STATE OF ICT IN ASIA AND THE PACIFIC 2016

UNCOVERING THE WIDENING BROADBAND DIVIDE

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Technical Paper by the Information and Communications Technology and Disaster Risk Reduction Division

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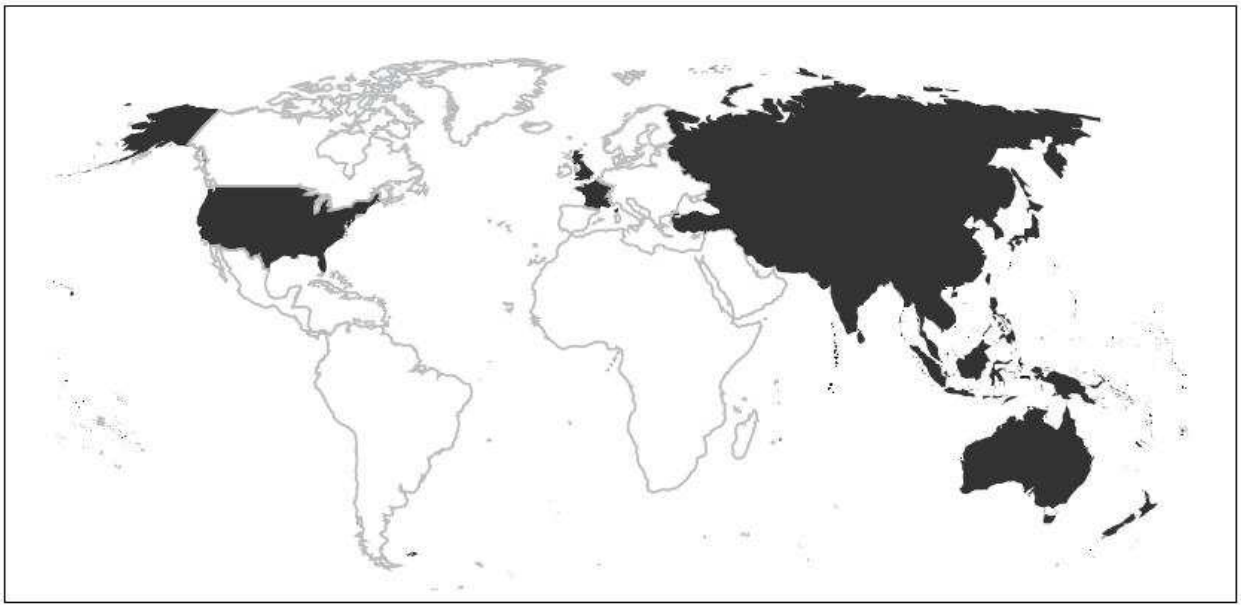

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Acronyms

3G	Third Generation (of wireless mobile telecommunications technology)
4G	Fourth Generation (of wireless mobile telecommunications technology)
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
B2B	Business-to-Business
B2C	Business-to-Consumer
ESCAP	Economic and Social Commission for Asia and the Pacific
GDP	Gross Domestic Product
GNI	Gross National Income
GSMA	Groupe Spécial Mobile Association
HAP	High Altitude Platform
ICT	Information and Communications Technology
IoT	Internet of Things
IP	Internet Protocol
ISOC	Internet Society
ISP	Internet Service Provider
ITU	International Telecommunication Union
LDC	Least Developed Country
LLDC	Landlocked Developing Country
LTE	Long-Term Evolution
NGO	Non-Governmental Organization
OBOR	One Belt One Road
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing Power Parity
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
VoIP	Voice over Internet Protocol
WEF	World Economic Forum
WSIS	World Summit on the Information Society

1. Overview 2016: ICT in Global and Regional Contexts

The digital technology has been fundamentally transforming not only the way we interact in society and the economy, but also the way the development paradigm is evolving. The Global Information Technology Report 2016,[1] published by the World Economic Forum (WEF) in July 2016, highlights that the digital revolution is changing the nature of innovation, which is increasingly based on the digital technology and associated new business models. Encouraging businesses to embrace the power of the digital technology, therefore, should be an imperative of governments. This requires, among others, the right governance frameworks to anticipate the impact of emerging technologies and react quickly to changing circumstances due to new economic and social dynamics. The WEF report concludes that the role of technology, broadband in particular, is critical to drive growth and enable collaborative innovation in many areas, from production to processes.

Asia and the Pacific has been leading information and communications technology (ICT) growth in the past decade. Some of the region's ICT-advanced economies are top performers in major ICT indicators. The above-mentioned WEF report reveals that seven Asia-Pacific countries (Australia, Hong Kong (China), Japan, Republic of Korea, New Zealand and Singapore) are among the top 20 countries in terms of overall ICT readiness in the Networked Readiness Index.[2] The United Nations Conference on Trade and Development (UNCTAD) published the Business-to-Consumer (B2C) E-Commerce Index[3] in July 2016 with updated e-commerce indicators[4] to help policy- and decision-makers assess the readiness of their economies to engage in online commerce. According to the index, three of the Asia-Pacific economies (Japan, Republic of Korea and New Zealand) are among the top 10 economies in e-commerce readiness. Furthermore, the United Nations E-Government Survey 2014[5] ranked the Republic of Korea, Australia and Singapore as the world's top three e-government leaders, followed by Japan and New Zealand, ranked 6th and 9th, respectively. The International Telecommunication Union (ITU) ICT Development Index 2015,[6] which measures ICT access, usage and skills, lists the Republic of Korea at the top of the list, followed by Hong Kong, China (9th), Japan (11th) and Australia (13th).

The question, however, remains—what happened to the rest of the countries in the region? Earlier this year, the World Bank published the World Development Report 2016: Digital Dividends.[7] While noting

[1] WEF, *Global Information Technology Report 2016* (Geneva, 2016). Available from http://reports.weforum.org/global-information-technology-report-2016/.
[2] Ibid. The Networked Readiness Index assesses and ranks 139 economies according to the state of networked readiness in order to provide insights into the economies' preparedness to reap the benefits from emerging technologies and opportunities created by digital innovation.
[3] UNCTAD, "B2C E-Commerce Index 2016", UNCTAD Technical Notes on ICT for Development, April 2016. Available from http://unctad.org/en/PublicationsLibrary/tn_unctad_ict4d07_en.pdf.
[4] The updated e-commerce indicators are: Internet use penetration, secure servers per 1 million inhabitants, credit card penetration and a postal reliability score.
[5] United Nations, *E-Government Survey 2014: E-Government for the Future we Want* (New York, 2014). Available from http://www.un.org/en/development/desa/publications/e-government-survey-2014.html.
[6] ITU, "ICT Development Index 2015: IDI 2015 Rank". Available from http://www.itu.int/net4/ITU-D/idi/2015/.
[7] World Bank, *World Development Report 2016: Digital Dividends* (Washington D.C., 2016). Available from http://live.worldbank.org/world-development-report-2016.

the transformative impacts the Internet has brought to businesses, governments and peoples around the world, the report reminds us that a significant digital divide still remains. Are countries in Asia and the Pacific making progress in ICT development and reaping the socioeconomic benefits of ICT investments, as anticipated at the World Summits on the Information Society a decade ago? Or is ICT widening the development gap, whereby the more ICT-advanced countries become more affluent and the rest are unable to catch up? Is the digital divide, in particular the broadband divide, actually shrinking or widening in the region?

Before we answer the questions, it is important to remind ourselves that ICT is a meta-infrastructure, a growth sector that contributes to economic development, and importantly, a key enabler for sustainable development. The Internet, as part of the meta-infrastructure, has transformed the way we live by providing instant connectivity to the remotest areas in the world and transmitting data, information and knowledge in multiple formats and languages over fibre optic cables, wireless networks or satellites. Being highly versatile, ICT now permeates every facet of our lives, by enabling trillions of dollars of financial transactions every day, connecting weather forecasts to agricultural production and disaster management, managing intelligent transport, controlling epidemics, advancing climate change adaptation, and creating new businesses, employment and even industries.

In addition, ICT-enabled financial, transport and trade facilitation infrastructure has encouraged innovations and developed an inclusive digital economy in the region. Broadband-enabled technologies, such as smart grids, intelligent transport systems, integrated water management systems and single e-government windows, are some of the efficiencies that will drive growth in all sectors of the economy. These emerging infrastructures are built on the broadband networks and facilitate the movements of goods, services, people and money across countries and thereby act as building blocks of the emerging digital economy.

This report intends to identify and bring to the attention of ICT decision- and policy-makers, regional ICT snapshots, emerging trends and salient features of ICT for development. The report will focus in particular on broadband connectivity in Asia and the Pacific as a basis for not only ICT development but also the achievement of the Sustainable Development Goals (SDGs) and other internationally-agreed development goals.

The initiatives towards building the digital economy, digital society and smart cities are based on the premise that reliable, resilient, affordable and robust connectivity exists. But the majority of the countries in Asia and the Pacific still have not reached the point yet, as this report illustrates. ICT ministries and departments, especially in smaller economies, do not appear to be fully equipped to keep up with the speed of technological changes and address the implications of these changes in their countries. Some of the key issues that ICT ministries and departments face include bridging the connectivity gap, and meeting the diverse and evolving needs for ICT in various socioeconomic sectors.

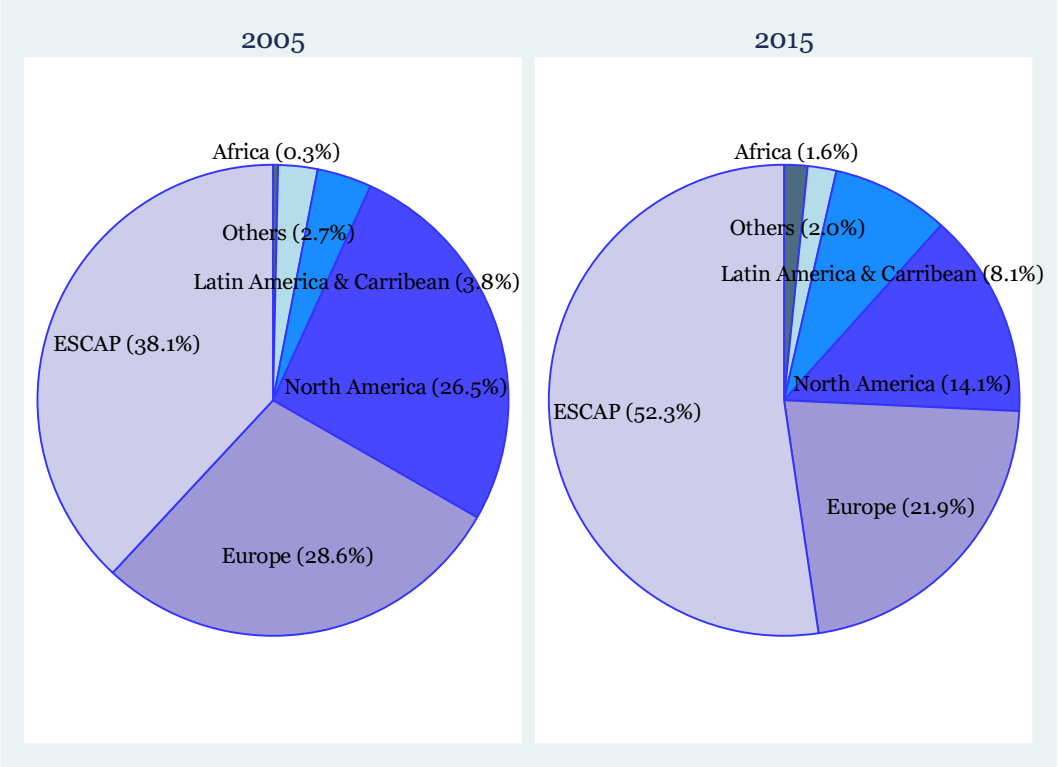
Taking advantage of the increased data availability and analytical capabilities, this report aims to deepen our understanding of the digital divide in Asia and the Pacific.

2. Regional ICT Snapshot 2016[8]

More than half of the global fixed broadband subscriptions are from Asia and the Pacific

According to the latest ITU data for 2015, over 52.3% of the global fixed broadband subscribers come from member countries of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).[9] This is followed by Europe (21.9%) and North America (14.1%). The data shows a dramatic increase from 2005 when subscriptions in the ESCAP region merely constituted 38.1% of the global total fixed broadband subscriptions, followed by Europe (28.6%) and North America (26.5%), (see Figure 1).

Figure 1: Global shares of total fixed broadband subscriptions in 2005 and 2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

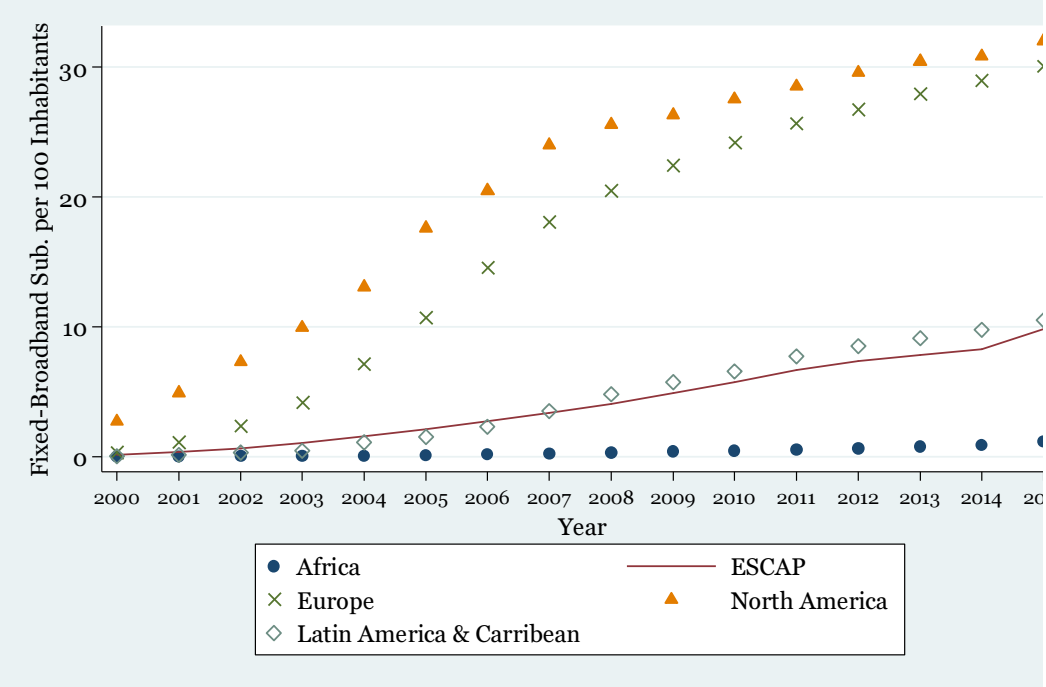
[8] Annual percentage growth rates for each country are computed from the annual percentage change between two years for the period 2000-2015. The data points for total subscriptions in Australia in 2007, in Thailand in 2002 and in the Islamic Republic of Iran in 2004 and 2005 are obtained by linear interpolation as the original estimates were missing in the data provided by ITU.

[9] See Annex V for the list of country groupings.

Asia and the Pacific is lagging behind in fixed broadband penetration

Despite the above-mentioned increase in the total number of fixed broadband subscriptions, the fixed broadband subscriptions per 100 inhabitants in the ESCAP region is behind Latin America and the Caribbean, and far lower than Europe and North America (see Figure 2). Fixed broadband penetration in Asia and the Pacific is even below the world's average of 11.2 subscriptions per 100 inhabitants in 2015. Figure 2 also illustrates a relatively slow growth in broadband uptake in Asia and the Pacific.

Figure 2: Fixed broadband subscriptions per 100 inhabitants (average) by region, 2000–2015



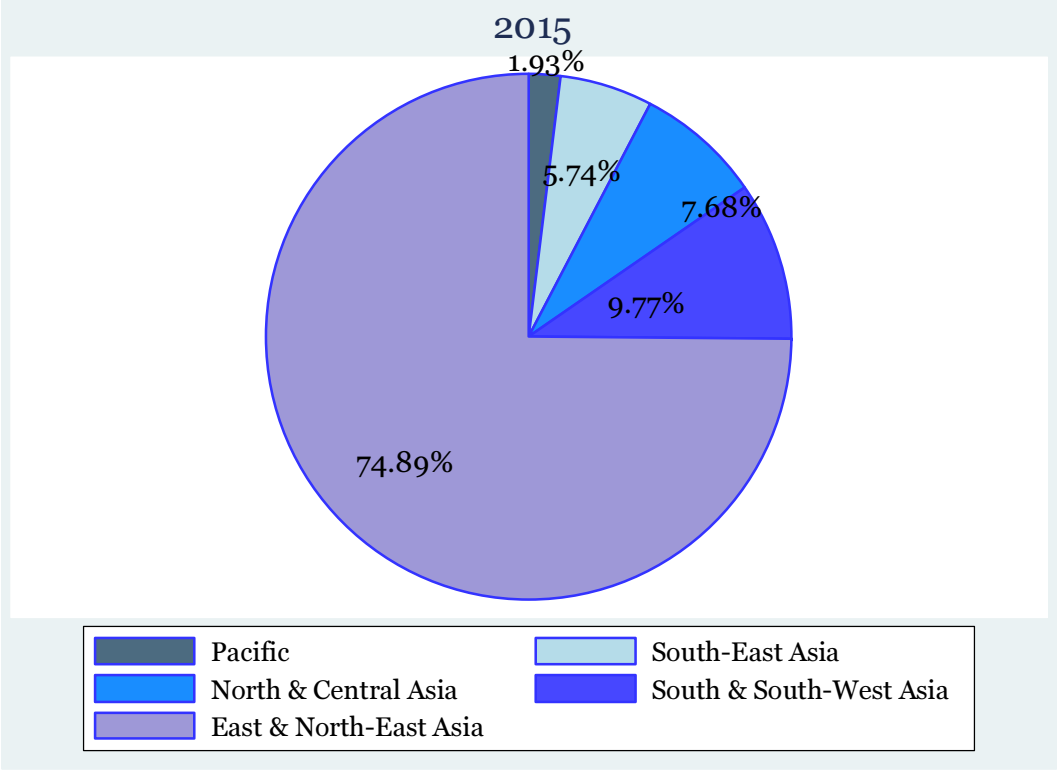
Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

75% of fixed broadband subscriptions in Asia and the Pacific are driven by East and North-East Asia

When analysed by subregion (as categorized by ESCAP),[10] it becomes clear that the total number of fixed broadband subscriptions in 2015 derives predominantly from East and North-East Asia (74.89%), followed by South and South-West Asia (9.77%), North and Central Asia (7.68%), South-East Asia (5.74%) and the Pacific (1.93%). In 2014 East and North-East Asia recorded 68.87%, followed by South-East Asia (11.3%), South and South-West Asia (9.76%), North and Central Asia (8.1%) and the Pacific (2%), illustrating an intensified concentration in East and North-East Asia.

[10] See Annex V for the list of country groupings.

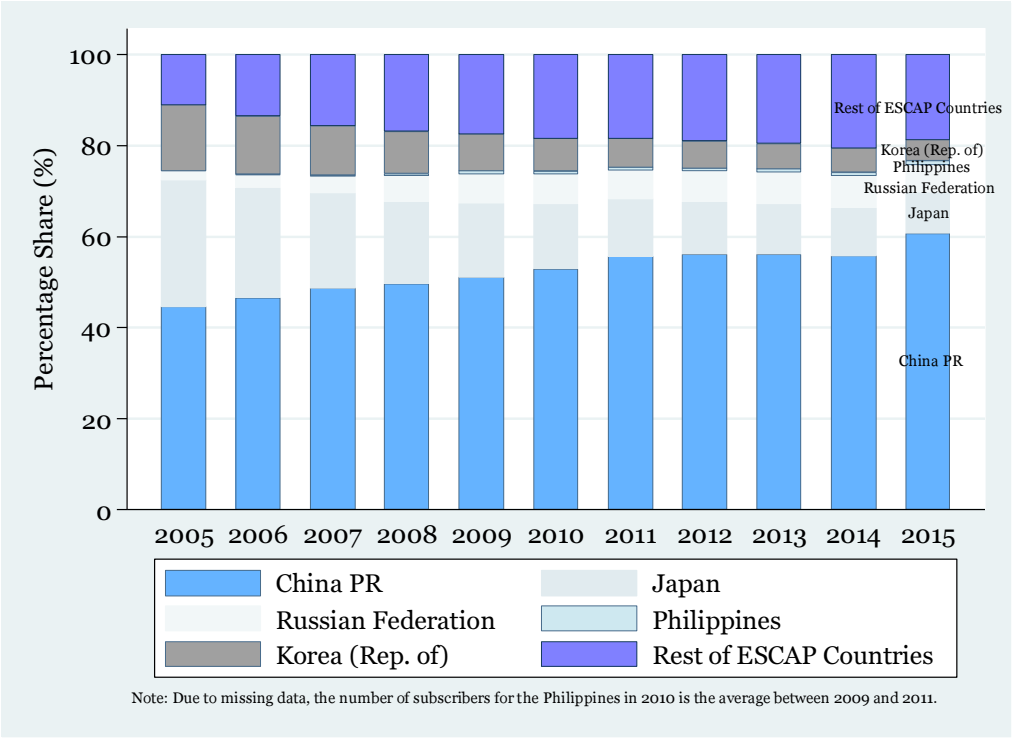
Figure 3: Fixed broadband subscriptions by subregion in 2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

When the total number of fixed broadband subscriptions is further disaggregated by country, the strong performance in North and Central Asia is found to be driven by China. In fact, in Asia and the Pacific, more than half of the broadband subscriptions were registered in China in 2015. The growth of broadband subscriptions in China has increased steadily over the past decade (see Figure 4).

