Unleashing the Potential of the Internet for ASEAN Economies

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Preface

This report is the second in the regional research series by the Internet Society (ISOC) to identify and propose ways to lift barriers to Internet development. The first report focused on 20 countries in Africa and was published in May 2013. Building on the methodology and learnings from the first report, the ISOC Asia-Pacific Regional Bureau commissioned this first of a new series of reports that looks into unleashing the full potential of the Internet for building a digital economy. This report takes a closer look at the regional Internet ecosystem of the 10 Association of Southeast Asian Nations (ASEAN) member economies and the impact of Internet connectivity on the emerging digital economy. This report takes stock of the progress ASEAN member economies have made in terms of Internet access and regional connectivity, the prospects of Internet interconnections enabling inclusive, integrated and sustainable development, and the potential opportunities and constraints on the emergence of an ASEAN digital economy.

The motivations for the ASEAN focus are two-fold: first, the importance of ASEAN as an emerging online market and the subsequent innovation created is increasing strongly. The ASEAN regional bloc encompasses economies now recognized to be some of the most prolific users of smartphones and social media in the world, and the Internet is increasingly viewed as a critical driver of economic growth and social development. Second, ASEAN is rapidly approaching an iconic milestone – establishment of the ASEAN Economic Community (AEC) in 2015. Connectivity, encompassing the physical, human and digital arenas, is one of the most critical requirements the ASEAN economies need to achieve in order to reduce development gaps, enhance competitiveness and ultimately move closer to achieving the ambitious goals of the AEC.

Taking these issues into account, this report examines the current status of the Internet ecosystem across the 10 ASEAN countries and identifies where bottlenecks exist from supply, usage and regulatory perspectives. However, access and connectivity is only the first step; to fully unleash and capture the benefits of the Internet, the focus needs to shift towards promoting interoperability and interconnectivity of networks, particularly in areas where the potential benefits can have an impact on social and economic development. This report, therefore, also looks at the disruptive impact that the Internet could enable through interconnectivity among traditionally siloed activities, processes and entities and how successfully these interconnections are advancing social and economic development goals such as education, health and empowerment within ASEAN. This report argues that ASEAN stands at a position to proactively drive the digitisation of public, commercial and social activities, and to realise and benefit from a digitally integrated and inclusive society.

This report will serve as a guide to inform the strategy and content of the ISOC Asia-Pacific Bureau's engagement activities in 2015 and beyond. At the same time, we also invite you to read and make use of the knowledge from this report. In particular, we hope that this report will be a useful source of information and a reference point for ASEAN governments and policymakers involved in the Internet and the digital economy. We also hope that the Internet community at large may find this report useful to further advance advocacy towards an open, free and robust Internet in the ASEAN region and beyond.

Introduction

Demographic Overview

The Association of South East Asian Nations (ASEAN) as a single entity would be the seventh largest economy in the world according to the World Bank, with a combined nominal GDP in excess of USD2 trillion in 2013. ASEAN is also one the fastest growing regional blocs, with the OECD projecting a real average GDP growth rate of 5.4% per annum between 2014-2018.[1] Established in 1967 by Indonesia, Malaysia, the Philippines, Singapore, and Thailand, to promote regional peace and stability, ASEAN has expanded to include Brunei, Cambodia, Lao PDR, Myanmar and Vietnam, and its focus today is towards the economic prosperity and growth among its members. Although the ten ASEAN member states are at vastly differing stages of development, there is tremendous growth potential both within each economy, and across ASEAN as a whole.

Figure 1. ASEAN Development Indicators

Myanmar	
GDP Per Capita	868*
Population	53.3 mil
Median Age	27.9

Lao PDR	
GDP Per Capita	1,661
Population	6.8 mil
Median Age	22

Vietnam	
GDP Per Capita	1,911
Population	89.7 mil
Median Age	29.2

Thailand	
GDP Per Capita	5,779
Population	67.0 mil
Median Age	36.2

Philippines	
GDP Per Capita	2,765
Population	98.4 mil
Median Age	23.5

Malaysia	
GDP Per Capita	10,538
Population	29.7 mil
Median Age	27.7

Cambodia	
GDP Per Capita	1,007
Population	15.1 mil
Median Age	24.1

Singapore	
GDP Per Capita	55,182
Population	5.4 mil
Median Age	33.8

Brunei	
GDP Per Capita	38,563
Population	0.4 mil
Median Age	29.3

Indonesia	
GDP Per Capita	3,475
Population	249.9 mil
Median Age	29.2

*IMF estimate
Source: TRPC, based on World Bank Indicators (2014), http://data.worldbank.org/indicator, CIA World Factbook (2014) Age Structure, https://www.cia.gov/library/publications/the-world-factbook/fields/2010.html

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[1] OECD (2014), Economic Outlook for Southeast Asia, China and India 2014: Beyond the Middle-Income Trap, http://www.oecd.org/site/seao/Pocket%20Edition%20SAEO2014.pdf

Table 1. ASEAN Development Indicators

	GDP Per Capita (Current USD)	Population	Population Density (People per sq km)	Urban Population (% of Total)
Brunei	38,563	417,784	79	77
Cambodia	1,007	15,135,169	86	20
Indonesia	3,475	249,865,631	138	52
Lao PDR	1,661	6,769,727	29	36
Malaysia	10,538	29,716,965	90	74
Myanmar	868*	53,259,018	82	34
Philippines	2,765	98,393,574	330	49
Singapore	55,182	5,399,200	7,713	100
Thailand	5,779	67,010,502	131	35
Vietnam	1,911	89,708,900	289	32

*IMF estimate

Source: World Bank Indicators (2014), http://data.worldbank.org/indicator

Figure 1 and Table 1 illustrate the varying levels of economic development and makeup of the ten ASEAN economies. Across ASEAN there exists a wide range of GDP per capita, population size and density, and urbanization as exemplified by the differences between Singapore (with the highest GDP per capita of USD55,182), and Myanmar (lowest GDP per capita of USD868).

ASEAN is also characterized by a young population as shown in Figure 2 and Table 2, with an average median age of 28.3 years. Brunei, Indonesia, Malaysia, Myanmar and Vietnam all have over 40% of their population below the age of 24, while in Cambodia, Lao PDR and the Philippines over 50% are younger than 24. Only in Singapore and Thailand do the numbers drop to around 30%.

Figure 2. ASEAN Population by Age

Source: CIA World Factbook (2014) Age Structure, https://www.cia.gov/library/publications/the-world-factbook/fields/2010.html
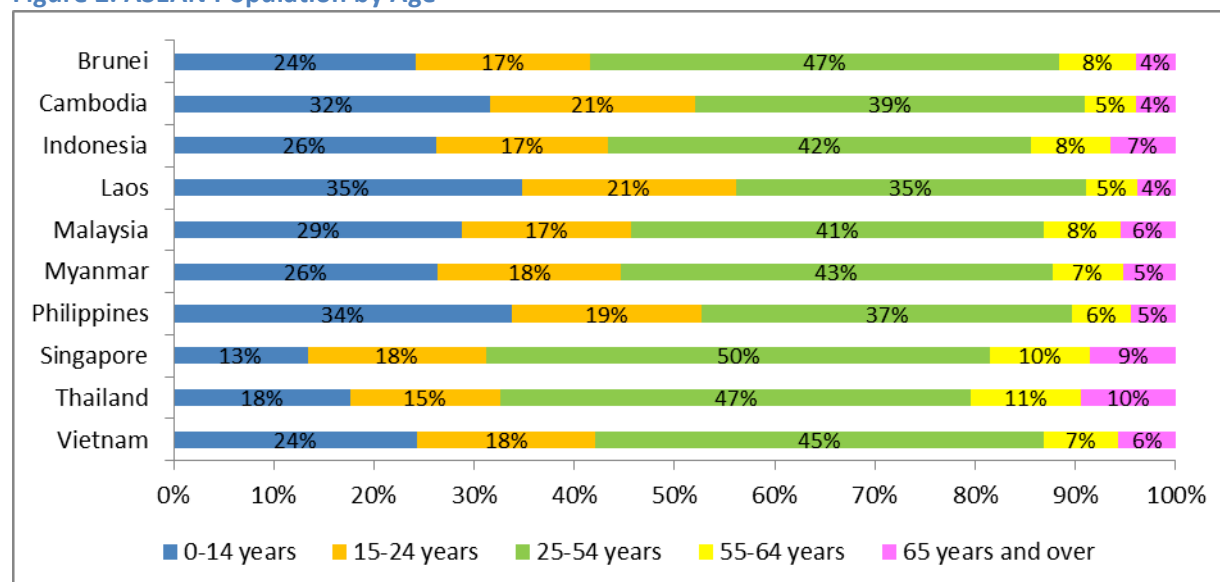
Table 2. Median Age in ASEAN Countries

Country	Median Age	Country	Median Age
Brunei	29.3	Myanmar	27.9
Cambodia	24.1	Philippines	23.5
Indonesia	29.2	Singapore	33.8
Lao PDR	22	Thailand	36.2
Malaysia	27.7	Vietnam	29.2
Average Median Age	**28.3**		

Source: CIA World Factbook (2014) Age Structure, https://www.cia.gov/library/publications/the-world-factbook/fields/2010.html

The Internet and ASEAN

The Internet is an exemplary case of what economists term a General Purpose Technology (GPT): a technology that not only impacts on everything upstream and downstream in production, but that is also embedded in all other sectors. In other words, is economically and socially transformative. The Internet has become perhaps *the* essential component of the emerging digital economy and digital society.

However, not everyone is able to equally access the Internet. Across ASEAN countries Internet penetration varies from as much as 73% of the population in Singapore to little more than 1% in Myanmar. The consequences of this gap are profound. The digital divide *within* nations is between the 'haves' and the 'have-nots' in terms of Internet connectivity and affordable usage. The digital divide *between* nations is about bandwidth (capacity) and transmission speeds (usage), so not only do the lower-income countries of ASEAN suffer from poor coverage, they suffer from low bandwidths, latency, network congestion and other service quality issues. This then becomes an impediment to the development of both the digital economy and digital society. And, as the Internet expands into machines and things, and becomes more imbedded in everyday lives, the cost of *not* getting online will continue to mount for countries already at a disadvantage, thereby potentially exacerbating the gap.

Central to its community-building efforts is the creation in 2015 of the ASEAN Economic Community (AEC) with the following key characteristics: "(a) a single market and production base, (b) a highly competitive economic region, (c) a region of equitable economic development, and (d) a region fully integrated into the global economy," as highlighted in the AEC Blueprint.[2] The AEC thus aspires to a common market of ten countries that vary considerably in terms of language, culture, currencies, *per capita* incomes, and the structure of their economies, but who share a common aim to reduce economic differences (including digital), align economic and social goals and foster growth.

The 2015 milestone of the AEC means there is a sense of urgency in achieving digital inclusion across the region.[3] Connectivity, encompassing the physical, human and digital arenas, is one of the most critical requirements the ASEAN economies need to achieve in order to reduce development gaps, enhance competitiveness by improving the production and distribution networks in the region and ultimately move closer to the ambitious goals of the AEC. Accordingly, the ASEAN Leaders adopted

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[2] ASEAN (2007), *ASEAN Economic Community Blueprint*, http://www.asean.org/archive/5187-10.pdf
[3] Basu Dals, et al (2013), *The ASEAN Economic Community, A Work in Progress*, http://www.adb.org/sites/default/files/pub/2013/aec-work-progress.pdf

the Master Plan on ASEAN Connectivity at the 17th ASEAN Summit in Hanoi in October 2010 to enhance intra-regional connectivity within ASEAN.

ASEAN leaders have recognized that the Internet, along with other ICT Infrastructure, is "fundamental to supporting trade, facilitating investments and enlarging markets through its ability to facilitate information exchange, to connect people, to support delivery of services and to reduce the cost of business and trade-related transactions."[4]

With the AEC milestone as the backdrop, the Internet Society launched the second in a regional in-depth study series on the state of Internet connectivity. The objectives of this report are three-fold. First, examine the status of Internet access and adoption across ASEAN economies by taking stock of progress that has been made along the Internet supply-chain, from international bandwidth to last mile connectivity. Next, highlight the remaining challenges in achieving robust and affordable Internet connectivity through an analysis of market and regulatory drivers that can explain the current landscape of Internet access. Importantly, the report sets out to assess where ASEAN stands in realising an integrated and interconnected society, utilising the Internet to create a digital economy and digital society. Third, the report provides recommendations for unleashing the Internet's potential so as to achieve the goals of the AEC.

Conceptual Framework: the Internet Interconnectivity Model

The Internet has for some time been transforming from a communications platform into a universal platform through which social activities are performed, transactions are carried out and value – economic, social – is created. This means the traditional approach of measuring Internet access and connectivity can fall (far) short of appreciating the full scale and scope of the Internet today. In this report, the underlying premise is that the Internet, and Internet Protocol (IP)-enabled networks, form the foundation of the emerging digital economy; not just for Internet-based companies, but inclusive of *all* sectors of the economy that make use of the Internet or IP-enabled networks. This is particularly pertinent for the ASEAN region wherein the lower-income countries have a realistic opportunity to leapfrog into becoming digital economies and digital societies, helped by the emphasis ASEAN is placing upon regional connectivity.

The conceptual framework developed in this report rests upon a distinction between the Internet economy and a digital economy. An Internet economy, as commonly understood, refers to the economic activities, inputs, outputs and employment, directly associated with the use of the Internet. This could include an Internet Service Provider (ISP), an online shopping website, a search engine facility, application and content development for Internet-enabled mobile phones, etc. Typically this appears to equate to between 3-4% of gross domestic product (GDP) in countries with good basic Internet connectivity.[5]

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[4] ASEAN (2012), *Master Plan on ASEAN Connectivity*, pp. 15,
http://www.asean.org/images/2012/publications/Master%20Plan%20on%20ASEAN%20Connectivity.pdf
[5] McKinsey Global Institute, (2011), *Internet Matters: the Net's Sweeping Impact on Growth, Jobs and Prosperity*,
http://www.mckinsey.com/features/sizing_the_internet_economy

Definitions of the digital economy are more varied, but the most common understanding is the share of GDP accounted for by the ICT sector.[6] But this is increasingly seen as too narrow, and for the purposes of this report the digital economy is defined far more broadly, as *the entirety of sectors that operate using IP-enabled communications and networks*, irrespective of which industry they fall under. This is discussed in more detail in the second part of this report (see *Internet Connectivity and the Digital Economy*). In sum, this report uses the distinction between basic Internet connectivity and the enhanced interconnectivity of networks and interoperability of digital platforms as a framework from within which to assess the state of Internet development in ASEAN (see Figure 3 below).

The premise of this report is that the Internet itself, and the use of IP standards for communications systems throughout the economy – from public fixed and mobile telephone networks to private networks used by banks, payment systems companies, airlines, and corporations to government and public service networks – create the structural foundations for the digital economy. While today not *all* digital traffic is everywhere moved over networks employing IP, it *is* increasingly the case the infrastructure employs IP. It has become the pervasive paradigm of the digital economy.[7]

As a society makes the progression towards a digital economy, two developments are necessary at the technical level. First is the *interconnections* of networks[8], made easier by the deployment of IP. This brings greater economies of scale, as the fixed costs of network rollout are spread across a *greater level of output* bringing about a fall in unit costs.[9] Second is the *interoperability* of operating system platforms that rely upon the networks to support various applications. This brings about economies of scope, as fixed costs are spread across a *wider range of output* of different products and services. Economies of scale and of scope create a virtuous loop, they drive down costs, increase user choice of products and services, and that in turn stimulates market innovation and the growth of the digital economy.
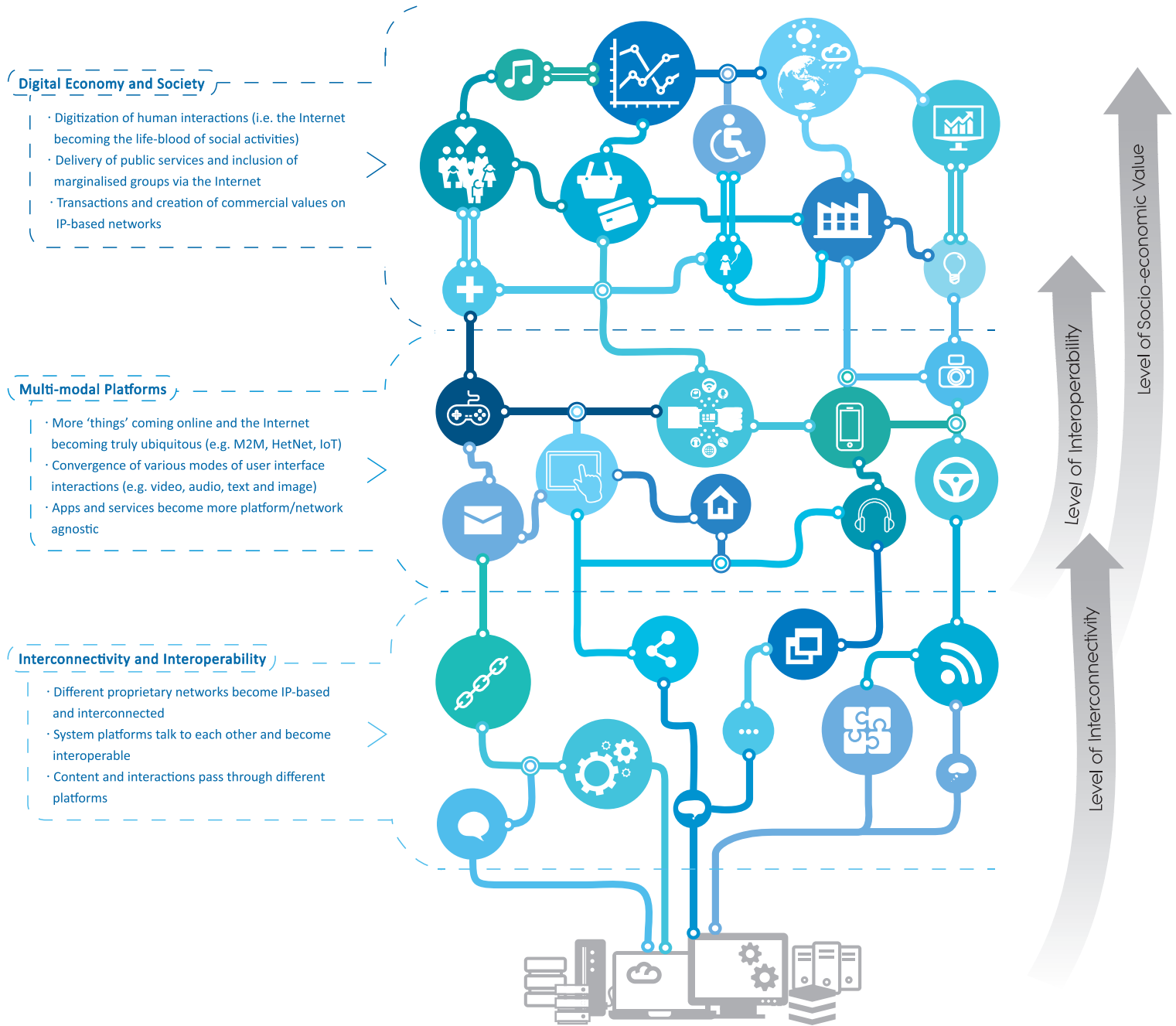
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[6] OECD (2014), Measuring the Digital Economy A New Perspective, http://www.oecd.org/sti/ieconomy/9789264221796-sum-en.pdf

[7] The early digital telephone exchanges adopted the Asymmetric Transfer Mode (ATM) which were veritable digital workhorses, able to 'switch' or 'route' most types of traffic, including, for example, ITU-standard X.25 for email, frame relay for corporate data using no-IP 'frames' or packets of data, etc. By contrast, modern Next Generation Networks (NGNs) are end-to-end all-IP.

[8] This should be not confused with the common definition of the Internet, which is the "network of networks." The networks here refer to previously proprietary networks such as payments, airlines, businesses and public networks, becoming interconnected.

[9] In communications this is also referred to as 'network effects' whereby there is a multiplication of possible connections between users which grows the market for communications service providers and allows operators to spread their costs (see Box 1).

Figure 3. Conceptual Framework – Interconnectivity Model

Digital Economy and Society

- · Digitization of human interactions (i.e. the Internet becoming the life-blood of social activities)
- · Delivery of public services and inclusion of marginalised groups via the Internet
- · Transactions and creation of commercial values on IP-based networks

Multi-modal Platforms

- · More 'things' coming online and the Internet becoming truly ubiquitous (e.g. M2M, HetNet, IoT)
- · Convergence of various modes of user interface interactions (e.g. video, audio, text and image)
- · Apps and services become more platform/network agnostic

Interconnectivity and Interoperability

- · Different proprietary networks become IP-based and interconnected
- · System platforms talk to each other and become interoperable
- · Content and interactions pass through different platforms

Level of Socio-economic Value

Level of Interoperability

Level of Interconnectivity

Source: Illustration by TRPC

It is beyond the interconnectivity of networks and interoperability of platforms that is the fundamental requirement for the enhancement of economic and social interactions that comprise the digital society. An obvious and prominent example is the rise of social media, and how it is being used for a multitude of economic and social purposes, such as e-commerce and e-government. This is the focus of the second part of the paper, with examples chosen specifically to illustrate the important role of interconnection and interoperability in the development of these digital society services within the ASEAN region, and as a step towards the economic integration envisaged by the AEC blueprint.[10]

Box 1. Economies of Scale and Scope

Economies of **scale** refer to factors that cause the average cost of producing something to fall as the volume of its output increases while the economies of **scope** are factors that make it cheaper to produce a range of products together than to produce each one of them on its own.

Economies of **scale** are about gaining benefits by producing large volumes of a product, whereas economies of **scope** bring benefits by producing a wide variety of products through efficient use of operations. Economies of **scale** use the most efficient process, whereas economies of **scope** use the same process to produce 'similar' products using technology.

Outline of the Report

Thus, this captures both the connectivity and the *interconnectivity* being enabled by the growth of the Internet. As such, the report is divided into two parts: Part 1 reviews the state of Internet adoption and usage in ASEAN countries focusing on the Internet connectivity supply chain. Key segments include:

- the availability of *international bandwidth* for Internet transit traffic;
- the role and economics of *Internet exchange points* (*IXPs*);
- the supply of *national broadband connectivity and other backbone technologies* to ensure universal access; and
- an assessment of *Internet access affordability of and speed* at the last mile.

