Burundi	7.56
161	Nicaragua	7.22
162	Papua New Guinea	6.07
163	Togo	6.02
164	Afghanistan	5.97
165	Yemen	5.85
166	Djibouti	5.56
167	Brunei Darussalam	4.48
168	Cameroon	4.27
169	Benin	4.24
170	Iraq	3.55
171	Tanzania	3.19
172	Niger	1.84
173	South Sudan	1.42
174	Chad	1.38
175	Central African Rep.	1.05
176	Kiribati	0.35
177	Guyana	0.23
178	Haiti	0.16
179	Equatorial Guinea	0.04
	Comoros	n/a
	Congo (Rep.)	n/a
	Cuba	n/a
	D.P.R. Korea	n/a
	Eritrea	n/a
	Guinea-Bissau	n/a
	Libya	n/a
	Marshall Islands	n/a
	Micronesia	n/a
	Nauru	n/a
	Palestine*	n/a
	S. Tomé & Principe	n/a
	Somalia	n/a
	Turkmenistan	n/a
	Tuvalu	n/a
	Vatican	n/a

*Notes: The table includes ITU Member States. * Palestine is not an ITU Member State; the status of Palestine in ITU is the subject of Res. 99 (Rev., Busan 2014) of the ITU Plenipotentiary Conference.*
n/a – not available.
Source: ITU Telecom/ICT Indicators Database.

Annex 4: Percentage of households with Internet, Developing Countries, 2015

Rank	Economy	% of households with Internet
1	Korea (Rep.)	98.79
2	Qatar	95.82
3	United Arab Emirates	95.40
4	Saudi Arabia	94.00
5	Singapore	89.50
6	Bahrain	88.71
7	Macao, China	86.30
8	Oman	83.95
9	Kazakhstan	82.22
10	Brunei Darussalam	81.70
11	Kuwait	80.46
12	Hong Kong, China	78.97
13	Azerbaijan	76.70
14	Israel	76.00
15	Jordan	75.90
16	Cyprus	71.21
17	St. Kitts and Nevis	70.50
18	Malaysia	70.06
19	Turkey	69.54
20	Lebanon	69.00
21	Morocco	66.50
22	Trinidad & Tobago	65.00
23	Barbados	62.90
24	Bahamas	61.10
25	Costa Rica	60.18
26	Mauritius	60.00
27	Uruguay	59.73
28	Chile	59.70
29	Seychelles	59.44
30	Dominica	58.40
31	Antigua & Barbuda	56.30
32	Armenia	56.20
33	Argentina	55.52
34	Brazil	54.50
35	China	54.17
36	Panama	52.71
37	Uzbekistan	52.60
38	Palestine*	52.40
39	Iran (I.R.)	52.18
40	Thailand	52.16
41	South Africa	50.58
42	Maldives	49.62
43	St. Vincent and the Grenadines	49.40
44	Georgia	44.81
45	Suriname	44.23
46	Grenada	42.80
47	Syria	42.27
48	Egypt	41.84
49	Colombia	41.80
50	St. Lucia	39.70
51	Tonga	39.50
52	Mexico	39.18

Rank	Economy	% of households with Internet
53	Indonesia	38.40
54	Tunisia	36.09
55	Venezuela	34.70
56	Vanuatu	34.50
57	Ghana	34.15
58	Sudan	33.50
59	Ecuador	32.80
60	Algeria	31.88
61	Bhutan	31.70
62	Fiji	31.32
63	Jamaica	30.29
64	Philippines	28.30
65	Paraguay	27.43
66	Cape Verde	27.00
67	Guyana	26.12
68	Belize	25.60
69	Samoa	25.50
70	Namibia	24.50
71	Mongolia	24.50
72	Viet Nam	24.10
73	Pakistan	24.00
74	Bolivia	23.80
75	Dominican Rep.	23.64
76	Peru	23.17
77	Honduras	22.80
78	Swaziland	22.30
79	Timor-Leste	21.70
80	Cambodia	21.00
81	Libya	20.36
82	India	20.00
83	Botswana	19.60
84	Kenya	19.60
85	Iraq	18.70
86	Sri Lanka	18.11
87	Zimbabwe	18.07
88	Gabon	18.00
89	Guatemala	17.38
90	Côte d'Ivoire	17.22
91	Kyrgyzstan	16.50
92	Senegal	15.70
93	Mauritania	15.60
94	El Salvador	15.00
95	Myanmar	15.00
96	Nicaragua	14.00
97	Gambia	13.30
98	Mozambique	13.20
99	Zambia	12.70
100	Burkina Faso	12.48
101	Lesotho	11.50
102	Lao P.D.R.	11.40
103	Nigeria	11.40
104	South Sudan	11.20