Figure 4: Shares of total fixed broadband subscriptions of top 5 ESCAP countries and other countries, 2005–2015



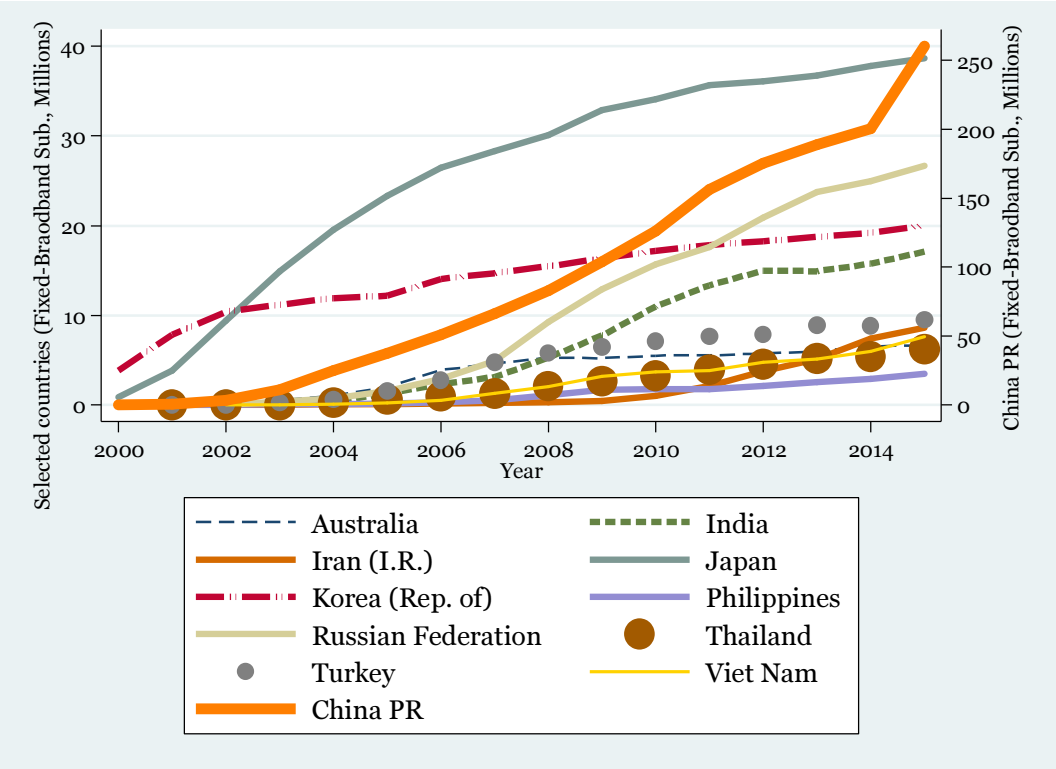
Note: Due to missing data, the number of subscribers for the Philippines in 2010 is the average between 2009 and 2011.

Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Figure 5 on the growth of total fixed broadband subscriptions during 2000-2015 shows China's significant rise in subscriptions (121.85% average annual growth rate for the period), amounting to 260 million subscriptions in 2015.[11]

[11] For comparison, the Russian Federation had an average annual growth rate of 278% over the same period (2000-2015). Other selected countries showing noticeable growth rates include the Islamic Republic of Iran (233%), Thailand (159%), Viet Nam (156%), and Turkey (108%).

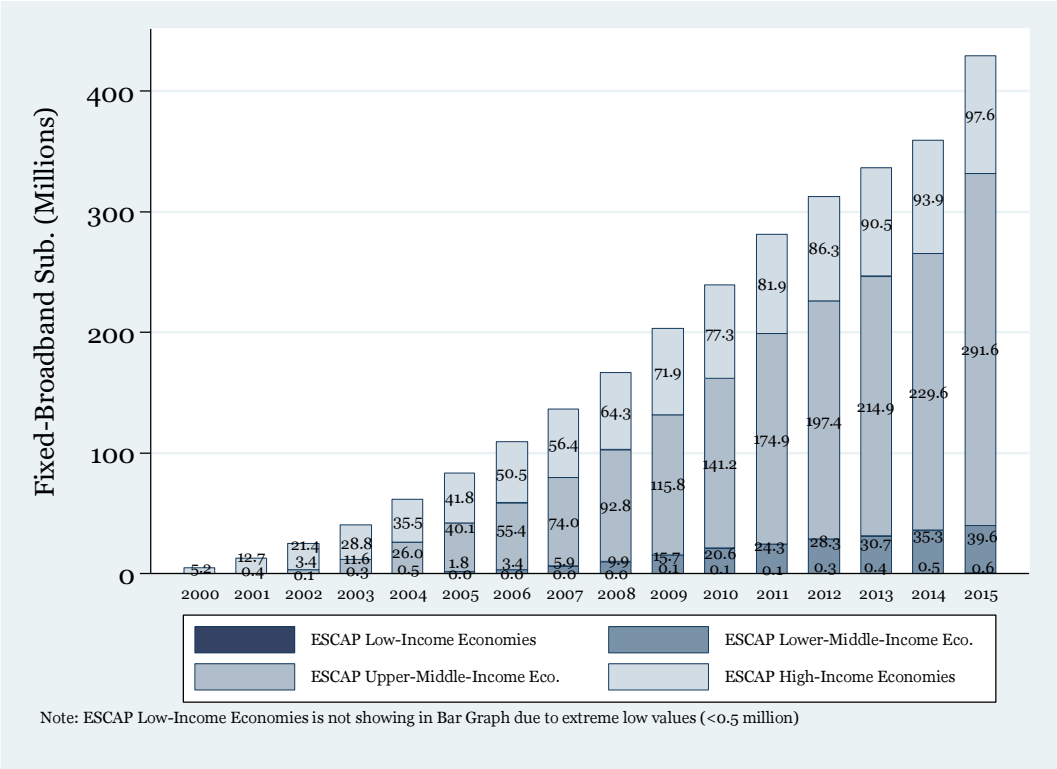
Figure 5: Total fixed broadband subscriptions in selected ESCAP countries, 2000-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Countries of different income levels are experiencing different growth rates in fixed broadband subscriptions. The upper-middle-income economies have the highest number of subscriptions since 2004, driven by the growth in China, and are the fastest growing group of countries in the region. The high-income economies demonstrate stable but slower growth, while lower-middle-income economies demonstrate accelerated growth since 2009. The most worrying development is the lack of progress in the total number of fixed broadband subscriptions among low-income economies, further accentuating the digital divide among countries (see Figure 6).

Figure 6: Total fixed broadband subscriptions by income group, 2000-2015



Note: ESCAP Low-Income Economies is not showing in Bar Graph due to extreme low values (<0.5 million)

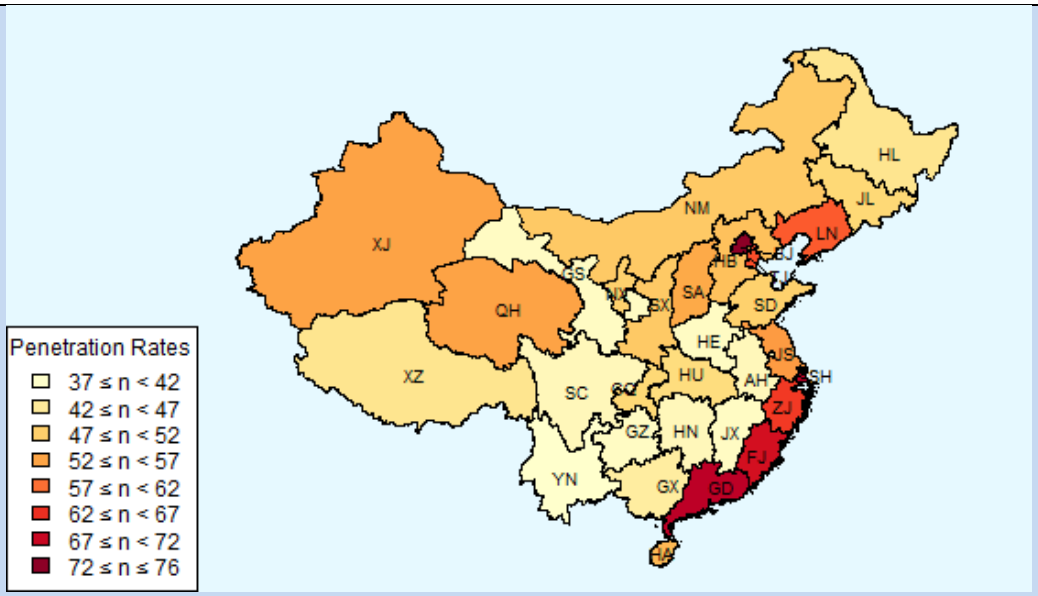
Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Box 1: One Belt One Road Initiative of China

According to ESCAP's analysis on China's ICT infrastructure and e-resilience in 2015,[12] there are significant regional differences across China in its deployment of the ICT infrastructure, and the availability and affordability of ICT services.

Map 1: Internet penetration in China, by province

[12] ESCAP, *Building e-Resilience in China: Enhancing the Role of Information and Communications Technology for Disaster Risk Management* (Bangkok, 2016). Available from http://www.unescap.org/resources/building-e-resilience-china-enhancing-role-information-and-communications-technology.



Source: Produced by ESCAP, based on data from the China Internet Network Information Center, "The 37th Statistical Report on Internet Development in China", January 2016. Available from http://www1.cnnic.cn/IDR/ReportDownloads/201604/P020160419390562421055.pdf.

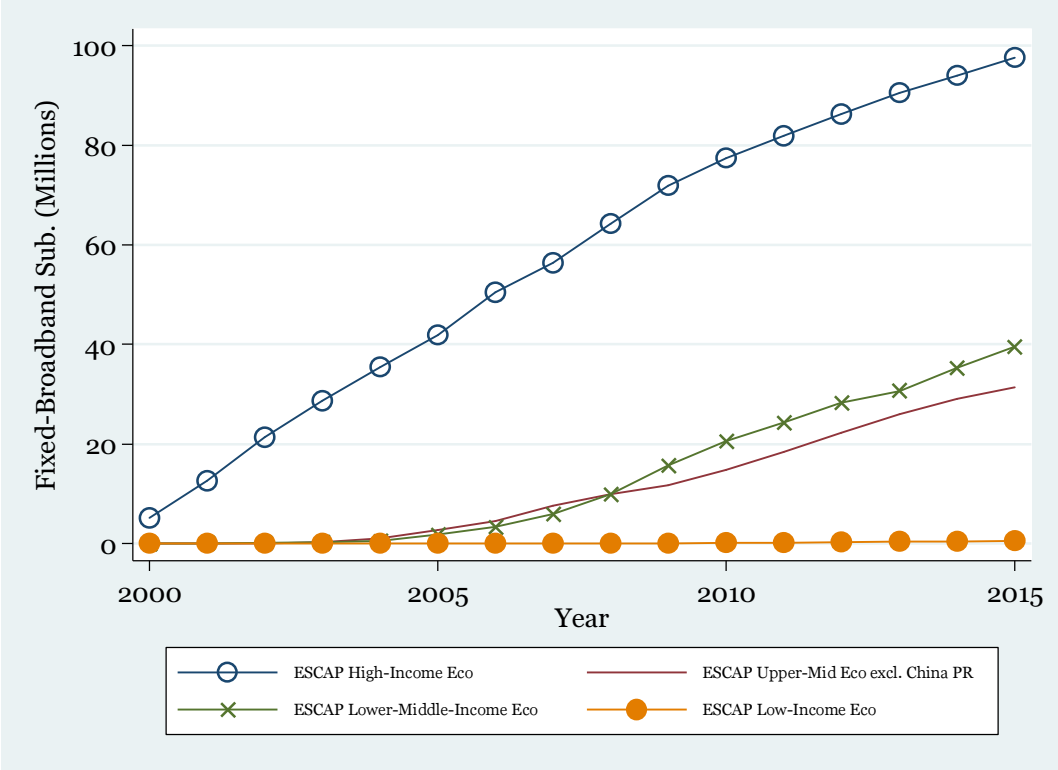
In 2015, the government announced the One Belt One Road (OBOR) initiative, based on six economic corridors corresponding to the Silk Road. These economic corridors (China-Mongolia-Russia Corridor; New Eurasia Land Bridge; China-Central Asia-West Asia; China-Pakistan; Bangladesh-China-India-Myanmar; and China-Indochina Economic Corridor) aim to promote connectivity of these economies with China through infrastructure, trade and investment based on the original Silk Road's pathway.

Considering the successful broadband growth and Internet bandwidth made available along China's major cities and China's intention to expand the infrastructure inland through OBOR, this initiative, in particular the ICT connectivity segment, could bring multiple socioeconomic benefits. Rural and underserved areas in China, as well as neighbouring countries could benefit from the connectivity with China's coastal areas.

Lack of progress in fixed broadband among low-income countries is a manifestation of the growing digital divide

The latest data from ITU shows that the lack of progress in expanding fixed broadband access among low-income economies is consistent over the period 2000-2015 (see Figure 7). When the total number of fixed broadband subscriptions in China is excluded, the picture appears slightly different: the share of upper-middle-income economies fall below that of lower-middle-income countries, while low-income economies show marginal progress throughout the years.

Figure 7: Total fixed broadband subscriptions by income group in 2000-2015, excluding China

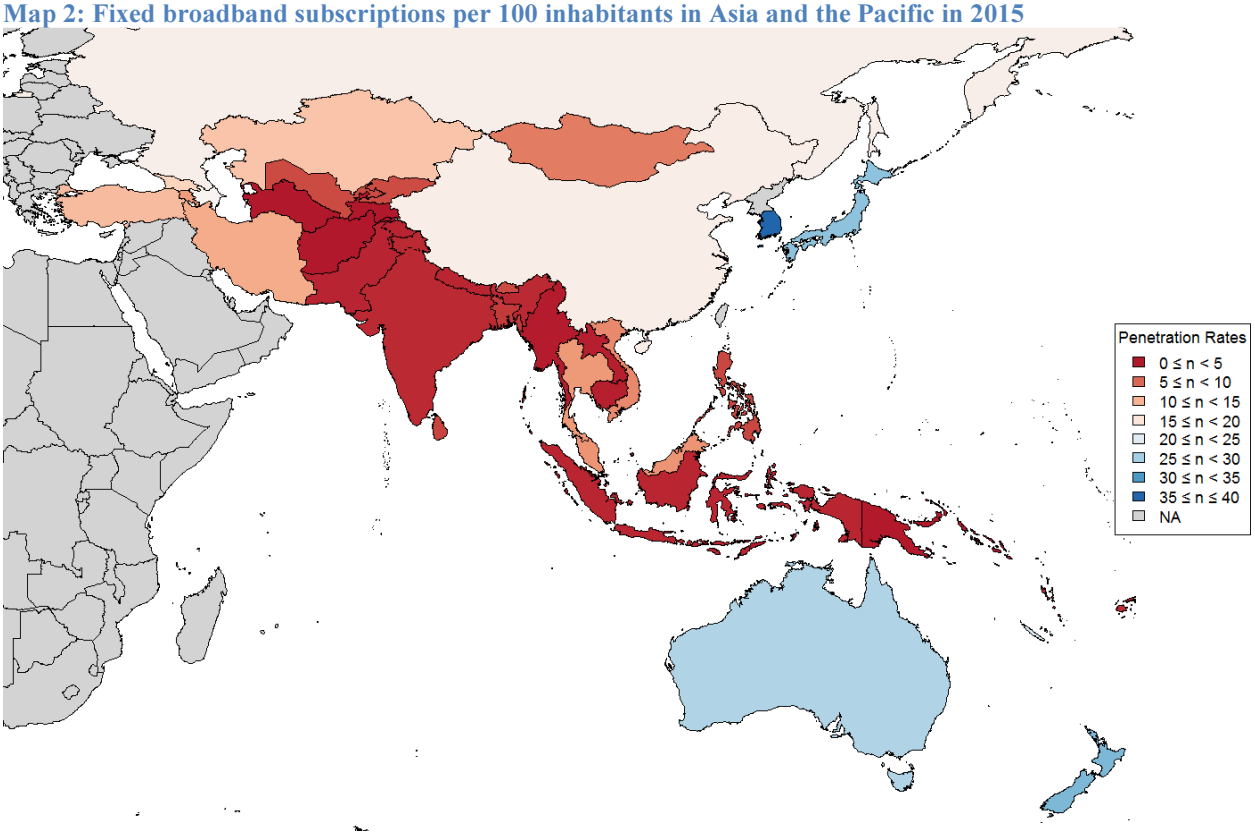


Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

The total number of broadband subscriptions is an important indicator, if the market size and commercial opportunities are to be considered. Even if a country has a 50% fixed broadband penetration, the market remains small if the total number of broadband subscriptions is 10,000. However, from the social and digital inclusion perspectives, the higher percentage of broadband subscriptions per 100 inhabitants would be a far more important indicator to a given society.

The geographical overview of fixed broadband subscriptions per 100 habitants across the region is shown in Map 2.

Map 2: Fixed broadband subscriptions per 100 inhabitants in Asia and the Pacific in 2015

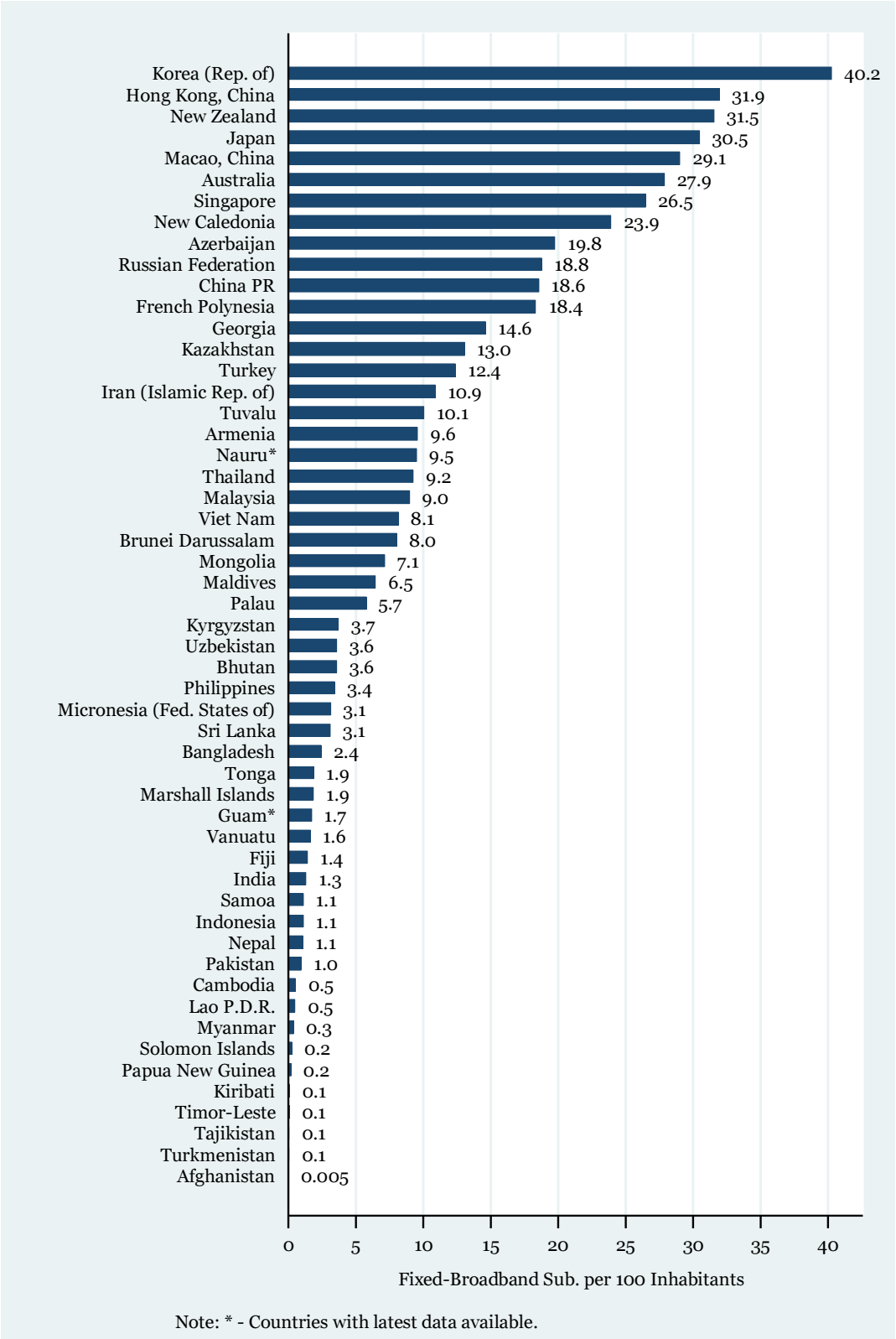


Source: ITU, World Telecommunication/ICT Indicators database: Fixed-broadband subscriptions. Available from http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx (accessed 27 July 2016).

As many as 20 ESCAP countries have below 2% fixed broadband adoption

In 20 ESCAP countries, less than 2% of their population have adopted fixed broadband in 2015, (see Figure 8).

Figure 8: Fixed broadband subscriptions per 100 inhabitants in ESCAP countries in 2015



Note: * - Countries with latest data available.

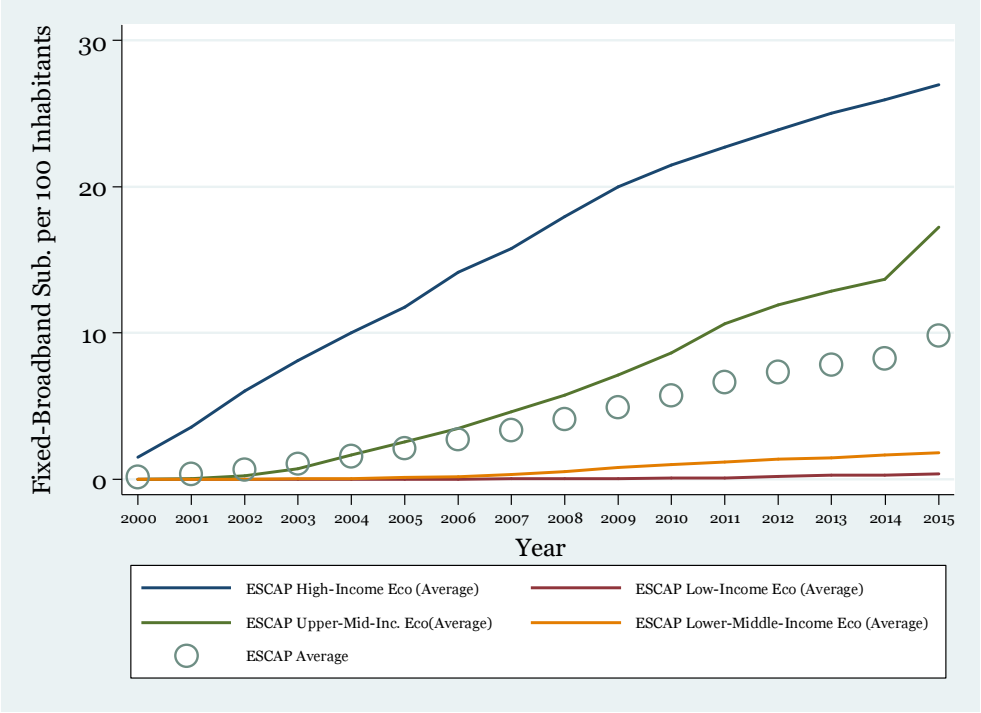
Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

With the exception of Guam,[13] the remaining 19 countries appear to be categorized in the lower half[14] of the Worldwide Governance Indicators' Regulatory Quality Index.[15] In addition, out of the 20, there are 10 countries ranked at the lowest 25th quartile of the Regulatory Quality Index. According to the World Governance Indicators' definition, regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Hence, specific regulatory interventions towards improving private sector development in the area of ICT infrastructure could be considered for these 20 ESCAP members to create an enabling environment and promote higher investment, in addition to other factors such as affordability and availability of infrastructure.