Analysis from Part 1 shows that countries in ASEAN divide into three clusters in terms of Internet penetration. While the level of Internet access and usage corresponds *generally* to levels of economic development (as measured by GDP per capita see Figure 5), it is not a universally true relationship; clearly then there are other market and policy conditions playing a significant role in driving – or constraining – Internet adoption, and these are identified and examined.

Part 2 explores the *interconnectivity* of networks, people and devices that rely upon IP. Various examples and qualitative analysis are provided to illustrate the transformation being afforded by the interconnectivity of networks and the interoperability of systems. These include multi-platform interoperable networks being developed by mobile network operators (MNOs) that offer services from TV content to m-payment systems accessible by a variety of devices, and digital finance systems including payments that are opening up a host of possibilities in the finance and commerce

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[10] ASEAN (2007), *ASEAN Economic Community Blueprint*, http://www.asean.org/archive/5187-10.pdf

space. Others include social re-engineering in education and health and provision of public services such as e-government services, social empowerment and disaster risk management.

These examples show the importance of interconnectivity and interoperability, and the role that ASEAN governments can play in both aspects of growth and transformation. They also show the opportunity inherent for ASEAN economies to progress up the value chain and increase their competitiveness. The wealth created by a digital economy offers the means for governments to pay for social improvements, while Internet technologies offer a means of delivery and consumption of social benefits, including for education, health, inclusion and empowerment, and a host of e-government initiatives.

I. ASEAN Internet Connectivity

I-1. Internet Access and Usage in ASEAN

In recent years, ASEAN economies experienced healthy growth of Internet penetration measured by the proportion of Internet users and broadband subscribers. The region's Internet population doubled from 81 million in 2009 to 162 million in 2013.[11] Wireless broadband subscriptions grew 30-fold during the same period.[12] Given that the growth of *fixed*-broadband penetration was minimal, wireless broadband has been the key driver of rapid Internet uptake across the region (Figure 4).

Figure 4. ASEAN Internet Penetration (2009-2013)
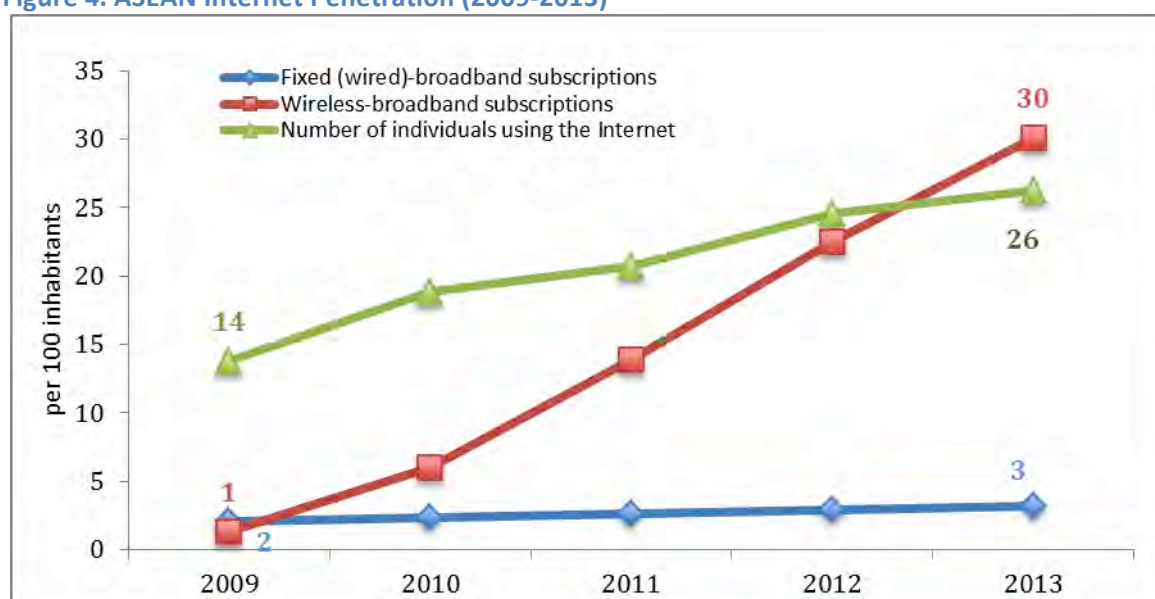
Source: TRPC research using data from the ITU (2014), ITU World Telecommunication/ICT Indicators database, Population, Fixed (Wired)-Broadband Subscriptions, Wireless-Broadband Subscriptions, Percentage of Individuals Using the Internet.

When compared with the rest of the world, however, ASEAN's connectivity still lags. According to the ITU, global Internet penetration in 2013 reached 40%, with an average penetration of 78% in developed countries and 32% in developing countries.[13] ASEAN's comparable figure was only 26%. Average ASEAN *fixed* broadband penetration lags significantly (3.2 subscribers per 100 inhabitants compared to the world average of 9.4) while *wireless* broadband penetration is barely on par with the world average (30.1 subscribers per 100 inhabitants compared to the world average of 32).

Penetration rates of ASEAN member economies however are scattered across a wide range from Singapore with 73% to countries to Myanmar with a little over 1% (Figure 6). What factors determine such varied levels of Internet penetration? The level of economic development is obviously one important factor. But when we performed a simple least-square linear regression
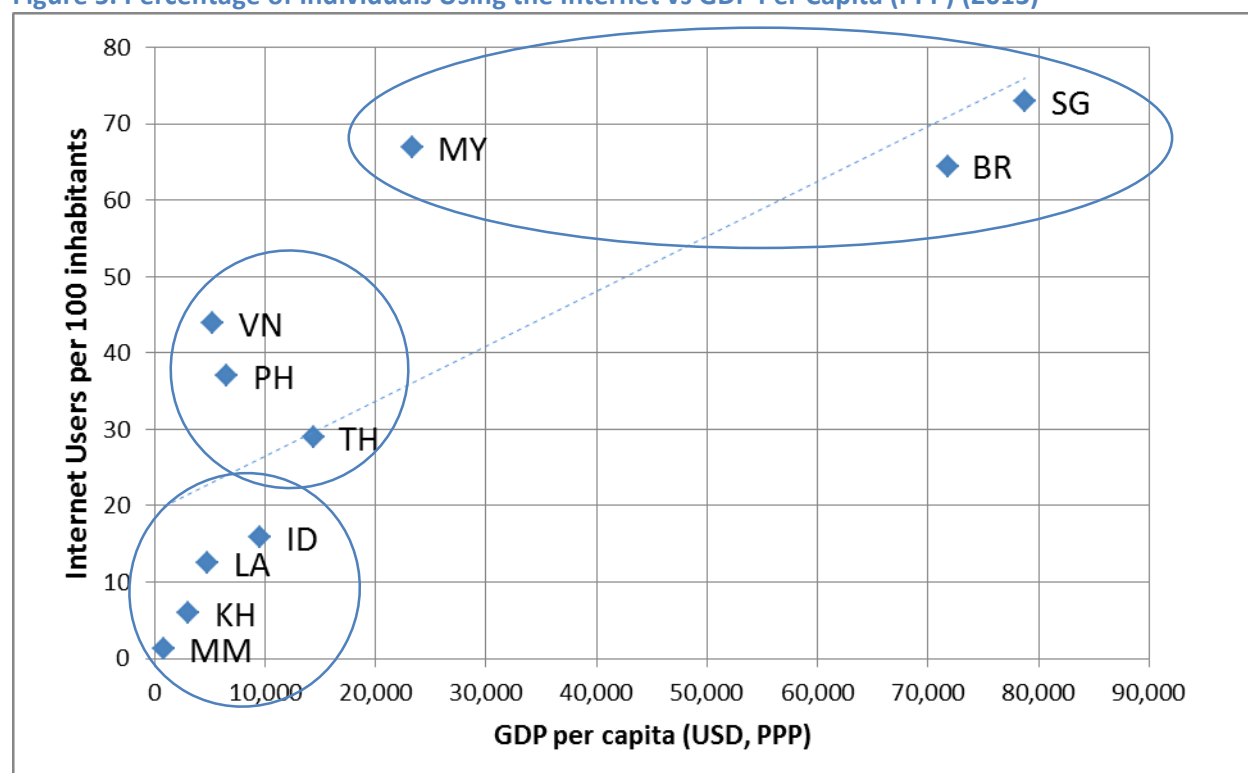
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[11] ITU (2014), *ITU World Telecommunication/ICT Indicators database 2014*, Percentage of Individuals Using the Internet

[12] ITU (2014), ITU World Telecommunication/ICT Indicators database 2014, Wireless Broadband Subscriptions

[13] ITU (2014), *The World in 2014: ICT Facts and Figures*, http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf

analysis between GDP per capita of ASEAN economies and percentage of Internet users, the results provided two insights (Figure 5).[14]

Figure 5. Percentage of Individuals Using the Internet vs GDP Per Capita (PPP) (2013)

Source: ITU World Telecommunication/ICT Indicators Database 2014; World Bank Indicators (2014), GDP per capita, PPP (current international $), http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD

First, there is a generally good fit between *levels* of GDP per capita and different levels of Internet usage. In other words, there is a correlation between income level and Internet access, but perhaps no more than around 60%.[15] Second, ASEAN countries cluster into three distinct groups, but when compared with the World Bank's income classification (Table 3), Indonesia and Thailand fall below where their income levels suggest, while Malaysia rises above its comparable income level.

Looking at Figure 5, three clusters of Internet penetration clearly emerge: the top tier consists of Singapore, Brunei and Malaysia, all above 60% Internet penetration; the second group clusters Vietnam, the Philippines and Thailand with between 25-60% penetration; the lower cluster comprises Indonesia, Lao PDR, Cambodia and Myanmar, all under 20% penetration. When these clusters are compared with World Bank income classifications (high-income, upper-middle, lower-middle and low-income), a more nuanced picture emerges (Table 3). Within Cluster 1, Malaysia, an upper-middle income country, is clearly punching above its weight, having achieved high Internet

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[14] We assumed that the number of the Internet users grow at a steady rate as income rises, thus used the least-square regression line to analyse the relationship. The purchasing power parity (PPP) values in US dollars were used to more accurately capture what local currencies will buy in their domestic markets. Using nominal currency prices, however, makes no overall difference to the pattern with the exception of Brunei moving from above to slightly below the curve. There isn't yet an official PPP value for Myanmar's income so current price was used instead.

[15] The resulting r^2 is 0.61, which means that income is responsible for about 61% of the variation of the Internet penetration is explained by the regression line on GDP per capita.

penetration rates relative to its level of economic development, comparable with Brunei and Singapore. In contrast, Thailand, another upper-middle income country, clusters with Vietnam and the Philippines, which are lower-middle income countries, while Indonesia, another lower-middle economy in terms of GDP per capita clusters with the low-income economies in terms of Internet penetration.

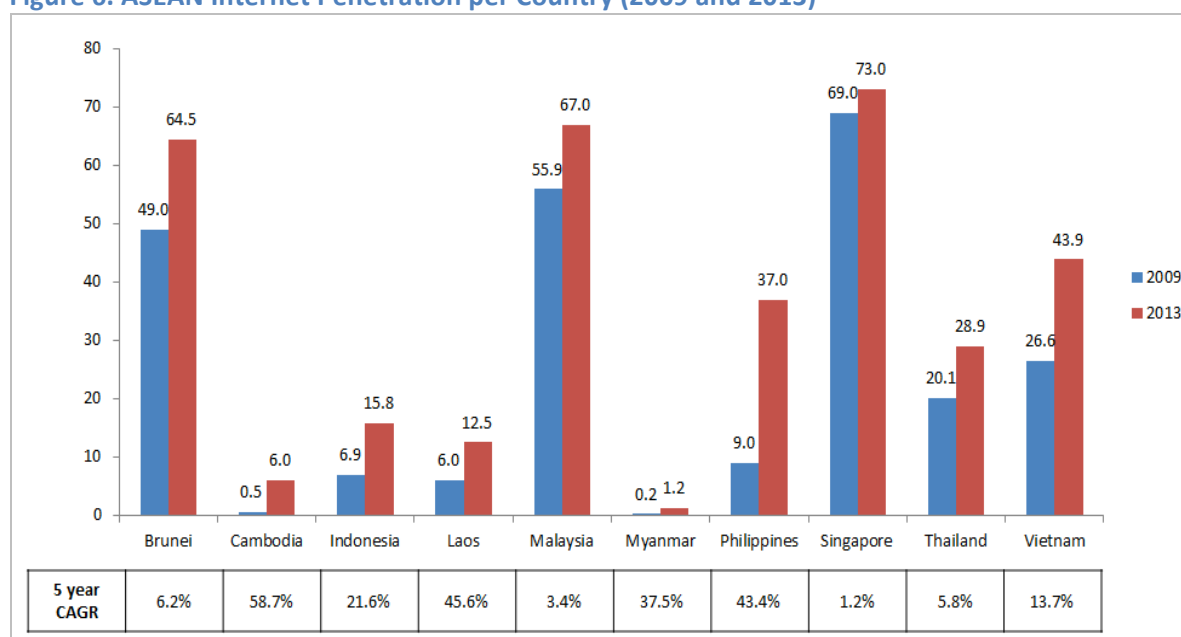**Table 3. Clusters According to Internet Penetration**

	CLUSTER 1	CLUSTER 2	CLUSTER 3
% of Internet Users (2013)	**Majority access** (Above 60%) • Singapore (SG): 73% • Malaysia (MY): 67% • Brunei Darussalam (BR): 65%	**Partial access** (25%-45%) • Thailand (TH): 29% • Philippines (PH): 37% • Vietnam (VN): 44%	**Low access** (1% - 20%) • Indonesia (ID): 16% • Lao PDR (LA): 13% • Cambodia (KH): 6% • Myanmar (MM): 1%
Country income classification (GDP per capita, PPP current international $)	• SG: High-income (USD 78,744) • BR: High-income (USD 71,759) • MY: Upper-middle (USD 23,298)	• TH: Upper-middle (USD 14,390) • PH: Lower-middle (USD 6,533) • VN: Lower-middle (USD 5,293)	• ID: Lower-middle (USD 9,559) • LA: Low-income (USD 4,812) • KH: Low-income (USD 3,042) • MM: Low-income (USD 868*)

Source: World Bank Indicators (2014) http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD

* There isn't yet an official PPP value for Myanmar's income so current price was used instead

ASEAN economies also experienced strong growth in the number of Internet users since 2009, albeit at different rates. While developed markets such as Singapore saw a growth rate of less than 1.2% between 2009 and 2013, the least developed economies of Cambodia, Lao PDR, and Myanmar saw far stronger growth rates of 59%, 46% and 38% respectively, albeit off a low base (Figure 6). Clearly, the less developed countries in the region are driving Internet adoption. The results make intuitive sense; the higher income countries are already heading towards the adoption of higher-speed broadband Internet and broader usage, while the less developed countries still have substantial room for growth of both basic and broadband services.

Figure 6. ASEAN Internet Penetration per Country (2009 and 2013)

	Brunei	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
2009	49.0	0.5	6.9	6.0	55.9	0.2	9.0	69.0	20.1	26.6
2013	64.5	6.0	15.8	12.5	67.0	1.2	37.0	73.0	28.9	43.9
5 year CAGR	6.2%	58.7%	21.6%	45.6%	3.4%	37.5%	43.4%	1.2%	5.8%	13.7%

Source: Internet Society Global Internet Report 2014, http://www.internetsociety.org/map/global-internet-report/

The inverse relation between Internet penetration and connectivity growth can be observed more clearly in Table 4. Cluster 1, grouping the three economies with high Internet penetration show 5-year compound annual growth rates (CAGRs) in the low single digits, while the economies in Clusters 2 and 3 almost all show double-digit CAGRs, tending to increase in inverse relation to the existing lack of penetration. The standout examples are once again Thailand and Indonesia. Thailand, an upper-middle income economy with a relatively low Internet penetration of 29% shows only 6% CAGR between 2009-2013, while Indonesia, a lower-middle income economy with only 16% penetration shows a much stronger 22% CAGR for the period, but still far weaker than it's cluster peers. By contrast, the Philippines, also a lower-middle income economy of some 37% penetration in 2013, enjoyed 43% CAGR over the same period. Thus, neither economic development levels nor existing access can fully and simply explain Internet access growth.

**Table 4. Internet Penetration and Growth per Cluster**

	Cluster 1	Cluster 2	Cluster 3
% of Internet Users (2013)	*Majority access* • BR: 65% • SG: 73% • MY: 67%	*Partial access* • TH: 29% • VN: 44% • PH: 37%	*Low access* • ID: 16% • LA: 13% • KH: 6% • MM: 1%
Growth of the Internet Users (CAGR from 2009-2013)	*Slowing growth* • BR: 6% • SG: 1% • MY: 3%	*Moderate growth* • TH: 6% • VN: 14% • PH: 43%	*Strong growth* • ID: 22% • LA: 46% • KH: 59% • MM: 38%

Source: Internet Society Global Internet Report 2014, http://www.internetsociety.org/map/global-internet-report/

Teledensity

Teledensity, or the percentage of the population having access to a telephone connection, has long been used as an indicator of the communication infrastructure and economic development of a country, as it tends to have significant correlation with GDP per capita. Before widespread adoption of broadband and mobile wireless Internet connections, many early adopters depended on fixed telephone lines and dial-up access to the Internet. Today however, fixed lines are becoming increasingly less important as many subscribers use mobile phones and mobile access for voice and Internet services. Notably, there are only two economies in ASEAN that do not have a mobile phone penetration rate over 100%: Lao PDR at 66% and Myanmar at 13% (Figure 7).

Recalling the strong growth of the wireless broadband subscribers in the region (Figure 4) and the varied regional growth rates (Figure 6), one conclusion is that consumers from less developed countries in the region are driving Internet adoption and are doing so through broadband connections using their mobile phones.

Figure 7. ASEAN Teledensity Overview (2013)
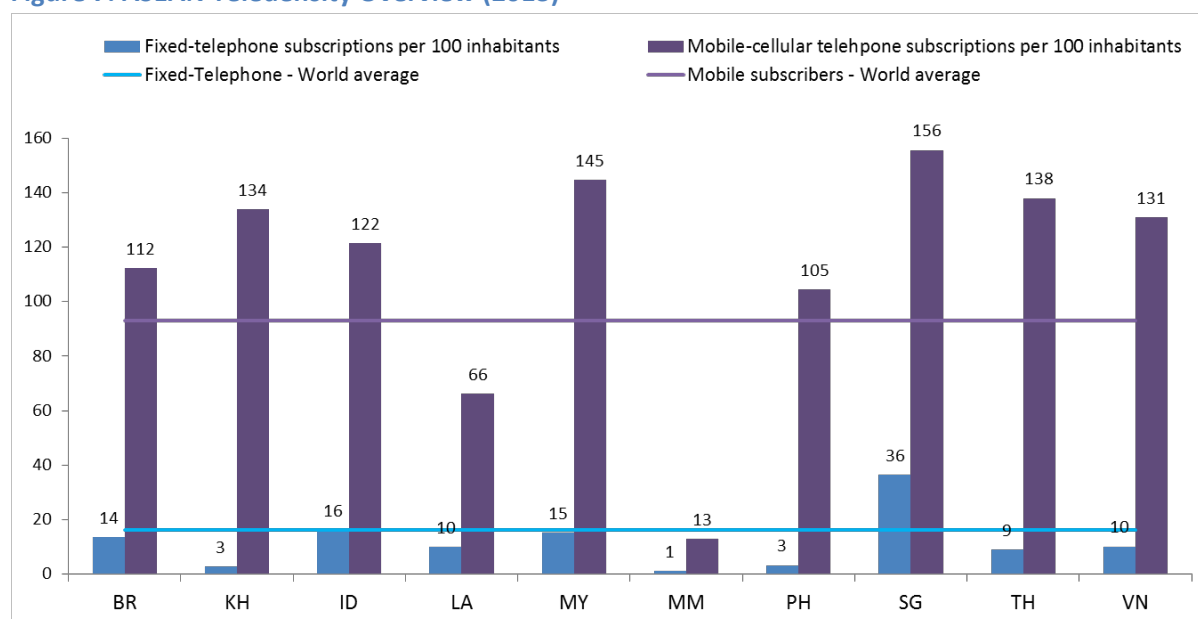
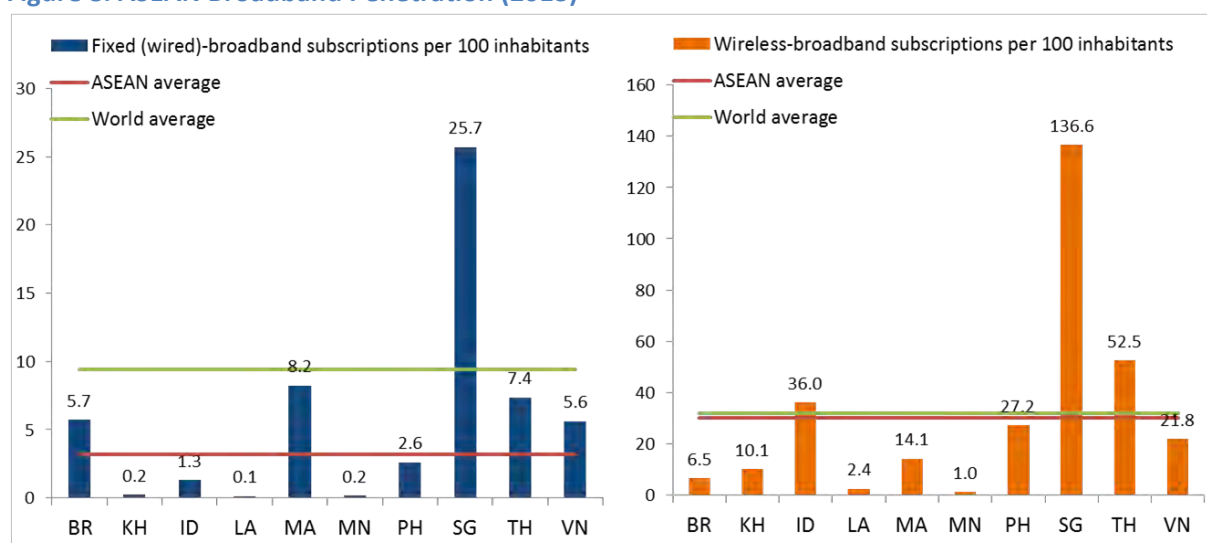Source: ITU World Telecommunication/ICT Indicators database 2014

Broadband Penetration

Broadband penetration has replaced teledensity in measuring the communications infrastructure and has become more often used to represent Internet access in recent years. As mentioned earlier, this is an area where ASEAN ranks behind the world average, especially in fixed-line broadband, but even in wireless broadband ASEAN's average does not yet quite match the global average.