Rank	Economy	% of households with Internet
105	Bangladesh	11.00
106	Angola	10.20
107	Ethiopia	9.80
108	Malawi	9.10
109	Equatorial Guinea	8.94
110	Tajikistan	8.77
111	Cameroon	8.58
112	Mali	8.25
113	Djibouti	8.10
114	Uganda	7.20
115	Rwanda	6.72
116	Kiribati	6.30
117	Nepal	6.30
118	Solomon Islands	6.30
119	Togo	6.20
120	Madagascar	5.79
121	Cuba	5.56
122	Yemen	5.48
123	Benin	5.38
124	Papua New Guinea	5.30
125	Comoros	4.68
126	Tanzania	4.51
127	Haiti	4.35
128	Burundi	4.00
129	Afghanistan	3.90
130	Guinea	3.70
131	Chad	3.08
132	Central African Rep.	2.90
133	Liberia	2.73
134	Niger	2.60
135	Congo (Dem. Rep.)	2.40
136	Congo (Rep.)	2.29
137	Guinea-Bissau	2.06
138	Eritrea	1.70
	D.P.R. Korea	n/a
	Marshall Islands	n/a
	Micronesia	n/a
	Nauru	n/a
	S. Tomé & Principe	n/a
	Sierra Leone	n/a
	Somalia	n/a
	Turkmenistan	n/a
	Tuvalu	n/a

*Notes: The table includes ITU Member States. * Palestine is not an ITU Member State; the status of Palestine in ITU is the subject of Res. 99 (Rev., Busan 2014) of the ITU Plenipotentiary Conference.*
n/a – not available.
Source: ITU World Telecommunication/ICT Indicators Database.

Annex 5: Percentage of Individuals using the Internet, 2015

Rank	Economy	% of Individuals using Internet
1	Iceland	98.20
2	Luxembourg	97.33
3	Andorra	96.91
4	Norway	96.81
5	Liechtenstein	96.64
6	Denmark	96.33
7	Bahrain	93.48
8	Monaco	93.36
9	Japan	93.33
10	Netherlands	93.10
11	Qatar	92.88
12	Finland	92.65
13	United Kingdom	92.00
14	United Arab Emirates	91.24
15	Sweden	90.61
16	Korea (Rep.)	89.90
17	Canada	88.47
18	Estonia	88.41
19	New Zealand	88.22
20	Switzerland	87.97
21	Germany	87.59
22	Belgium	85.05
23	Slovakia	85.02
24	Hong Kong, China	84.95
25	France	84.69
26	Australia	84.56
27	Austria	83.93
28	Singapore	82.10
29	Kuwait	82.08
30	Czech Republic	81.30
31	Ireland	80.12
32	Latvia	79.20
33	Israel	78.89
34	Spain	78.69
35	Bahamas	78.00
36	Azerbaijan	77.00
37	Malta	76.18
38	Barbados	76.11
39	St. Kitts and Nevis	75.70
40	United States	74.55
41	Oman	74.17
42	Lebanon	74.00
43	Russian Federation	73.41
44	Slovenia	73.10
45	Kazakhstan	72.87
46	Hungary	72.83
47	Cyprus	71.72
48	Lithuania	71.38
49	Brunei Darussalam	71.20
50	Malaysia	71.06
51	TFYR Macedonia	70.38
52	Croatia	69.80