High-income countries are more digitally inclusive

When it comes to the broadband adoption rate, high-income economies in the region have shown steady growth over the past years; the growth rate matched only by the upper-middle-income economies (see Figure 9). However, unless other income groups, in particular the lower-middle-income and low-income economies, accelerate growth through targeted policy interventions, the gap with high-income countries is unlikely to narrow, given the current growth patterns.

Figure 9: Fixed broadband subscriptions per 100 inhabitants by income group, 2000-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

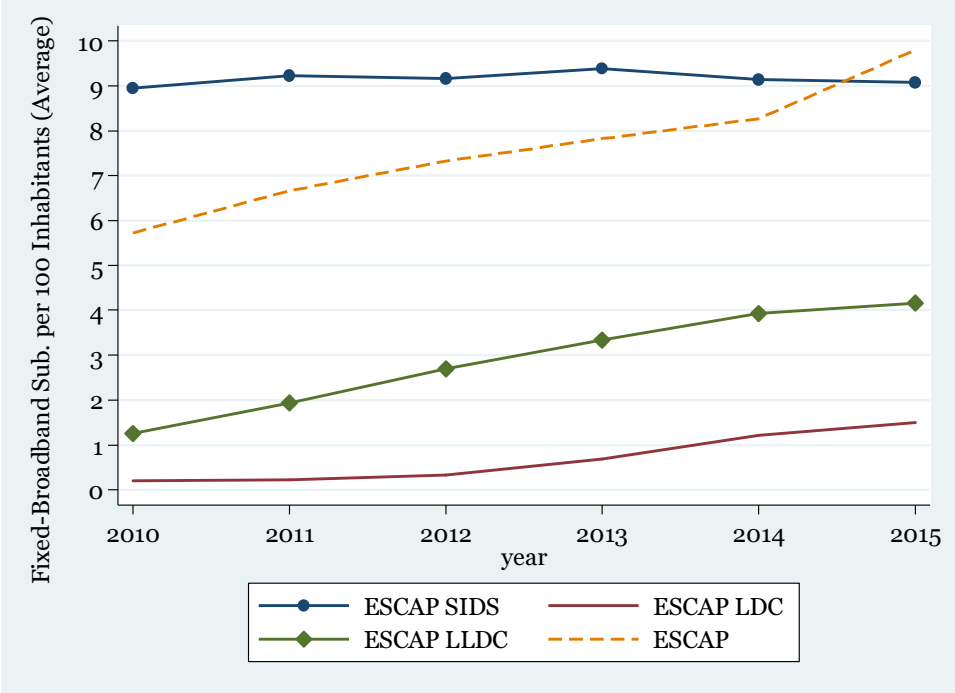
[13] Although the estimate is quite low (0.18) and has shown a significant deterioration between 2005 and 2014.
[14] With an index of -2.5 as weak and vice versa.
[15] Worldwide Governance Indicators. Available from http://info.worldbank.org/governance/wgi/index.aspx.

Landlocked developing countries are growing faster in Asia-Pacific

When the ESCAP average is compared with the average among least developed countries (LDCs), landlocked developing countries (LLDCs) and small island developing states (SIDS) in the region, the LLDCs show faster progress than SIDS and LDC groups, respectively, since 2010 (see Figure 10). The faster growth among the LLDCs has been led by growth in Central Asia.

The LDCs as a whole have been showing the slowest progress, and this may be due to the huge challenge of attracting public and private investment to expand the ICT infrastructure. This is further elaborated in the section below on the relationship between telecommunications investment and broadband expansion.

Figure 10: Fixed broadband subscriptions per 100 inhabitants (average) in ESCAP LDCs, LLDCs and SIDS, 2010-2015

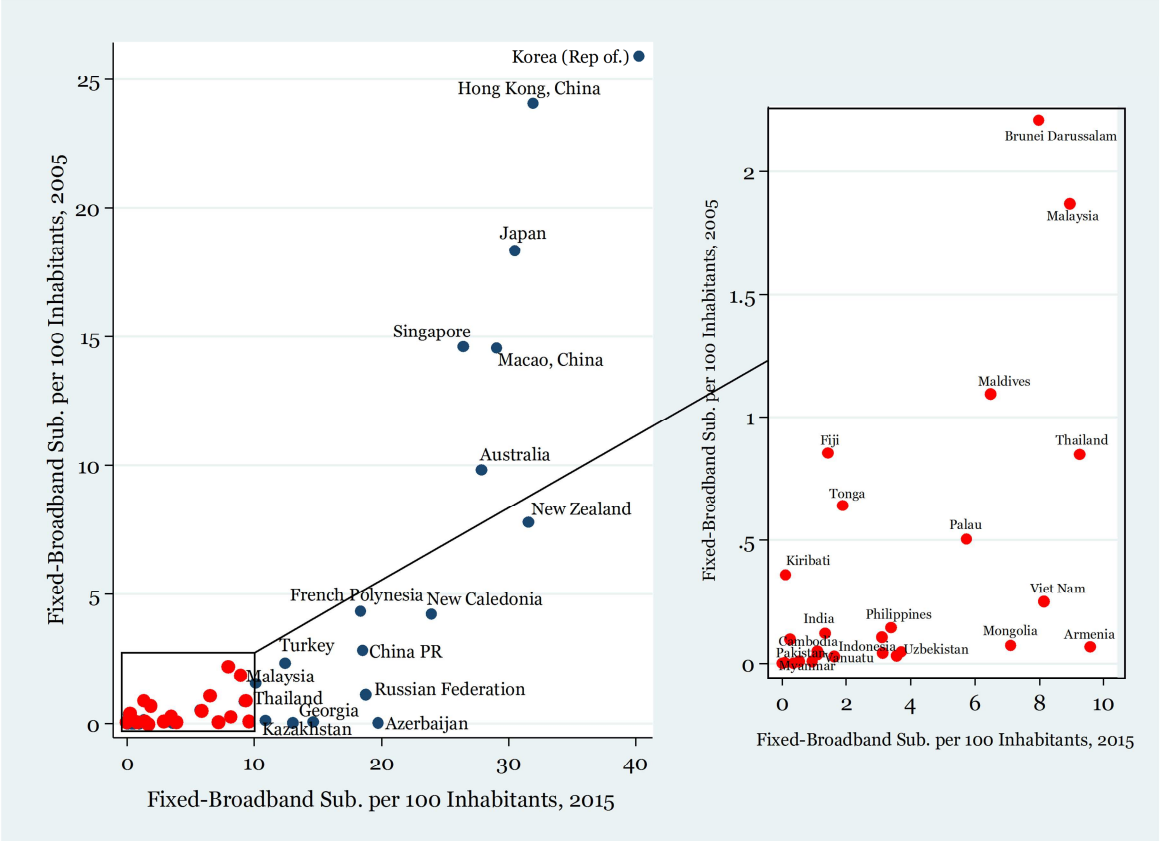


Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Fixed broadband growth patterns varies over time

At the country-level, fixed broadband connectivity performance varies among ESCAP countries over time. Figure 11 compares the countries' fixed broadband subscriptions per 100 inhabitants between 2005 and 2015. The chart on the right is a close up of the bottom-left corner of the left chart.

Figure 11: Fixed broadband subscriptions per 100 inhabitants in ESCAP countries in 2005 and 2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Online services are critical to the creation of demand for ICT infrastructure and to the achievement of the SDGs

In May 2016, the Copenhagen Consensus Center published a report on the cost-benefit analysis of various development interventions in Bangladesh.[16] The report found that out of over 70 development activities that were analysed, the most cost-efficient development interventions were ICT-related, such as e-procurement (USD 663 in benefits for USD 1 spent), followed by digitizing land records (USD 619 in benefits for USD 1 spent). Services provided at community digital centres that are spread throughout the country and the expansion of broadband are also listed as having positive benefits in the report. If aggregated at the regional level, the economic as well as developmental benefits are substantial.

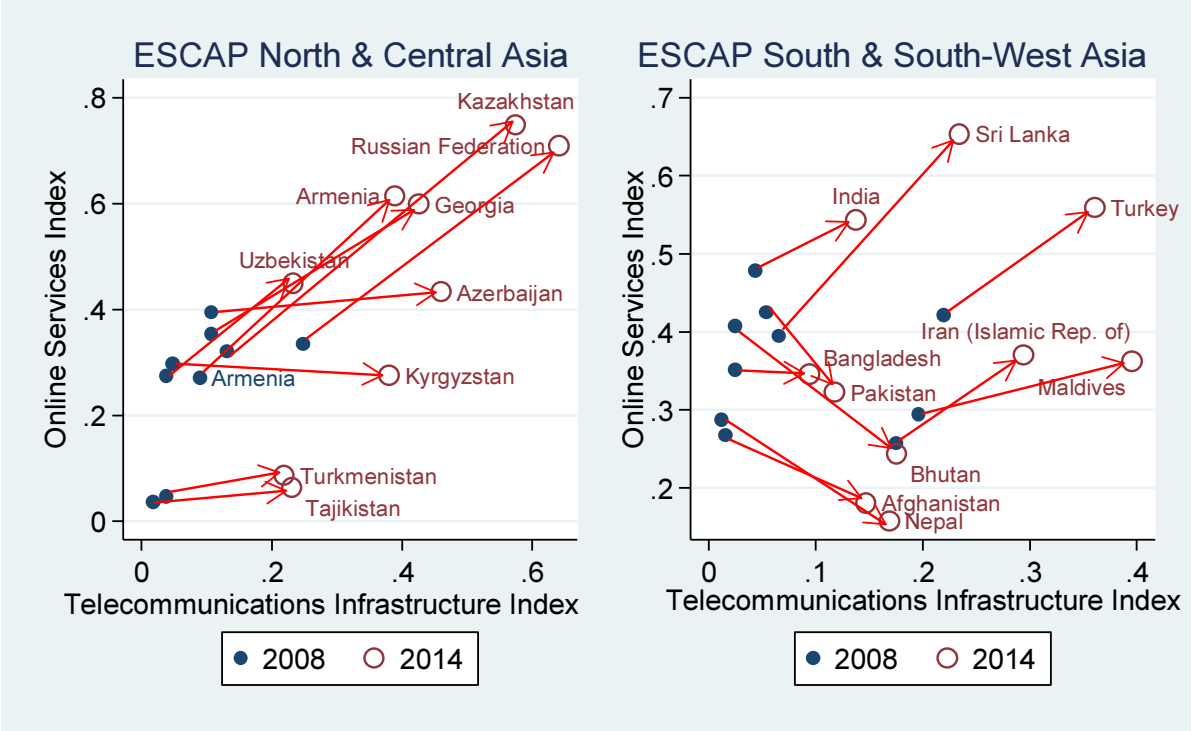
The availability of online content and services, especially from governments, is expected to support the achievement of the SDGs and fuel demand for ICT infrastructure, which would then allow more services and applications to be launched, thus creating a virtuous cycle. Governments in Asia and the Pacific have

[16] Copenhagen Consensus Center, "Bangladesh Priorities: Smarter Solutions for Bangladesh". Available from http://www.copenhagenconsensus.com/bangladesh-priorities. It is also featured in The Economist at http://www.economist.com/news/finance-and-economics/21698302-ambitious-attempt-work-out-best-use-scarce-resources-how-spend-it.

made significant progress in using ICT to deliver public services. The above-mentioned United Nations survey on e-government conducted in 193 United Nations Member States concluded that five of ESCAP countries—Republic of Korea, Australia, Singapore, Japan and New Zealand—are among the top 20 leaders in online public service delivery in 2014. The integration of e-services, expanded roll out of mobile applications and provision for e-participation were the key drivers behind their top performance.

Based on the United Nations E-Government Survey data,[17] ESCAP analysis found that the development of online content[18] is strongly associated[19] with the development of the telecommunications infrastructure. However, as shown below, ESCAP member countries demonstrate diverse growth patterns between the development of online services and the telecommunications infrastructure.

Figure 12: Online services versus telecommunications infrastructure in North and Central Asia, and South and South-West Asia in 2008 and 2014



Source: Produced by ESCAP, based on data sourced from the United Nations Public Administration Country Studies/E-Government Development Index Database (accessed April 2016).

[17] United Nations, *E-Government Survey 2014: E-Government for the Future we Want* (New York, 2014). Available from http://www.un.org/en/development/desa/publications/e-government-survey-2014.html.

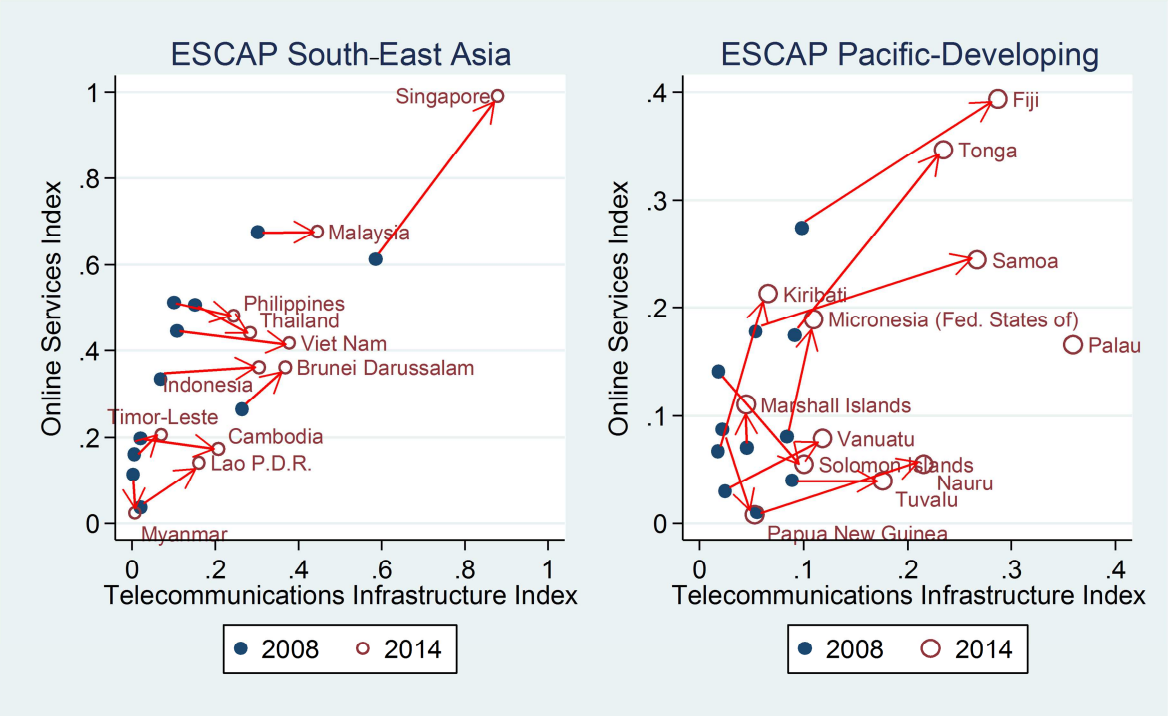
[18] The Online Service Index of the E-Government Survey 2014 uses the following four stages to assess governments' online service performance: (1) Government websites provide information on public policy, governance, laws, regulations, relevant documentation and types of government services provided; (2) Government websites deliver enhanced one-way or simple two-way e-communication between government and citizen, such as downloadable forms for government services and applications; (3) Government websites engage in two-way communication with their citizens, including requesting and receiving inputs on government policies, programmes, regulations, etc. Some form of electronic authentication of the citizen's identity is required to successfully complete the exchange; and; (4) Government websites have changed the way governments communicate with their citizens. They are proactive in requesting information and opinions from the citizens using Web 2.0 and other interactive tools.

[19] Correlation = 0.74 for 2008 and 2014.

Kazakhstan (North and Central Asia) has shown the most progress in both online services and telecommunications infrastructure development between 2008 and 2014 (see Figure 12). Other Asia-Pacific countries that have performed well in both axes include the Russian Federation, Armenia, Georgia and Uzbekistan.

In the case of South and South-West Asia, Sri Lanka, Turkey, India and the Islamic Republic of Iran progressed well in both online services and telecommunications infrastructure development between 2008 and 2014. Other countries such as Bangladesh and Maldives performed well predominantly in the development of the telecommunications infrastructure.

Figure 13: Online services versus telecommunications infrastructure in South-East Asia and developing countries in the Pacific in 2008 and 2014



Source: Produced by ESCAP, based on data sourced from the United Nations Public Administration Country Studies/E-Government Development Index Database (accessed April 2016).

In South-East Asia, Singapore stands out as progressing extremely well in the delivery of online services and telecommunications infrastructure. To a lesser degree, Brunei Darussalam, Timor-Leste and Lao PDR have shown similar patterns (see Figure 13). For the developing countries in the Pacific,[20] Fiji, Tonga, Kiribati, Marshall Islands and the Federated States of Micronesia, progressed well between 2008 and 2014 in developing online services and telecommunications infrastructure.

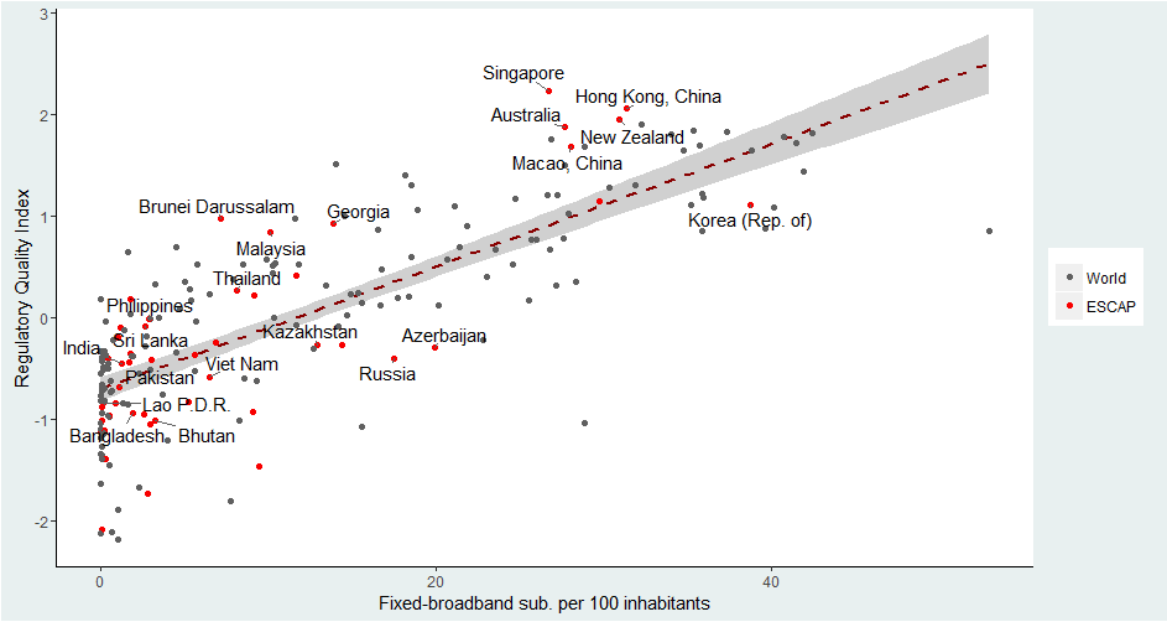
[20] Australia and New Zealand progressed well in both axes.

The importance of digital content and services has gained increasing attention, not only from the ICT for development practitioners, but also from a wider spectrum of policy- and decision-makers in various socioeconomic sectors. This issue should be examined and analysed further in the context of expanding connectivity capabilities in Asia and the Pacific.

There is a strong correlation between quality of regulation and fixed broadband adoption

One explanation for these varied patterns of progress is the perception on the quality of regulations, as briefly described above. The perception of poorer regulations in promoting business development is strongly correlated with lower ICT connectivity (lower fixed broadband penetration) and vice versa in ESCAP countries and globally (see Figure 14). Quality regulations include pro-competitive policies, open international gateways and efficient internet traffic management. The recent move by the government of Pakistan to open international gateway is seen by neighbouring landlocked countries as an opportunity to increase ICT connectivity and redundancy (see Annex II).