However, while ASEAN economies, with the exception of Singapore, lie below the world average for fixed broadband penetration, as Figure 8 illustrates, Indonesia (36%) and Thailand (53%) have joined Singapore in surpassing the global average for wireless broadband subscriptions, with the Philippines and Vietnam close behind.

While the penetration of fixed-broadband hardly registers statistically in many countries in ASEAN, a more realistic way of measuring fixed-broadband penetration is on a business or household level. More often than not, a household or small business will subscribe to a fixed line and then use a Wi-Fi router to connect multiple mobile devices for family members or employees. This may translate to a four or even five-fold increase in access points than the number of fixed-broadband subscribers would suggest.[16]

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[16] The same argument can be made about mobile phones or telephone lines, which used to be shared among family members or rented for a fee within a community.

Figure 8. ASEAN Broadband Penetration (2013)

Source: ITU World Telecommunication/ICT Indicators database 2014

Clustering according to Internet penetration is also useful in analysing regional broadband penetration. The proportion of broadband subscribers – be it fixed or wireless – would be expected to progress as income rises.[17] However, across ASEAN there are a number of exceptions (Table 5). Firstly, Brunei falls significantly behind in the high access (and high-income) group for both fixed and wireless broadband penetration. Malaysia also is notably low in wireless broadband penetration, lagging behind countries in lower Clusters such as Indonesia, Philippines and Vietnam.

Table 5. Broadband Penetration per Cluster

	Cluster 1	Cluster 2	Cluster 3
Internet Penetration	*Majority access*	*Partial access*	Low access
Fixed-Wired Broadband	• SG: 26% • BR: 6% • MY: 8%	• TH: 7% • PH: 3% • VN: 6%	• ID: 1% • LA: 0.1% • KH: 0.2% • MM : 0.2%
Wireless-Broadband	• SG: 137% • BR: 7% • MY: 14%	• TH: 53% • PH: 27% • VN: 22%	• ID: 36% • LA: 2% • KH: 10% • MM: 1%

Source: ITU World Telecommunication/ICT Indicators database 2014

In a number of countries such as Indonesia, Singapore and Thailand, wireless broadband penetration rates exceed Internet penetration rates (Figure 8). One explanation is that in these economies many users subscribe to multiple Subscriber Identity Module (SIM) cards and possibly multiple devices to take advantage of lower on-net pricing. Indeed, a report by Nielsen shows that a number of economies in Southeast Asia have widespread multiple mobile ownership (Table 6).[18] This is in line

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[17] A World Bank study in 2009 for example found that a 10% increase in broadband penetration may boost economic growth by between 0.43-1.38% in GDP growth. See the World Bank ICT4Development Report 2009

[18] Nielsen (2014), *The Asian Mobile Consumer Decoded*, http://www.nielsen.com/ph/en/insights/news/2014/asian-mobile-consumers.html

with global trends and may be an indication that the use of multiple Internet access points is on the rise in these countries.[19]

Table 6. Multiple Handset Ownership

	Malaysia	Singapore	Indonesia	Thailand	Philippines
Own multiple handsets	47%	29%	15%	12%	10%

Source: Nielsen 2014 Decoding the Asian Mobile Consumer

Figure 9. Proportion of Internet Users, Fixed and Wireless Broadband Subscribers (2013)
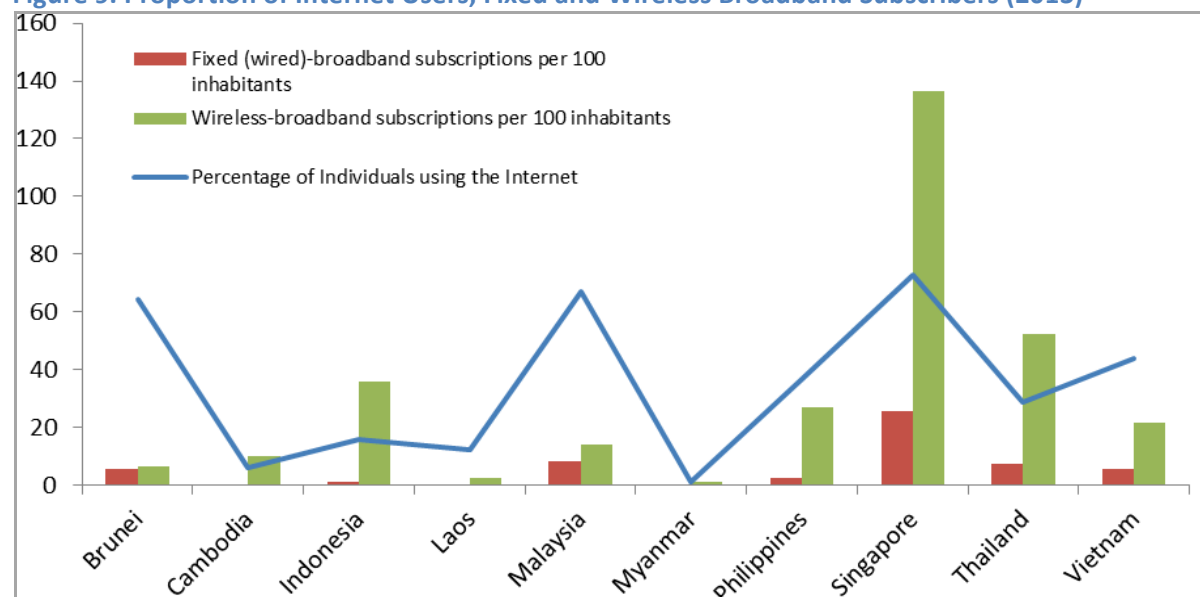
Source: ITU World Telecommunication/ICT Indicators database 2014

This analysis shows that the level of economic development is not the sole factor in driving the level of Internet adoption. In fact, the number of Internet users in a country is dependent on many variables, including but not limited to government policy, prices of services and devices, aspirational usage, complementary goods such as online content, as well as the overall level of infrastructure and commercial development and of disposable incomes within a country.

It is not the purpose of this report to undertake a full and detailed inquiry into why the Internet penetration rates in each country are as they are. Instead, it looks at key structural factors, namely international bandwidth, national backhaul and local connectivity, which constitute the Internet access supply chain, and highlight some of the important initiatives governments and the private sector can be taking to meet the aims and objectives of the AEC from 2015 onwards.

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[19] The Annual Broadband Report 2014, for example, estimates that the mobile subscribers outnumber the actual unique phone users by 1.5 to 2.05 globally on average. See Broadband Commission (2014), *The State of Broadband 2014: Broadband for All*, http://www.broadbandcommission.org/Documents/reports/bb-annualreport2014.pdf

I-2. International Internet Bandwidth

With the exception of local content from domestic websites and locally cached international content, a substantial portion of Internet traffic comes from overseas sources. International bandwidth, therefore, becomes an important indicator of the affordability and quality of Internet within a country.

Low-income countries lacking adequate international bandwidth experience a severe restraint on Internet access and usage, which results in higher prices and lower speeds. Higher prices are passed onto business users and consumers. Combined with lower speeds and higher latency, high prices result in reduced demand for Internet access. And without high demand for Internet access, investing in expensive international bandwidth becomes a difficult decision for ISPs.

In order to achieve downstream affordability[20] of the Internet at the retail level, one must understand how the upstream affordability at the wholesale level is determined. Two principle factors come into play in pricing international bandwidth: supply and ownership.

Supply of International Bandwidth: Submarine and Landline Cables

The supply of international bandwidth is supported by the extent and quality of fibre and other broadband infrastructure connecting economies. Table 7 summarizes the supply of bandwidth coming into the ten ASEAN economies, mostly by submarine cables but, in the cases of Cambodia, Myanmar and landlocked Lao PDR, landlines to neighbouring countries are included.

It should be noted that while satellites have been excluded as a relatively unimportant source of international Internet communications, they are nevertheless widely used in ASEAN countries.[21] They are most often used for TV broadcast services in the C, Ku and Ka bands, but also to provide Internet coverage in some remote or under-served areas. For example, landlocked Lao PDR uses a Thai satellite for some international traffic, while in Malaysia the Astro satellite operated by Maxis offers high-speed direct-to-home Internet services. But in general, satellite communications are reserved for backing-up submarine cables or to supplement national backhaul networks. As an OECD report points out, "A fibre pair can carry as much traffic as all geosynchronous satellites combined together. A single duct of fibre can carry all the traffic in the world."[22] This is partly due to the introduction to the market in 1996 of dense wave division multiplexing (DWDM), which by 1999 was enabling 96 separate wavelengths to be utilised down every strand of optical fibre. DWDM is costly and therefore used only on large international corporate networks, very heavily trafficked national backbone networks and on submarine optical cable networks, but it "changed the underlying economics of backhaul networks."[23]

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[20] Downstream affordability in this context refers to the affordability of Internet access as a service at the retail or user level, which is influenced by the upstream, which is the international bandwidth and national coverage.

[21] See for example, Galace, P. (2012), *Strong Demand Driving the Asia-Pacific Satellite Market*, Satellite Markets & Research, http://www.satellitemarkets.com/news-analysis/strong-demand-driving-asia-pacific-satellite-market

[22] OECD (2014) *International Cables, Gateways, Backhaul and Internet Exchange Points*, pp. 4, http://oecdinsights.org/wp-content/uploads/2014/02/International-cables-gateways-IXPs.pdf

[23] OECD (2014) *International Cables, Gateways, Backhaul and Internet Exchange Points*, pp. 13, http://oecdinsights.org/wp-content/uploads/2014/02/International-cables-gateways-IXPs.pdf

Table 7. International Capacity Supply

Country	Submarine + Landline Cables[24]	No. of Cables (Submarine + Landlines)	International Capacity per capita (kbps)[25]
Brunei	AAG; SJC; SMW-3;	3	n/a
Cambodia	AAE-1[1]; ASE[1]; MCT[1]; **Landlines:** 2.5Gbps Greater Mekong Subregion (GMS) optical fibre ring linking to Thailand, Vietnam, Lao PDR, China and eventually to Myanmar; link to Vietnam upgrade to 10Gbps; two separate links to Thailand and Vietnam	0 + 6[2]	0.764
Indonesia	APX-West[1]; ASC[1]; B3JS; BDM; BRCS; BSCS; DMCS; JAKABARE; ; MIC-1; MSC; PGASCOM; SJC SMW-3; SWM-5[1]; TIS;	12	1.030
Lao PDR	**Landlines**: China (CT 2Gbps), Thailand (CAT 5Gbps and CAT 2Gbps), Vietnam (VNPT 5Gbps and VDIC 5Gbps) and Cambodia (TC 2.5Gbps)	0 + 6[2]	0.383
Malaysia	AAE-1[1]; AAG; APCN-2; APG[1]; ASE; BBG; BDM; BRCS; DMCS; FEA; MCT[1]; SAFE; SMW-3; SMW-4; SWM-5[1]	11	15.6
Myanmar	SMW-3; SWM-5[1]; **Landlines:** China-Myanmar International (CMI 2-20 Gbps); India-Myanmar (622Mbps); Myanmar-Thailand (10Gbps); China-Lao PDR-Thailand GMS network (2.5Gbps)	1 + 3[2]	0.286
Philippines	AAG; ASE[1]; APCN-2; EAC-C2C; SJC; SMW-3; SMW-4; TGN-IA	7	5.450
Singapore	AAE-1[1]; AAG; APCN-2; APG[1]; APX-West[1]; ASC[1]; ASE[1]; B3JS; BSCS; EAC-C2C; i2icn; JAKABARE; MIC-1; MSC; PGASCOM; SJC; SMW-3; SMW-4; SWM-5[1]; TGN-IA; TIC; TIS	16	258.3
Thailand	AAE-1[1]; AAG; APG[1]; SWM-5[1]; APCN-2; APG[1]; FEA; MCT[1]; SJC; SMW-3; SMW-4; SMW-5[1]; TIS; TVH	7	6.622
Vietnam	AAE-1[1]; AAG; APG[1]; SMW-3; TGN-IA; TVH	6	5.150

Source: TRPC Research. Note: (1) Planned or under construction. (For cable acronyms see Table 8.) (2) Landlines

The same clusters emerge in Table 5 as for Internet and broadband penetration rates in the previous section. Singapore is way ahead of the pack with 16 cables landing and 258.3kbps per capita of bandwidth for international communications, followed a long way behind by Malaysia, Thailand, the Philippines and Vietnam.

Singapore took measures to open its international and domestic telecommunications markets by 1997. This brought down prices and stimulated outgoing International traffic growth, which rose from 20 million minutes in July 1997 to 640 million minutes in July 2014 or, if transit traffic is included, to over 1,500 million minutes.[26] By comparison, Cambodia has no submarine cable landing stations, landlocked Lao PDR is dependent upon low-capacity landlines, and Myanmar has connection to just one aging and low-capacity cable. As an OECD report notes, if "the market for backhaul and co-location is dominated by an incumbent telecommunications carrier, which does not allow independent co-location facilities to emerge, there is a significant obstacle to the development of the Internet in that country" and "control over landing stations has been a source of monopoly

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[24] Includes landlines in the case of Cambodia, Lao PDR and Myanmar

[25] United Nations ESCAP (2013), *An In-Depth Study of Broadband Infrastructure in the ASEAN Region*, http://www.unescap.org/sites/default/files/Broadband%20Infrastructure%20in%20the%20ASEAN%20Region_0.pdf

[26] IDA (2014*), Statistics on Telecom Services*, http://www.ida.gov.sg/Infocomm-Landscape/Facts-and-Figures/Telecommunications/Statistics-on-Telecom-Services

power."[27] On the contrary, as the report also notes, sharing the costs of landing station and backhaul equipment with multiple carriers in a co-location data centre is a sensible way to improve the economics of running an international gateway and lowering the costs of the Internet.

Equally important for countries wanting to attract foreign companies to locate and invest, as well as making their own businesses more competitive in international markets, are the options available in the operation of backhaul, from the international cable landing station to the international gateway, and on to points-of-presence (POPs) created by foreign carriers wanting to serve corporate clients. In more open and competitive markets carrier wholesale prices tend to be lower, and competition accelerates as the monopoly power of the incumbent declines. For instance, in three bi-annual studies for the Asia Pacific Carriers Coalition (APCC) over the years 2009-2012, TRPC research shows that "it is a reasonable assumption that where the local market is characterized by competition local access prices are likely to be lower" but also cautions that "the determinants of local access prices are far from transparent."[28]

The Role of Content over the Internet

International capacity per capita correlates strongly with the proportion of Internet users per country; countries with higher per capita bandwidth have a higher proportion of Internet users. With the Internet, greater bandwidth leads to greater utility, and therefore greater usage, in turn leading to more users. An important and growing ingredient in this equation is the role of content over the Internet, and especially how much of it is cached locally. Content providers such as Google and Netflix, and content distribution networks (CDNs) such as Akamai, Amazon Cloudfront, Cachefly and others, all have an interest in bringing content closer to the end users in order to reduce Internet transit costs and maintain a high quality of service delivery. To this effect, ISOC recently released an in-depth study on the impact of local content hosting and the importance of developing an enabling environment to encourage the local hosting of content by local content developers as well as international content delivery networks.[29]

Local caching facilities, for example, local data centres connected by broadband to international submarine cable gateways, can also encourage local content vendors to bring home and cache locally the content they previously chose to host on out-of-country servers to ensure its availability to foreign markets. The result is greater volumes of local Internet traffic, which strengthens the economics underlying IXPs for ISP peering (see next section).[30] The evidence strongly supports the proposition that the demand for broadband access as well as usage will grow accordingly. An oft-cited example is from Kenya where, following the installation of a Google Global Cache (GGC) in April

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[27] OECD (2014) *International Cables, Gateways, Backhaul and Internet Exchange Points*, pp. 11 & 27, http://oecdinsights.org/wp-content/uploads/2014/02/International-cables-gateways-IXPs.pdf. Both Cambodia and Myanmar have dominant incumbent carriers, Lao PDR is a fixed-line duopoly.

[28] See APCC studies on *Access Price Benchmarking Reports* at: http://asiapacificcarriers.org/index.php?pageID=8. Note the prices are those reported by the carriers involved in the study, and may include bulk discounts.

[29] ISOC (2015), *Promoting Local Content Hosting to Develop the Internet Ecosystem*, http://www.internetsociety.org/doc/promoting-local-content-hosting-develop-internet-ecosystem

[30] OECD (2014) *International Cables, Gateways, Backhaul and Internet Exchange Points*, http://oecdinsights.org/wp-content/uploads/2014/02/International-cables-gateways-IXPs.pdf; the report also cites a Swedish analytics company Pingdom suggesting a strong correlation between OECD countries that have competitive Internet markets and those that host a higher percentage of websites domestically, see pp.19.

2011, "traffic volumes rose more than ten-fold within the year, the lion's portion of it was streamed video, for example from YouTube, as latency dropped by 20%..."[31] With more bandwidth, users are better able to access and enjoy a wider range of online services, such as search, email, downloads, playing games, using social media, making voice over IP (VoIP) calls and streaming high definition (HD) videos. Without adequate bandwidth, users experience latency and eventually lose interest in using such services. For example, research in 2004 showed the average tolerable waiting time for a webpage download to be two seconds.[32] A decade later, those expectations have only increased.

The silver lining in the cloud for the three least-well served economies of Lao PDR, Cambodia and Myanmar is that they stand to improve bandwidth from two sources: upgrades to existing cables and from new cables becoming available. In the case of Myanmar, for example, it is reported that Myanmar Post & Telecommunications (MPT), under the Ministry of Communications and Information Technology (MCIT), has plans to add a connection to SEA-ME-WE-4 by terrestrial cable to Bangladesh, which could add a further 40Gbps. Currently most international traffic passes through the terrestrial China-Myanmar International (CMI) cable to China which is undergoing an upgrade. In the case of Cambodia, NTT (Japan) has offered to link Cambodia to the planned Asia Submarine-cable Express (ASE). The cable will offer transmission speeds of 40Gbps with a capability to incorporate 100Gbps technology.[33] Another option is that Internet service provider (ISP) Ezecom has plans to invest in a cable to Malaysia,[34] and from there to the Asia-American Gateway (AAG). The availability of these cables would roughly coincide with the launch of AEC 2015. In the case of Lao PDR, further overland cables being planned include a Thailand-China-Russia cable, an additional cable link from Thailand and an agreement with NTT (Japan) to connect to the Asia Submarine-cable Express (ASE).[35]

With new and upgraded access to international broadband, the capacity constraint would be greatly relaxed. However, for the three economies of Cambodia, Lao PDR and Myanmar, most traffic – voice as well as data and Internet – still transits through Thailand or Vietnam. Therefore, transit pricing becomes an important factor in driving Internet affordability and the cost of IP transit in recent years have typically been around USD100 per Mbps.[36] The issue of IP transit pricing is addressed in detail in the following section.

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[31] World Bank (2013), *IP-Based Interconnection, Broadband Toolkit,* ch 3.4, http://broadbandtoolkit.org/3.4 Also see ISOC's report titled *Lifting Barriers to Internet Development: Suggestions for Improving Connectivity* (2013) for examples from Kenya and Nigeria. http://www.internetsociety.org/doc/lifting-barriers-internet-development-africa-suggestions-improving-connectivity

[32] Nah, F. (2004), "A study on tolerable waiting time: how long are Web users willing to wait?", *Behaviour & Information Technology,* http://cba.unl.edu/research/articles/548/download.pdf

[33] Lightwave (2014), *NTT to Extend Asia Submarine-cable Express Undersea Cable to Cambodia,* http://www.lightwaveonline.com/articles/2014/06/ntt-extends-asia-submarine-cable-express-undersea-cable-to-cambodia.html

[34] Morton, E. (2014), *Construction on submarine cable yet to begin,* The Phnom Penh Post, http://www.phnompenhpost.com/business/construction-submarine-cable-yet-begin

[35] Vientiane Times (2012), *Laos plans for direct int'l internet link,* Asia News Network, http://www.asianewsnet.net/news-29066.html

[36] United Nations ESCAP (2013), *An In-Depth Study of Broadband Infrastructure in the ASEAN Region,* http://www.unescap.org/sites/default/files/Broadband%20Infrastructure%20in%20the%20ASEAN%20Region_0.pdf

International Bandwidth in Numbers

Does this mean that low-income countries in ASEAN would not be able to afford the necessary international bandwidth? The answer is, fortunately, no. There are three crucial bandwidth numbers: design capacity, lit capacity, and speed available over separate fibres,[37] and these change over time as and when cables are upgraded. Modern cables are designed with a capacity in terabits far outreaching actual usage. The reason behind the oversupply of capacity from the outset is that the marginal cost for additional *potential* capacity is negligible. In other words, it is very expensive to lay down new cables but relatively cheap to increase capacity within existing cables.

What this means for ASEAN as a whole is that there is, in principle, no shortage of capacity for future growth. The international capacity is there if the investment to connect it is forthcoming. The economics come into play when the owners of the cable decide to light up individual fibres. This has to be justified commercially, and only carriers with the demand from their customers will warrant the investment. Governments do not have a direct bearing on these decisions, but through policies of liberalization *they can help create the market conditions* that produce the demand. Table 8 captures bandwidth information on the various cables serving the ASEAN region.[38] The lit capacity of existing submarine cables is, as highlighted previously, far below design capacity, leaving substantial amounts of 'dark fibre' available for future use. That means that current submarine cables are able to handle the immediate future growth of Internet bandwidth demand as long as carriers see commercial justification.