Rank	Economy	% of Individuals using Internet
53	Saudi Arabia	69.62
54	Argentina	69.40
55	Trinidad & Tobago	69.20
56	Portugal	68.63
57	Poland	68.00
58	Dominica	67.60
59	Greece	66.84
60	Italy	65.57
61	Serbia	65.32
62	Antigua & Barbuda	65.20
63	Bosnia and Herzegovina	65.07
64	Uruguay	64.60
65	Montenegro	64.56
66	Chile	64.29
67	Albania	63.25
68	Belarus	62.23
69	Venezuela	61.87
70	Costa Rica	59.76
71	Brazil	59.08
72	Armenia	58.25
73	Seychelles	58.12
74	Mexico	57.43
75	Palestine*	57.42
76	Morocco	57.08
77	Bulgaria	56.66
78	Colombia	55.90
79	Romania	55.76
80	Maldives	54.46
81	Grenada	53.81
82	Turkey	53.74
83	Jordan	53.40
84	Viet Nam	52.72
85	St. Lucia	52.35
86	Dominican Rep.	51.93
87	South Africa	51.92
88	St. Vincent and the Grenadines	51.77
89	Panama	51.21
90	China	50.30
91	Mauritius	50.14
92	Moldova	49.84
93	Ukraine	49.26
94	Ecuador	48.94
95	Tunisia	48.52
96	Nigeria	47.44
97	Fiji	46.33
98	Kenya	45.62
99	Georgia	45.16
100	Bolivia	45.10
101	Tonga	45.00
102	Paraguay	44.38
103	Iran (I.R.)	44.08
104	Jamaica	43.18

Rank	Economy	% of Individuals using Internet
105	Cape Verde	43.02
106	Uzbekistan	42.80
107	Suriname	42.76
108	Tuvalu	42.70
109	Belize	41.59
110	Peru	40.90
111	Philippines	40.70
112	Bhutan	39.80
113	Thailand	39.32
114	Algeria	38.20
115	Guyana	38.20
116	Egypt	35.90
117	Micronesia	31.50
118	Cuba	31.11
119	Swaziland	30.38
120	Kyrgyzstan	30.25
121	Sri Lanka	29.99
122	Syria	29.98
123	Botswana	27.50
124	Guatemala	27.10
125	El Salvador	26.92
126	Sudan	26.61
127	India	26.00
128	S. Tomé & Principe	25.82
129	Samoa	25.41
130	Yemen	25.10
131	Gabon	23.50
132	Ghana	23.48
133	Vanuatu	22.35
134	Namibia	22.31
135	Indonesia	21.98
136	Myanmar	21.80
137	Senegal	21.69
138	Mongolia	21.44
139	Equatorial Guinea	21.32
140	Côte d'Ivoire	21.00
141	Zambia	21.00
142	Cameroon	20.68
143	Honduras	20.36
144	Nicaragua	19.70
145	Marshall Islands	19.28
146	Uganda	19.22
147	Libya	19.02
148	Cambodia	19.00
149	Tajikistan	18.98
150	Lao P.D.R.	18.20

Rank	Economy	% of Individuals using Internet
151	Pakistan	18.00
152	Rwanda	18.00
153	South Sudan	17.93
154	Nepal	17.58
155	Iraq	17.22
156	Gambia	17.12
157	Zimbabwe	16.36
158	Lesotho	16.07
159	Mauritania	15.20
160	Turkmenistan	15.00
161	Bangladesh	14.40
162	Timor-Leste	13.40
163	Kiribati	13.00
164	Angola	12.40
165	Haiti	12.20
166	Djibouti	11.92
167	Ethiopia	11.60
168	Burkina Faso	11.39
169	Mali	10.34
170	Solomon Islands	10.00
171	Malawi	9.30
172	Mozambique	9.00
173	Afghanistan	8.26
174	Papua New Guinea	7.90
175	Congo (Rep.)	7.62
176	Comoros	7.46
177	Togo	7.12
178	Benin	6.79
179	Liberia	5.90
180	Tanzania	5.36
181	Burundi	4.87
182	Guinea	4.70
183	Central African Rep.	4.56
184	Madagascar	4.17
185	Congo (Dem. Rep.)	3.80
186	Guinea-Bissau	3.54
187	Chad	2.70
188	Sierra Leone	2.50
189	Niger	2.22
190	Somalia	1.76
191	Eritrea	1.08
	D.P.R. Korea	
	Nauru	
	San Marino	
	Vatican	

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n/a – not available.
Source: ITU World Telecommunication/ICT Indicators Database.