Figure 14: Perception on quality of regulation and fixed broadband connectivity, 2014



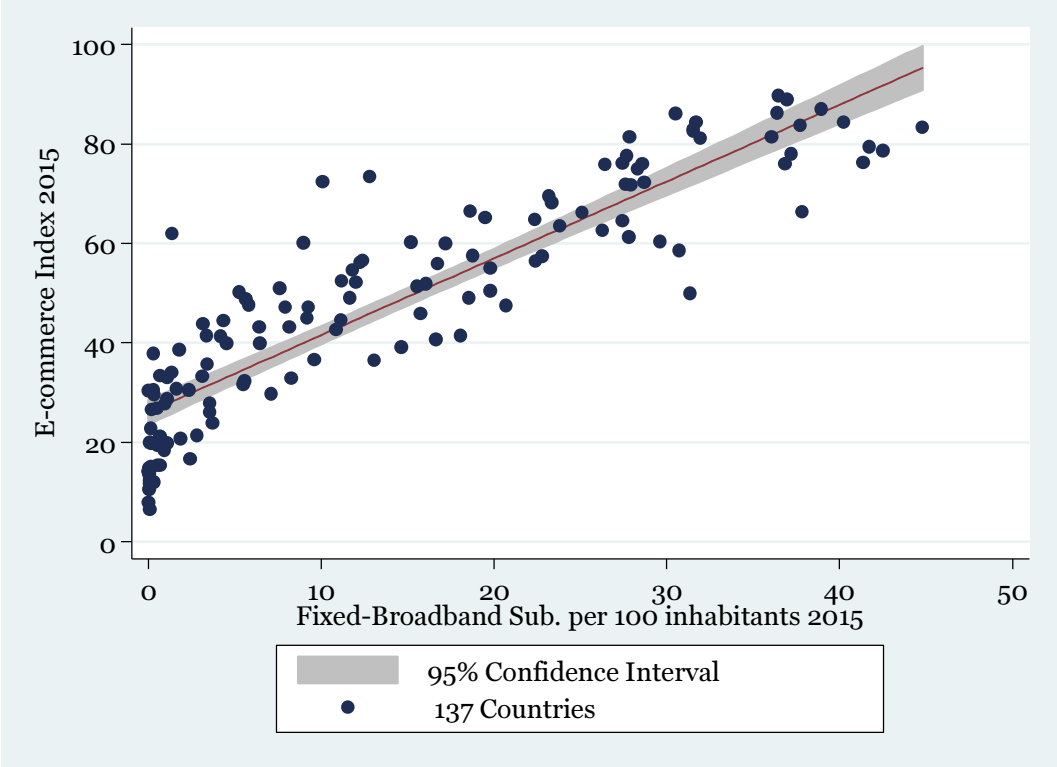
Sources: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed June 2015); and Regulatory Quality Index sourced from World Governance Indicators, World Bank.
Note: Estimates for regulatory quality ranges between -2 (poor regulatory quality) and +2 (very good regulatory quality); 95% confidence interval shaded in grey.

There is a strong correlation between e-commerce and fixed broadband adoption

Broadband connectivity is a critical component for online trade. With the limited data on e-commerce, access to fixed broadband connectivity is found to be strongly correlated with e-commerce. Using UNCTAD's 2016 E-Commerce Index, the top-ranked countries[21] conducting business-to-business (B2B) e-commerce is strongly correlated (0.90) with access to fixed broadband connectivity (see Figure 15), while the correlation between e-commerce and mobile broadband connectivity is less obvious.

This means, enhancing the ICT infrastructure connectivity will very likely increase B2B trade and e-commerce in Asia-Pacific countries. Moreover, smaller businesses stand to gain from the opportunities provided by e-commerce with global reach.

Figure 15: E-commerce versus fixed broadband access, 2015



Sources: ESCAP estimates; UNCTAD B2C E-Commerce Index 2016; and fixed broadband per 100 sourced from ITU.

[21] The 137 countries covered in the UNCTAD E-Commerce Index are listed in Annex VI.

High pricing is a major deterrent for fixed broadband adoption

Affordability of access is one of the key factors driving the adoption of fixed broadband by consumers and businesses in the region. According to a recent study on Central Asia,[22] the cost of fixed broadband in two of the 10 countries surveyed—Afghanistan and Tajikistan—represents over a quarter of personal income in purchasing power parity (PPP) terms (see Table 1). This high price deters the vast majority from accessing broadband. In three countries—Pakistan, Turkmenistan and Uzbekistan—the study indicates that the price of fixed broadband access is expensive (as defined by a Broadband Commission—more than 5% of personal income in PPP terms).

Table 1: Affordability of fixed broadband services in Central and South Asia

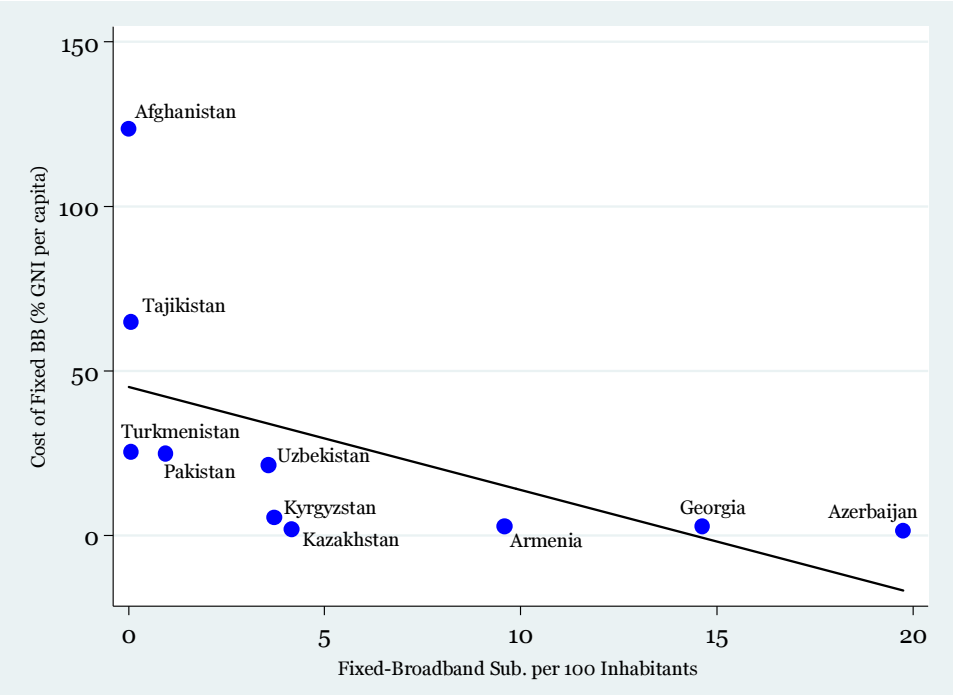
Country	Monthly subscription for fixed broadband (USD)	Cost of fixed broadband (% GNI/capita)	Cost of fixed broadband (% GNI/capita PPP)	Evaluation
Afghanistan	69.00	123.6%	42.2%	**Unaffordable**
Armenia	8.77	2.8%	1.2%	Affordable
Azerbaijan	9.50	1.5%	0.7%	Affordable
Georgia	8.95 (2 Mbps no cap)	2.9%	1.4%	Affordable
Kazakhstan	20.60 (4 Mbps no cap)	2.1%	1.1%	Affordable
Kyrgyz Republic	5.83	5.6%	2.2%	Moderate
Pakistan	29.40 (4 Mbps no cap)	25.0%	6.9%	**Expensive**
Tajikistan	58.44	64.9%	26.4%	**Unaffordable**
Turkmenistan*	171.40 (512 Kbps no cap)[54]	25.6%	14.2%	**Expensive**
Uzbekistan	37.50	21.5%	7.7%	**Expensive**

Source: ADB, ESCAP and ISOC, "Unleashing the Potential of the Internet in Central Asia, South Asia, the Caucasus and Beyond", 16 December 2015. Available from http://www.unescap.org/resources/unleashing-potential-internet-central-asia-south-asia-caucasus-and-beyond.
Note: Turkmenistan has a USD38 monthly subscription for a 1Mbps plan, however, it is capped at 400Mb monthly, and charges excess fees of USD0.03 per Mb.

As illustrated in Figure 16, the fixed broadband subscriptions per 100 inhabitants is higher in the countries where the cost of fixed broadband is lower (i.e., more affordable). All the countries with unaffordable or expensive broadband access in Table 1 are listed among the 20 countries with less than 2% fixed broadband adoption (see Figure 8).

[22] ADB, ESCAP and ISOC, "Unleashing the Potential of the Internet in Central Asia, South Asia, the Caucasus and Beyond", 16 December 2015. Available from http://www.unescap.org/resources/unleashing-potential-internet-central-asia-south-asia-caucasus-and-beyond.

Figure 16: Broadband affordability and fixed broadband subscriptions among 10 countries in Central Asia, South Asia and the Caucasus, 2015



Sources: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016). Gross national income (GNI) per capita (current USD) sourced from World Development Indicators, World Bank.

In a recent ESCAP study on broadband networks in the Association of Southeast Asian Nations (ASEAN) subregion,[23] findings show that the lack of diversity in ICT connectivity reduces competition and increases the cost of access to global networks, including via submarine cables. The study found a varied level of costs for Internet transit connectivity, which is correlated with the cost of fixed broadband subscriptions, i.e, end users living in a country with high charges for Internet transit connectivity have to bear the brunt by paying higher subscriptions.

Table 2: Monthly cost for Internet transit among ASEAN countries

Country	Cost per Month (USD)	Country	Cost per Month (USD)
Cambodia	100 per Mbps	**Philippines**	80 per Mbps
Indonesia	From >100 to 60/70 per Mbps	**Singapore**	<10 per Mbps bought in volume
Lao PDR	100 per Mbps	**Thailand**	80 per Mbps
Malaysia	25-30 per Mbps bought in volume	**Viet Nam**	70 per Mbps
Myanmar	>100 per Mbps		

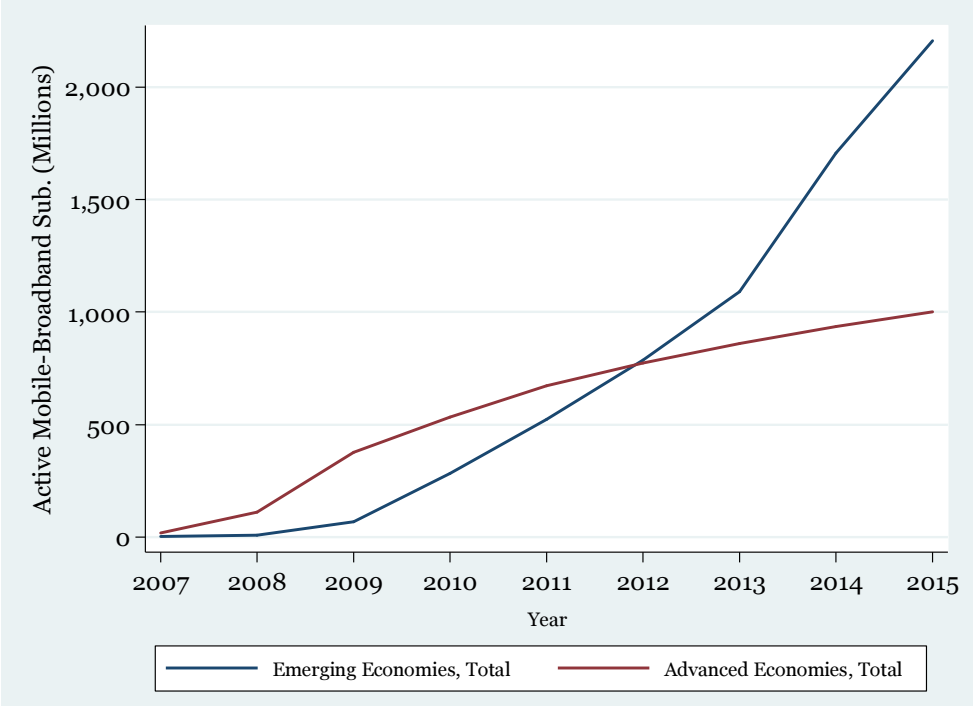
[23] ESCAP, "Technical Report – A Pre-Feasibility Study on the Asia-Pacific Information Superhighway in the ASEAN Sub-region: Conceptualization, International Traffic and Quality Analysis, Network Topology Design and Implementation Model", 3 March 2016. Available from http://www.unescap.org/resources/pre-feasibility-study-asia-pacific-information-superhighway-asean-sub-region.

In mobile broadband uptake, emerging economies surpass advanced economies

Asia and the Pacific fared much better with mobile broadband uptake,[24] which clearly indicates the broadening access to mobile broadband among the majority of people, and the increased capacity of their mobile devices. This trend captures the latent demand for high-speed access to data and information.

Globally, the exponential growth in mobile broadband subscriptions from emerging developing countries has overtaken those in advanced economies since 2012 (see Figure 17).

Figure 17: Total worldwide active mobile broadband subscriptions, 2007-2015



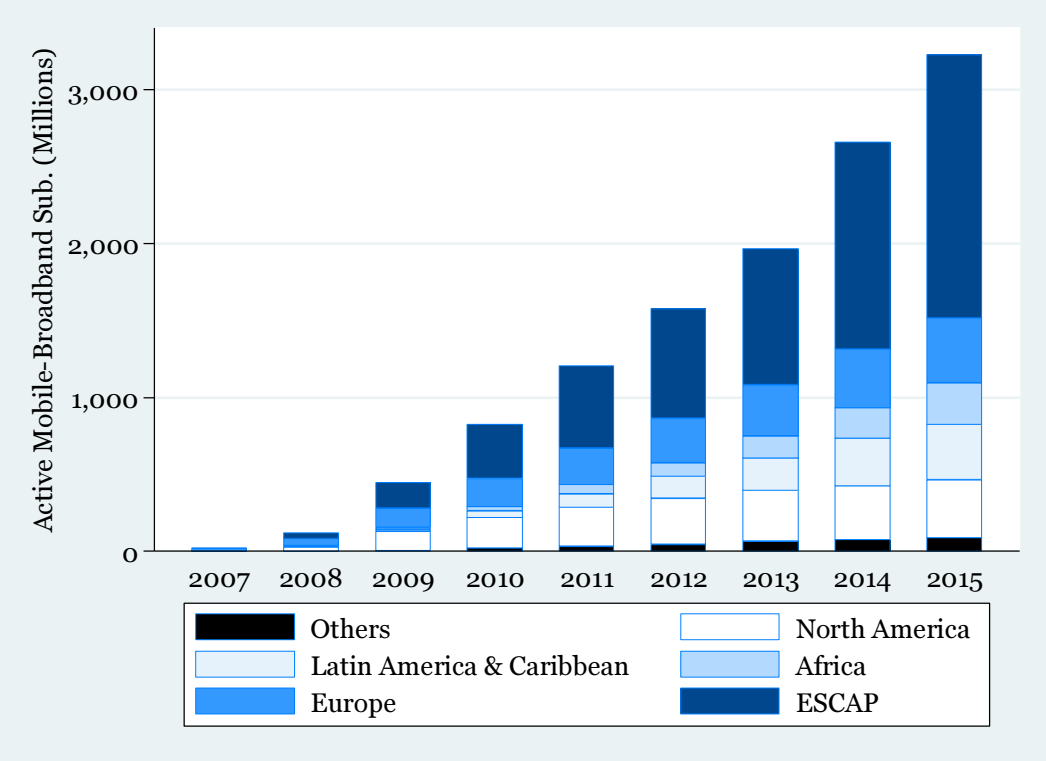
Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Asia and the Pacific is leading in global mobile broadband expansion

When mobile broadband data is disaggregated by region, it is clear that the ESCAP region is leading growth with the majority of global mobile broadband subscriptions residing in the region (see Figure 18).

[24] Mobile broadband has many advantages: (1) it enables Internet access wherever and whenever required, without having to pay any fees for connecting to fixed networks; (2) it does not require physical infrastructure to reach each home and does not require purchasing a landline and additionally paying for landline rental; and (3) there are no set-up fees involved, making it a cost-efficient option compared to fixed (wired) broadband.

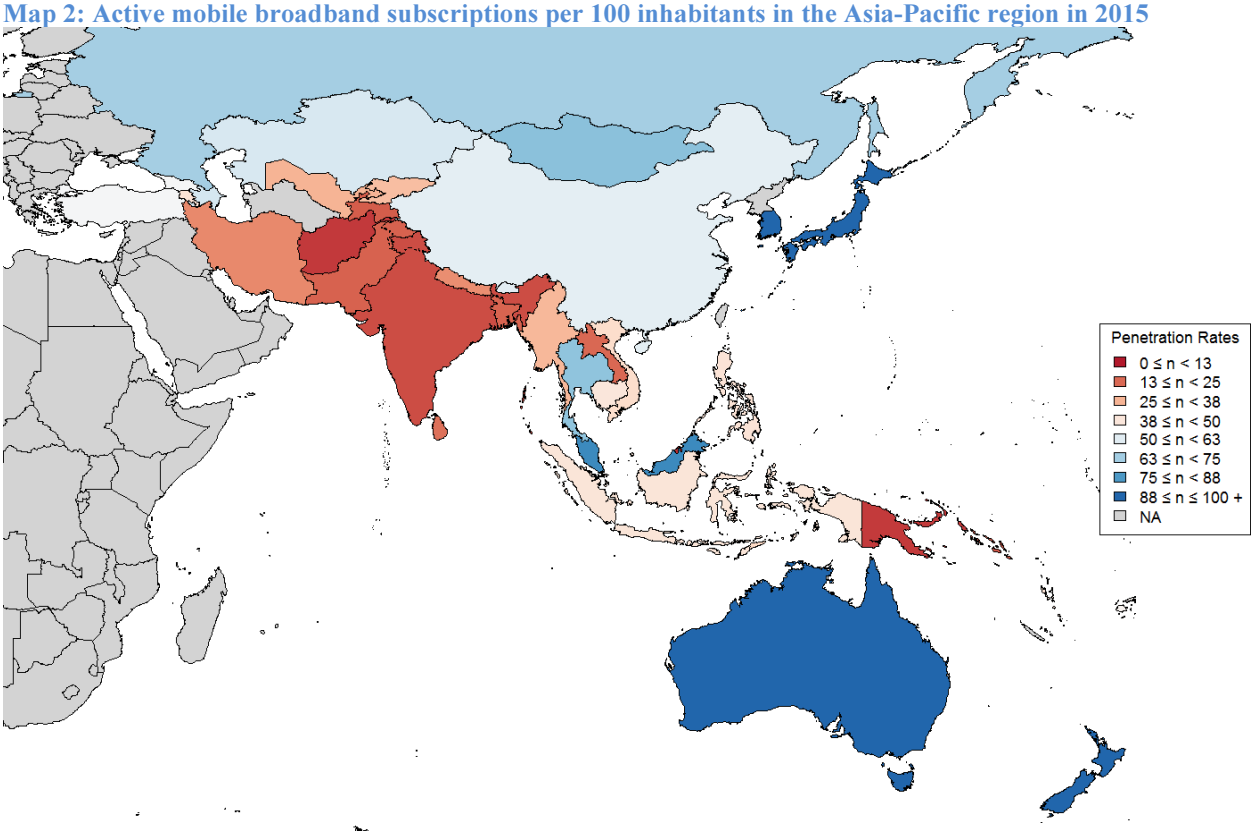
Figure 18: Total worldwide active mobile broadband subscriptions by major regions, 2007-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Although the total number of mobile subscriptions in emerging economies surpasses those in advanced economies, the average mobile broadband subscriptions per 100 inhabitants in advanced economies are almost four times higher than in emerging economies. The ESCAP region's performance in average mobile broadband subscriptions per 100 inhabitants falls well below North America, Europe and the Middle East. For further analyses on mobile broadband connectivity, see Annex III.

Map 2: Active mobile broadband subscriptions per 100 inhabitants in the Asia-Pacific region in 2015

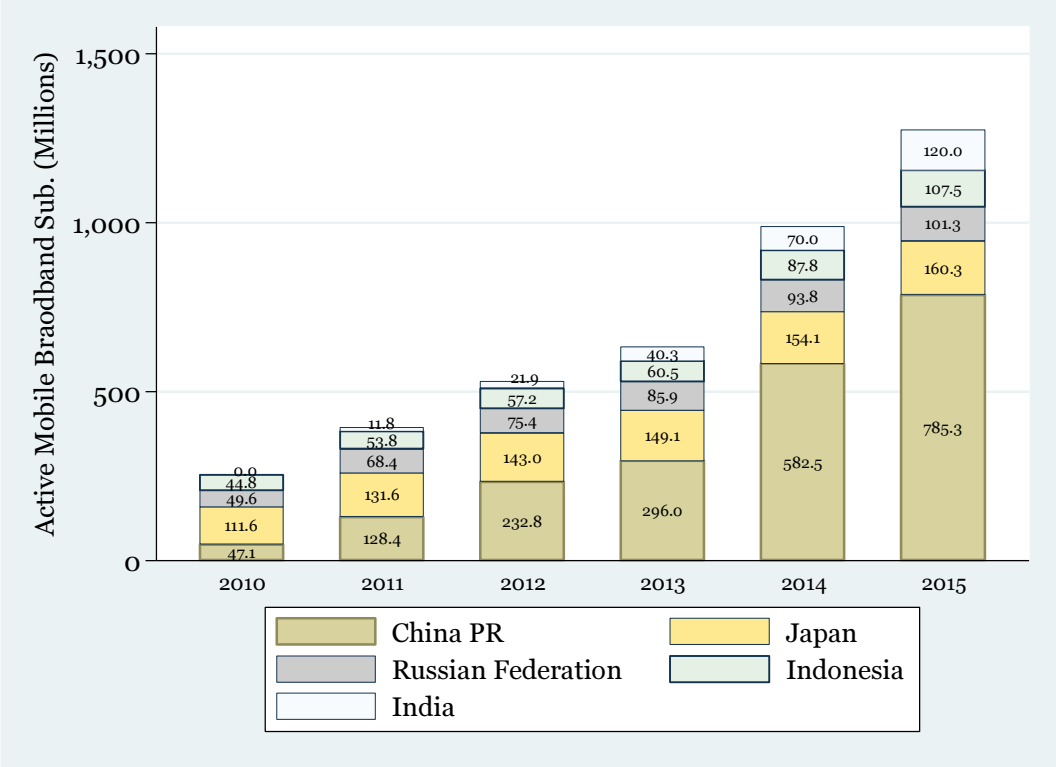


Source: ITU, World Telecommunication/ICT Indicators database: Active mobile broadband subscriptions. Available from http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx (accessed 27 July 2016).

The region's growth in total mobile broadband subscriptions is moderate to slow, without China

China is the largest market for active mobile broadband subscriptions in Asia and the Pacific (see Figure 19).