Table 8. International Bandwidths

	International and Regional Submarine Cables serving ASEAN	Speeds on cables up to	Lit Capacity	Designed Capacity
1	AAE-1[1]: Asia Africa Europe-1	10Gbps		40Tbps
2	AAG: Asia-America Gateway		1.88Tbps	6Tbps
3	APCN-2: Asia Pacific Cable Network-2	10Gbps	3.84Tbps	21.12Tbps
4	APG[1]: Asia Pacific Gateway			54.8Tbps
5	APX-West[1]: Asia-Pacific Crossing-West	100Gbps		32Tbps
6	ASC[1]: Australia-Singapore Cable (ASC)	100Gbps		24Tbps
7	ASE[1]: Asia Submarine-cable Express	100Gbps		15Tbps
8	B3JS: Jakarta-Bangka-Bintan-Batam-Singapore			380Gbps
9	BBG: Bay of Bengal Gateway	100Gbps		10Tbps
10	BDM: Batam Dumai Melaka Cable System	10Gbps	80Gbps	1.28Tbps
11	BRCS: Batam-Rengit Cable System[2]	128Mbps[1]		
12	BSCS: Batam Singapore Cable System	10Gbps		80Gbps
13	DMCS: Dumai-Melaka Cable System	20Gbps		320Gbps
14	EAC-C2C: East Asia Crossing – C2C	160Gbps	3.26Tbps	30.55Tbps

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[37] Lit capacity differs from speed available as the latter is impacted by the switching technology at the ends, cost and demand factors. Associated costs include upgrading switches in the international gateway so they cope with advanced technologies such as MPLS (Multiprotocol Label Switching) that use all the frequencies of the rainbow (ROYGBIV) to pack multiple transmissions along a single fibre. (ROYGBIV is an acronym for the sequence of colours which are commonly described as making up a rainbow: Red, Orange, Yellow, Green, Blue, Indigo, Violet.)

[38] Eid, A. (2014*), The Naked Truth about Submarine Cables*,
http://www.ptc.org/ptc14/images/papers/upload/Presentation_SubmarineWS_EidAmr.pdf and TeleGeography (2014), *Submarine Cable Map 2014*, http://submarine-cable-map-2014.telegeography.com/

	International and Regional Submarine Cables serving ASEAN	Speeds on cables up to	Lit Capacity	Designed Capacity
15	FEA: FLAG-European	100Gbps	440Gbps	4.68Tbps
16	i2i cn: i2i Cable Network	10Gbps	3200Gbps	8.4Tbps
17	JAKABARE	40Gbps	160Gbps	1.28Tbps
18	MCT[1]: Malaysia-Cambodia-Thailand	40Gbps		8Tbps
19	MCS: Matrix Cable System		170Gbps	5.12Tbps
20	MIC-1: Moratelindo International Cable System-1	10Gbps		
21	PGASCOM		160Gbps	160Gbps
22	SAFE	10Gbps		440Gbps
23	SJC: SEA Japan Cable System		1.2Tbps	28.8Tbps
24	SMW-3: SeaMeWe-3	10Gbps	410Gbps	460Gbps
25	SMW-4: SeaMeWe-4		3.59Tbps	6.4Tbps
26	SMW-5[1]: SeaMeWe-5	100Gbps		24Tbps
27	TGN-IA: Tata TGN-Intra Asia		1.9Tbps	9.6Tbps
28	TIC: Tata Indicom Cable	10Gbps	640Gbps	47.2Tbps
29	TIS: Thailand-Indonesia-Singapore		30Gbps	320Gbps
30	TVH: Thailand-Vietnam-Hong Kong			560Gbps

Source: TRPC Research. Note: (1) Planned or under construction

If there is no supply shortage in the immediate growth of Internet bandwidth, then the question of ownership comes into play in determining the downstream retail price of Internet access. For local Internet access to become affordable, competing ISPs need equitable access to international bandwidth. The following section looks at the issue of ownership along with IP transit prices.

I-3. IP Transit Pricing and the Economics of IXPs

The economics of Internet wholesale pricing are no different from any other networked industry such as energy grids or payments networks, where ownership of the network is all important. This is especially true in telecommunications when bandwidth is a finite resource. For basic telephone calls, international bandwidth is, in general, no longer in short supply, and the ITU-promoted international accounting and settlement rates system established a cap on what carriers would charge each other. That system has long since been by-passed. From the 1990s onwards techniques such as call-back and disguised rerouting of traffic from higher to lower cost transit paths were workarounds and, as the Internet became available, it too became an additional means for doing this. The result was lower prices for consumers and lost revenue for the carriers. However, no such system ever existed for Internet traffic, so carriers who own the international bandwidth and IXPs for the routing of transit traffic have a commercial advantage. Table 9, summarising IP transit cost per country, illustrates the point.

Table 9. Monthly Cost of Internet Transit Traffic

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	Vietnam	$70 per Mbps
Myanmar	> $100 per Mbps		

Source: ESCAP *An In-Depth Study of Broadband Infrastructure in the ASEAN Region* 2013

Comparing Table 9 with Table 7, International Capacity Supply, it can be seen that countries with access to a large number of international submarine cables and large amounts of international bandwidth enjoy lower transit prices. For example, the monthly cost of Internet transit traffic in Singapore is less than USD10 per Mbps (when bought in volume), compared to *more than 10 times this amount* in Cambodia, Lao, and Myanmar. The enormous difference in cost between routing Internet traffic from Singapore and from other ASEAN countries is due to Singapore's status as an Internet hub. This is created by having an open market for data centres and IXPs, which *in turn* depends on having excellent international connectivity. A big hurdle to creating this virtuous circle in other ASEAN economies is the dominance of incumbent carriers, who run their own Internet transit points and have a commercial motivation to resist IP peering arrangements with their weaker competitors. (See example of the Philippines in the Economics of IXPs section).[39]

Despite the liberalization of most telecom markets in the ASEAN region, the traditional incumbent carriers largely remain dominant in the fixed line market. In most cases these dominant carriers originate from state-owned enterprises and often the state retains an equity interest even after privatization. The Philippine Long Distance Telephone Company (PLDT) is the exception to the rule, having been always privately-owned but for many years enjoyed a government-supported *de facto* monopoly status. Dominant carriers have a commercial self-interest to operate peering arrangements with foreign carriers of equal status, but impose bi-lateral arrangements on local

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[39] Where IXPs are successful in offering equal access to a community of local ISPs the competitive effects are more strongly felt. In Hong Kong, for example, an independent IXP managed under the auspices of the Chinese University of Hong Kong ensured a competitive market despite the dominant incumbent carrier, PCCW, not joining.

carriers and local ISPs on their own terms. Thus there is a notable lack of carrier-neutral IXPs in the ASEAN region.

The lack of carrier-neutral IXPs in the region forces weaker competitors to transit their traffic through the incumbent's network even when that traffic is domestic. The incumbent then routes this off-net traffic through an IXP located in an intermediate country, for example, through Japan or the US, before bringing it back in-country and delivering it to the domestic destination – a process known as tromboning. This results in a significant slowing down of the speed of delivery (latency) and creates potential quality of service issues. This approach enables the incumbent to enforce its own commercial wholesale prices, and weakens its competitors. Given that there is a preponderance of dominant incumbent operators across ASEAN, this becomes a serious issue. Box 2 illustrates how this process works in the Philippines.

Box 2. The Philippines and the Lack of a Carrier Neutral National IXP

The Philippines provides a telling example of the need for a carrier-neutral IXP to serve all ISPs on an equal commercial footing. PLDT, the dominant carrier, operates its own Vitro Internet Exchange and is able to deliver traffic from origination to termination anywhere in the Philippines at minimum cost and latency. Other ISPs, including major service providers such as Globe, Sky, Bayan DSL, and ETPI, are able to peer with each other on a bilateral basis and through a host of Internet exchanges such as PHIX, PHOpenIX, CORE and MIX.

However the Internet exchange market is fragmented, insofar as no exchange has the full participation of all major ISPs. The lack of cooperation means that consumers end up having to take double the amount of time to access local websites as traffic is routed to other countries before returning back to the Philippines. According to one estimate, 40-70% of local traffic is routed through either Hong Kong or Los Angeles (US), and most of this is due to transit through PLDT's gateway.[40] As PLDT has the major market share, they are not much interested in joining a multi-peering IXP and have consistently resisted calls by the National Telecommunications Commission (NTC) to mandate an IP peering policy, citing concerns regarding the security and adequacy of the technical arrangements of local Internet exchanges such as PHOpenIX.

One group of users adversely affected are local gamers trying to connect to the platform of gaming providers, such as Garena, that use PLDT as its ISP. This leads to significant delays for gamers using other ISPs when they want to play online games with their peers who are using the PLDT network.[41]

Besides the problem of peering there is also the issue of access bottlenecks to international gateways and submarine landing stations, and to the backhaul required to carry Internet traffic from domestic to international markets for smaller competitors. For example, competing carriers may be required to connect indirectly through the incumbent's network, and may face bandwidth restrictions and be charged premium rates. Without affordable access, smaller ISPs have little

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[40] Fafunwa, T. (2010), *The Need for a True National Internet Exchange (Philippines) – V1.2*, http://www.scribd.com/doc/36570333/The-Need-for-a-True-National-Internet-Exchange-Philippines-V1-2-by-Tunde-Fafunwa-of-Kitskoo-com
[41] Agcaoili, L. (2014), *Globe urges PLDT to allow exchange of traffic among ISPs*, philStar, http://www.philstar.com/business/2014/07/16/1346628/globe-urges-pldt-allow-exchange-traffic-among-isps

commercial bargaining power with powerful incumbents. *Regulators concerned with keeping markets open and competitive, promoting demand and protecting consumers, need to address this issue.*

Economics of Internet Exchange Points (IXPs)

In order to understand the market dynamics of an IXP, the basic economics of the exchange need to be appreciated. To begin, the volume of traffic is crucial. The basis of any exchange, be it an IXP or a street market, is liquidity, and for an IXP that means the volume of traffic being peered through the exchange. For an ISP, the difference in cost between peering through an exchange and the charges for IP transit is crucial. This is notable when a substantial proportion of the ISP traffic is domestic rather than international because it avoids both the extra costs of tromboning and the potential loss of latency. This can be expressed as:

$$\text{Total bandwidth costs} = \frac{[P_D(a) + P_i(1-a)]}{P_i}$$

P_i and P_D are respectively the price of international and domestic bandwidth, where $P_i > P_D$, and (a) is the proportion of total traffic that can be routed through the IXP. As the proportion of domestic traffic rises and the value of (a) rises, the average unit cost of bandwidth will fall.[42] It follows therefore that: as the total volume of traffic, and therefore the total volume of bandwidth required by that traffic, rises, the liquidity of the exchange improves; as the proportion of traffic that is domestic rises, so the increased bandwidth required will cost less than if the additional bandwidth was for international traffic. In this case, the IXP reduces costs for individual ISPs and as traffic rises, revenues rise as well providing financial sustainability to the IXP. A carrier-neutral IXP is in the best position to realise these gains, and share them with their ISP customers with no incentive to discriminate, but instead encourage the full cooperation of all ISPs. This will allow the IXP to build critical mass and enjoy economies of scale.

These points are elaborated and well-illustrated in the Internet Society's 2014 report on the topic.[43] A key point is that, even if at the start traffic volumes cannot cover costs and a subsidy may be required, "as the digital economy grows, so will the number and type of parties connecting to IXPs. For example, in Europe between 2008 and 2010 the percentage of connections to IXPs from content providers increased from 85% to 96.3%, by VoIP providers from 36.8% to 48.1%, by enterprises such as airlines and banks from 30% to 46.2%, by search engines from 25% to 48% and by governments from 50% to 77.8%. For developing countries, these are trends to take note of as *IXPs have an important role in triggering and accelerating the local digital economy*, so even if an IXP initially requires some form of subsidy, if successful it will generate sufficient volume of traffic makes itself sustainable."[44] At that point, different charging models can be adapted to suit local circumstances. This virtuous cycle whereby a carrier-neutral IXP attracts content caching, making it increasingly

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[42] M. Mueller, J.Y. Hui and C.H. Cheng (1997), "The Hong Kong Internet Exchange: The economics, Evolution and Connectivity of Asian Internet Infrastructure" in B. Kahin and J. H. Keller (1997) *Coordinating the Internet* pp.404-419
[43] ISOC (2014), *The Internet Exchange Point: Toolkit and Best Practices Guide* ch. 4 http://www.internetsociety.org/sites/default/files/Global%20IXPToolkit_Collaborative%20Draft_Feb%2024.pdf
[44] World Bank (2013), *IP-Based Interconnection, Broadband Toolkit*, ch 3.4, http://broadbandtoolkit.org/3.4; data from S, Silvius (2011), *Internet Exchange Points* https://www.euro-ix.net/documents/894-ixp-research-pdf?download=yes

available and stimulating further usage has been replicated in many markets. For example, in Kenya IXP traffic rose tenfold in one year following the installation of Google Global Cache.[45] An exception would be in territories where Internet traffic is already monopolised by the incumbent.

Status of Carrier-Neutral IXPs in the ASEAN Region

Outside of Singapore there are few carrier-neutral IXPs in the ASEAN region, compounding the problem of poor domestic and regional connectivity. Examples include:

- **Indonesia:** Equinix has opened a carrier-neutral data centre in Jakarta to interconnect ISPs.[46]
- **Cambodia**: There are two private carrier-neutral IXPs in Cambodia, Finder IXP and the Cambodian Internet Exchange run by the Sabay Digital Corporation, a multi-platform content provider. In 2009 the Ministry of Post and Telecommunication (MPT) issued a notice to all ISPs to interconnect through Telecom Cambodia, but rescinded the notice within a year.[47]

In most cases the dominant carriers operate on a bi-lateral exchange basis, while in some cases the government promotes a national not-for-profit IXP, including the following:[48]

- **Malaysia**: the Ministry of Communications and Multimedia has promoted MyIX as a neutral IXP, with estimates of foreign savings of RM2.36 billion (USD650 million) over the first five years.[49]
- **Vietnam:** the Ministry of information and Communications has established a common Vietnam National Internet Exchange (VNIX) hosting 17 ISPs as of September 2014.[50]
- **Thailand:** There are 10 domestic IXPs, the largest being CAT-NIX (THIX) with more than 100Gbps domestic bandwidth.[51] Although it was mandated in 2003 that all ISPs connect with the Internet Information Research (IIR) Public Internet Exchange (PIE) only one commercial ISP does so and the IIR PIE is now run by the National Electronics and Computer Technology Center (NECTEC) and is used only for academic and research purposes.[52] However, a new IXP in Bangkok (BKNIX) to facilitate full peering is due to be launched in the first quarter of 2015.

Note that at least two of the above countries with a government policy for a national IXP, Malaysia and Vietnam, have been marked as high performers when it comes to Internet penetration. This may

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[45] infoDev (2011), *Broadband in Kenya: Build It and They Will Come*, http://broadbandtoolkit.org/Custom/Core/Documents/ke.pdf

[46] Equinix (2014), *Jakarta Data Centres & Colocation Services*, http://www.equinix.com/locations/indonesia-colocation/jakarta-data-center

[47] C. Nelson (2012), *Internet Freedom in Cambodia – A Timeline*, http://ltocambodia.blogspot.sg/2012/08/ Internet-freedom-in-cambodia-timeline.html

[48] It is not always clear when an IXP is fully open to peering among all peers and when they are simply a bilateral exchange of traffic.

[49] *Malaysia's Internet Exchange*, Enterprise IT News, http://www.enterpriseitnews.com.my/news/market-trends/item/167-the-rise-of-myix-%E2%80%93-malaysia%E2%80%99s- Internet-exchange.html

[50] VNNIC (2014), *Vietnam Internet Network Information Center*, http://www.vnnic.vn/en/dns-vnix?lang=en

[51] Internet Services Center, Data Communications Dept, CAT (2014), *Thailand Internet Exchange*, http://archive.apnic.net/meetings/14/sigs/ix/docs/ix-pres-wachira-thix.pdf

[52] Wikipedia (2014*), Internet in* Thailand, http://en.wikipedia.org/wiki/Internet_in_Thailand

not be the preferred option in many countries and indeed a voluntary approach that is based upon clearly perceived market incentives is likely to attract more willing ISPs, but it does highlight the importance of government playing a constructive role in promoting wider access and adoption of the Internet. Box 3 illustrates constraints that the three least connected economies face in providing adequate Internet connectivity due to the lack of well-functioning or neutral IXPs.

Box 3. Challenges in Cambodia, Lao PDR and Myanmar

Cambodia

The leading ISPs are those with ownership of, or direct access to, transmission capacity, gateways, terrestrial fibre, back-haul networks, and with their own data centres/IXPs for interconnecting traffic. These include Camnet (Telecom Cambodia), Ezecom, Chuanwei, MekongNet, Cogetel Online and WiCam. TRPC performed speed tests on these leading ISPs in early September 2014, finding that downloading varied from 644kbps up to 2.2Mbps, which are slow-to-quite good. Although there are now two carrier-neutral IXPs, they are unlikely to have a big impact until there is a considerable improvement in international bandwidth availability at lower prices, and local tail-end or retail prices fall far enough to generate high volumes of traffic.

Lao PDR

The MPT has set up the Lao National Internet Centre (LANIC) which will connect to NTT's Tier-1 network. All ISPs are supposed to interconnect through LANIC, but enforcement has been lax. According to ITU data, by the end of 2013 around 12.5% of the population (around 800,000 people) were using the Internet. Some have fixed-line or mobile subscriptions to Lao Telecom Co. (LTC), Enterprise Telecom Lao (ETL), Star Telecom Lao (STL), VimpelCom Lao (Beeline), Planet Online , Sky Telecom, and Lane Xang Internet Service (LIS). Many others use Internet cafes, of which there are several hundred across Lao PDR. Access using cheap smartphones in the urban areas is on the increase, assisted by 3G and 4G networks. According to one report, because in 2012 the MPT regulated minimum charges per Mbit on mobile phones, Internet access shifted to data-cards or tablets, although residents close to the Thai border can use Thai SIM cards for Internet access.

Myanmar

There currently is no IXP in Myanmar. According to the ISOC *Global Internet Report*, Myanmar comes at the bottom of the world league table (178th) with 1.2% Internet penetration, although growing at a commendable 37.5% CAGR since 2009. The main providers of Internet connectivity have been the MPT, Myanmar Teleport (formerly Bagan Cybertech) and Yatanarpon Teleport, in which the MPT is a shareholder. There appears to be a cluster of smaller ISPs including Information Technology Central Services (ITCS), Red Link Communications, Digicel and SkyNet. According to one source, the domestic Internet backbone is limited to 14Gbps, so the need for increased national bandwidth is an urgent requirement to remove bottlenecks, especially as expectations of latent user demand are high.[53] As a step towards upgrading Internet services, in July 2014 the MCIT put out a tender for IP Transit services.

As noted earlier, international bandwidth and ownership are the key determinants of Internet pricing and speeds in the developing economies of ASEAN. There is an old debate between facilities

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[53] ESCAP An In-Depth Study of Broadband Infrastructure in the ASEAN Region 2013

versus services competition that plays out here as well, and goes back to the importance of owning a network rather than leasing bandwidth from one. Facilities ownership allows the controlling carrier to design the network in ways that best suit its own needs, and gives the carrier a means to deny access, backhaul, bandwidth or quality of service to competitors who are leasing their lines. In cases where the incumbent carrier is also the dominant ISP this has the potential to be a real problem and may require regulations be put in place to guarantee equal access to bottleneck facilities to maintain a competitive and open market. An additional option is to encourage facilities sharing among operators to lower fixed costs.

Many ISPs face a margin-squeeze, in which wholesale prices are high but retail prices are kept close to, or even below, cost by incumbent operators. Even ownership of an international gateway is no guarantee of economies of scale. For example, in Thailand there are ten operators of international gateways, but the cost of bandwidth per Mbit per capita remains high. And, while smart regulation can bring about equal access to promote effective competition in the domestic market, it cannot guarantee the investment needed for additional international bandwidth. The level of investment needed can only be driven by market forces, which means the promotion of a buoyant domestic demand. While regulation can help make competition more effective, governments, through their actions, may end up either encouraging or discouraging the growth of local demand.[54]

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[54] For example, the government of Cambodia in 2006 threatened to ban 3G phones on the grounds that they could be used to transit salacious content, see A, Tan (2006), *Cambodia Bans 3G Mobile Services*, Bloomberg Businessweek, http://www.businessweek.com/stories/2006-05-29/cambodia-bans-3g-mobile-services

I-4. National Connectivity of the Internet

Having looked at international bandwidth of the Internet within ASEAN economies, the next segment of the Internet supply chain that needs examination is national connectivity, including fixed broadband connectivity, wireless and mobile broadband coverage.

Across ASEAN economies, and especially in the lower-income economies, the means of access to the Internet is increasingly wireless. Mobile devices have many ways to connect such as through mobile networks, public and shared Wi-Fi, and sometimes by satellite and VSAT. Mobile networks need to achieve close to national coverage, at least for the main cities and towns, to be competitive, and to achieve that level of coverage they need the existence of a national fibre backbone for long-haul traffic. For this reason local access issues are not looked at separately as they would traditionally otherwise be in landscapes in which fixed local loop connections were of dominant or paramount importance. Indeed, across the region the global trend towards fixed-mobile substitution is very evident. Moreover, in the next phase of the emerging digital economy, wireless communications will become even more significant as wearable devices become popular and smart city developments see the widespread deployment of sensors and machine-to-machine (M2M) data communications.

The importance of a national fibre optic backbone connecting all cities and provinces, and the branches off to smaller towns and villages, cannot therefore be overstated. Mobile wireless devices may be cheaper to buy and the subscription rates may be lower than fixed lines, but this still means that high capacity local and long-distance optical fibre backhaul are crucial in enabling mobile networks that increasingly provide last mile connectivity.

Many citizens within ASEAN are today accessing the Internet through wireless broadband connections, rather than through fixed connections. This may include paid subscriptions to wireless broadband plans,[55] 3G/4G mobile data plans for tablets or smartphones, or even using free or paid Wi-Fi services offered by businesses and hotels. Just as prepaid cards boosted the take-up and usage of mobile phones from the late-1990s by lowering access prices and allowing users to calibrate their usage charges, "free" Wi-Fi is offering users of all income ranges opportunities to access and use the Internet. Such access is frequently provided "free" either because the operator offers it at no charge (for example, in selected government funded public locations[56]), or because the business subscribing to a fixed or fixed-wireless broadband service then broadcasts the access, making it available for free, such as in an airport or a coffee shop. Suddenly, the idea of an Internet café, which used to not serve any drinks becomes a genuine café offering free Wi-Fi to customers who *do* buy drinks. This interesting reversal shows how Internet communications is becoming an integral part of non-communication businesses. And thus instead of the few discrete examples of youths playing games in old-style Internet cafés, now people of all ages are engaging with 'apps', social networking and social media.

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[55] Wireless broadband plans refer to mobile broadband plans provided through a USB dongle, or modem to provide Internet access to laptops and other wireless devices to connect to.