Annex 6: Percentage of Individuals using the Internet, Developing Countries, 2015

Rank	Economy	% of individuals using Internet
1	Bahrain	93.48
2	Qatar	92.88
3	United Arab Emirates	91.24
4	Korea (Rep.)	89.90
5	Hong Kong, China	84.95
6	Singapore	82.10
7	Kuwait	82.08
8	Israel	78.89
9	Bahamas	78.00
10	Macao, China	77.60
11	Azerbaijan	77.00
12	Barbados	76.11
13	St. Kitts and Nevis	75.70
14	Oman	74.17
15	Lebanon	74.00
16	Kazakhstan	72.87
17	Cyprus	71.72
18	Brunei Darussalam	71.20
19	Malaysia	71.06
20	Saudi Arabia	69.62
21	Argentina	69.40
22	Trinidad & Tobago	69.20
23	Dominica	67.60
24	Antigua & Barbuda	65.20
25	Uruguay	64.60
26	Chile	64.29
27	Venezuela	61.87
28	Costa Rica	59.76
29	Brazil	59.08
30	Armenia	58.25
31	Seychelles	58.12
32	Mexico	57.43
33	Palestine*	57.42
34	Morocco	57.08
35	Colombia	55.90
36	Maldives	54.46
37	Grenada	53.81
38	Turkey	53.74
39	Jordan	53.40
40	Viet Nam	52.72
41	St. Lucia	52.35
42	Dominican Rep.	51.93
43	South Africa	51.92
44	St. Vincent and the Grenadines	51.77
45	Panama	51.21
46	China	50.30
47	Mauritius	50.14
48	Ecuador	48.94
49	Tunisia	48.52
50	Nigeria	47.44
51	Fiji	46.33

Rank	Economy	% of individuals using Internet
52	Kenya	45.62
53	Georgia	45.16
54	Bolivia	45.10
55	Tonga	45.00
56	Paraguay	44.38
57	Iran (I.R.)	44.08
58	Jamaica	43.18
59	Cape Verde	43.02
60	Uzbekistan	42.80
61	Suriname	42.76
62	Tuvalu	42.70
63	Belize	41.59
64	Peru	40.90
65	Philippines	40.70
66	Bhutan	39.80
67	Thailand	39.32
68	Algeria	38.20
69	Guyana	38.20
70	Egypt	35.90
71	Micronesia	31.50
72	Cuba	31.11
73	Swaziland	30.38
74	Kyrgyzstan	30.25
75	Sri Lanka	29.99
76	Syria	29.98
77	Botswana	27.50
78	Guatemala	27.10
79	El Salvador	26.92
80	Sudan	26.61
81	India	26.00
82	S. Tomé & Principe	25.82
83	Samoa	25.41
84	Yemen	25.10
85	Gabon	23.50
86	Ghana	23.48
87	Vanuatu	22.35
88	Namibia	22.31
89	Indonesia	21.98
90	Myanmar	21.80
91	Senegal	21.69
92	Mongolia	21.44
93	Equatorial Guinea	21.32
94	Côte d'Ivoire	21.00
95	Zambia	21.00
96	Cameroon	20.68
97	Honduras	20.36
98	Nicaragua	19.70
99	Marshall Islands	19.28
100	Uganda	19.22
101	Libya	19.02
102	Cambodia	19.00

Rank	Economy	% of individuals using Internet
103	Tajikistan	18.98
104	Lao P.D.R.	18.20
105	Pakistan	18.00
106	Rwanda	18.00
107	South Sudan	17.93
108	Nepal	17.58
109	Iraq	17.22
110	Gambia	17.12
111	Zimbabwe	16.36
112	Lesotho	16.07
113	Mauritania	15.20
114	Turkmenistan	15.00
115	Bangladesh	14.40
116	Timor-Leste	13.40
117	Kiribati	13.00
118	Angola	12.40
119	Haiti	12.20
120	Djibouti	11.92
121	Ethiopia	11.60
122	Burkina Faso	11.39
123	Mali	10.34
124	Solomon Islands	10.00
125	Malawi	9.30

Rank	Economy	% of individuals using Internet
126	Mozambique	9.00
127	Afghanistan	8.26
128	Papua New Guinea	7.90
129	Congo (Rep.)	7.62
130	Comoros	7.46
131	Togo	7.12
132	Benin	6.79
133	Liberia	5.90
134	Tanzania	5.36
135	Burundi	4.87
136	Guinea	4.70
137	Central African Rep.	4.56
138	Madagascar	4.17
139	Congo (Dem. Rep.)	3.80
140	Guinea-Bissau	3.54
141	Chad	2.70
142	Sierra Leone	2.50
143	Niger	2.22
144	Somalia	1.76
145	Eritrea	1.08
146	D.P.R. Korea	n/a
147	Nauru	n/a

*Notes: The table includes ITU Member States. * Palestine is not an ITU Member State; the status of Palestine in ITU is the subject of Res. 99 (Rev., Busan 2014) of the ITU Plenipotentiary Conference.*
n/a – not available.
Source: ITU World Telecommunication/ICT Indicators Database.