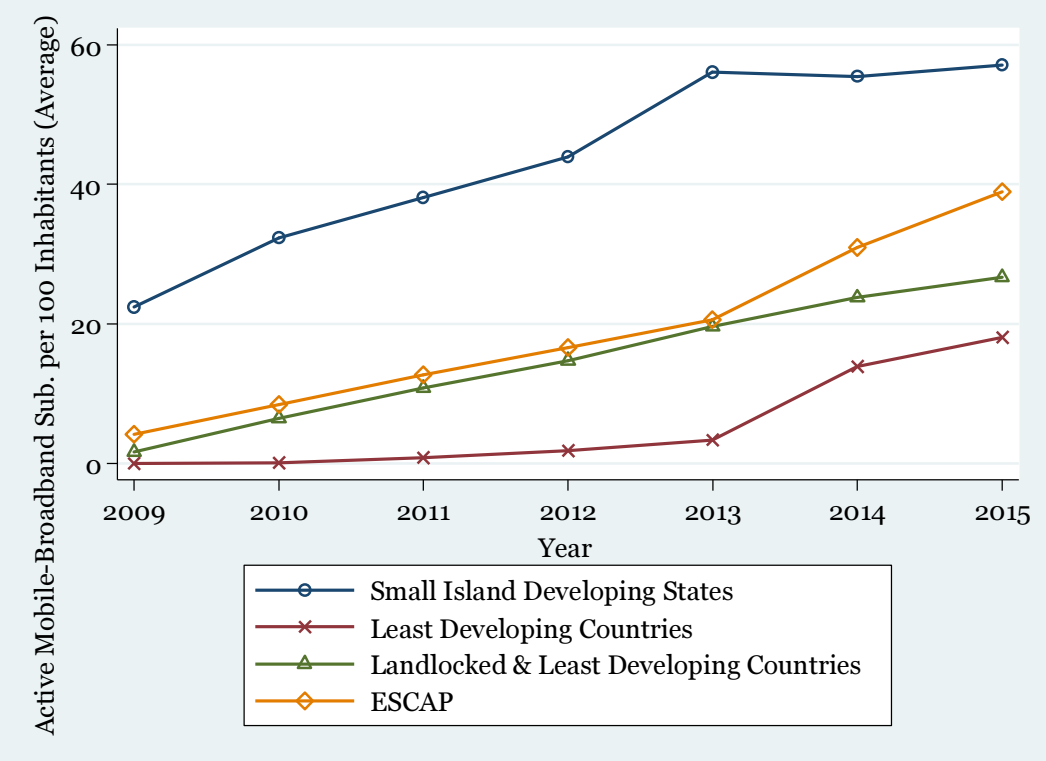
Figure 19: Total active mobile broadband subscriptions in top 5 ESCAP markets in 2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Particularly interesting is the fact that when disaggregated by LDCs, LLDCs and SIDs, all groups of countries follow similar patterns of growth in mobile broadband subscription per 100 inhabitants (see Figure 20). This may indicate that the predicaments normally associated with landlocked or small island countries are not the determining factors in the expansion of mobile broadband access; but rather, other factors such as income level, the regulatory environment and quality of mobile infrastructure are affecting mobile broadband uptake in these groups of countries.

Figure 20: Average active mobile broadband subscriptions per 100 inhabitants in ESCAP LDCs, LLDCs and SIDS, 2009-2015

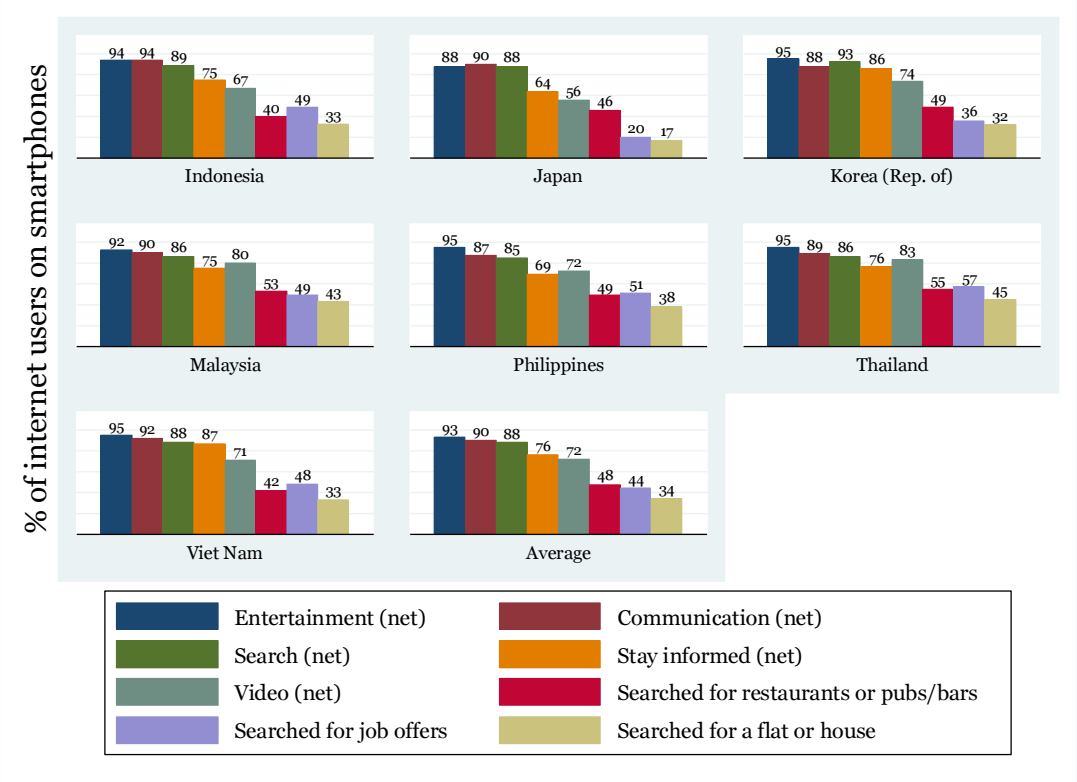


Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Mobile broadband is widely used for entertainment, but less so for productivity and developmental purposes

A Groupe Spécial Mobile Association (GSMA) study on smartphone usage (Figure 21) reveals that the services offered by operator websites in emerging Asian markets primarily address the entertainment segment of the market. Services that focus on productivity such as m-agriculture, m-education and m-employment are less common. Raising the awareness of the availability of these productivity and educational services is therefore critical to help service providers and users reap the benefits available through mobile Internet services.

Figure 21: Smartphone activity in selected ESCAP countries in 2015



Source: Adapted from GSMA, "Mobile Internet usage challenges in Asia - awareness, literacy and local content", July 2015. Available from http://www.gsma.com/mobilefordevelopment/programme/connected-society/mobile-internet-usage-challenges-in-asia-awareness-literacy-and-local-content/.

The future research agenda should include studies on the use of mobile applications for government services, as mobile devices are more widely available among the poor and rural populations in developing countries, and thus present significant opportunities for SDG initiatives.

Non-governmental organizations (NGOs) are constrained by limited ICT infrastructure

The Global NGO Online Technology Report[25] finds that there are diverse regional differences in how NGOs worldwide utilize online technology. Within the Asia-Pacific region, the report notes that the NGOs' use of online technology varies greatly from subregion to subregion. For instance, India has hundreds of thousands of NGOs likely to come online in the next five years, while Internet access throughout South-East Asia is growing as smartphone sales soar across the country. Overall, the report concludes that in Australia and Oceania, Europe and North America, NGOs' use of web and e-mail

[25] Public Interest Registry and Nonprofit Tech for Good, "2016 Global NGO Online Technology Report", 2016. Available from http://www.nptechforgood.com/wp-content/uploads/2016/01/2016-Global-NGO-Online-Technology-Report.pdf. This report aims to gain a better understanding of how NGOs worldwide use online technology to communicate with their supporters and donors.

communications, online fundraising tools, and social media is high, but NGOs in Asia, Africa and Latin America lag behind. The lack of a fully robust Internet infrastructure in the latter regions is suggested as a potential cause for this NGO divide. The report remarks that social, economic and political factors have either hastened or hindered the development of the Internet infrastructure, and thereby also the uptake of Internet technology by the NGO sector.

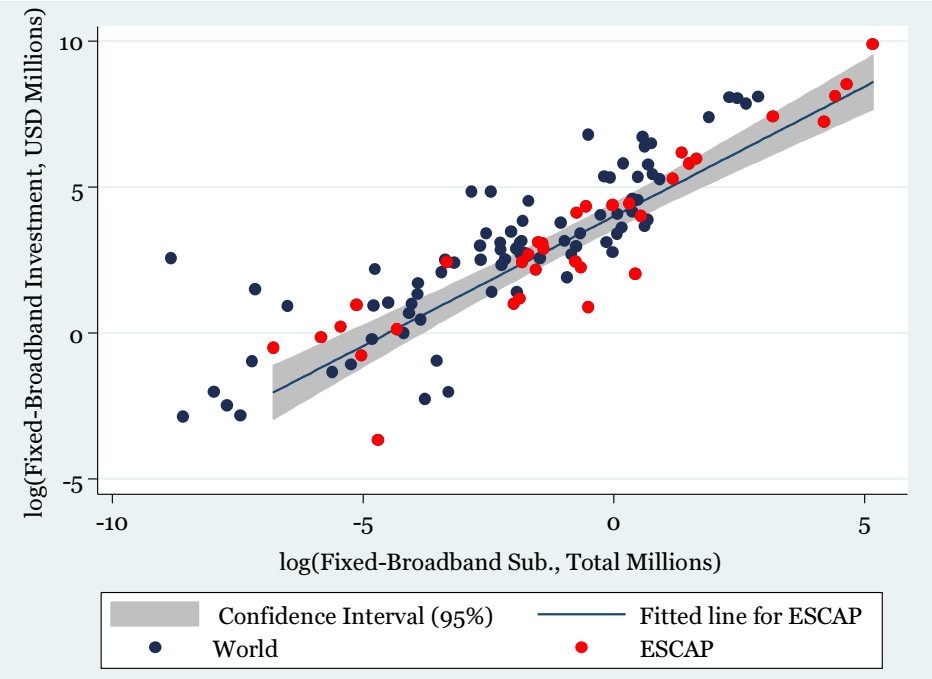
Investment in the ICT infrastructure increases access

Using a panel dataset for the world with available data on investment and access between 2000 and 2015, a positive relationship is found for fixed broadband and mobile broadband, demonstrating the critical role of investment in infrastructure on increasing access to ICT. The positive correlation however, is stronger for the role of investment in fixed broadband subscriptions with a coefficient of (0.87)[26], statistically significant at $p<0.01$, than for mobile broadband.

The stronger and statistically positive relationship between investment and fixed broadband subscription provides support towards the important role of investing in costlier physical ICT infrastructure for fixed broadband networks, whereas mobile broadband in comparison might not require an equal level of infrastructure investment. The positive relationship between investment in the ICT infrastructure (fixed broadband and mobile broadband) and access is important in all countries of different income groups (see Figures 22 and 23). While these trends highlight the important role of investing in ICT infrastructures to improve access, conducive government policies and regulations will continue to influence private telecom operators investment in the ICT infrastructure.

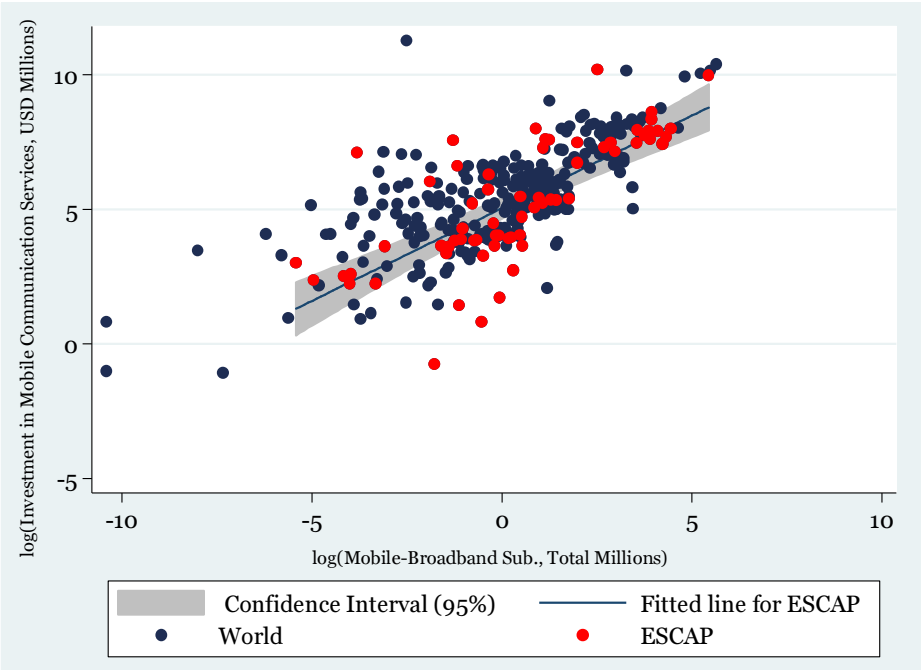
[26] Pearson's correlations indicate almost normal distribution for both variables.

Figure 22: The relationship between telecommunications investment and total fixed broadband subscriptions in 2000-2015.



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Figure 23: Relationship between telecommunications investment and total mobile broadband subscriptions in 2000-2015.



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Summary

From the above findings, the following can be observed:

- The broadband growth commonly observed in Asia and the Pacific has been primarily driven by growth in China. More than 50% of the fixed broadband subscriptions are registered in China, which has also increased the share of Asia-Pacific in the global total of fixed broadband subscriptions to more than half.
- The slowest progress has been observed among low-income countries in Asia and the Pacific. Therefore, future support should focus on this group of countries to reduce the digital divide in the region.
- Countries with slow uptake of fixed broadband seem to have scored lower in the Regulatory Quality Index of the Worldwide Governance Indicators. In fact, a strong correlation has been observed between quality regulation and fixed broadband penetration rates in the region.
- Higher prices continue to be a major deterrent for fixed broadband adoption. The countries with unaffordable and expensive retail level broadband access and/or with high Internet transit cost are found among the 20 countries with less than 2% of fixed broadband subscription adoption rates.
- When online services and telecommunications infrastructure development are compared, some countries have shown corresponding growth in both services and infrastructure, especially in Central Asia, while others have emphasized more exclusively on infrastructure, most notably in South Asia.
- Regarding total mobile broadband subscriptions, a phenomenal growth has been observed among emerging economies, overtaking advanced countries.
- However, if weighted with population, it is clear that advanced countries have a much higher adoption rate than the rest.
- Mobile devices are used more for entertainment, communication and daily information search than for developmental purposes, while the use of online technologies by NGOs in Asia and the Pacific might be constrained by the limited ICT infrastructure.
- Broadband is a critical factor to e-commerce development globally.
- Telecommunication investments are found to be associated with fixed and mobile broadband subscriptions. However, the correlation is stronger with fixed broadband than mobile broadband.

What could all these mean? It is worrisome that the digital divide in fixed broadband subscriptions is growing and there does not seem to be any sign of the gap narrowing. Fixed broadband subscriptions are an indication of individual and institutional usage of broadband, and are a basis for e-commerce uptake. Taking into account the actual speed and quality of access, the low level of fixed broadband adoption among low-income countries may indicate and lead to their limited contributions to productivity increase or economic activities in the digital era.

Inclusiveness matters. Broadband adoption rates can tell us the number of people with access to information and services through broadband devices and services. Those with access and devices will be more likely to have better, accurate and up-to-date information to make informed decisions on their lives. The higher the rate, the more equally the benefits could be distributed within society. Despite impressive growth in the total number of broadband users, the access to broadband within Asia and the Pacific and

when compared with other regions is unequal. Mobile broadband is particularly important for bridging this broadband divide within and between regions.

3. Empirically Demystifying the Digital Divide

Accelerated by advanced ICT capabilities, and the availability of data and the Internet of Things (IoT), big data has attracted international and regional attention from a wide range of groups. Taking advantage of such analytical capabilities and the data presented above, this section seeks to answer the question of whether the digital divide is statistically widening or narrowing, by using descriptive statistical analysis.

In statistics, the standard deviation is used to measure the variation of a sample from its mean. "The more variation there is in the data (from the sample's mean), the higher will be the standard deviation. If there is no variation at all, the standard deviation will be zero."[27] In the context of broadband connectivity, this means that in a sample of countries that differ largely in terms of their shares of the population having access to the Internet, the standard deviation variation will be large. Therefore, the use of standard deviation[28] is a useful tool in examining if all countries in a sample have similar access to the Internet (digital inclusion) or differential access (digital divide).

Another useful tool is the coefficient of variation (also known as relative standard deviation), which is a standardized measure of dispersion of a sample distribution. The coefficient of variation method[29] interprets the relative magnitude of the standard deviation.

In this section, the digital divide in fixed broadband subscription per 100 inhabitants is examined, as the availability of data in time series and country coverage on mobile broadband is limited.

Box 2: Box and Whisker Plots

Box and whisker plots are popular for visualizing variation. Box and whisker plots use the median and quartiles to provide a useful graphical description of the distribution and how it evolves over time. A dataset can be divided into quartiles. The lower quartile contains the lowest 25% of all observations of a sample. The upper quartile contains the highest 25% of all observations of the same sample. In a box and whisker plot, these two quartiles are displayed by the whiskers. The median is shown by the line in the middle of the box. A median is the point in a sample where 50% of all observations lie above its value and 50% of all observations lie beneath.[30] The second and third quartiles are displayed as the areas in the box left and right of the median. The fingers of the whiskers indicate the smallest and largest observations in the sample that are not outliers.[31]

[27] D. G. Rees, *Essential Statistics: Texts in Statistical Science*, fourth edition (Chapman and Hall/CRC, 2000), p. 40.

[28] $s = \sqrt{\frac{\sum(X-\bar{X})^2}{n}}$ where s = sample standard deviation, n = sample's total number of countries, $\bar{X}$ = sample's mean, and X = observation value.

[29] CV = $s/\bar{X}$.

[30] D. G. Rees, *Essential Statistics: Texts in Statistical Science*, fourth edition (Chapman and Hall/CRC, 2000).

[31] Note that outliers may not be included in some graph for reasons of visibility.

The means and standard deviations of the world sample of 82 countries on fixed broadband subscriptions per 100 inhabitants for the years 2005-2015[32] are found to have increased (see Table 4). This trend implies that on average more people are connected globally (increasing mean), but the differences in performance are increasing (increasing standard deviation). Assuming that the minimum and maximum values are not outliers, then those values may explain this phenomenon. In addition, the countries that were already doing quite well in 2005 were doing even better in 2015, while those countries that were not doing well in 2005 continue to not do well in 2015. The coefficient of variation has decreased over time suggesting that a number of countries in the middle (relative to the mean) converged faster over time on access to fixed broadband subscriptions compared to countries that were performing well and those that were not. Nevertheless, in spite of overall improvement in these countries, some countries are still far behind with relatively little improvement across the time span, as can be seen from the examination of the range (minimum and maximum values), namely some LCDs, LLCDs and SIDS.[33]

Table 4: World sample of 82 countries' fixed broadband subscription per 100 inhabitants, 2005-2015

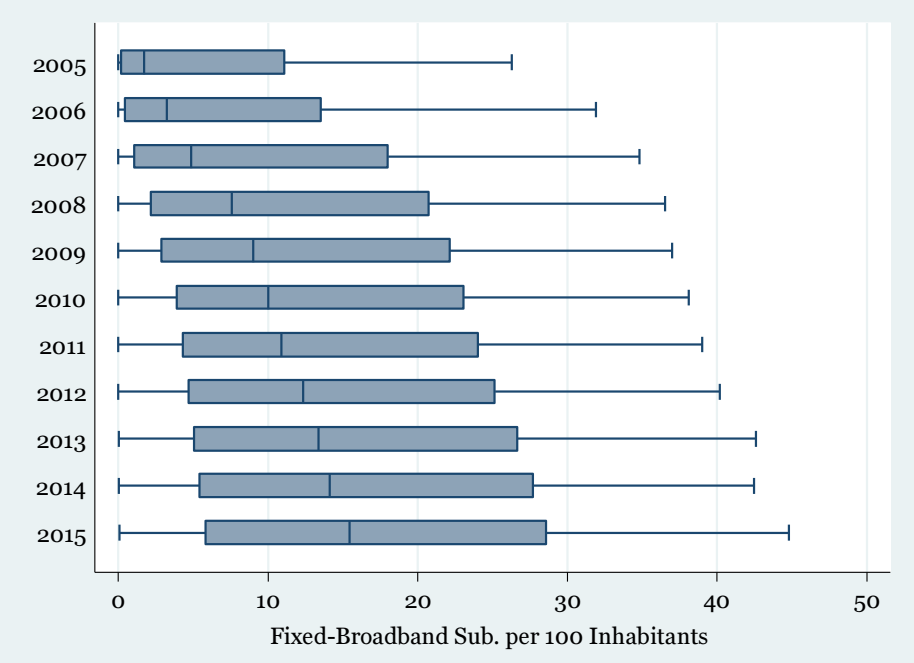
Year	Sample (n)	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Median	Maximum Value	Interquartile Range
2005	82	5.9	8.0	1.34	0.000	1.7	26.3	10.9
2006	82	7.9	9.5	1.19	0.000	3.2	31.9	13.1
2007	82	9.9	10.6	1.07	0.001	4.9	34.8	17.0
2008	82	11.3	11.1	0.98	0.002	7.6	36.5	18.6
2009	82	12.6	11.6	0.92	0.004	9.0	37.0	19.3
2010	82	13.7	11.9	0.87	0.005	10.0	38.1	19.2
2011	82	14.8	12.2	0.83	0.007	10.9	39.0	19.7
2012	82	15.6	12.4	0.79	0.009	12.3	40.2	20.5
2013	82	16.5	12.7	0.77	0.024	13.4	42.6	21.6
2014	82	17.1	13.0	0.76	0.024	14.1	42.5	22.3
2015	82	17.9	13.3	0.75	0.068	15.4	44.8	22.8

Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).
Note: Only countries with data available for all years were included in this sample. See Annex V for a complete list of countries included in the world sample.

Using box and whiskers, Figure 24 shows that the digital divide on the world sample has not improved since 2005 for some countries, as shown by the closeness to zero[34] of the minimum values of the whiskers and the 25% quartile. In addition, the interquartile range (width of the box) has widened indicating that the variation in countries' connectivity performances has increased over time in the global sample.