[56] Examples include Wireless@SG in Singapore and the "Free Wi-Fi" plan by the ICT Office, Department of Science and Technology (DOST) in the Philippines. The Indonesian government is also looking at similar service in their National Broadband Plan.

These developments are frequently referred to as "consumerization", meaning that the old boundaries between business and residential customers, so familiar in the days of the public switched telephone networks (PSTN), are rapidly becoming indistinct:

- People at work use smartphones and tablets as BYOD (Bring-Your-Own-Device) tools.
- Mobile device 'apps' replace discrete, and more expensive, business software programmes.

National Internet connectivity is the bedrock upon which all this becomes possible. In many ways this is good for the least developed Internet societies because mobile access increasingly means a lower cost of access. For example, a new wave of cheap smartphones retailing at USD25 or less, is reaching the markets. These include Internet data-card only phones. *But the investment in national connectivity still needs to be forthcoming for the potential of smartphones and the mobile Internet to be realised.*

Detailed comparable data on coverage across ASEAN is hard to come by, but it is still useful to compare available numbers according to the three clusters identified earlier to identify common traits among high and low performers. The following section provides a snapshot of the state of coverage and penetration in terms of the number of subscribers across each of the three clusters and a high level view on where success has been achieved and where challenges remain within ASEAN.

Cluster 1: Brunei, Singapore, and Malaysia

The economies within Cluster 1 are way ahead of the rest of ASEAN with advanced levels of bandwidth (Table 10).

Table 10. Brunei, Singapore and Malaysia

Country	Fixed Broadband	Mobile Wireless
Brunei	TelBru began building fibre-to-the-home infrastructure in 2010, targeting 80% national coverage by 2014.	DST offers 4G.
Singapore	Coverage of the Next Generation Nationwide Broadband Network (NGNBN) reached 95% coverage in 2013.	SingTel's 4G and 42Mbps 3G reached 97% in 2014.
Malaysia	Telekom Malaysia completed phase 1 of its High Speed Broadband (HSBB) project to provide Next-Generation Network (NGN)[57] backbone to the Inner Klang Valley, and all key economic and industrial zones throughout the country; East Malaysia still underserved.	Over 80% 3G coverage in populated areas; 4G LTE covers 15% of the population.

Source: TRPC Research based on government and carrier websites

Malaysia may lag Singapore and Brunei but is still relatively strong in comparison with other ASEAN economies. Peninsular Malaysia enjoys good national broadband coverage of the most populous and affluent regions, but not ubiquitous coverage of the less affluent North-East. In Eastern Malaysia (part of Borneo) fixed broadband coverage is much less. The government decided the approach to a national broadband network would be based upon a subsidy to the partially state-owned virtual

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[57] Next-Generation Network (NGN) refers to a telecommunications packet-based network that handles multiple types of traffic (such as voice, data, and multimedia).

monopoly incumbent, Telekom Malaysia. As a result, investment in a national broadband network is not being driven by competition.

Singapore presents an interesting success case in achieving Internet connectivity. With competition in the fixed line market limited, the policy-maker and regulator decided to partially subsidize a structural separation solution, creating a wholesaler of broadband and giving equal access to retailers. Although there have been problems with the ambiguous role of the incumbent, SingTel, who retains the right to compete directly with the wholesaler, the result is a more competitive Internet market with newcomers such as MyRepublic and ViewQwest.

Cluster 2: Thailand, the Philippines, and Vietnam

Overall, the economies in Cluster 2 show steady investment in fixed broadband connectivity and wireless-broadband coverage tends to serve most urban areas. However, 4G is nascent in all, and all three economies have underserved remote areas where broadband penetration is limited, if not non-existent.

In Thailand, domestic fibre backbone infrastructure provides connectivity to most provinces of the country, totalling 30,000 kilometres.[58] The Thai government also constructed an additional 8,000 kilometres of dark fibre for the research and education communities as part of the 2009 stimulus package. However, there has been policy stasis over the roles of the two state-owned telecom enterprises and new entrants, stunting market innovation. This is illustrated by the relatively delayed emergence of 3G services, which was only launched in 2013, and the often-delayed auction of spectrum for 4G.

The Philippines has the historical problem of a dominant carrier that has been commercially driven to focus on high revenue areas and is able to keep its major competitor at bay. The mobile markets are competitive, but the national fixed line coverage leaves many remote areas under-served. There have been recent announcements of further investments in fibre-optic networks to serve more remote areas and upgrade networks to become 4G-compatible, which may effect much-needed improvements in speed in the not too distant future.[59]

In Vietnam, state-owned companies have been encouraged to be competitive, but investment decision in extending national fibre cables to remote regions is still highly dependent upon often overtly-politicized policy-making.

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[58] United Nations ESCAP (2013), *An In-Depth Study of Broadband Infrastructure in the ASEAN Region*, http://www.unescap.org/sites/default/files/Broadband%20Infrastructure%20in%20the%20ASEAN%20Region_0.pdf
[59] PLDT announced investment of PHP544 million in October 2014 to boost its current fibre-optic network by 13%, taking the total capacity of PLDT to 4.6 Tbps. PLDT deployed over 400 TD-LTE sites, bringing the total number of LTE cell sites to over 1,800 in October 2014. Around the same time, Globe completed its 4G HSPA+ project to equip the network with 4G capability, *TRPC Asian IT Briefing*, Oct 2014.

Table 11. Thailand, the Philippines and Vietnam

Country	Fixed Broadband	Mobile Wireless
Thailand	CAT operates national fibre backbone to most provinces, but the North-East under-served; VSAT coverage for provincial businesses; Fixed line coverage of population: 79%; Broadband coverage: 39%.[60] 5.225 million broadband subscribers.	3G services only launched in 2013. 4G auctions set for 2015, but TrueMove currently provides 4G on a 3G spectrum. 55 million 3G subscribers out of 97.6 million mobile subscribers.
Philippines	PLDT operates national fibre backbone, comprising 90,000 km fibre-optic network; Globe operates two optical fibre networks of its own. Mindanao region and Palawan province remains under developed; VSAT coverage for some areas.	PLDT (Smart) 3G coverage: 71% of population, with over 1,800 LTE cell sites for both fixed and mobile applications. 4G only available in larger cities.
Vietnam	2 x North-South OF cable (VNPT) + Metropolitan fibre networks in major cities; inland Northern and Western provinces under-served; bandwidth c.475Gbps (2012)	Vietnam to begin deploying 4G in 2015.

Source: TRPC Research based on government and carrier websites

Cluster 3: Indonesia, Cambodia, Lao PDR, and Myanmar

In Indonesia, the vast scale of the archipelago presents a daunting task. The Palapa Ring is a long-standing project to provide domestic submarine cable access to all islands, but besides the incumbent operator, Telekom Indonesia, none of the other carriers are yet ready to commit their share of the investment. Indonesia's national connectivity is highly dependent upon the expansion of its wireless mobile networks using transmission towers, but the coverage remains heavily concentrated upon the higher-income islands such as Java and Bali and is vulnerable to an inconsistent supply of electricity from the national grid. GSMA estimates that 5% of cell towers are off-grid and many others have significant problems. For example, in Sumatra, over 42% of cell towers have inconsistent electricity supplies from the grid.[61]

Incomplete nationwide coverage issues aside, the disparity in available bandwidth across the country remains a problem. Simply put, available bandwidth is concentrated in urban areas and there is not enough bandwidth outside the major metropolitan areas. This is true also for Cambodia, Lao PDR and Myanmar where the problems are both connectivity and bandwidth. Besides the main cities and provinces, national connectivity is patchy or non-existent and small villages and remote areas in the rural centres of these countries are often unserved and underserved.

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[60] By 2014, 97% of the fixed line was broadband.
[61] GSMA (2013), *Greening the Network: Indonesia Market Analysis*, http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/04/GPM-Market-Analysis-Indonesia_April2013.pdf

Table 12. Indonesia, Cambodia, Lao PDR and Myanmar

Country	Fixed Broadband	Mobile Wireless
Indonesia	15 domestic submarine cables + Palapa Ring (Nusantara Highway) incomplete, due to funding problems especially the Eastern provinces which are currently served by VSATs.	90.29 million *unique* subscribers with a market penetration below 50%; almost 3 SIMs per subscriber; GSMA estimate over 90,000 tower sites serving the islands across the country, but at least 9% of them have power supply problems.[62]
Cambodia	Every province connected to fibre; Metfone (Viettel) claims over 80%;[63] others are Telecom Cambodia and Cambodia Fibre Optic Communication Company (CFOCN)	3G in most large towns, 4G launched 2014 in Phnom Penh, 2G in most rural areas.
Lao PDR	Fibre optic backbone runs along the primary highway, with smaller segments connecting select provinces. Metropolitan fibre network of 24 fibre pairs covers key government locations in Vientiane. Lacks connectivity within large areas of the country, especially in the east.	3G coverage across all provinces and almost all districts. 4G limited to downtown Vientiane.
Myanmar	National fibre backbone only links to major cities and towns, supplemented by 11 VSAT stations.	Monopoly of MPT broken by new licenses to Yatanarpon, Telenor and Ooredoo, who are to complete nationwide rollout of 2G and 3G network by 2018; Ooredoo launched 3G services in major cities and surrounding regions in Aug 2014.; Consortium of SingTel, KBZ and M-Tel to build mobile network covering 95% of population by 2016.[64] 4G expected in 2015.

Source: TRPC Research based on government and carrier websites

It is important for national economic and social development that broadband Internet becomes widely available, but that requires a commitment to invest. Even where demand is assured, the scale of investment for national coverage can often be beyond the financial resources of a single company, and there are now numerous examples of governments deciding to support private-sector initiatives.[65] For example, in the case of Singapore, the government funded a consortium of private and partially-state-owned companies to build a national high-speed fibre network to provide wholesale services to the competitive retail sector on a non-discriminatory basis. In neighbouring Malaysia, the government chose to subsidize the dominant incumbent, Telekom Malaysia, to build out a national high-speed fibre network for retail services with an equal access commitment giving competitors the right to lease capacity. There are many possible financial models for governments to follow, ranging from state-funding to public-private partnerships to subsidies. Subsidies themselves can be allocated in many different ways, for example, to incumbents owing to their national

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[62] GSMA (2013), *Greening the Network: Indonesia Market Analysis*, http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/04/GPM-Market-Analysis-Indonesia_April2013.pdf

[63] T. Brennan and D. Weinland (2011), *Metfone's major fibre expansion*, The Phnom Penh Post, http://www.phnompenhpost.com/business/metfone%E2%80%99s-major-fibre-expansion

[64] SingTel (2013), *SingTel, KBZ and M-Tel to Transform Lives of Myanmar People*, http://info.singtel.com/about-us/news-releases/singtel-kbz-and-m-tel-transform-lives-myanmar-people

[65] Encouraging investment in national high speed broadband networks can take many forms, often involving the separation of wholesale from retail operations. A useful overview is provided by Gilbert & Tobin (2012) *Separation regulation of dominant telecommunications operators in today's legacy networks and tomorrow's next generation networks* http://www.gtlaw.com.au/wp-content/uploads/Separation-regulation.pdf

presence, to separate regional companies, and maybe by using a least-cost auction which can offer an even greater opportunity for smaller operators to play a role.

Box 4. IPv6

IPv6

To accommodate the rapid growth of Internet-enabled devices, IPv6 (Internet Protocol version 6) addresses have been introduced to gradually replace the use of IPv4. IPv6 addresses use 128 bits where IPv4 use only 32 bits. Although well over 90% of Internet traffic is still carried on IPv4, the shift will be absolutely necessary as IPv4 numbers run out and as demand grows, especially from M2M communications such as smart meters and from wearable devices. The table below shows the Relative Index of adoption of IPv6. For comparison purposes, the US scores 6.9 out of 10.

Country	Cisco's Relative Index of Adoption (Max 10)
Brunei	0
Cambodia	1.4
Indonesia	2.1
Lao PDR	0.2
Malaysia	5.3
Myanmar	0.2
Philippines	1.7
Singapore	4.7
Thailand	2.9
Vietnam	1.3

Source: Cisco, 6lab IPv6 Website, http://6lab.cisco.com/stats/ (Jan 2015)

As low-income countries attempt to move up the value chain towards a digital economy, developing a strong presence in IPv6 will become a necessity.

I-5. Affordability and Quality of Service

The previous sections highlighted the interplay of bandwidth, ownership and the market influence of IXPs and ISPs in determining Internet pricing. Where access is available, affordability becomes a crucial factor in driving Internet adoption by consumers and businesses. In order to illustrate the sharply varying affordability of Internet access across the region, Table 13 provides a comparison of selective 2014 broadband pricing plans, estimating the proportion of broadband service prices against GDP per capita measured in purchasing power parity (PPP).

Of the bottom cluster of countries, Cambodia and Lao PDR appear expensive and Myanmar as unaffordable, whereas Indonesia, the Philippines and Vietnam can be seen to be moderate. Conversely, countries with more disposable incomes tend to enjoy Internet access at a more affordable price.

Table 13. Broadband Price Plan Comparisons per Country

Country	Monthly subscription for basic mobile cellular with data *(for1.5GB data, unless stated otherwise)*	Monthly subscription for fixed-broadband *(for 1Mbps, unless stated otherwise)*	Cost of fixed broadband (% GDP/ cap)[66]	Cost of fixed broadband (% GDP/ cap, PPP)[67]	Evaluation
Brunei	USD28	USD52	1.6%	0.87%	**Moderate**
Cambodia	*USD30*	*USD35 (+ USD35 deposit)*	41.7%	13.8%	**Expensive**
Indonesia	USD7.6 *(2GB)*	USD63 –10Mbps	2.2%	0.8%	**Moderate**
Lao PDR	USD6.2 *(5GB)*	USD35	25.5%	8.7%	**Expensive**
Malaysia	USD9.5 *(1GB)*	USD28	3.2%	1.4%	**Moderate**
Myanmar	N/A	USD100	138.2%		**Unaffordable**
Philippines	USD7	USD23.5 *(2Mbps,+USD11.8 initial fee)*	5.1%	2.2%	**Moderate**
Singapore	USD24 *(2GB)*	USD25.5 *(15Mbps plan)*	0.04%	0.03%	**Affordable**
Thailand	USD9.7 *(750MB)*	USD19.5 *(15Mbps plan)*	0.3%	0.1%	**Affordable**
Vietnam	USD5.7	USD11 *(3Mbps plan)*	2.3%	0.8%	**Moderate**

Source: TRPC research (Figures are selected from the most basic offerings of leading carriers in ASEAN economies.)

These prices, expressed in terms of PPP, are an important corrective to the view that Internet access is invariably unaffordable in these countries. That said, the Broadband Commission recommends the upper limit of 5% for telecommunications expenditures as a percentage of personal incomes in PPP terms.[68] This means that Cambodia, Lao PDR and Myanmar are facing major price barriers to broad broadband access, which for the moment at least, is really reserved for the better-off consumer and the business elite. The danger therefore is that as the higher income countries with near ubiquitous coverage and high adoption rates continue to move ahead, the gap will continue to widen between

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[66] Annual cost of a 1Mbps fixed-broadband monthly plan as a percentage of GDP per capita

[67] Annual cost of a 1Mbps fixed-broadband monthly plan as a percentage of GDP per capita, PPP

[68] Prices measured according to purchasing power parity are notably lower, about one-third of the price, in terms of local expenditure than when measured in nominal terms.

countries still trying to create a basic Internet economy and those advancing towards a digital economy and digital society. This implies a greater income, innovation and development chasm between these countries, making progress towards the aims of the AEC an even greater challenge.

Aside from affordability, speed at the last mile is another key indicator of last mile connectivity. Reliable and consistent speeds and throughput are also bedrocks of Internet demand, further spurring investment in national connectivity. Figure 10 shows the *theoretical* bandwidth per Internet user based on the international bandwidth coming into the different ASEAN economies. Singapore was omitted from the graph due to the massive difference in the scale of bandwidth supply per Internet user – at least ten-fold higher than the next closest country. This figure is a good reference for low-income countries that are experiencing high growth in terms of the number of Internet users such as Cambodia, Lao PDR and Myanmar. Unless investment into international and national connectivity is forthcoming, the Internet experience will increasingly be a poor one due to inadequate bandwidth.

**Figure 10. International Internet Bandwidth (Mbit/s) per Internet User**
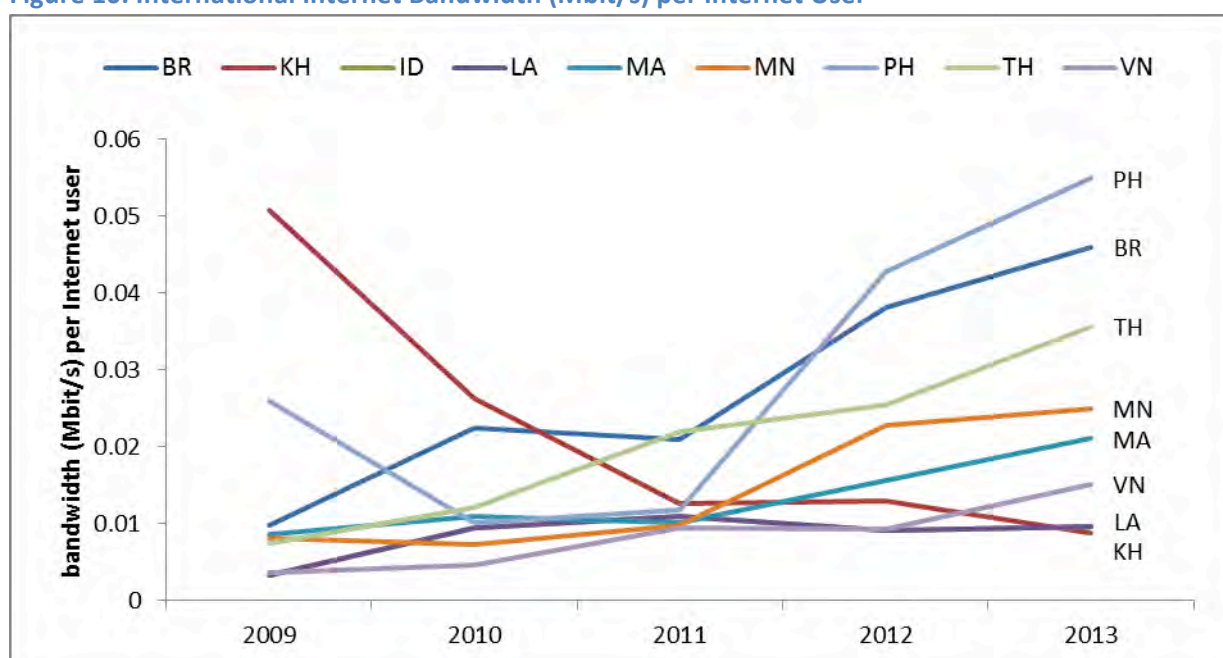
Source: ITU World Telecommunication/ICT Indicators database 2014

Figure 11 shows the results of Internet speed tests aggregated by Ookla,[69] a global broadband and web diagnostics company, and provides a crucial illustration of where the remaining challenges are for ASEAN economies in accomplishing affordable and reliable last mile connectivity. Firstly, ASEAN as a whole falls below the world average when it comes to Internet speed, measured by the speed of downloads on fixed broadband connections. Countries previously classified as high performers should not be complacent either. Brunei and Malaysia, for example, are trailing behind Vietnam. The Philippines and Indonesia both have a lot of catching-up to do as well in terms of closing the Internet speed gap, particularly if they are to accommodate double-digit growth of users and the consequent increase in bandwidth demand.

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[69] Ookla's speed tests are aggregated by users running tests and submitting data in their respective regions. These data points are used to provide an indicator of the Internet speeds in these regions.

Figure 11. Average Internet Speed (2014)
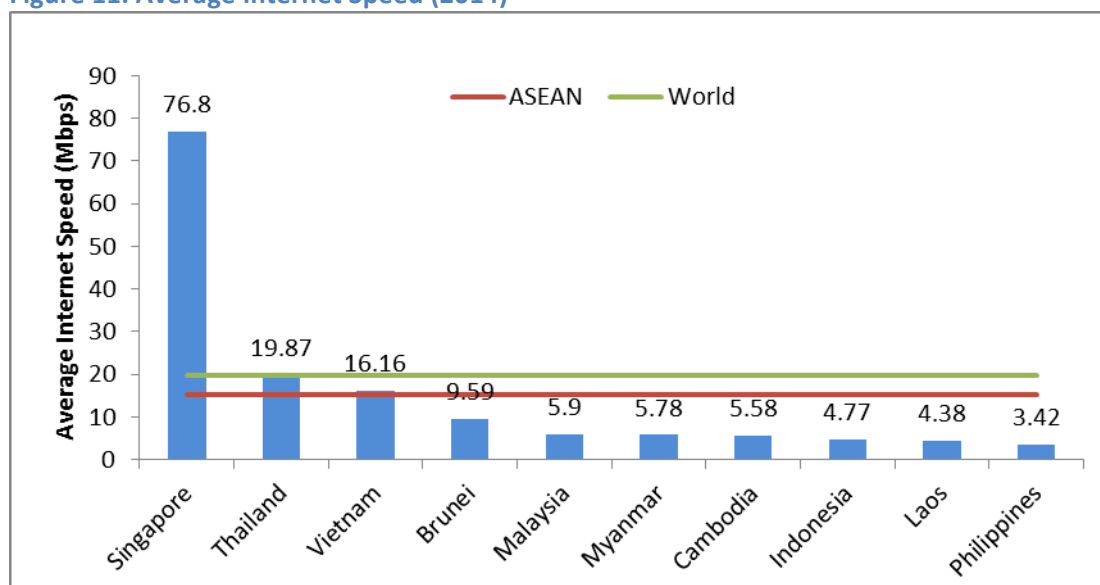
Source: Net Index 2014 www.netindex.com retrieved 25 Aug 2014

The demand and supply sides of telecommunications markets, including for broadband and Internet, are by their very nature 'virtuous', meaning that as supply increases revealed demand increases and that in turn is an incentive for incumbents and new entrants to increase supply still further. This is, in principle, a 'build it and they shall come' industry, as long as there is an adequate supply of access devices at affordable prices, and access and usage charges are within range. The components of supply in this case are availability of access, affordability of access, and the availability and affordability of access devices such as smartphones. Because of the strategic importance of broadband access there is inevitably a role for governments to create conditions favourable to investment in networks and competitive markets, and to remove barriers to a plentiful supply of devices. In particular, in lower income countries, where demand is constrained by low incomes and high prices, policies need to encourage investment in supply to drive down both wholesale and retail prices to the point where latent demand can show itself. The history of broadband and Internet usage demonstrates that users, especially in urban environments, will always find the means to use up the bandwidth available.