Annex 7: Percentage of Individuals using the Internet for LDCs, 2015

Rank	Economy	% of Individuals using Internet
1	Tuvalu	42.70
2	Bhutan	39.80
3	Sudan	26.61
4	S. Tomé & Principe	25.82
5	Yemen	25.10
6	Vanuatu	22.35
7	Myanmar	21.80
8	Senegal	21.69
9	Equatorial Guinea	21.32
10	Zambia	21.00
11	Uganda	19.22
12	Cambodia	19.00
13	Lao P.D.R.	18.20
14	Rwanda	18.00
15	South Sudan	17.93
16	Nepal	17.58
17	Gambia	17.12
18	Lesotho	16.07
19	Mauritania	15.20
20	Bangladesh	14.40
21	Timor-Leste	13.40
22	Kiribati	13.00
23	Angola	12.40
24	Haiti	12.20
25	Djibouti	11.92

Rank	Economy	% of Individuals using Internet
26	Ethiopia	11.60
27	Burkina Faso	11.39
28	Mali	10.34
29	Solomon Islands	10.00
30	Malawi	9.30
31	Mozambique	9.00
32	Afghanistan	8.26
33	Comoros	7.46
34	Togo	7.12
35	Benin	6.79
36	Liberia	5.90
37	Tanzania	5.36
38	Burundi	4.87
39	Guinea	4.70
40	Central African Rep.	4.56
41	Madagascar	4.17
42	Congo (Dem. Rep.)	3.80
43	Guinea-Bissau	3.54
44	Chad	2.70
45	Sierra Leone	2.50
46	Niger	2.22
47	Somalia	1.76
48	Eritrea	1.08

Notes: The table includes ITU Member States.
n/a – not available.
Source: ITU World Telecommunication/ICT Indicators Database.

List of Acronyms and Abbreviations

ADSL	Asymmetric Digital Subscriber Line
AR	Augmented Reality
ANATEL	National Telecommunications Agency of Brazil
CAGR	Compound Annual Growth Rate
CITC	Communications and Information Technology Commission of Saudi Arabia
DAU	Daily Average Users
DSL	Digital Subscriber Line
EfA	Education for All
EU	European Union
FCC	Federal Communications Commission of the United States
FDI	Foreign Direct Investment
FTTB	Fibre-To-The-Building
FTTH	Fibre-To-The-Home
FTTS	Fibre-To-The-Street
GDP	Gross Domestic Product
GNI	Gross National Income
GSMA	GSM Association
GSMAi	GSMA Intelligence
HTS	High Throughput Satellite
IADB	Inter-American Development Bank
ICTs	Information Communication Technologies
ICT4D	ICT for Development
IDC	International Data Corporation
ILO	International Labour Organization
IMT	International Mobile Telecommunication
IoST	Internet of Small Things
IoT	Internet of Things
ITU	International Telecommunication Union
KPIs	Key Performance Indicators
LAN	Local Access Network
LDCs	Least Developed Countries
LLDCs	Landlocked Developing Countries
LLU	Local Loop Unbundling
LTE	Long-Term Evolution
MAU	Monthly Average Users
MDGs	Millennium Development Goals

MoI	Means of Implementation
M2M	Machine-to-Machine
NBN	National Broadband Network
NBP	National Broadband Plan
NFV	Network Function Virtualization
NGN	Next-Generation Network
NGO	Non-Governmental Organization
NGSO	Non-Geostationary Satellite Orbit
OECD	Organisation for Economic Cooperation and Development
OSPs	Online Service Providers
PC	Personal Computer
PPP	Public-Private Partnership
QoE	Quality of Experience
QoS	Quality of Service
SDGs	Sustainable Development Goals
SDN	Software Defined Networking
SIDS	Small Island Developing States
SMEs	Small- and Medium-Sized Enterprises
STEM	Science, Technology and Mathematics
TIP	Telecom Infra Project
TVWS	TV white spaces
UAV	Unmanned Aerial Vehicle
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USF	Universal Service Fund
USOs	Universal Service Obligations
VAT	Value-Added Tax
WDR	World Development Report
WRC	World Radiocommunication Conference
WSN	Wireless Sensor Networks
2G	Second-generation mobile
3G	Third-generation mobile
4G	Fourth-generation mobile
5G	Fifth-generation mobile

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