[32] Data by ITU, countries were only included in calculations if there is data available for the whole 2005-2015 period. See Annex V for a complete list of countries included in the world sample.
[33] Due to the inherent data problems in LDCs, SIDS, and LLDCs, some countries with poor performance were more likely to be excluded in this analysis.
[34] Fixed broadband subscriptions per 100 inhabitants.

Figure 24: Box and whiskers plot of the world sample in 82 countries, 2005-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

However, it is worth noting that more countries globally has improved their ICT connectivity as shown by the increasing median over time and the concentration of the data at the upper quartiles (distribution skewness[35] to the right). A closer look at the different regions of the world is necessary to evaluate whether this global trend is driven by certain groups of countries. The mean for the world sample in 2015 is 18 with a standard deviation of 13.3.

Table 5 shows the variation in fixed broadband connectivity in the sample of 32 ESCAP member countries where data is available since 2010. Although a noticeable increase in the mean of fixed broadband subscriptions per 100 inhabitants can be observed, this development does not seem to be inclusive across all countries. When comparing standard deviation in 2010 and 2015, it has increased by 16%, indicating a widening digital divide in the sample of ESCAP member countries during this period. The coefficient of variation has decreased over time suggesting that a number of ESCAP member countries positioned in the middle (relative to the mean) converged faster over time on access to fixed broadband subscriptions compared to countries that were performing well and those that were not.

[35] Concentration of the data more to the right side of the median in all years.

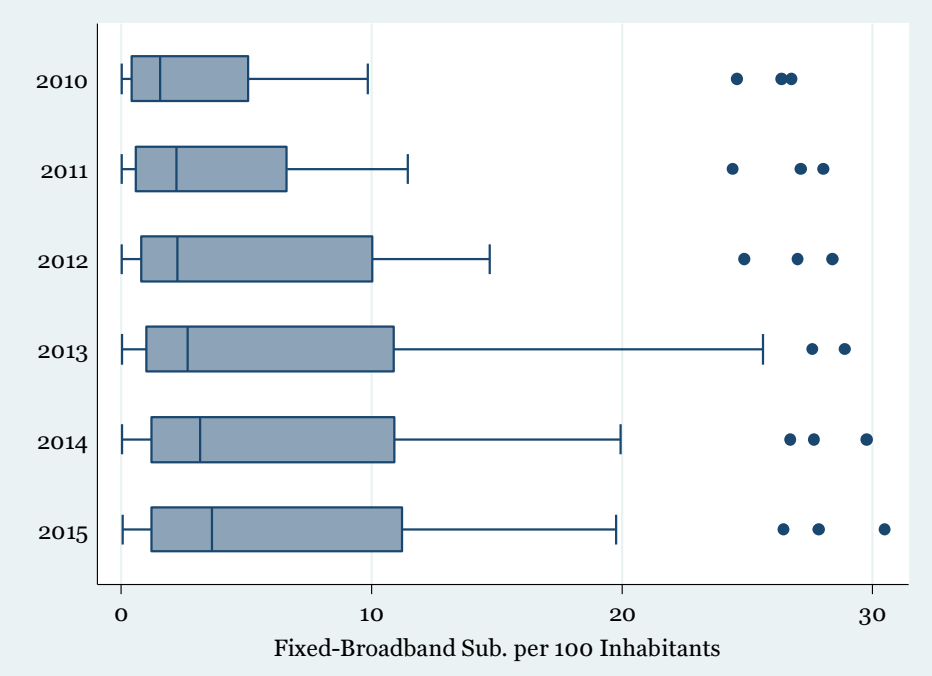
Table 5: ESCAP sample of 32 countries' fixed broadband subscription per 100 inhabitants, 2005-2015

Year	Sample (n)	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Median	Maximum Value	Interquartile Range
2010	32	4.7	7.4	1.58	0.014	1.5	26.8	4.6
2011	32	5.5	7.7	1.41	0.022	2.2	28.0	6.0
2012	32	6.2	7.9	1.29	0.027	2.2	28.4	9.2
2013	32	6.9	8.3	1.20	0.034	2.7	28.9	9.9
2014	32	7.4	8.5	1.15	0.043	3.1	29.8	9.7
2015	32	7.7	8.6	1.12	0.056	3.6	30.5	10.0

Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).
Note: Only countries with data available for all years were included in this sample. See Annex V for a complete list of countries included in the Asia-Pacific sample.

The box and whisker plots (see Figure 25) shed further light. While the median for the ESCAP countries sample has increased since 2010, certain countries have not improved much by 2015—as shown by the closeness to zero of the minimum values of the whiskers and the 25% quartile. In addition, the interquartile range (width of the box) has widened over time, indicating that the variation in countries' connectivity performances has increased over time in the ESCAP sample. However, there are strong performers in the ESCAP sample, as indicated by the maximum values of the whiskers and the 75% quartile. The median for the ESCAP sample in 2015 is around 3.6 per 100 inhabitants, with a mean of 7.7 and standard deviation of 8.6.

Figure 25: Box and whiskers plot of ESCAP sample in 32 countries, 2010-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

The digital divide pattern in the European sample (see Table 6) is different from other major regions. The mean subscription per 100 inhabitants has increased by 188% between 2005 and 2015, suggesting a significant narrowing of the digital divide. The standard deviation has generally remained stable since 2005, indicating that the majority of the European sample is performing well—better fixed broadband connectivity. The coefficient of variation has decreased over time suggesting that a number of European countries in the middle (relative to the mean) converged faster over time on access to fixed broadband subscriptions compared to countries that were performing well and those that were not.

Table 6: European sample of 31 countries' fixed broadband subscription per 100 inhabitants, 2005-2015

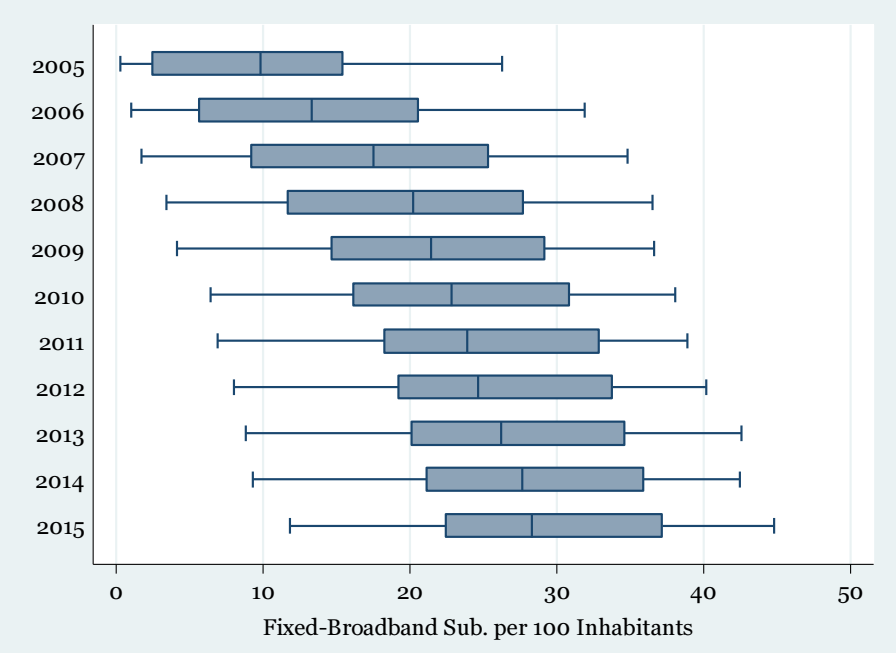
Year	Sample (n)	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Median	Maximum Value	Interquartile Range
2005	31	10.1	8.1	0.80	0.3	9.8	26.3	12.9
2006	31	13.8	9.1	0.66	1.0	13.3	31.9	14.9
2007	31	17.3	9.4	0.55	1.7	17.5	34.8	16.1
2008	31	19.7	9.2	0.47	3.4	20.2	36.5	16.0
2009	31	21.6	8.8	0.41	4.1	21.4	36.6	14.5
2010	31	23.4	8.6	0.37	6.4	22.8	38.1	14.7
2011	31	24.6	8.5	0.34	6.9	23.9	38.9	14.6
2012	31	25.7	8.5	0.33	8.0	24.6	40.2	14.6
2013	31	26.9	8.6	0.32	8.8	26.2	42.6	14.5
2014	31	27.9	8.6	0.31	9.3	27.6	42.5	14.8
2015	31	29.1	8.6	0.29	11.8	28.3	44.8	14.8

Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Note: Only countries with data available for all years were included in this sample. See Annex V for a complete list of countries included in the European sample.

The box and whiskers plot in Figure 26 shows that the minimum value in this sample has increased from 0.3 to 11.8 over the eleven-year period, while the interquartile range (width of the box) has remained stable. The median for the European sample in 2015 is 28.3 per 100 inhabitants, with a mean of 29.1 and standard deviation of 8.6. Both the mean and median are the highest of any region. Further analyses on other major regions (Africa and Latin America and the Caribbean) are given in Annex IV.

Figure 26: Box and whiskers plot of the European sample in 31 countries, 2005-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

To sum up this section, three important messages are worth noting from this analysis:

- The use of standard deviation is an effective tool in explaining the digital divide, which is found to be widening in all major regions, except in the European sample.
- While several countries in Asia and the Pacific are converging faster on fixed broadband connectivity over time, there is a group of countries left behind.
- ICT connectivity performance at the country level within Asia-Pacific is heterogeneous with several top performers such as the Republic of Korea, Hong Kong (China), New Zealand and Japan. At the same time, we find other countries in the Asia-Pacific region that are significantly less connected, particularly the LDCs, LLDCs and SIDS.

4. Conclusion

This report is designed to provide snapshots of emerging trends and development in the area of ICT for development, with a particular focus on fixed and mobile broadband connectivity, in Asia and the Pacific. Despite the phenomenal mobile expansion and proliferation of social media, the report finds that connectivity still constrains not only ICT development but also various socioeconomic development

opportunities. For instance, the above-mentioned UNCTAD report finds that despite the unparalleled promise of the digital economy, the main barrier to B2C transactions in Asia and the Pacific appear to be the low Internet penetration, the relatively poor postal reliability, and the low number of secure servers, which are essential for online shopping sites. The same concern over the lack of extensive connectivity has been echoed in the WEF report.

As shown above, the region's uptake and expansion of broadband has been mixed. China has demonstrated an exponential increase in fixed and mobile broadband, while slowest growths have been detected among LDCs, LLDCs and SIDs. The persistent challenge is that one third of ESCAP member countries have made only negligible progress over the last 15 years. In these countries, broadband access is still largely unavailable and unaffordable, while the gap with the fast growing economies are widening. Some subregions, such as Central Asia, seem to have made more holistic progress. The report also conducted descriptive statistical analysis using standard deviation on fixed broadband subscriptions per 100 inhabitants so as to statistically understand the digital divide. The results show that Europe is the only region that has demonstrated a reduction in the broadband digital divide, while in Asia and the Pacific, it is in fact widening.

Despite the increasing spotlight on newer technologies such as the IoT that aims to connect millions of devices and machines worldwide, the region still suffers from the lack of ICT connectivity. In addition, this report sheds light on the unevenness in broadband expansion and the deepening digital divide due to the lack of progress among 20 countries in the region. Mobile broadband has been expanding and providing access to an ever increasing number of people in the region, but this report has referenced that mobile applications for socioeconomic development might still be limited, and mobile devices are mainly used for communication and entertainment. The report finds that some countries have focused on broadband access expansion over online content and service development, but in the long run both infrastructure and content should be developed in tandem. The telecommunications investment seems to correlate with fixed broadband subscriptions more strongly than with mobile broadband, indicating the investment-intensive nature of the fixed broadband infrastructure, which is a prerequisite for e-commerce. The report also finds that weak regulatory framework might have associations with slow broadband growth.

These trends and development have been observed as a backdrop to the 2030 Development Agenda for Sustainable Development that shapes the overall development framework for the years to come. The new Sustainable Development Goals (SDGs) recognize the multi-faceted and cross-cutting roles of ICT as the foundational infrastructure for sustainable development and as a development enabler. ICT is expected to lead the transformation and play a pivotal role in enhancing efficiency, effectiveness, inclusiveness and accountability in the implementation of the SDGs, based on the robust, reliable, affordable and available broadband infrastructure.

In 2015, the United Nations General Assembly adopted the outcome document on the World Summit on the Information Society (WSIS) that underlined the enhanced importance of ICT for the achievement of the SDGs, and encouraged member countries and international organizations to align SDGs and the WSIS framework by highlighting the role of ICT in achieving the SDGs. The alignment of WSIS implementation with the SDGs, as well as renewed strategic orientation will continue at the global, regional and national levels in 2016 and beyond.

As the new development frameworks of the SDGs and WSIS have been put in place, it is time to reflect on what has been achieved and to better understand the gaps and opportunities moving forward. In the process, ICT policy and decision makers are confronted by compounding factors, such as fast evolving technologies, and varied and diverse demands for socioeconomic applications and services, that need to be addressed within the available resources. Some of the emerging technologies, such as IoT, big data and

over-the-top content, might require update to regulations and legal frameworks, with government facilitating rather than regulating the industry, as the nature of the challenges and opportunities become more inter-connected.

A more affordable, reliable, resilient and robust broadband network has increasingly been seen as a prerequisite for accelerated and inclusive development, and for achieving the SDGs and WSIS goals. Regional broadband initiatives, such as the Asia-Pacific Information Superhighway,[36] have become an essential and strategic development intervention that will shape the future of the region.

[36] ESCAP, "Asia-Pacific Information Superhighway". Available from http://www.unescap.org/our-work/ict-disaster-risk-reduction/asia-pacific-information-superhighway.

Annex I: ICT Outlook 2016

Given the above trends and developments in fixed and mobile broadband expansion in the region, emerging technologies, applications and services could further increase demand for broadband services and access, and widen or ameliorate the digital divide. This section aims to sketch the latest ICT landscape, how they might impact broadband uptake, and what it means to Asia and the Pacific.

Cloud computing

As the broadband infrastructure matures, it has become increasingly viable to offer applications, data and services using cloud computing technologies in the region. Alibaba, for instance, announced that it would invest USD 1 billion in cloud computing and data centres globally to enhance their e-commerce platform.[37] This technology has significant potentials not only for economic benefits, but also for e-resilience and security purposes. According to a 2015 industry survey, 56% of the decision-makers in the region identified cloud computing as the top priority.[38] Cloud technologies will continue to be used for resource optimization, disaster recovery, on-demand services and business efficiency. It is not only the business sector that is adopting cloud computing but increasingly the public sector is as well. This will further increase demands for bandwidth, quality and speed among Asia-Pacific countries, although revision and update to the legal frameworks will be required.

More effective use of the ICT infrastructure

The Digital Economy Outlook 2015 of the Organisation for Economic Co-operation and Development (OECD) notes the phenomenal growth in mobile broadband expansion in the OECD countries. But the growth needs to be sustained with the expansion of the fixed broadband networks, as the traffic needs to be offloaded and backhauled from wireless to wired infrastructure.[39] The report also notes that the potential of broadband and the digital economy has not fully been realized. Although 95% of the companies in the OECD countries have a broadband connection, the usage in enterprise resource planning (31%), cloud computing services (22%) and receiving electronic orders (21%) is still considerably low. Nevertheless, new business models of collaborative production and crowdsourcing have been making their way in the global supply chains. Since up to 90% of e-commerce transactions are B2B, the private sector companies in the Asia-Pacific region will be compelled to use broadband to be integrated in the global supply chains and business/financial transactions.

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[37] The Economist Intelligence Unit, "Infrastructure and networks", 28 August 2015. Available from http://www.eiu.com/industry/article/1953461579/infrastructure-and-networks/2015-08-28.
[38] Frost & Sullivan, *The New Language of Cloud Computing* (2015). Available from https://f5.com/Portals/1/PDF/News/Frost%20Sullivan%20F5%20The%20New%20Language%20of%20Cloud%20Computing_Final%20(10April2015).pdf.
[39] OECD, *OECD Digital Economy Outlook 2015* (Paris, 2015). Available from http://www.oecd.org/internet/oecd-digital-economy-outlook-2015-9789264232440-en.htm.

Box I-1: Net Neutrality

What is net neutrality?

The Internet has been built around the idea of openness. It allows people to connect and exchange information freely, provided that the information or service is not illegal. The principle of net neutrality is that data packets on the Internet should be moved impartially, without regard to content, destination or source. Anybody who accesses the Internet does so without any interference from Internet Service Provider (ISP). Some countries have rules that enforce net neutrality but most do not. Instead, the principle is followed because that is how it has always been. Net neutrality requires that all Internet users be treated equally, without charging differential rates depending on user, content, site, platform, application, type of attached equipment, or mode of communication.

Why it is controversial?

A neutral, non-discriminatory Internet is fundamental to economic growth and social progress.[40] Without net neutrality, ISPs will have the power and tendency to shape Internet traffic to derive extra benefit from it. Instead of free access, there could be "package plans" for consumers or maybe different connection speed for different type of content, depending on the amount paid for the services. Inadequate net neutrality regulation could severely hurt the cycle of innovation, depress investment and reduce job opportunities.[41]

Free Basics, formerly known as Internet.org, has sparked discussions in India and is one such case of net neutrality. This initiative pursues telecom companies in emerging markets, such as India—the world's second largest market—to provide their customers free access to Facebook and entailing websites willing to play by its rule.[42] TechCrunch notes that these Facebook rules make it difficult to build competing social network or messaging applications.

In February 2016, the Telecom Regulatory Authority of India announced the prohibition of Internet services such as Free Basics, claiming that they offer discriminatory tariffs for data services on the basis of content. While this may be a victory for neutrality supporters, others might be disappointed with the outcome as the goal of the Facebook initiative is to connect people who may otherwise not have Internet access. The ruling will be in place for two years but may be open for review—it is still an open question whether the project will succeed in the long term.

Fierce competition for spectrum

The competition for spectrum has significant impacts on the cost and affordability associated with broadband networks and access. As observed in the cases of the recent fourth generation (4G) spectrum auctions in India and Thailand, the quests for bandwidth and frequency would intensify along with the demand for mobile access and services, and subsequent need for more extensive broadband infrastructure. The Economist Intelligence Unit in its 2015 World Telecommunications Outlook predicts that the mobile operators will continue their quest for spectrums in the years to come for the roll out of 4G/LTE networks, as more mobile broadband subscriptions are added to the networks and will constrain the capacity of existing networks.[43] As mobile access has saturated and mobile operators revenues has

[40] World Wide Web Foundation, "Net Neutrality in India: A submission to the Department of Telecommunications, Ministry of Communications and Information Technology", 1 May 2015. Available from http://webfoundation.org/wp-content/uploads/2015/05/Net-Neutrality-India-Submission-to-DoT.pdf.
[41] New York City Council, "Net Neutrality's Impact on Internet Innovation", 20 November 2009. Available from http://entropyeconomics.com/wp-content/uploads/2009/12/ee-tech-research-nycc-nn-testimony-112009pdf.pdf.
[42] Financial Times, "Zuckerbergs hypocritical war on net neutrality in India", 4 January 2016. Available from http://ftalphaville.ft.com/2016/01/04/2149000/zuckerbergs-hypocritical-war-on-net-neutrality-in-india/.
[43] The Economist Intelligence Unit, *World Telecommunications Outlook* (2015). Available from http://www.eiu.com/industry/article/1903461574/world-telecommunications-outlook/2015-08-28.

plummeted,[44] operators are positioning themselves to provide value-added data and application services. At the same time, some countries in the region, along with the US and Europe, have already been planning and developing fifth generation (5G) wireless mobile telecommunications technologies.[45] All of these developments would increase demand for more extensive physical infrastructure.

Expanded investment in fibre and mobile infrastructure

Asia-Pacific countries are expanding their investments in the ICT infrastructure. For instance in July 2015, the Chinese State Council announced the plan to develop underground telecommunication networks connecting 10 cities, which will be funded by the USD 160 billion bond programme designed for infrastructure projects.[46] A mobile operator in India announced its plan to spend USD 9 billion for their mobile broadband network expansion in the next 3 years.[47] The Maldives will soon have USD 25 million nationwide fibre optic submarine networks of 1,200 kilometres to provide high-bandwidth services throughout the island nation.[48] A mobile operator in Brunei announced the plan for a nationwide Wi-Fi network roll out through more than 60 hotspots.[49]

Although most of the new infrastructure projects in the region focus on national infrastructure expansion, there are developments in regional projects as well. An example is the Trans-Eurasian Information Superhighway that aims to lay a fibre optic network between Frankfurt, Germany and Hong Kong (China) via Kazakhstan, Azerbaijan, Georgia and Turkey, with a redundant route via Russia, Ukraine and Poland.[50]

Given the increasing demand for bandwidth, access, services and the physical infrastructure, much more needs to be done to enhance availability, affordability, reliability, inclusiveness and resilience of the broadband infrastructure.

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[44] James Barton, "Strong data revenue growth is the silver lining of Pakistan's ailing mobile sector", *Developing Telecoms*, 22 December 2015. Available from http://www.developingtelecoms.com/index.php?option=com_content&view=article&id=6219:strong-data-revenue-growth-is-the-silver-lining-of-pakistan-s-ailing-mobile-sector&catid=126:investment&Itemid=408.

[45] The Economist Intelligence Unit, "Infrastructure and networks", 28 August 2015. Available from http://www.eiu.com/industry/article/1953461579/infrastructure-and-networks/2015-08-28.

[46] Reuters, "China to raise $160 bln in bonds to build infrastructure", 31 July 2015. Available from http://uk.reuters.com/article/china-bonds-infrastructure-idUKL3N10B2I120150731.

[47] James Barton, "Bharti Airtel investing $9 billion in 3-year network expansion plan, *Developing Telecoms*, 3 December 2015. Available from http://www.developingtelecoms.com/business/investment/6175-bharti-airtel-investing-9-billion-in-3-year-network-expansion-plan.html.