I-6. Conclusion

The first part of this study has shown the broad variation in Internet penetration rates across the ASEAN region, with one cluster of countries below 20%, a second cluster between 25% to 50%, and a third cluster above 60%. And while for the most part countries find themselves in the cluster corresponding to their respective income level, there are exceptions such as Indonesia and Thailand, demonstrating the importance of other key variables. In both cases they are found in a lower Internet clustering than might be expected. Clearly, therefore, *per capita* GDP is not a complete guide.

By investigating the levels of international Internet connectivity available to these countries, together with the national coverage of their domestic networks, it can be seen that in lower income countries the costs, and therefore prices, of providing Internet connectivity can be prohibitive for many citizens. At the same time, there is no reason to believe that latent demand is any less in these countries, and if policy makers can find ways to encourage the necessary investment in the infrastructure to provide greater coverage at affordable prices, *demand will be forthcoming*. Another important enabler is the plentiful supply of access devices at affordable prices. This is beginning to happen with a new generation of low-end smartphones, which are especially helpful in poorer countries. Wireless is now often the preferred choice over fixed line access owing to the convenience of being able to carry the device (portability) and use it anywhere (mobility).

There are also significant gaps in national network coverage in several ASEAN countries, and this is certainly the case for both Indonesia and Thailand. The topography and scale of the Indonesian archipelago poses a major challenge to full network coverage, while in the case of Thailand well-populated areas such as the North East remain seriously underserved.

Part 1 also established that broadband connectivity penetration rates are even more skewed than basic Internet connectivity, with Singapore being far ahead of all others. But of greater significance is the role of wireless broadband as the growing means of Internet access for low and middle-income citizens of ASEAN economies. This is fortuitous given that it is far easier and cheaper to construct mobile cellular networks than fixed-line networks, but to achieve national coverage comprehensive provision by a fixed-line backhaul network remains a necessity. *This is still yet to be achieved in most of the lower income countries.*

It has been shown that the capacity of international bandwidth coming into a country, and of national backhaul bandwidth available within a country, are major constraints upon Internet development in the economies concerned. There is a chicken-and-egg problem here as the lack of Internet development means traffic volumes and revenues are insufficient to attract private-sector investment in these networks, and insufficient network capacity chokes off access to the Internet, keeps prices high and the quality of service low. The role of government in cases of market failure is to bridge the gap between supply and pent-up demand until a virtuous cycle of development can kick-in. For example, government can play a leadership role in creating a national backbone either by building it themselves, subsidizing it or working with private sector partners. But if governments give preferential treatment to incumbent operators at the expense of opportunities for competitive entry then the benefits of additional investment are far less likely to arise, innovation in services and pricing bundles will not take place, and Internet development will be slowed to a snail's pace.

Governments have a number of options in front of them to encourage uptake. Reference has been made to the model adopted in Malaysia, where a state-subsidy has been awarded to Telekom Malaysia, the incumbent carrier subject to an equal access requirement to enable market entry of competitors; in Singapore, a subsidy was awarded to build and maintain a carrier-neutral broadband next generation high-speed island-wide network, and a carrier neutral wholesale operator was created to resell the bandwidth to retail service providers. In both cases the government concluded that the economic and social benefits more than justified the cost of the state subsidy. In these models, a national broadband network is similar to building a national road or rail highway.

One of the ASEAN-wide problems is the general lack of carrier-neutral peering locations to minimize the constraints. Without carrier-neutral peering, in most ASEAN countries non-incumbent carrier ISPs have no choice but to trombone their Internet traffic overseas and back again, adding to cost and latency. The lack of international bandwidth and the anti-competitive market conditions for IXPs and ISPs translate into unaffordable Internet access and poor speed in countries that are most in need of it. This leaves ASEAN with not only a digital divide *within* countries between those served and those not served, and those who can afford and those who cannot afford, but also *between* countries for those with and without sufficient bandwidth. The digital divide between ASEAN countries is therefore not confined to basic access and pricing but also includes areas of coverage and service speeds or the bitrates that are available to users.

The impetus for ASEAN to address the connectivity divide is clear. With the AEC set to be established in 2015, policy makers, industry groups and user communities could use the moment to become involved in strategies to identify the key bottlenecks in supply and demand. On the supply side, access to international bandwidth should be a priority for Cambodia, landlocked Lao PDR and Myanmar alongside national backbone networks that can provide access to that bandwidth. These are primarily large capital expenditure projects, but once made, the incremental costs can fall rapidly as demand responds to supply. On the demand side, two key elements are pricing and the availability of low-cost access devices. Pricing is a commercial issue for the service providers, and the more open the market is to competition, the more innovative pricing packages can become. [70] The good news on access is that a new generation of low-cost smart devices has entered the markets, but it remains important that restrictions on imported devices do not deny the benefits from being realised.

In today's global economy ASEAN needs to be strongly digital to compete, to link into business supply chains, to reach new markets, to respond to market information in a timely fashion – which is especially true, for example, of the financial services markets – and to innovate in digital goods and services. A growing digital divide is not a good foundation for an integrated and connected ASEAN. The lack of sufficient bandwidth and widely available access to the Internet in many ASEAN countries can only undermine progress towards a digital economy and integrated society.

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[70] In the days of the plain old telephone service (POTS) the difference between access pricing and usage pricing was reasonably clear-cut; access prices would cover fixed costs and usage prices variable costs. Today there is a greater variety of pricing, from flat-rate to pricing by bands, and pricing by bundles of services. This has opened up markets to greater innovation in pricing,

II. Internet Connectivity and Digital Economy

II-1. From Connectivity to Interconnectivity: Introduction

Having examined the levels of basic Internet connectivity and Internet penetration across ASEAN countries in the first half the report, the second half shifts gears to examine the progress being made in achieving *interconnectivity* of these networks and, in tandem, the interoperability of platforms, operating systems and applications that can be accessed over these networks when they do start interconnecting.

The Interconnectivity Conceptual Model

Behind this conceptualization is the understanding that while basic connectivity gives rise primarily to economies of scale, for example, network economics which trace out a geometric progression in the value of a network as additional persons or nodes are added to it (see Box 5), interconnectivity of networks gives rise to additional economies of scope by greatly diversifying the range of communications, products and services that it becomes possible to produce.[71] For example, in an ATM payments network; if there is no interconnectivity, each bank simply offers its own services, but if there is interconnectivity customers can access their bank from a common ATM network, and if bank systems are interoperable then money transfers and other transactions, for example, e-commerce payments to third parties can take place between them. This becomes the basis of a digital economy.

Box 5. Network Effects: The Economics of Interconnection

The issue of interconnection can be explained as follows: The 'value' or number of one-directional connections (i.e., who can call whom) that are possible over any network is proportional to the square of the number of devices or users connected to it. This can be expressed mathematically as **n(n-1)**, so if 3 persons are connected to a network, *3(3-1) = 6* independent connections are possible, and if 5 persons are connected then *5(5-1) = 20* are possible, and so on. It follows that every time a new person joins the network the value of the network, as measured by the maximum number of calls possible, increases not arithmetically but geometrically. If then two separate networks interconnect, this immediately maximizes the total number of possible connections. This is known as the 'network effect'. Society and the economy are the beneficiaries, but a previously dominant network loses its quasi-monopoly.

The essence of this argument is that from basic telecoms *connectivity* comes access to the Internet, which directly stimulates economic growth by way of economies of scale. This can be called the Internet Economy, as outlined under the *Conceptual Model* in the Part I of this report. Internet extends the reach of businesses and of people in very important economic and social ways. To reap the full benefits of that additional reach it becomes necessary to achieve an interconnection of networks and an interoperability of the platforms, which depend upon those networks to launch

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[71] This distinction is meant to convey the principle differences between connectivity and interconnectivity, and not to imply there are no economies of scope possible in a single network, because clearly there are. A telecoms network can offer many services from basic voice to a range of value-added services, but the commercial sustainability of a single network rests upon the economies of scale.

applications that increasingly drive contemporary commercial and social life. Interconnectivity and interoperability can be understood first at the level of technology, in that it is important to establish the technical capacity to interconnect different networks and for different pieces of software and applications to work together. That lays the foundation for a digital economy to emerge through the interconnection of commercial life and the potential interoperability of different commercial systems. With broader interconnectivity and interoperability, economy-wide growth is triggered through the economies of scope. Everyone can communicate and trade with everyone else, and businesses can offer a much wider range of goods and services to different markets. A digital economy and digital society come into being.

Box 6. Economies of Scope: A Simple illustration

Company A has a supplier B1. At first, whenever stocks run low, A calls B1 to place an order. Then A adopts an Intranet to put B1 on line to speed up placement of orders. Next A opens the Intranet to B2 and B3 and competition ensues for A's orders. A then discovers that B1 is better and cheaper at supplying product P1, B2 is better and cheaper at supplying product P2 and B3 has a range of new products to supply. Lower prices, better products and new products expand A's sales and the market grows. Growth has gone from linear (more products over time) to non-linear (different products growing at different speeds over time). The key development was A opening its network to new suppliers. A more sophisticated development would be to allow suppliers access to A's inventory database, to make it interoperable with theirs, to speed up the delivery fulfilment process and reduce transactions costs even further. So interconnection and interoperability have productivity effects.

The impact of interconnecting telecom networks, IXPs, banking payment networks, power grid networks, airline hubs, indeed any industry-level and economy-wide networks will have similar macro-level productivity effects, even though incumbent network operators may fear they will lose their market dominance.

Outline of Internet Connectivity and the Digital Economy

Definitions of an Internet economy and a digital economy were discussed in Part 1 earlier. For the purposes of this paper, the Internet economy is the first step towards a digital economy which is an economy in which the use of the Internet and of IP-enabled networks is pervasive across *all* major sectors of society, irrespective of what they produce, sell or trade. The second half of this report is therefore focused on examples of the transition from an Internet economy to a digital economy based upon the requirement that networks interconnect and platforms for applications adopt interoperable standards. In both cases, there are technical considerations, but also business decisions.[72]

The transition from basic connectivity to the Internet to the interconnectivity of networks and interoperability of systems is a progression lower-income ASEAN countries need to accomplish to lay the foundations of their digital economies. ASEAN member states still at the early stages of this process can benefit from the experience of higher income members further down the path, notably

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[72]A well-known example is Apple's walled garden ecosystem where its products and services are deliberately not always interoperable with the products of other vendors.

Singapore. By laying these foundations it will be easier for the AEC to achieve its goal of greater interconnectedness across the region. Two types of networks are focused upon as examples in the next section to illustrating these issues.

The first is the emergence of multi-modal platforms[73] that are becoming common to telecom service providers, and especially MNOs. Users are now able to access the same apps and content from a variety of different devices, some fixed like a PC or an Internet-connected TV, others are wireless and mobile such as a tablet or a smartphone. Such an enabler is not simply restricted to entertainment, but has also become a productivity tool of growing significance for business. When married to cloud computing, this becomes a tool that can be accessed from anywhere, anytime.

The second example illustrating the importance of interconnectivity and interoperability to a comprehensive development of the digital economy is a payments network. Payments are the lifeblood of all commerce and irrespective of whether the delivery of goods and services are online or offline, an online payments system enables commerce to function smoothly. If ASEAN countries are to increase their inter-regional cross-border trade, cross-border interoperable payments systems are critical.

Following this discussion of networks, the paper turns to the importance of interconnectivity and interoperability for the delivery of social welfare services as an integral part of a digital society. The examples chosen of e-health, e-education, disaster risk management using ICTs, empowerment of marginalized groups and e-government have been selected precisely because they illustrate these themes.

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[73] Multi-modal platforms enable convergence of various modes of user interface interaction -- video, audio, text and image. Multimodal platform allows one to use both voice and visual modes simultaneously to provide input and output. Multimodality gives end users the option to move from visual to voice mode and vice versa or to use both modes simultaneously using a mobile device. By combining both voice and visual interfaces, applications can exploit the strengths and minimize the weaknesses of both modes.

II-2. Internet Interconnectivity in Action

Multichannel and Multi-modal Platforms

While the interconnectivity of mobile networks is not always assured,[74] it is an important step towards networks maximizing the benefits of economics of scale. Moving beyond that point by developing multi-modal platforms, mobile networks are creating business opportunities for the developers of content and apps and providing local enterprises with valuable productivity tools. For example, a logistics company can coordinate its fleet of vehicles using real-time data conveyed simultaneously to all depots via smartphones, tablets or notebook computers. With data roaming and interconnection with networks in neighbouring countries, the information can seamlessly enable cross-border trade and deliveries. Some examples of multi-modal mobile platforms are given below.

- **Malaysia**: Telekom Malaysia offers a range of services for residential homes including fixed-line fibre/DSL broadband, narrowband, voice services, games, music, TV, news, magazines, Yellow Pages and even learning tools for students. These are all available online for smartphones, tablets, and PCs through Apple iOS or Google Android apps, or through an Internet browser.[75]

- **Philippines**: PLDT offers broadband services, including fibre and DSL; value-added services such as a TelPad which allows free landline calls to other PLDT landlines, and tablet functions such as surfing, multimedia, apps; a Smart TV service which allows movie and TV show streaming on an on-demand basis, and app downloads; an OTT app for free calls to PLDT landlines, messaging services for Android devices and TelPad units; and a music service for Apple and Android smartphones and tablets.[76]

- **Vietnam**: Mobifone provides mMusic service, which may be accessed through the browser or through the use of an app, for a variety of platforms; MobileTV service is available through the browser or an app, including for live television, and on-demand content such as replay Television, videos, karaoke, and audio books.[77]

Among the important trends arising from the development of multi-modal platforms beginning to impact ASEAN economies are the following. First, consumers are becoming platform agnostic in their digital media consumption. This also means the channels of communication to consumers *as citizens* with an interest in civic affairs are also diversifying. Consumers are also choosing when and how they'd like to consume digital content. A market research study by comScore, '*2013 Southeast Asia Digital Future in Focus*', noted that in South East Asia:[78]

> [Consumers] started watching a film at home on their TV, continued watching it on their smartphone on the way to work, and finished watching it in bed at night on their tablet.

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[74] Besides private networks and government networks, in the early years of a mobile market there have been cases where public mobile networks have not interconnected. This was true, for example, in Cambodia.

[75] Telekom Malaysia (2014), *Telekom Malaysia website*, https://www.tm.com.my/Home/Pages/Home.aspx

[76] PLDT (2014), *PLDT website*, http://pldthome.com/

[77] Mobifone (2014), *Mobifone website*, http://www.mobifone.com.vn/portal1/en/

[78] comScore (2013), *2013 Southeast Asia Digital Future in Focus*, https://www.comscore.com/Insights/Presentations-and-Whitepapers/2013/2013-Southeast-Asia-Digital-Future-in-Focus

Second, consumption patterns of the ASEAN online population are changing rapidly. The same report found that mobile handsets, PCs and tablets each had their separate peak hours of usage, illustrated in Figure 12.

Figure 12. Device Usage According to Time of Day
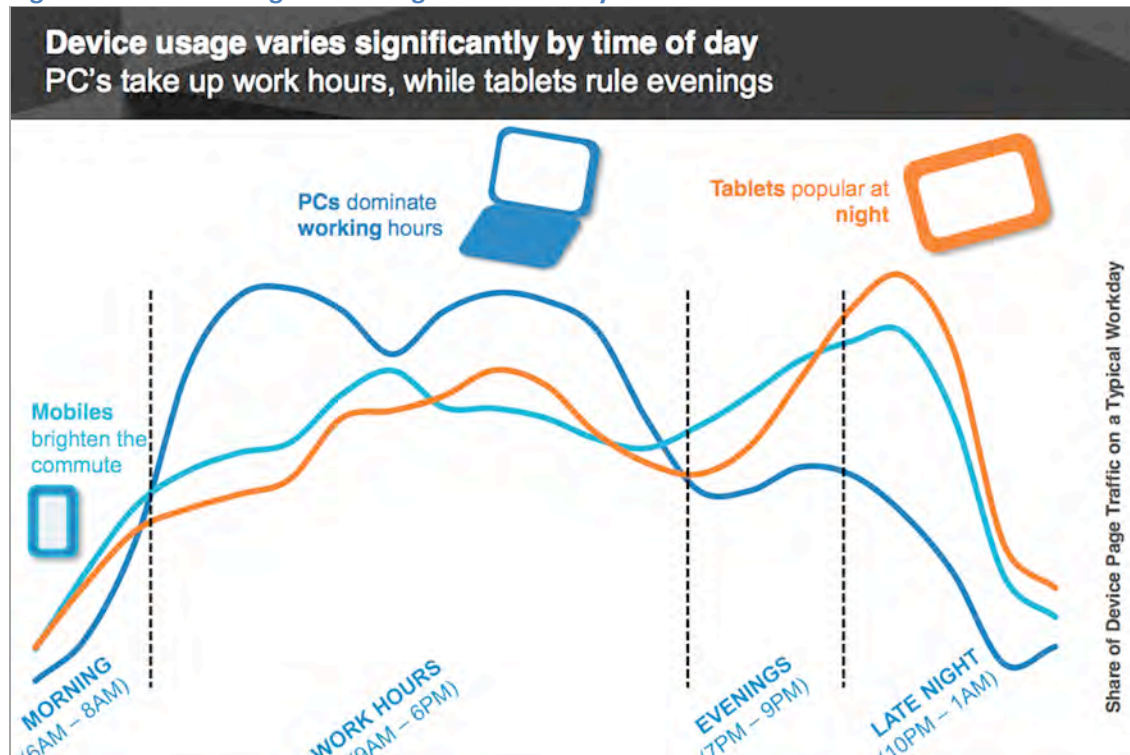
Source: ComScore 2013 Southeast Asia Digital Future in Focus

Significantly, the volume of traffic from each of these devices over the networks was shifting away from the PC and towards mobile devices as shown in Figure 12. For businesses and government alike, this implies the need to focus on mobile devices as the new platform for content and service delivery, which may signal the need for a re-engineering of business processes and the potential emergence of new business models. Social media, for example, has undergone some major changes to accommodate the growing use of mobile devices to access their pages, including the re-sizing of formats for a small screen. Advertisers and broadcasters have reacted similarly. Governments developing the reach of e-services for citizens using smartphones are another example of having to re-engineer existing platforms and develop customised applications.

Third, the implications of affordable smartphones and the increasing numbers of digital natives throughout ASEAN will be far-reaching.[79] The rapid adoption of smartphones and tablets across the region is already transforming who and how people access the Internet, including those at the bottom of the pyramid.[80] This market will be driven in increasing numbers by cheap handsets from

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[79] Digital natives refer to people born or brought up during the age of digital technology who grow up familiar with computers, the Internet and digital devices from an early age.

[80] The bottom of the pyramid covers annual incomes of less than $3,000, and over 80% of people living in Greater Asia (including the Middle East) fall into that category, with over 40% below $1,000 per capita income. See C.K.Prahalad and S. Hart (2002), *The Fortune at the Bottom of the Pyramid.* Also see J.Ure (2008), *Bottom of the Pyramid and Mobile Payments*, TRPC Working Paper, http://trpc.biz/wp-content/uploads/2008-09_TRP_MPaymentsandBoP_WorkingPaper.pdf

companies like Karbonn (India) which is retailing smartphones in the UK at £26 (around USD40)[81] and Xiaomi (China) which in Jakarta in September 2014 sold out its initial stock in seven minutes.[82]

Figure 13. Changes in Device Usage
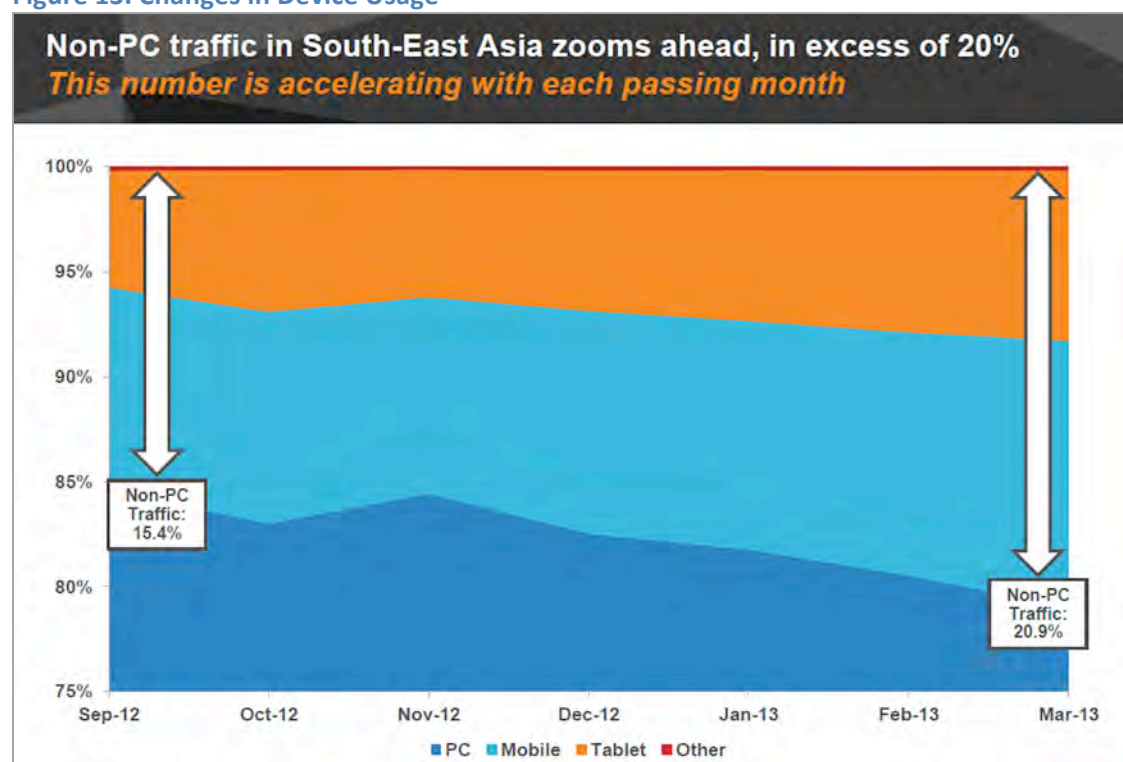
Source: ComScore 2013 Southeast Asia Digital Future in Focus

Consumers in Southeast Asia, including many lower demographic groups and first time users, are already eager adopters of smartphones. By March 2014 smartphones made up 55% of the combined handset markets of Singapore, Malaysia, Indonesia, Thailand, Philippines, Cambodia and Vietnam, with Indonesia alone accounting for two-fifths of all smartphones in use. In the first quarter of 2014 smartphone sales volumes were reported up on a year-on-year basis by 68% in Indonesia, 59% in Vietnam and 45% in Thailand.[83] In Singapore and Malaysia, almost 70% of the online population already have a smartphone, compared with the global average of 52%. The penetration rate of tablets in South East Asia is also high, 27% compared with 18% globally.[84]

Lastly, interconnecting networks, apps and content is the inherent function of the Internet, and this is now being taken to the next level by cloud computing. Cloud computing enables 'virtualization,' which is the process of creating virtual documents, programmes, processing power, etc., in the

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[81] M. Sparkes (2014), *Should the £26 Indian Smartphone Worry Apple?*, the Telegraph, http://www.telegraph.co.uk/technology/mobile-phones/10995383/Should-the-26-Indian-smartphone-worry-Apple.html
[82] Initial stock was 5000 handsets. Over 60,000 accounts had been registered to buy the smartphone since the previous week. D. Bushell-Embling (2014), *Xiaomi Sells Out Fast During Indonesia Debut*, telecomasia.net, http://www.telecomasia.net/content/xiaomi-sells-out-fast-during-indonesian-debut
[83] GfK (2014), *First Quarter Smartphone Sales in Southeast Asia Reached 18 million in Units and USD2.4 Billion in Worth: GfK*, http://www.gfk.com/sg/news-and-events/press-room/press-releases/pages/first-quarter-smartphone-sales-in-southeast-asia-reached-18-million-in-units-and-usd4-2-billion-in-worth-gfk-.aspx
[84] Accenture (2013), *Surfing Southeast Asia's Powerful Digital Wave*, http://aseandigital.accenture.com/static/uploaded/assets/report/pdf/12-1515_-_ASEAN_digital_wave_v16_final.pdf

Internet 'cloud' so they can be accessed and used from any source, often on a cost-efficient pay-on-demand basis. Box 7 illustrates the current status of cloud computing in ASEAN countries.

Box 7. Cloud Computing

Technically, the Internet through the cloud already interconnects everything IP to everything IP, but for both commercial and security reasons this interconnectivity is not always facilitated. This notwithstanding, the adoption of cloud throughout ASEAN is steadily advancing. The Asia Cloud Computing Association (ACCA) report *Cloud Readiness Index 2014* highlights the importance of promoting and facilitating interconnection of networks and the interoperability of systems.[85]

> "The ability of companies to use cloud technologies innovatively is tied to the ability of its peers, because businesses and firms exist within an ecosystem. The network effects of having similar IT systems comes into play as a business accelerant, but only when business processes are well-integrated together, and where companies across industries match synergies horizontally and vertically." (pp.13)

Countries with remaining connectivity problems for Internet access, or coverage and bandwidth problems, can still benefit from cloud take-up. The demonstration effect can therefore sharpen awareness for the need to catch-up.

Some examples of cloud adoption within different industries in Southeast Asia include:

➢ **Myanmar**: the Central Bank partnered with Daiwa Institute of Research (DIR), Fujitsu and KDDI Corporation of Japan to deploy a private cloud platform to improve the efficiency of its operations and help to shift the Bank away from a paper-based and labour-intensive system.

➢ **Thailand**: three local technology companies (cloud-based Loxinfo, retail management software firm Adasoft and IT retail chain Advice) jointly launched a tablet-based cloud management solution for retail, to replace conventional electronic cash registers and desktop computer-based management systems.

➢ **Vietnam**: the city of Da Nang is part of IBM's Smarter Cities. Da Nang's traffic control centre is using these cloud-based tools to forecast and prevent potential congestion and better coordinate city responses to accidents, adverse weather conditions, etc. Data from across multiple systems can be integrated, stored and analysed for control and anomalies detection.

Interconnectivity from Digital Payments Platforms

Commerce in its entirety, both online and offline, depends upon the interconnectivity of payments systems, which now resides increasingly upon IP-based networks at points along their lines of transactions processing. Just as mobile platforms have become ubiquitous, so payment networks are beginning to integrate with mobile networks and are transforming the financial services landscape in the following two important ways.

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[85] ACCA (2014), *Cloud Readiness Index 2014*, ACCA website, http://asiacloudcomputing.org/research/cri2014

First, digital payment platforms facilitated by IP-networks provide the potential for extending direct financial inclusion to populations without access to the instruments of the formal financial system. Increasingly, more financial related services, such as insurance and commerce, are being offered on mobile money platforms. Traditional banking systems tend to have limited geographical coverage and charge high transaction fees in many countries. Money saved from lower transaction fees or avoiding travel to a bank means more funds in the hands of people and businesses. Since mobile money transfer is also instantaneous, time savings also become an increasingly important benefit, particularly for small businesses.

Second, digitally integrated payment platforms positively impact the private sector and stimulate entrepreneurial activities. When set up properly, mobile money can provide cheaper, faster and safer means of transferring or storing funds, compared to traditional alternatives in many countries.

ASEAN economies are increasingly recognizing the importance of digitally integrated payments systems are beginning to make progress. The following are some examples from different ASEAN member economies:

- **Indonesia:** in May 2013, the three major mobile operators in Indonesia – Telkomsel, Indosat and XL – jointly made their mobile money networks interoperable,[86] including the use of POS networks.[87] This is one of the first examples of its kind anywhere in the world, and as such is a landmark and a benchmark for ASEAN. A national standard of chip card specification (NSICCS) for ATM/debit cards has been adopted by the major interbank networks,[88] which include Prima (25 banks), ATM Bersama (83 banks) and Alto (22 banks). This is an important step towards enhancing confidence in the security of the payments systems.[89]

- **Malaysia**: the Malaysian Electronic Clearing Corporation (MyClear), a subsidiary of Bank Negara, Malaysia's Central Bank, launched a mobile e-banking facility 'MyMobile' linking up the three largest mobile operators, serving 93% of the market, with the three largest banks and with the participation of the telecoms regulator and the Prime Minister's Office. MyMobile subscribers can perform mobile airtime reloads, third party fund transfers, and payments for bills and credit cards, in real time using feature phones as well as smartphones.[90]

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[86] G. Camner (2013), *In Indonesia, Operators Choose Interoperability and Collaboration*, GSMA website, http://www.gsma.com/mobilefordevelopment/in-indonesia-operators-choose-interoperability-and-collaboration

[87] L. Shrader (2013), *Indonesia Moves Towards a Cash Light Economy*, CGAP website, http://www.cgap.org/blog/indonesia-moves-towards-cash-light-economy

[88] Bank Indonesia, *Payment, Clearing and Settlement Systems in Indonesia*, http://www.emeap.org/emeapdb/upload/WGMeeting/Payment,clearing%20and%20settlement%20systems%20in%20Indonesia.pdf

[89] Chip cards, also known as EMV(Europay, MasterCard, Visa), increase the authentication and security aspects of transaction, which in turn helps build consumer trust.

[90] MyClear (2013), *Bank Negara's MyClear Rolls Out MyMobile, Tapping on 38 Million Mobile Phones To Boost E- payments*, http://www.myclear.org.my/press_release/bank-negaras-myclear-rolls-out-mymobile-tapping-on-38-million-mobile-phones-to-boost-e-payments/

- **Philippines**: the county's major ATM systems, MagaLink, Bancnet and Expressnet, have been interconnected since 2006,[91] but the Bangko Sentral ng Pilipinas (BSP) has been pushing for a higher level of interoperability to allow for transfers between banks. There has been talk of the two main MNOs Globe Telecom's GCASH and PLDT's SMARTMoney negotiating interoperability. These will result in a lowering of transaction fees, greater financial access and ultimately significant savings of resources such as money and time for the people.[92]

- **Singapore:** the regulator launched a project in 2012 to create a common mobile payments platform connecting mobile operators, banks, and payment providers in an operator-neutral manner with the appointment of a 'trusted third party' to manage the system.[93] This is designed to open the way for the use of Near Field Communications (NFC) using a mobile device such as a smartphone or even a wearable device such as a smart watch.

- **Thailand:** the National Interbank Transaction Management Exchange (ITMX) provides an inter-bank payment system which supports electronic payments and funds transfer from various channels, including ATMs, counters, Internet, phone and mobile channels.[94]

- **Vietnam:** in 2004 the State Bank of Vietnam allowed the establishment of the Vietnam National Financial Switching Company (VNFSC), or BanknetVN in 2004 to interconnect seven of the leading banks and the Vietnam Data Communication Company.[95] In 2010, BanknetVN enabled interconnection of POS terminals in Hanoi as the first part of a national project, with eight participating banks and the Bank of Vietnam (SBV).[96]

- **Myanmar:** the two new MNOs, Ooredoo and Telenor, signed an MOU with the GSMA to work together towards interoperability. Along with the CB Bank they have launched their platforms for payments.[97]

Creating interconnected payments networks and interoperable payments systems is a good example of how the provision of basic connectivity for Internet access becomes the platform for higher-value economic and social networking.[98] As a report from First Data in 2009 points out "most of the largest merchants made the switch from legacy dial-up POS systems to IP years ago."[99] In the same way the

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[91] T. Torres (2006), *Full ATM Interconnection Starts Next Month*, Philstar, http://www.philstar.com/banking/339386/full-atm-interconnection-starts-next-month

[92] According to the Bank of Philippines Deputy Governor, the objective is for the unification of all ATMs, mobile money transfer and electronic point-of-sale (POS) transaction as well as remove any blocks to make for a more efficient utility. "Basically, we want to break down the barriers between a Bancnet and MegaLink and POS and mobile," Cited by L. C. Chipongian (2014), *BSP Pushes for ATM Merger*, Manila Bulletin, http://www.mb.com.ph/bsp-pushes-for-atm-merger/

[93] S. G. Chua et. al. (2011), *The Mobile Ecosystem in Asia Pacific*, AT Kearney website, http://www.atkearney.com/documents/4409500/4415806/the_mobile_ecosystem_in_asia_pacific.pdf/d1335d2c-b629-4941-a54b-2bc0c948fa62

[94] National ITMX (2011), *National ITMX website*, https://www.itmx.co.th/homepage/default/index/lang/_en

[95] BanknetVN website, http://www.banknetvn.com.vn/sites/english/introduction/Trang/default.aspx

[96] VCIINEWS (2010), *POS Connection Launched*, talkvietnam website, http://www.talkvietnam.com/2010/10/pos-connection-launched/

[97] Mondato (2014), *Mobile Money in Myanmar*, http://mondato.com/blog/myanmar/

[98] For example, as early as 2001 MasterCard unveiled plans to develop a new global payment processing system that will use the credit card company's IP network to link its 20,000 member banks to retailers and other merchants. *Computerworld* April 2001, http://www.computerworld.com/article/2592369/financial-it/mastercard-sets-plan-for-ip-based-global-payment-network.html

[99] First Data (2009) *Leveraging a Secure IP-Based Payment Connection Network to Reduce Costs and Increase Customer Satisfaction* https://www.firstdata.com/downloads/thought-leadership/fd_secureipbasedpayment_whitepaper.pdf

development of multi-platform mobile networks has become the basis for a new generation of digital content distribution and the digital consumption of media and information products and services. In each case, at the technical level the precondition is the building of networks and platforms that are capable of interconnection and interoperability. IP is half the answer. The way in which businesses decide to write the algorithms that run the programmes is the other half.

Governments and regulators are rightly reluctant to impose technologies and standards, but they have a role to encourage the industry to make choices that enable interconnectivity and interoperability in sectors that are considered crucial to public welfare. Adopting such an approach keeps the door to innovation open while at the same time serving the interests of the public.

II-3. Creating a Digitally Integrated Society

The previous section examined the importance of moving beyond the basic IP infrastructure of networks and the economies of scale associated with them, towards the full interconnectivity and interoperability of networks and the platforms and applications they support. This gives rise to societal economies of scope and the superstructure of the digital economy. From the digital economy comes a digital society and a breakthrough in the possibilities to apply ICTs in general to the provision of social welfare services, whether by the state, the private sector or community-based agencies and non-governmental organizations (NGOs). In some ASEAN countries, notably Singapore, best practices are often being set for the provision of a digital society and social welfare services; but in others the resources and capacity to deliver a digital society in the supply of health services, education services and the like is extremely limited.

This implies that the digital divide across ASEAN goes way beyond basic Internet access issues with the likelihood that the gap between the least and most well-off will widen. A major challenge for ASEAN and the AEC therefore will be to narrow this gap significantly by helping the poorest countries develop their own capacity. ASEAN can do this is in many ways, but the two to be highlighted here are: (i) to develop the right policy framework that encourages investment and innovation in Internet-related technologies and services, and focus regulations on areas of greatest social need, making the regulations themselves 'smart' rather than blunt instruments of bureaucracy or vested interests; and (ii) demonstrate how ICTs can be used most effectively in the delivery of social welfare services. There are many ways in which policies can become smart and in which they can be demonstrated. In the context of this paper, the focus is upon policies that build upon the opportunities that interconnection of networks and interoperability of systems open up and the close involvement of the stakeholders involved.

This section of the report examines the ways in which the issues of interconnectivity and interoperability are central to the successful development and delivery of electronic welfare services. The following sub-sections of the report are designed to illustrate the central role interconnection and interoperability play in the design and delivery of these services, and in doing so where there are shortcomings that should be addressed in future plans. All the examples are chosen from within the past 5-year period, and the issues they highlight, for example, the need for interoperable systems across the health community, will remain relevant into the foreseeable future.

Health

The Internet and the interconnectivity it enables among people and devices, present exciting opportunities in advancing the public health agenda. These opportunities have been a long-time in the making. E-health enables significantly better informed decision making, real-time treatment or consultations to remote regions, universal records reducing the risk of negative drug interactions, and many more.[100] Recent advancements in sensor technologies, health-related wearables, and

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[100] The World Health Organization (WHO) defines E-health as "the transfer of health resources and health care by electronic means. It encompasses three main areas: (i) the delivery of health information, for health professionals and

transition to electronic medical records (EMRs) are bringing about important changes in the delivery of health care and medicine.

Recognizing the importance and potential benefits Internet may bring to their populations, governments within ASEAN have identified e-health as part of the development agenda, either featuring within their national health plans, or have specific projects revolving around E-health, telemedicine or electronic medical health records (Table 14).

Table 14. E-health (or related) Plans in ASEAN Economies.

Country	E-health Plans
Brunei	Brunei Darussalam Healthcare Information and Management System
Cambodia	Health Strategic Plan 2008-2015
Indonesia	Strategic Plan of the Ministry of Health 2010-2014
Lao PDR	National Health Information System Strategic Plan 2009-2015
Malaysia	10th Malaysia Country Health Plan 2011-2015
Myanmar	National Health Plan 2011-2016
Philippines	eHealth Strategic Framework and Plan
Singapore	National E-Health Record System
Thailand	Smart Health
Vietnam	2011-2015 plan for eHealth

Source: TRPC Research

Applying electronic means to the management and delivery of health services to a community invariably involves the need for interconnected digital fixed and mobile networks, and interoperable management systems, for example for the sharing of electronic health records, sending medical images or health-related alerts or notifications.

Therefore, each ASEAN economy needs to examine their e-health plans to see what underlying interconnected infrastructure is required to ensure ubiquitous delivery of e-health services, and what levels of interoperability of software platforms – platforms that can be accessed by a variety of different devices from a variety of different locations – and applications are envisaged and over what timescale.

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health consumers, through the Internet and telecommunications, (ii) using the power of IT and e-commerce to improve public health services, e.g. through the education and training of health workers, and (iii) the use of e-commerce and e-business practices in health systems management.

Box 8. E-Health in Thailand

Thailand is known in the ASEAN region for its high standards of healthcare. Indeed, 'health tourism' has become a rather important source of overseas income. The initial costs of setting up healthcare IT systems are quite high, and for that reason it is the private sector rather than state-funded hospitals that take the first steps towards adopting e-health. The good news for public hospitals is that Thailand's Ministry of Public Health has plans in the pipeline to develop an electronic Health Information Exchange (HIE) that will link the public healthcare facilities across the country to improve patient care and increase efficient use of resources. [101]

Interconnectivity is essential to connect health care providers with laboratories, patients and government health departments. However, the development of interconnectivity within e-health systems still lags. According to one analysis, "basic IT adoption in Thai hospitals appears to have passed the tipping point" but there is a preponderance of services and applications for administrative and management purposes, and an underdevelopment of infrastructure (i.e. connectivity) and especially of standards and interoperability. The same analysis states that "eHealth foundations lagged behind" and perhaps more seriously there is "no national eHealth policy" to provide national leadership in interoperability. [102]

Education

As early as 2000, in the *e-ASEAN Framework Agreement*, ASEAN recognized the need to promote "awareness, general knowledge and appreciation of ICT, particularly the Internet" and "to increase ICT literacy and expand the base of ICT workers in the region, Member States shall develop a regional human resource development programme covering schools, the community and the work place." The objectives were "(a) fostering the development of a knowledge-based society; (b) narrowing the digital divide; (c) enhancing competitiveness of the workforce; (d) facilitating freer flow of knowledge workers; and (e) usage of ICT to enhance the spirit of ASEAN community."[103]

Within the context of the ASEAN ICT Masterplan 2015, the 10 ASEAN countries further committed to bridging the ICT development gap through a range of initiatives such as promoting public education, prioritising broadband roll-outs to schools, including ICT as part of the curricula and others (Table 15).[104] Some countries such as Brunei, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam have connected, or planned to connect, public schools to the Internet. Other than the computers available on school compounds, laptops and tablet PCs have also been made available for students.

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[101] A, Chee (2015), *Telesurgery in Asia,* Asian Hospital & Healthcare Management, http://www.asianhhm.com/information-technology/telesurgery-asia
[102] N. Theera-Ampornput (2011), E-Health in Thailand: Status and Trend
[103] ASEAN (2000), *e-ASEAN FRAMEWORK AGREEMENT,* Article 8, http://www.asean.org/news/item/e-asean-framework-agreement.
[104] ASEAN (2012), *ASEAN ICT Masterplan (AIM2015),* http://www.asean.org/images/2012/publications/ASEAN%20ICT%20Masterplan%20(AIM2015).pdf

Table 15. ASEAN ICT Masterplan Initiative 6: Bridging the Digital Divide

ACTION	DESCRIPTION
Prioritise roll-out to schools	• Establish collaboration between ICT and education sectors to provide broadband Internet access to schools within ASEAN • Include ICT as part of ASEAN school curricula to promote early ICT education
Collaborate between ICT and education sections within ASEAN	• Provide comprehensive ICT training to teachers to encourage the use of ICT in education • Establish ICT exchange programmes for teachers and students • Promote joint collaboration activities to raise awareness of ICT
Promote ASEAN integration through exposure to different cultures within ASEAN at an early age	• Replicate the ASEAN Cyberkids Camp across ASEAN • Educate children to use ICT creatively and effectively beyond the school environment in an interactive manner • Encourage the positive use of the Internet • Create similar camps for teachers

Source: Initiative 6.2: Connect schools and advocate early ICT education, ASEAN ICT Masterplan 2015 [105]

The launching of the AEC in 2015 underscores the relevance and importance of these aims. ASEAN countries have committed to them in the ASEAN ICT Masterplan 2015 through a range of initiatives such as prioritising broadband roll-outs to schools, and placing ICT studies in school curricula. But missing from this set of programmes is any explicit recognition that in addition to an ICT infrastructure for basic Internet connectivity, it is equally important to build interoperable platforms and applications for collaborative e-learning between schools across ASEAN to foster greater integration and a sense of ASEAN identity, which is one of the aims listed in the Masterplan.

Among the early challenges facing many of the lower income ASEAN countries are issues of basic connectivity for schools, the cost of connection, the bandwidth available, the costs of maintenance and the human resources required to explore the opportunities for e-learning in schools. With the spread of smartphones a new challenge will arise, using multi-modal connectivity for educational applications that combine audio-visual and interactive elements over the Internet using wireless and mobile networks in the classroom and outside for homework.

Within ASEAN most economies have introduced basic computing or computing related courses, but at varying different stages of education, as illustrated in Table 16. While most countries begin introducing basic computing skills at the primary level, some countries such a Lao PDR and the Philippines only do so at the lower secondary level, and Cambodia and Myanmar only choose to do so at the upper secondary level.

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[105] ASEAN (2012), *ASEAN ICT Masterplan (AIM2015),*
http://www.asean.org/images/2012/publications/ASEAN%20ICT%20Masterplan%20(AIM2015).pdf

Table 16. ASEAN Countries ICT programmes

Countries with programmes that are stand-alone sector-wide (covering from primary to tertiary)	Countries with stand-alone but not sector-wide programmes	Countries with no stand-alone programmes but include ICTs for education in a national plan	Countries with no plan on ICT in education
Malaysia Philippines Singapore	Cambodia	Indonesia Myanmar Thailand	Lao PDR

Source: UNESCO (2014), *Information and Communication Technology (ICT) in Education in Asia: A comparative analysis of ICT integration and e-readiness in schools across Asia* [106]

Basic Internet connectivity and ICT literacy are but the first steps for any educational establishment; the step beyond is the need to create a dedicated SchoolNet[107] for schools, colleges, universities and research institutes. Examples include:

- In **Brunei** the Ministry of Education's roadmap includes an EduNet to connect the nation's schools through the Internet.[108]

- In **Indonesia** the Jardiknas SchoolNet was launched as a national-scale network infrastructure to connect 20,000 educational institutions and education offices throughout the country.[109] The program, supported by Telkom's launching of a Speedy SchoolNet program, has provided low-budget, high-speed Internet access for connected educational institutions.[110]

- In **Malaysia**, the Smart School Pilot Project, which was initially perceived as "just another Ministry pilot project",[111] has given rise to the 1Bestarinet project, a 5-year programme to connect nearly 10,000 schools to the Internet and a virtual learning module (VLM) platform.[112]

- In **Thailand**, SchoolNet was launched in 1995 as a pilot project to connect 5,000 secondary schools nationwide, led by the National Electronics and Computer Technology Centre (NECTEC) in collaboration with the Telephone Organization of Thailand (TOT) and CAT Telecom.[113] The SchoolNet project was passed to the Ministry of Education in 2003 and

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[106] No data for Brunei Darussalam and Vietnam was included in the study.