[48] James Barton, "Ooredoo and Huawei deploying nationwide fibre optics in the Maldives", *Developing Telecoms*, 18 December 2015. Available from http://www.developingtelecoms.com/index.php?option=com_content&view=article&id=6212:ooredoo-and-huawei-deploying-nationwide-fibre-optics-in-the-maldives&catid=167:optical-networks&Itemid=922.

[49] James Barton, "TelBru Selects Aptilo for Nationwide Carrier Wi-Fi Network in Brunei", *Developing Telecoms*, 8 December 2015. Available from http://www.developingtelecoms.com/index.php?option=com_content&view=article&id=6184:telbru-selects-aptilo-for-nationwide-carrier-wi-fi-network-in-brunei&catid=33:wireless-networks&Itemid=603.

[50] Trans-Eurasian Information Super Highway, "About". Available from http://tasim.net/about.html.

Innovative infrastructure development

The year 2015 has seen a plethora of innovative approaches to expanding connectivity. High altitude platforms (HAPs) have become more widely recognized as a possible alternative to broadband connectivity. Considering shortcomings of other technologies, such as latency in satellite communication, limited coverage of submarine cables and cost in terrestrial networks, HAPs, vehicles launched to the stratosphere, can be deployed quickly and provide high capacity and accessible maintenance.[51] An example is ABSOLUTE,[52] a pilot initiative supported by the European Commission.

According to a GSMA report, network sharing has been increasing, as it encourages new entrants to the markets, fosters competition, leads to optimization of resources and reduces retail prices.[53] Another emerging technology, radio-over-fibre, enables mobile and Wi-Fi signals to be transported on fibre optic networks and optimizes the use of existing resources and infrastructure.[54]

Mobile applications for socioeconomic development

Considering the rapid growth in mobile broadband access, mobile-enabled applications that deliver socioeconomic benefits are expected to attract more attention. For instance, mobile-enabled financial applications can potentially stimulate broadband demand in the region's developing countries where a large part of the population remain unbanked and the financial infrastructure is deficient or, in many cases, non-existent. In addition to promoting broadband adoption, this technology:

- Can deliver significant digital dividends by fostering financial inclusion of underprivileged segments of the population;[55]
- Is less costly than other financial transfer systems as it takes advantage of the widespread mobile communication infrastructure; and
- Could potentially increase average revenue per user for mobile operators by increasing data traffic.[56]

In Pakistan, a combination of market-led growth in mobile and an IT policy has resulted in a thriving mobile money industry. By 2014, there were eight mobile money service providers operating in the country; the average value per transaction increased by almost 35% between December 2011 and

[51] University of York, "High Altitude Platforms (HAPs) and Satellites: Projects". Available from https://www.york.ac.uk/electronics/research/comms/haps/.
[52] ABSOLUTE, "Aerial Base Stations with Opportunistic Links for Unexpected and Temporary Events". Available from http://www.absolute-project.eu/.
[53] GSMA, *Mobile Infrastructure Sharing* (2012). Available from http://www.gsma.com/publicpolicy/wp-content/uploads/2012/09/Mobile-Infrastructure-sharing.pdf.
[54] Asia-Pacific Telecommunity, "APT Report on Integration of Radio over Fiber with WDM PON for Seamless Access Communication System", September 2015. Available from http://www.apt.int/sites/default/files/Upload-files/ASTAP/APT-ASTAP-REP-19_WDM_PON_with_Radio_over_Fiber.docx.
[55] World Bank, *World Development Report 2016: Digital Dividends* (Washington D.C., 2016). Available from http://live.worldbank.org/world-development-report-2016.
[56] Ernst & Young, *Mobile money: An overview for global telecommunications operators* (2009). Available from http://www.ey.com/Publication/vwLUAssets/Mobile_Money./$FILE/Ernst%20&%20Young%20-%20Mobile%20Money%20-%2015.10.09%20%28single%20view%29.pdf.

December 2014; and within 5 years (2008-2013), mobile money transactions had reached 3.5% of gross domestic product (GDP).[57] The government's approach to accelerate development of connectivity and IT—e.g. licensing of wireless carriers since 2005, launch of 3G and 4G services in 2014, and provisioning of e-government services—has significantly contributed to the dramatic growth in mobile broadband subscriptions (13.5 million by mid-2015 from a non-existent initial base). High-speed broadband will be essential for effective mobile banking and to further stimulate adoption.

Conclusion

Some of the emerging technologies are poised to lower barriers for new operators and encourage competition, while others would save costs and accelerate the digital inclusion. These developments and emerging trends will have significant impact on the demand for bandwidth and physical infrastructure on the one hand, and on people's well-being on the other. The governments in the region, having realized the role of ICT and its importance in sectoral developments, have initiated a number of ICT applications to deliver services such as e-government, finance and education. These applications, in turn, are critical in boosting demands for broadband access and services. It has been found in some subregions, such as Central Asia, that the number of subscriptions increased drastically with the roll out of the mobile infrastructure,[58] thus creating a virtuous cycle. This is also evidenced in Chapter 2 of this report that highlighted the rapid growth of mobile broadband uptake and corresponding growth in online services in Central Asia. The question and challenge for all of us is how we can create and sustain such virtuous cycle for all the subregions and income groups, catalyze the emerging technologies, deliver socioeconomic benefits, and ensure that the region is ever ready for the future.

Annex II: Pakistan's Opportunity

Pakistan telecom policy reform to allow private carriers to terrestrially connect the country with its neighbours (Afghanistan, China, India, Islamic Republic of Iran and Tajikistan) has given the country an

[57] ADB, ESCAP and ISOC, "Unleashing the Potential of the Internet in Central Asia, South Asia, the Caucasus and Beyond", 16 December 2015. Available from http://www.unescap.org/resources/unleashing-potential-internet-central-asia-south-asia-caucasus-and-beyond.
[58] Ibid.

opportunity to be the central hub (gateway) for Central Asia+5 countries.[59] This is in line with the report[60] released by the Asian Development Bank (ADB), ESCAP and the Internet Society (ISOC) that articulated the potential demand and presented the need for the subregion to connect to international submarine cables and provide greater bandwidth.

Already Pakistan exports Internet bandwidth to countries such as Afghanistan and Tajikistan. The USD 44 million 820 kilometre fibre optic cable being laid between Pakistan and China will provide redundancy by linking with the Trans-Asia Europe cable in China, which will provide both Pakistan and China with alternative routes for their international telecom traffic.[61] Furthermore, Pakistan carriers have given permission to use the Islamic Republic of Iran's EPEG network that will enable Pakistan to bypass the Suez Canal chokepoint for Pakistan-Europe traffic, once operational.[62]

Pakistan is currently connected with the world through four undersea fibre optic cables.[63] These cables include the India-Middle East-Western Europe (I-ME-WE), South-East Asia-Middle East-Western Europe 3 (SEA-ME-WE-3), SEA-ME-WE-4 operated by Pakistan Telecommunication Company Limited (PTCL), and TWA-1 owned by the Trans-World Associates. A fifth undersea cable—SEA-ME-WE-5 is being laid to connect Pakistan with the rest of the world.

The ADB-ESCAP-ISOC report concludes that, if Pakistan is able to capitalize on its strategic geographical location and position itself as a provider of international bandwidth to its landlocked neighbours, as well as an alternative route to others, it will consolidate the early transitional developments and help accelerate transformation of the Central Asia+5 digital economy.

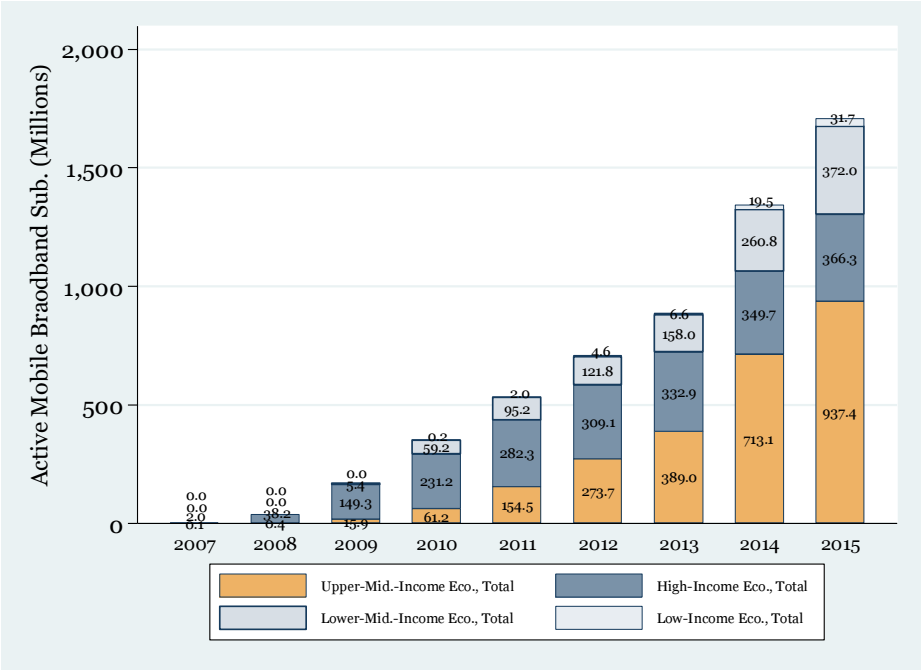
[59] Abu Saeed Khan, "Pakistan unlocks cross-border telecoms. India is next", *LIRNEasia*, 12 December 2015. Available from http://lirneasia.net/2015/12/pakistan-unlocks-cross-border-telecoms-india-is-next/.
[60] ADB, ESCAP and ISOC, "Unleashing the Potential of the Internet in Central Asia, South Asia, the Caucasus and Beyond", 16 December 2015. Available from http://www.unescap.org/resources/unleashing-potential-internet-central-asia-south-asia-caucasus-and-beyond. The Central Asia+5 countries are Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan and Uzbekistan.
[61] Dunya News, "PM performs groundbreaking of Pak-China optic fiber project", 20 May 2016. Available from http://dunyanews.tv/en/Pakistan/337436-PM-performs-groundbreaking-of-PakChina-optic-fibe'.
[62] Abu Saeed Khan, "Pakistan unlocks cross-border telecoms. India is next", *LIRNEasia*, 12 December 2015. Available from http://lirneasia.net/2015/12/pakistan-unlocks-cross-border-telecoms-india-is-next/.
[63] South Asia Investor Review, "Pakistan's Fiber Connectivity Growth", 28 April 2015. Available from http://southasiainvestor.blogspot.se/2015_04_01_archive.html.

Annex III: Active Mobile Broadband Connectivity

When the total number of active mobile broadband subscriptions is disaggregated by income level, it is clear that there are groups of economies—specifically the upper-middle-income economies and the low-income economies—that have experienced accelerated growth, while the high-income economies and lower-middle-income economies have shown moderate to negligible growth (see Figure III-1).

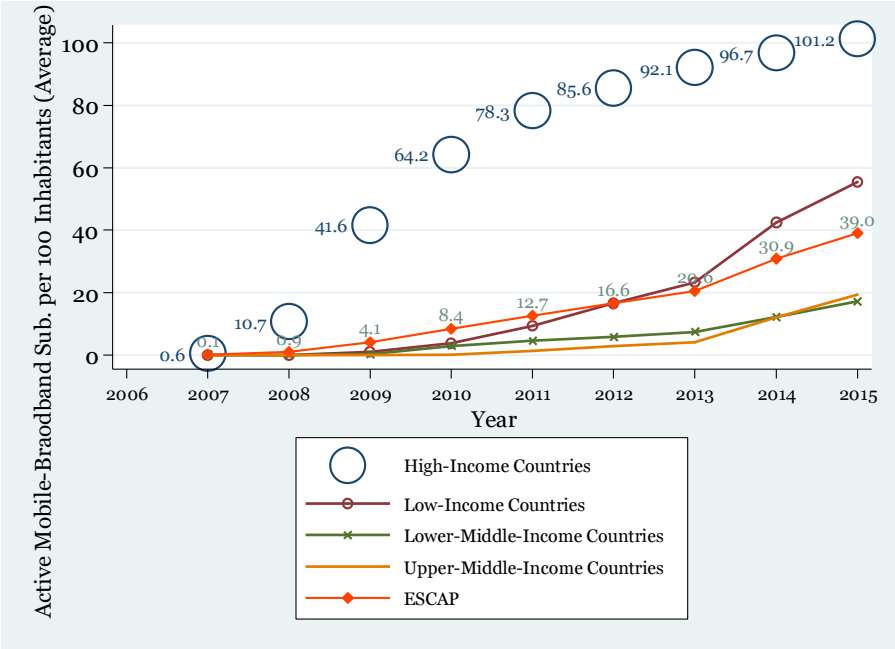
Figure III-2 shows that the former group of economies have recently shown saturation and slower growth for both fixed and mobile broadband, and the latter group has not been showing significant change, even after taking into account the population size.

Figure III-1: Total active mobile broadband subscriptions in ESCAP countries by income groups, 2007-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

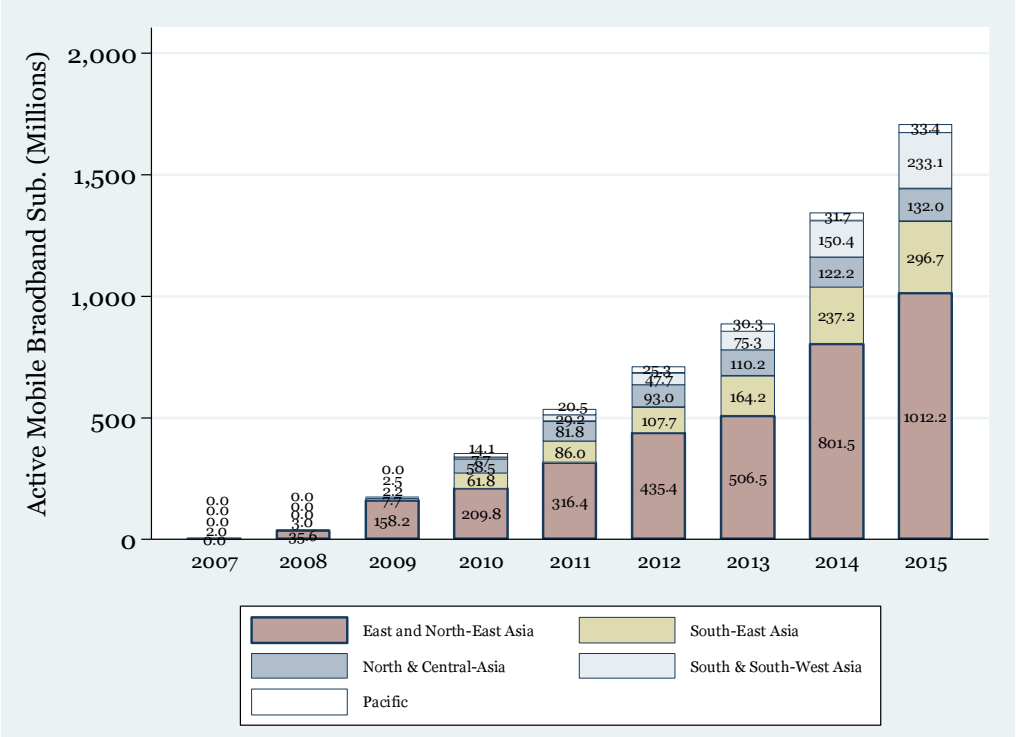
Figure III-2: Average mobile broadband subscriptions per 100 inhabitants in ESCAP countries, 2006-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

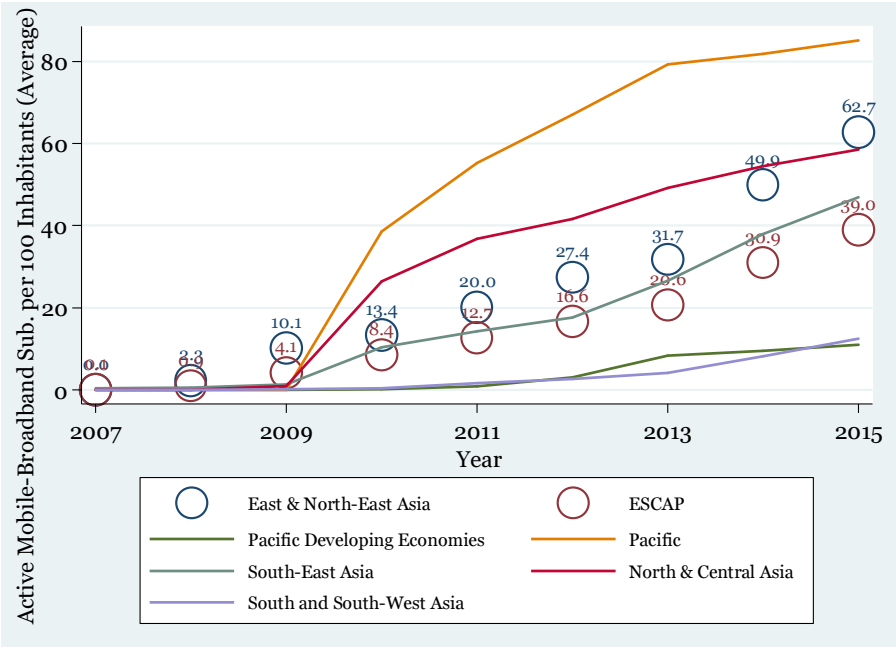
In China, the growth in mobile broadband subscriptions has been strong—similar to its growth in fixed broadband—while the rest of the ESCAP region have been experiencing moderate to slow growth in comparison (see Figure III-3).

Figure III-3: Total active mobile broadband subscriptions, by subregions, 2007-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Figure III-4: Average mobile broadband subscriptions per 100 inhabitants by subregion, 2007-2015

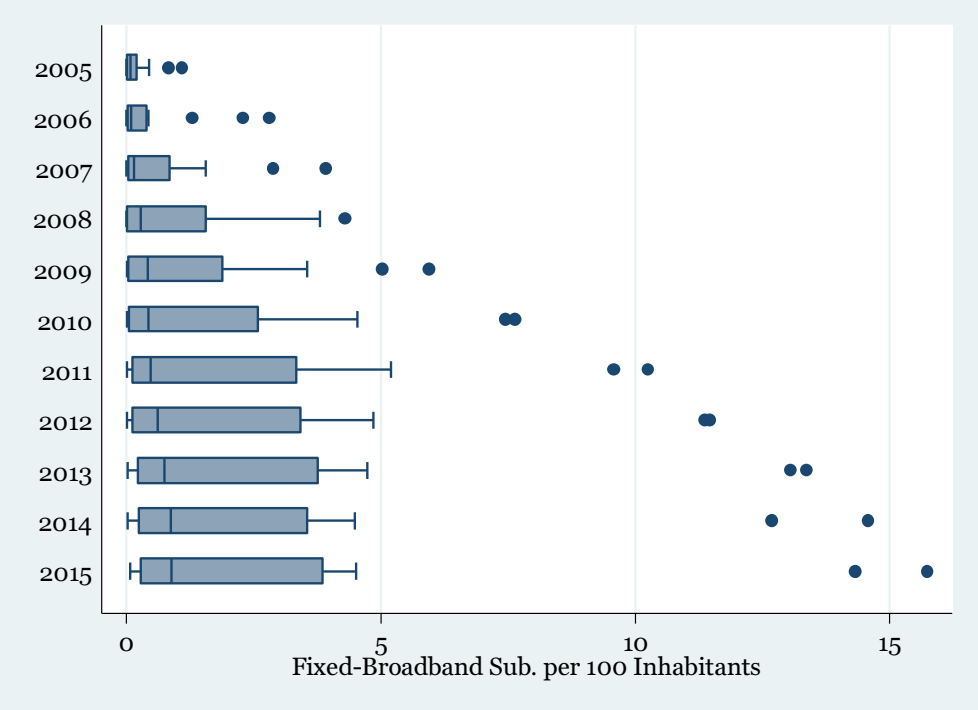


Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Annex IV: The Digital Divide in Africa and Latin America & Caribbean

In Africa, the standard deviation increases by an astonishing 1533% from 2005 to 2015, while the mean only increases from close to zero up to 3.2 for fixed broadband subscriptions per 100 inhabitants. Half of all the countries in the African sample have less than or equal to 0.9 fixed broadband subscriptions per 100 inhabitants, while 75% have equal to or less than 3.86. With the maximum value being more than 15, this shows that the majority of the African countries in the sample struggle with very low rates of connectivity, while only a few are performing well (see Figure IV-1).

Figure IV-1: Box and whiskers plot of the African sample in 16 countries, 2005-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

The median for the African sample in 2015 is around 0.9 per 100 inhabitants, with a mean of 3.2 and standard deviation of 4.9(see Table IV-1).

Table IV-1: African sample of 16 countries' fixed broadband subscription per 100 inhabitants, 2005-2015

Year	Sample (n)	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Median	Maximum Value	Interquartile Range
2005	16	0.2	0.3	1.55	0.0001	0.1	1.1	0.2
2006	16	0.5	0.9	1.70	0.0003	0.1	2.8	0.4
2007	16	0.7	1.1	1.58	0.0013	0.2	3.9	0.8
2008	16	1.0	1.4	1.40	0.0018	0.3	4.3	1.5
2009	16	1.3	1.9	1.42	0.0041	0.4	5.9	1.9
2010	16	1.8	2.6	1.47	0.0047	0.4	7.6	2.5
2011	16	2.3	3.4	1.49	0.0071	0.5	10.3	3.2
2012	16	2.5	3.8	1.53	0.0093	0.6	11.5	3.3
2013	16	2.8	4.3	1.54	0.0236	0.7	13.4	3.5
2014	16	2.9	4.4	1.52	0.0241	0.9	14.6	3.3
2015	16	3.2	4.9	1.53	0.0684	0.9	15.7	3.6

Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).
Note: Only countries with data available for all years were included in this sample. See Annex V for a complete list of countries included in the African sample.

In the Latin America and Caribbean sample, the trend shows a gradual widening of the digital divide for some countries between 2005 and 2015, as indicated by the increasing standard deviation. At the same time, fixed broadband penetration in general has improved for other countries, as indicated by the increasing mean (see Table IV-2).

Table IV-2: Latin America and Caribbean sample of 15 countries' fixed broadband subscription per 100 inhabitants, 2005-2015

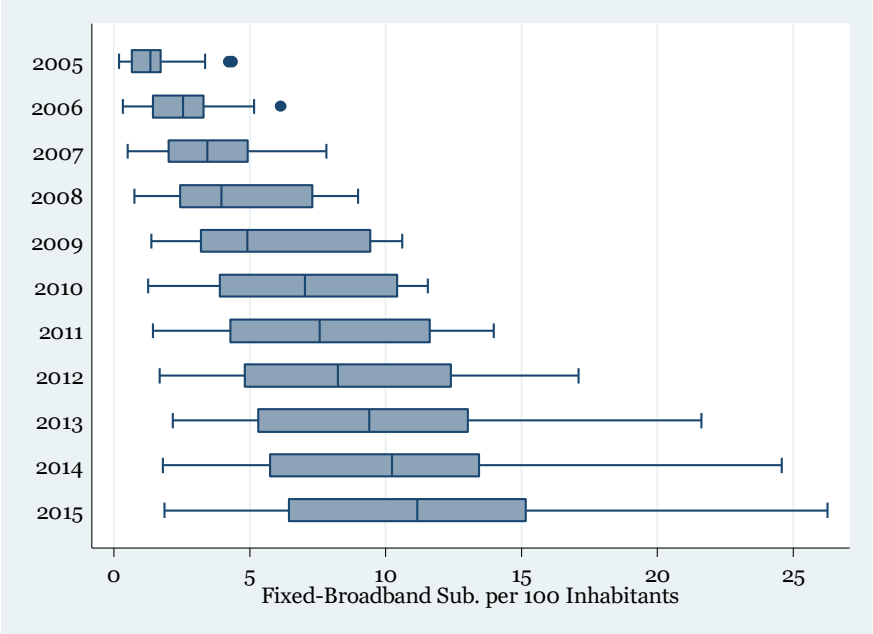
Year	Sample (n)	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Median	Maximum Value	Interquartile Range
2005	15	1.6	1.3	0.82	0.2	1.3	4.3	1.1
2006	15	2.6	1.7	0.64	0.3	2.5	6.1	1.9
2007	15	3.7	2.2	0.61	0.5	3.4	7.8	2.9
2008	15	4.8	2.7	0.58	0.8	4.0	9.0	4.8
2009	15	5.9	3.2	0.54	1.4	4.9	10.6	6.3
2010	15	6.8	3.5	0.52	1.3	7.0	11.6	6.5
2011	15	7.8	3.7	0.47	1.4	7.6	14.0	7.3
2012	15	8.6	4.2	0.48	1.7	8.3	17.1	7.6
2013	15	9.4	4.8	0.51	2.2	9.4	21.6	7.7
2014	15	10.2	5.4	0.53	1.8	10.2	24.6	7.7
2015	15	11.0	5.8	0.53	1.9	11.2	26.3	8.7

Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Note: Only countries with data available for all years were included in this sample. See Annex V for a complete list of countries included in the Latin America and Caribbean sample.

The box and whiskers plot (Figure IV-2) also shows improving fixed broadband connectivity for some countries as shown by the increasing median over time. However, the increasing interquartile range indicates that variation in the performances of countries exists.

Figure IV-2 : Box and whiskers plot of the Latin America and Caribbean sample in 15 countries, 2005-2015



Source: Produced by ESCAP, based on data sourced from ITU World Telecommunications/ICT Indicators Database (accessed July 2016).

Annex V: Country Groupings

Advanced Economies:[64] Australia; Austria; Belgium; Canada; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hong Kong (China); Iceland; Ireland; Italy; Israel; Japan; Korea (Republic of); Latvia; Lithuania; Luxembourg; Macao (China); Malta; Netherlands; New Zealand; Norway; Portugal; Puerto Rico; San Marino; Singapore; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; United Kingdom; United States of America

Emerging and Developing Economies:[65] Afghanistan; Albania; Algeria; Angola; Antigua and Barbuda; Argentina; Armenia; Azerbaijan; Bahamas; Bahrain; Bangladesh; Barbados; Belarus; Belize; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Brunei Darussalam; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Cape Verde; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo; Congo (Democratic Republic of the); Costa Rica; Cote d'Ivoire; Croatia; Djibouti; Dominica; Dominican Republic; Ecuador; Egypt; El Salvador; Equatorial Guinea; Eritrea; Ethiopia; Fiji; Gabon; Gambia; Georgia; Ghana; Grenada; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; India; Indonesia; Iran (Islamic Republic of); Iraq; Jamaica; Jordan; Kazakhstan; Kenya; Kiribati; Kuwait; Kyrgyzstan; Lao People's Democratic Republic; Lebanon; Lesotho; Liberia; Libya; Madagascar; Malawi; Malaysia; Maldives; Mali; Marshall Islands; Mauritania; Mauritius; Mexico; Micronesia (Federated States of); Moldova; Mongolia; Montenegro; Morocco; Mozambique; Myanmar; Namibia; Nepal; Nicaragua; Niger; Nigeria; Oman; Pakistan; Palau; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Qatar; Romania; Russia; Rwanda; Saint Kitts and Nevis; Saint Lucia; Samoa; Sao Tome and Principe; Saudi Arabia; Senegal; Serbia; Seychelles; Sierra Leone; Solomon Islands; South Africa; Sri Lanka; St. Vincent and the Grenadines; Sudan; Suriname; Swaziland; Syria; Tajikistan; Tanzania; Thailand; Timor-Leste; Togo; Tonga; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Tuvalu; Uganda; Ukraine; United Arab Emirates; Uruguay; Uzbekistan; Vanuatu; Venezuela; Viet Nam; Yemen; Zambia; Zimbabwe

Geographical ESCAP Member Countries:[66] Afghanistan; American Samoa; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Korea (Democratic People's Republic); Fiji; French Polynesia; Georgia; Guam; Hong Kong (China); India; Indonesia; Iran (Islamic Republic of); Japan; Kazakhstan; Kiribati; Korea (Republic of); Kyrgyzstan; Lao People's Democratic Republic; Macao (China); Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Caledonia; New Zealand; Northern Mariana Islands; Pakistan; Palau; Papua New Guinea; Philippines; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Tonga; Turkey; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; Viet Nam

[64] International Monetary Fund, "World Economic Outlook", 2016. Available from http://www.imf.org/external/pubs/ft/weo/2016/01/.
[65] Ibid.
[66] ESCAP, "Economic and Social Commission for Asia and the Pacific Member States". Available from http://www.unescap.org/about/member-states.

Europe:[67] Albania; Andorra; Austria; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; Cyprus; Czech Republic; Denmark; Estonia; Faroe Islands; Finland; France; Germany; Gibraltar; Greece; Guernsey; Hungary; Iceland; Ireland; Italy; Jersey; Latvia; Liechtenstein; Lithuania; Luxembourg; Malta; Moldova; Monaco; Montenegro; Netherlands; Norway; Poland; Portugal; Romania; San Marino; Serbia; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; the former Yugoslav Republic of Macedonia; Ukraine; United Kingdom

Africa:[68] Algeria; Angola; Benin; Botswana; Burkina Faso; Burundi; Cameroon; Cape Verde; Central African Republic; Chad; Comoros; Congo; Congo (Democratic Republic of the); Cote d'Ivoire; Djibouti; Egypt; Equatorial Guinea; Eritrea; Ethiopia; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Kenya; Lesotho; Liberia; Libya; Madagascar; Malawi; Mali; Mauritania; Mauritius; Morocco; Mozambique; Namibia; Niger; Nigeria; Rwanda; Sao Tome and Principe; Senegal; Seychelles; Sierra Leone; Somalia; South Africa; South Sudan; Sudan; Swaziland; Tanzania; Togo; Tunisia; Uganda; Zambia; Zimbabwe

North America:[69] Bermuda; Canada; Greenland; United States of America

Latin America and Caribbean:[70] Antigua and Barbuda; Argentina; Aruba; Bahamas; Barbados; Belize; Bolivia; Brazil; Cayman Islands; Chile; Colombia; Costa Rica; Cuba; Dominica; Dominican Republic; Ecuador; El Salvador; Grenada; Guatemala; Guyana; Haiti; Honduras; Jamaica; Mexico; Nicaragua; Panama; Paraguay; Peru; Puerto Rico; Saint Kitts and Nevis; Saint Lucia; St. Vincent and the Grenadines; Suriname; Trinidad and Tobago; Uruguay; Venezuela; Virgin Islands (U.S.)

Least Developed Countries (LDCs):[71] Afghanistan; Angola; Bangladesh; Benin; Bhutan; Burkina Faso; Burundi; Cambodia; Central African Republic; Chad; Comoros; Congo (Democratic Republic of the); Djibouti; Equatorial Guinea; Eritrea; Ethiopia; Gambia; Guinea; Guinea-Bissau; Haiti; Kiribati; Lao People's Democratic Republic; Lesotho; Liberia; Madagascar; Malawi; Mali; Mauritania; Mozambique; Myanmar; Nepal; Niger; Rwanda; Senegal; Sierra Leone; Solomon Islands; Somalia; Sudan; Timor-Leste; Togo; Tuvalu; Uganda; Vanuatu; Yemen; Zambia

Landlocked Developing Countries (LLDCs):[72] Afghanistan; Armenia; Azerbaijan; Bhutan; Bolivia; Botswana; Burkina Faso; Burundi; Central African Republic; Chad; Ethiopia; Kazakhstan; Kyrgyzstan; Lao People's Democratic Republic; Lesotho; Malawi; Mali; Moldova; Mongolia; Nepal; Niger; Paraguay; Rwanda; South Sudan; Swaziland; the former Yugoslav Republic of Macedonia; Tajikistan; Turkmenistan; Uganda; Uzbekistan; Zambia; Zimbabwe

[67] ESCAP, *Statistical Yearbook for Asia and the Pacific 2015* (Bangkok, 2015). Available from http://www.unescap.org/resources/statistical-yearbook-asia-and-pacific-2015.
[68] Ibid.
[69] Ibid.
[70] Ibid.
[71] United Nations Department of Economic and Social Affairs, "List of Least Developed Countries", 2016. Available from http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_list.pdf.
[72] UN-OHRLLS, "Landlocked Developing Countries". Available from http://unohrlls.org/about-lldcs/country-profiles/.

Small Island Developing States (SIDS):[73] Antigua and Barbuda; Bahamas; Barbados; Belize; Comoros; Cuba; Dominica; Dominican Republic; Fiji; Grenada; Guinea-Bissau; Guyana; Haiti; Jamaica; Kiribati; Maldives; Marshall Islands; Mauritius; Micronesia (Federated States of); Nauru; Palau; Papua New Guinea; Saint Kitts and Nevis; Saint Lucia; Samoa; Sao Tome and Principe; Seychelles; Singapore; Solomon Islands; St. Vincent and the Grenadines; Suriname; Timor-Leste; Tonga; Trinidad and Tobago; Tuvalu; Vanuatu

ASEAN Members:[74] Brunei Darussalam; Cambodia; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Philippines; Singapore; Thailand; Viet Nam

ESCAP Low-Income Economies:[75] Afghanistan; Cambodia; Korea (Democratic People's Republic); Myanmar; Nepal; Tajikistan

ESCAP Lower-Middle-Income Economies: Armenia; Bangladesh; Bhutan; Georgia; India; Indonesia; Kiribati; Kyrgyzstan; Lao People's Democratic Republic; Micronesia (Federated States of); Pakistan; Papua New Guinea; Philippines; Samoa; Solomon Islands; Sri Lanka; Timor-Leste; Uzbekistan; Vanuatu; Viet Nam

ESCAP Upper-Middle-Income Economies: American Samoa; Azerbaijan; China; Fiji; Iran (Islamic Republic of); Kazakhstan; Malaysia; Maldives; Marshall Islands; Mongolia; Palau; Thailand; Tonga; Turkey; Turkmenistan; Tuvalu

ESCAP High-Income Economies: Australia; Brunei Darussalam; French Polynesia; Guam; Hong Kong (China); Japan; Korea (Republic of); Macao (China); New Caledonia; New Zealand; Northern Mariana Islands; Russian Federation; Singapore

ESCAP Members East and North-East Asia: China; D.P.R. Korea; Hong Kong (China); Japan; Korea (Republic of); Macao (China); Mongolia

ESCAP Members South-East Asia: Brunei Darussalam; Cambodia; Indonesia; Lao People's Democratic Republic; Malaysia; Myanmar; Philippines; Singapore; Thailand; Timor-Leste; Viet Nam

ESCAP Members North and Central Asia: Armenia; Azerbaijan; Georgia; Kazakhstan; Kyrgyzstan; Russian Federation; Tajikistan; Turkmenistan; Uzbekistan

ESCAP Members South and South-West Asia: Afghanistan; Bangladesh; Bhutan; India; Iran (Islamic Republic of); Maldives; Nepal; Pakistan; Sri Lanka; Turkey

ESCAP Members Pacific: American Samoa; Australia; Fiji; French Polynesia; Guam; Kiribati; Marshall Islands; Micronesia (Federated States of); Nauru; New Caledonia; New Zealand; Niue; Northern Mariana Islands; Palau; Papua New Guinea; Samoa; Solomon Islands; Tonga; Tuvalu; Vanuatu

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[73] United Nations Department of Economic and Social Affairs, "SIDS Member States". Available from https://sustainabledevelopment.un.org/topics/sids/memberstates.
[74] ASEAN, "ASEAN Member States". Available from http://www.asean.org/asean/asean-member-states/.
[75] ESCAP, *Statistical Yearbook for Asia and the Pacific 2015* (Bangkok, 2015). Available from http://www.unescap.org/resources/statistical-yearbook-asia-and-pacific-2015. All ESCAP country group definitions are found in this report.

Developing ESCAP Members Pacific: American Samoa; Fiji; French Polynesia; Guam; Kiribati; Marshall Islands; Micronesia (Federated States of); Nauru; New Caledonia; Northern Mariana Islands; Palau; Papua New Guinea; Samoa; Solomon Islands; Tonga; Tuvalu; Vanuatu

World Sample: Andorra; Austria; Azerbaijan; Belgium; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Cameroon; Cape Verde; Chile; Colombia; Costa Rica; Croatia; Cyprus; Czech Republic; Denmark; Dominican Republic; Ecuador; Egypt; Estonia; Ethiopia; Finland; France; Georgia; Germany; Ghana; Greece; Hong Kong (China); Hungary; Iceland; Ireland; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (Republic of); Lao People's Democratic Republic; Lithuania; Malaysia; Malta; Mauritania; Mauritius; Mexico; Morocco; Netherlands; New Zealand; Nicaragua; Norway; Pakistan; Panama; Peru; Poland; Portugal; Qatar; Romania; Rwanda; Saint Lucia; Saudi Arabia; Senegal; Serbia; Seychelles; Singapore; Slovak Republic; Slovenia; Spain; Sri Lanka; St. Vincent and the Grenadines; Switzerland; Syria; the former Yugoslav Republic of Macedonia; Tunisia; Turkey; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Venezuela; Zimbabwe

Europe Sample: Andorra; Austria; Belgium; Bosnia and Herzegovina; Bulgaria; Croatia; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Lithuania; Malta; Norway; Poland; Portugal; Romania; Serbia; Slovak Republic; Slovenia; Spain; Switzerland; the former Yugoslav Republic of Macedonia; Ukraine; United Kingdom

Africa Sample: Botswana; Cameroon; Cape Verde; Egypt; Ethiopia; Ghana; Kenya; Mauritania; Mauritius; Morocco; Rwanda; Senegal; Seychelles; Tunisia; Uganda; Zimbabwe

Latin America and Caribbean Sample: Brazil; Chile; Colombia; Costa Rica; Dominican Republic; Ecuador; Jamaica; Mexico; Nicaragua; Panama; Peru; Saint Lucia; St. Vincent and the Grenadines; Uruguay; Venezuela

Asia-Pacific Sample: Australia; Azerbaijan; Bangladesh; Bhutan; Cambodia; China; Fiji; Georgia; India; Indonesia; Japan; Kazakhstan; Kiribati; Kyrgyzstan; Malaysia; Maldives; Mongolia; Myanmar; Nepal; Pakistan; Palau; Philippines; Singapore; Tajikistan; Thailand; Tonga; Turkey; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu

Others Sample: Bahrain; Iraq; Jordan; Israel; Iraq; Kuwait; Lebanon; the Netherlands Antilles; Palestine; Qatar; Saudi Arabia; Syria; Taiwan; United Arab Emirates; Yemen

Annex VI: UNCTAD E-Commerce Index 2015 Country Listing

Afghanistan; Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahrain; Bangladesh; Belarus; Belgium; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Bulgaria; Burkina Faso; Burundi; Cambodia; Cameroon; Canada; Chile; China; Colombia; Costa Rica; Cote d'Ivoire; Croatia; Cyprus; Czech Republic; Denmark; Dominican Rep.; Ecuador; Egypt; El Salvador; Estonia; Ethiopia; Finland; France; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Honduras; Hong Kong, China; Hungary; Iceland; India; Indonesia; Iran (Islamic Rep. of); Iraq; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea (Rep. of); Kuwait; Kyrgyzstan; Lao P.D.R.; Latvia; Lebanon; Lesotho; Liberia; Lithuania; Luxembourg; T.F.Y.R. Macedonia; Madagascar; Malawi; Malaysia; Mali; Malta; Mauritius; Mexico; Moldova; Mongolia; Montenegro; Morocco; Myanmar; Nepal; Netherlands; New Zealand; Nicaragua; Niger; Nigeria; Norway; Oman; Pakistan; Panama; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russian Federation; Rwanda; Saudi Arabia; Senegal; Serbia; Sierra Leone; Singapore; Slovak Republic; Slovenia; South Africa; Spain; Sri Lanka; Sudan; Swaziland; Sweden; Switzerland; Tanzania; Thailand; Togo; Trinidad and Tobago; Tunisia; Turkey; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Uzbekistan; Venezuela; Viet Nam; Zambia; Zimbabwe.

Annex VII: Definitions

Digital inclusion	Defined as enabling universal, sustainable, ubiquitous and affordable access to ICTs by all.[76]
Fixed Internet subscriptions	Refers to the number of active fixed Internet subscriptions at speeds less than 256 kbit/s (such as dial-up and other fixed non-broadband subscriptions) and total fixed broadband subscriptions.[77]
Fixed Internet subscriptions per 100 inhabitants	Fixed Internet subscriptions divided by population and multiplied by 100.
Total fixed broadband subscriptions	Total (absolute) fixed (wired) broadband Internet subscriptions refers to subscriptions to high-speed access to the public Internet (a TCP/IP connection), at downstream speeds equal to, or greater than, 256 kbit/s.[78] Compared to earlier low-bandwidth connection technologies, fixed broadband offers many more development-enhancing applications, and can therefore have far-reaching potential for contributing to the achievement of national development goals. It has been demonstrated that broadband boosts GDP growth, enables job creation, and vitally stimulates innovation, whilst also enabling improvements in important sectors such as education and health (as cited by Intel). Fixed (wired) broadband growth in the world has been slowing globally, which is reflective of a broader shift towards mobile cellular broadband use, especially in developing countries that have had rapid growth in mobile cellular subscription numbers.
Fixed broadband subscriptions per 100 inhabitants	Fixed broadband subscriptions divided by population and multiplied by 100. Refers to subscriptions to high-speed access to the public Internet (a TCP/IP connection), at downstream speeds equal to, or greater than, 256 kbit/s. This includes cable modem, digital subscriber line, fibre-to-the-home/building, other fixed broadband subscriptions, satellite subscriptions and terrestrial fixed wireless subscriptions.[79]
Active mobile broadband subscriptions	Refers to the sum of standard mobile broadband and dedicated mobile broadband subscriptions to the public Internet. It covers actual subscribers, not potential subscribers, even though the latter may have broadband enabled-handsets.[80]
Mobile broadband subscriptions per 100 inhabitants	Active mobile broadband subscriptions divided by population and multiplied by 100.
Mobile cellular telephone	Refers to the number of subscriptions to a public mobile telephone

[76] WSIS Plan of Action, 12 December 2003. Available from http://www.itu.int/net/wsis/docs/geneva/official/poa.html.
[77] ITU, "ICT Development Index", 2015. Available from https://www.itu.int/net4/ITU-D/idi/2015/.
[78] ITU, "Definitions of World Telecommunication/ICT Indicators", 2010. Available from http://www.itu.int/en/ITU-D/Statistics/Documents/publications/handbook/2010/TelecomICT_Indicators_Definition_March2010_for_web_E.pdf.
[79] ITU, "ICT Development Index", 2015. Available from https://www.itu.int/net4/ITU-D/idi/2015/.
[80] Ibid.

subscriptions	service that provide access to the PSTN using cellular technology. The indicator includes the number of postpaid subscriptions, and the number of active prepaid accounts (i.e., that have been used during the last three months). The indicator applies to all mobile-cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging, machine-to-machine and telemetry services.[81]
Mobile cellular telephone subscriptions per 100 inhabitants	Mobile cellular telephone subscriptions divided by the population and multiplied by 100.
Individual using the Internet	Refers to an individual who have used the Internet from any location in the last three months. The Internet is a worldwide public computer network. It provides access to a number of communication services including the World Wide Web and carries e-mail, news, entertainment and data files, irrespective of the device used (not assumed to be only via a computer—it may also be by mobile telephone, tablet, PDA, games machine, digital TV, etc.). Access can be via a fixed or mobile network.[82]
Individual using a mobile-cellular telephone	Refers to an individual who have used a mobile telephone in the last three months. A mobile (cellular) telephone refers to a portable telephone subscribing to a public mobile telephone service using cellular technology, which provides access to the PSTN. This includes analogue and digital cellular systems and technologies such as IMT-2000 (3G) and IMT-Advanced. Users of both postpaid subscriptions and prepaid accounts are included.[83]
Household with Internet access	Refers to a household with Internet access (via fixed or mobile network) at home. The Internet is a worldwide public computer network. It provides access to a number of communication services including the World Wide Web and carries e-mail, news, entertainment and data files, irrespective of the device used (not assumed to be only via a computer—it may also be by mobile telephone, tablet, PDA, games machine, digital TV etc.).[84]

[81] Ibid.
[82] ITU, *Measuring the Information Society Report 2014* (Geneva, 2014). Available from https://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2014/MIS2014_without_Annex_4.pdf.
[83] Ibid.
[84] Ibid.