[107] UNESCO defines SchoolNet as an initiative that promotes the effective use of information and ICT in learning through supporting the connection of schools to the Internet and by creating a network of schools. This network is envisaged as being a means by which to: build connections among students, teachers and schools; share information and resources; and prepare learners for knowledge-based societies. SchoolNet also encourages the creation of locally-relevant and high-quality educational resources through ICT and champions lifelong learning.

[108] A.N.H. Abdullah (2007), *Usability: Effective Screen Design in Virtual Learning System*, http://www.academia.edu/4833993/Usability_Effective_Screen_Design_In_Virtual_Learning_System

[109] Jardiknas (2013), *Jardiknas Indonesia Education ICT Network*, http://jardiknas.kemdiknas.go.id/

[110] Telkom (2009), *TELKOM Organizes National Education Network In Almost 20,000 Schools Throughout Indonesia*, http://telkom.net/media-corner/press-release/telkom-organizes-national-education-network-in-almost-20-000-schools-throughout-indonesia.html.

[111] UNESCO (2004), *Integrating ICTs in Education* p.76, http://unesdoc.unesco.org/images/0013/001355/135562e.pdf

[112] http://1bestarinet.net/

[113] SchoolNet Thailand (2014), *SchoolNet Thailand*, http://www.school.net.th/

merged into a new EdNet educational network, which includes universities to optimize network utilization and other resources.[114]

- At a **regional** level, Thailand's UniNet provides backbone infrastructure across Thailand, Lao PDR, Myanmar, and Cambodia, interconnecting public universities and academic institutions in the region, as well as nine regional universities within Thailand.[115]

In schools and colleges with Internet connectivity, the role of Massive Open Online Courses (MOOCs) is emerging as a promising platform and collaborative learning tool. For example, GiapSchool is a localized MOOC that provides a range of, mostly-free, courses, which have been translated into Vietnamese.[116] The Education Ministry in Malaysia has also implemented MOOCs Malaysia for all public universities.[117] In Cambodia, the Ministry of Education Youth and Sport (MoEYS) and the Open Institute launched the Open Schools Program to use ICT to improve the quality of education for both students and teachers. These include creating ICT-based Open and Distance Learning tools and content which will help create a culture of sharing between teachers, students and scholars.[118]

These are examples of pedagogical innovations that can extend the reach of education to any areas that have good Internet connections and can access multi-modal educational platforms, including over wireless devices.

Disaster Risk Management (DRM)

ASEAN is one of the most disaster prone regions in the world; countries such as the Philippines and Indonesia are located on the 'Pacific Ring of Fire', a zone responsible for 90% of the world's earthquakes and volcanoes and many, such as Myanmar, the Philippines and Vietnam, are frequent victims of seasonal typhoons. According to the World Bank, more than 100 million people in ASEAN Member States have been affected by disasters since 2000, bringing the *annual* economic costs close to USD5 billion.[119] These losses constitute around 0.3% of the region's GDP, but for countries such as Myanmar, the Philippines and Lao PDR the proportion of GDP losses are significantly higher, "equivalent to 1.8%, 0.8% and 0.8% of GDP, respectively."[120]

ASEAN leaders issued the ASEAN Agreement on Disaster Management and Emergency Response (AADMER) and the ASEAN Committee on Disaster Management (ACDM) which advocates standard operating procedures and disaster information sharing between national and regional communications networks. AADMER has adopted the Hyogo Framework for Action (HFA) *2005-2015:*

[114] ITU (2009), *From SchoolNet to EdNet in Thailand*, http://connectaschool.org/?q=node/498

[115] UniNet (2013), *UniNet*, http://www.uni.net.th/UniNet/index.php

[116] Giapscool (2013), Giapschool, http://www.giapschool.org/.

[117] R. Rajaendram, (2014), *Government boost for online learning*, http://www.thestar.com.my/News/Education/2014/10/05/Govt-boost-for-online-learning/

[118] Open Institute (2010), *Open Schools*, http://www.open.org.kh/en/open-schools

[119] World Bank and GFDRR (2012 - Vol. 1 Main Report) *ASEAN: Advancing Disaster Risk Financing and Insurance in ASEAN Member States: Framework and Options for Implementation* http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/07/26/000333038_20120726015954/Rendered/PDF/714530v10ESW0W00ASEAN0REPORT0June12.pdf

[120] ASEAN (October 2011), 'Draft document for discussion with ASEAN Member States – *Advancing Disaster Risk Financing and Insurance in ASEAN Countries: Framework and Options for Implementation*' p.4; http://www.gfdrr.org/sites/gfdrr.org/files/DRFI_ASEAN_DRFI_draft_report%28October%2030,%202011%29.pdf

Building the Resilience of Nations and Communities to Disasters as the agreed framework for disaster risk reduction.[121] And, as an ISDR report notes, "Emergency Operations Centres are in place at the national level in most countries, with a few exceptions."[122]

In the Philippines, in the aftermath of Typhoon Yolanda/Haiyan, local fixed and wireless communications were mostly lost and emergency operations focused immediately on rescuing survivors, but one technology that came into play was the use of TV white spaces, which at the time was planned for school Internet networking. Access points were brought in by helicopter and linked up to satellite communications, and access devices were deployed to provide Internet connectivity. The solution was a temporary one, but illustrates how IP-enabled networks and devices can play an important, and immediate, role in DRM.

There are many aspects to disaster risk reduction, ranging through phases of preparedness, response, mitigation and reconstruction. Each of these aspects will involve the use of technologies such as sensors, monitoring and communications equipment, organizational readiness to provide emergency supplies of food, clean water, medical supplies, and temporary shelters and lastly the need for financial support. ICTs, and the Internet, in particular, come into play at each stage, crucially to provide fast, timely and efficient access to, and facilitate the exchange of, information, and increasingly to provide access to environmental analytics. A 2011 World Bank/GFDRR/ISDC report on ASEAN, however, makes the point that while there "has been progress in the development of disaster risk information…with often limited Internet connectivity, information dissemination remains a challenge."[123]

The role of ICTs, and especially of the Internet, in DRM is becoming ever more important. For environmental monitoring and early-warning systems, IP-networks enable two important innovations. First, multiple-platform communications systems significantly reduce the risk of recipients not receiving early warning signals because of the failure of a single point of reception. The message can be relayed to multiple devices and to multiple people. Second, cloud-based systems allow immediate access to environmental analytics and risk assessment from anywhere in the world. Early warnings therefore can, in principal, become 'crowd-sourced'.[124]

Empowerment of Vulnerable and Disadvantaged Groups

The Internet has been long hailed as the tool for social empowerment of the vulnerable and disadvantaged groups such as youth and women and persons with disabilities (PWDs). At the individual level, the Internet can provide the means to participate in economic activities, connect to communities and mobilise for a social cause. At the macro-level, the Internet has facilitated greater

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[121] PreventionWeb (2009), *ASEAN: Regional disaster management agreement enters into force* http://www.preventionweb.net/english/professional/news/v.php?id=12199
[122] ISDR (2012), *HFA Progress in Asia Pacific: Regional Synthesis Report 2009-2011* p.25 http://www.unisdr.org/files/21158_hfaprogressinasiapacific20092011.pdf
[123] World Bank, GFDRR, ISDR (2011), *Advancing Disaster Risk Financing and Insurance in ASEAN Countries: Framework and Options for Implementation*, (draft document) pp.9-10, https://www.gfdrr.org/sites/gfdrr.org/files/DRFI_ASEAN_DRFI_draft_report%28October%2030,%202011%29.pdf
[124] For example, the National Disaster Agency in Indonesia is creating a flood map of Jakarta using information gathered through Twitter. In the Philippines, both Google and Microsoft have partnered with the national weather agency to provide a web-based storm tracker.

citizen participation and provided stronger impetus for governments to enhance transparency and governance.

Recognizing the importance of e-inclusion for these groups, many ASEAN countries provide key public services for the disadvantaged groups via online channels. National income also serves as an important contributory factor in the extent of government's effort for e-inclusion of the vulnerable groups. For example, the latest *UN E-government Development Survey* found that the government of Singapore and Malaysia provide more than 86% of their key online services to disadvantaged and vulnerable groups, far in advance of Indonesia (36%); Vietnam (29%) and Cambodia (14%).[125] However, Thailand, Indonesia and the Philippines, though at lower per capita income level, offer the same level of services to disadvantaged and vulnerable groups compared to Brunei Darussalam—a high-income country. This shows progress is possible with the government's commitment and priority.

Gender Empowerment

ITU data shows that 37% of women in the world use the Internet compared with 41% of men, around 200 million fewer women than men.[126] In three countries noted by the 2014 *UN E-Government Survey*, women users outnumbered men, and ASEAN-member Thailand was one of the three, but otherwise the disparities are marked.[127] In many parts of the world, chances of women and girls gaining access to the Internet are limited, and where they can gain access they are often effectively excluded from acquiring ICT skills and jobs that would contribute both to their empowerment in society and to their county's GDP. There is evidently a pressing need for policy initiatives at every level of society to overcome this marginalization, but all too often the issue of empowerment of women itself is only rarely recognized in, if not entirely absent from, national ICT plans.

The evidence of ASEAN's commitment toward e-inclusion of women is weak. The 2010 *Masterplan on ASEAN Connectivity: One Vision, One Identity, One Community* (MPAC) makes just one mention of ICTs for women's empowerment: "ASEAN has embarked on a number of initiatives including education, culture, social welfare, youth, women, rural development and poverty eradication to name a few."[128] The 28-page implementation document, *ASEAN ICT Masterplan 2015,*[129] makes no mention of gender at all. The relative lack of effort in e-inclusion of women is not unique to ASEAN, of course. Searches of ICT and e-government development plans find that the entries concerning woman rarely occupy much space, and when they do they are rarely accompanied by specific targets.

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[125] United Nations (2014), *Bridging the Digital Divide*, UN E-Government Survey 2014, ch.6, http://unpan3.un.org/egovkb/Portals/egovkb/Documents/un/2014-Survey/Chapter6.pdf
[126] B. Sanou (2013), *ITU Celebrates International Women's* Day, ITU Blog, http://itu4u.wordpress.com/2013/03/08/itu-celebrates-international-womens-day/
[127] United Nations (2014), *UN E-Government Survey 2014*, pp.137
http://unpan3.un.org/egovkb/Portals/egovkb/Documents/un/2014-Survey/E-Gov_Complete_Survey-2014.pdf
[128] ASEAN (2011), *Master Plan on ASEAN Connectivity*, http://www.asean.org/resources/publications/asean-publications/item/master-plan-on-asean-connectivity-2
[129] ASEAN (2012), *ASEAN ICT Masterplan (AIM2015)*, http://www.asean.org/resources/publications/asean-publications/item/asean-ict-masterplan-2015

"Recent Broadband Commission research demonstrates that in 2012, only 30 countries or 29% of 119 countries included reference to gender as an issue in their National Broadband Plan (NBP). The Global Initiative on Inclusive Information and Communications Technology (G3ict) puts this proportion lower for overall policy, reporting that just 14% of countries had policies in place for women."[130]

The Commission notes that "integrating gender perspectives into national ICT policies is a key aspect in policy development but gender concerns are largely absent from ICT policies, just as ICT is largely absent from gender policies" (pp.28).

The evidence of economic and social benefits that accrue from promoting greater connectivity and interconnectivity of and for women is substantial and growing. For example, the Broadband Commission's *Doubling Digital Opportunity* report found that:

"In developing countries, every 10% increase in access to broadband translates to a 1.38% growth in GDP. That means that bringing an additional 600 million women and girls online could boost global GDP by as much as USD18 billion."[131]

An Intel-commissioned study, Women and Web[132] found that access to the Internet a) boosts women's income and income potential; nearly half of respondents used the web to search for and apply for a job, and 30% had used the Internet to earn additional income; b) increases women's sense of empowerment; more than 70% of Internet users considered the Internet "liberating" and 85% said it "provides more freedom"; and c) increases women's sense of equity. A study commissioned by the GSMA and the Cheryl Blair Foundation for Women looked at the gender digital divide in the mobile space.[133] The report highlights that on average globally, a woman is still 21% less likely to own a mobile phone than a man (*a mobile gender gap of some 300 million, equating to USD13 billion in potential missed revenues*), and that figure grows in poorer societies. (See Appendix for the full list of recent studies that show how connectivity empowers women).

It follows that ASEAN economies need to pay close attention to not only integrating low-income economies of the region and bridging the digital divide between nations but also including socially excluded groups and narrowing the divide within nations as well. Since empowerment of women and girls through ICT is so often left in the margins of top-level policy making, where the words may be worthy but bereft of detailed commitments and objectives, it is worth spelling out some action points.

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[130] ITU/UNESCO (2013), *Doubling Digital Opportunities: Enhancing the position of Women and Girls in the Information Society,* A Report by the Broadband Commission Working Group on Broadband and Gender http://www.broadbandcommission.org/Documents/working-groups/bb-doubling-digital-2013.pdf

[131] ITU/UNESCO (2013), *Doubling Digital Opportunities: Enhancing the position of Women and Girls in the Information Society,* A Report by the Broadband Commission Working Group on Broadband and Gender http://www.broadbandcommission.org/Documents/working-groups/bb-doubling-digital-2013.pdf

[132] Dalberg (2013), *Women and the Web, Bridging the Internet Gap and creating new global opportunities in low and middle-income countries*, Intel report, http://dalberg.com/documents/Women_Web.pdf

[133] Vital Wave Consulting (2010), *Women & Mobile: A Global Opportunity: A Study on the Mobile Phone Gender Gap in Low and Middle-income Countries*, GSMA and Cherie Blair Foundation for Women report, http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/01/GSMA_Women_and_Mobile-A_Global_Opportunity.pdf

1. ASEAN should look to strengthen its policies towards women's empowerment by delving deeper into the specific problems facing women accessing the Internet and, in particular, those who wish to gain ICT skills for job opportunities, and focus actions to overcome these challenges.

2. ASEAN should proactively encourage all member countries to include more women directly in the process of policy research and policy formation – particularly in those economies where there are currently few women involved.

3. Advocacy groups should be encouraged to formulate policy-specific steps towards the empowerment of women in relation to their access to and usage of ICTs and their access to skills training and employment in ICT sectors.

4. ASEAN should actively publicize programmes and case studies of success in empowering women and their communities through access and use of ICTs.

People with Disabilities (PWD) in a Digital Society

Thanks to global efforts such as *BIWAKO Plus Five,* disability is no longer viewed as an isolated and physical issue faced by a marginalized few but as a social issue that will be faced by everyone at some point in their lives.[134] International recognition of the rights of PWDs comes foremost in the 2006 United Nations' *Convention on the Rights of Persons with Disabilities* (CRPD).

ASEAN has made its own commitment. In December 2013, the *Report of the 3rd ASEAN Disability Forum* was delivered at the event in Bandar Seri Begawan, Brunei Darussalam: the twelve point declaration included calling upon all ASEAN countries to ratify and support within their budgets the CRPD, and to "shift from a charity-based approach to a rights-based approach in decision making in all matters affecting PWDs, based on the UN-CRPD principles."[135]

Interoperability and PWDs

The central proposition of this paper is that creating a digital economy and, through the development of markets and social policies, a digital society, is all about achieving a web of interconnected networks and multi-modal platforms that allow people to access all manner of services and collaborative work processes, to communicate and to share, via software and applications from any number of devices and locations. A *Global Initiative for Inclusive ICTs* (G3ict) paper reflects this well:

> "One of the important benefits of standards for persons with disabilities is to ensure a greater level of interoperability between systems, communication protocols and applications. In addition, from an ICT industry standpoint, the development of accessibility and assistive technology standards can greatly enhance market dynamics."[136]

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[134] WHO (2011), *World Report on Disability Summary*, http://whqlibdoc.who.int/hq/2011/WHO_NMH_VIP_11.01_eng.pdf and BMF (2009), the Biwako Plus Five and the Convention on the Rights of Persons with Disabilities, Millennium Framework for Action, http://www.unescap.org/stat/disability/reg-ws-dec09/BMF-Overview.pdf

[135] Disabled Peoples' International Asia Pacific Region (DPI-AP) (2014), *Report on the 3rd ASEAN Disability Forum*, http://www.dpiap.org/reports/detail.php?id=0000206&year=2014

[136] G3ict (2010), *e-Accessibility Policy Handbook for Persons with Disabilities*, pp.40 http://g3ict.org/resource_center/e-Accessibility%20Policy%20Handbook

A decade ago the concept of interoperability in ICT systems was often referenced by the term 'Universal Design' meaning, for example, designing websites and PC monitors so that the font size and the screen size could be easily changed, so that software could be used to 'read' the text and braille keyboards help people without sight to navigate the web. Reflecting these needs the DAISY Consortium has created standards for e-publications and e-readers which, since 1997, have been open standards based upon Internet formats.[137] Markets and technologies have created the capabilities, but it requires policies to apply them in areas of social priority. For example, software to read web-based text aloud has not been written for all local languages. In the Philippines this has been addressed through the 2012 Amendment of R.A. 1372, allowing printing, reproduction and distribution of copyrighted materials exclusive for persons with visual/print disabilities.

In Indonesia policy towards PWDs was promulgated in Law No.14 of 2008 on Public Information, but "IT access for PWDs in Indonesia is still limited; it is mostly concentrated in the urban areas while the disabled people who live in rural areas hardly have access to the information technology."[138] Nevertheless, multi-modal ICTs *are* increasingly now being made available. Telkom, for example, has produced a portal application for people with hearing disability which is called "I–Chat", to help teachers in special schools as well as the parents in the learning process for their deaf children and students. The presentation also notes the popularity and importance of social media in Indonesia as breaking down the barriers of isolation and exclusion.

Many societies have also suffered from the disabilities brought about through conflict, but none more so than Cambodia. According to the 2008 census, nearly 200,000 persons were classified as PWDs, 1.44% of the population.[139] In 2009 the Government of Cambodia passed the law on the protection and the promotion the right of persons with disabilities. A National Strategy Plan of Cambodia is being prepared, but beyond taking steps to train teachers and social workers in how to assist PWDs, the limited availability of resources and ICT infrastructure remain key problems, facing not only Cambodia in implementing such an objective, but all low-income countries. It is therefore important that the true nature of each challenge is fully reflected in policy thinking so as being able to successfully mobilize public and private resources and appropriately set the framework for transitioning to a digital society. As the G3ict acknowledges, it is "clear that digital accessibility is not merely about greater use of technologies by persons with disabilities. It is about transforming information-based policies and the ICT ecosystem".[140]

Unfortunately, according to the report, across the whole of Asia only "36 per cent of countries have a definition of accessibility which includes ICTs or electronic media in their laws or regulations

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[137] DAISY Consortium (2014), *About Us,* DAISY Consortium website, http://www.daisy.org/about_us

[138] Ministry of Social Affairs (2013) *'IT Policies for People with Disabilities in Indonesia*, presentation to Community Based Support Service for Persons with Disabilities, Bangkok, Thailand 8-11 October 2013. The presentation makes the point that "Unfortunately most Indonesian people still do not have enough information and knowledge on disability, consequently they have not understood that disability should be included as part of diversity." A sad point that no doubt applies to many societies, but an important one to recognize from a policy perspective.

[139] Disability Action Council (2013), *Cambodia Country Report*, presentation to Community Based Support Service for Persons with Disabilities, Bangkok, Thailand 8-11 October 2013.

[140] G3ict (2013), *Convention on the Rights of Persons with Disabilities 2013 ICT Accessibility Progress Report*, pp.1, http://g3ict.org/design/js/tinymce/filemanager/userfiles/File/CRPD2013/CRPD%202013%20ICT%20Accessibility%20Report.pdf

compliant with the definition of accessibility in CRPD Article 9; only 16% have a mechanism to involve Disabled Persons Organizations (DPOs) in the design, implementation and evaluation of laws, policies and programs regarding ICT accessibility; although 82% of the countries have a government body dedicated to persons with disabilities, and 62% have a government body solely dedicated to ICTs, only 31% of the countries have government funds allocated to programs in support of digital accessibility; only 35.6% provide services to the general public, including through the Internet, in accessible and usable formats for persons with disabilities." In some cases the ICTs themselves are lacking, but in many cases it would seem there remains a lack of policy awareness beyond the specialized ministries and agencies directly involved.

E-government

The e-government effort is far from new but it is entering a new chapter brought about by the rapid advancement in the Internet and social media along with sophistication and convergence in hardware and software of the ICT ecosystem. Open government data and cloud computing, coupled with consumerization of mobile devices, have further enriched the ecosystem. Under increasing pressure to provide easier access to public information and government services, many countries are integrating multichannel service delivery. The citizen touch-points that government now have to consider range from the physical channels such as counter and voice services, to online means like Internet access through PCs, mobile phones and tablets and to emerging media like mobile apps and social media.

The current status of e-government in ASEAN is far from ideal. Table 17 shows the ranking of the ASEAN economies in the latest e-government Development Survey by the United Nations.

Table 17. Ranking of ASEAN economies in the UN E-government Development Survey 2014

Country	Ranking	E-government Development Index (EGDI)
Singapore	3	0.9076
Malaysia	52	0.6115
Brunei	86	0.5042
Philippines	95	0.4768
Vietnam	99	0.4705
Thailand	102	0.4631
Indonesia	106	0.4487
Cambodia	139	0.2999
Lao PDR	152	0.2659
Myanmar	175	0.1869

Source: UN E-Government Survey 2014 http://unpan3.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2014

According to the UN survey, only Singapore has achieved the top quartile (above 0.75) of the *E-government Development Index* (EGDI). Malaysia and Brunei are placed in the second and the rest of the ASEAN economies are in the third and fourth quartiles. Brunei and Thailand, despite being high-income and upper-middle income countries, once again prove to be low performers while the Philippines and Vietnam appear ahead of their income groups. Among the least-developed countries, Cambodia was cited as one of the biggest improvers in terms of global ranking (from 155th to 139th) from the last survey done in 2012.

From the ranking above, it is obvious that income level has a strong influence on national e-government development. Providing adequate ICT infrastructure, integrating the backend operations of the government, and improving ICT literacy all cost resources and without these enabling factors in place, implementing e-government initiatives will be constrained even if the commitment, policies and national strategies are in place. However, national income certainly does not, by itself, constitute or guarantee advanced e-government development, as evidenced by some of the high and low performers within the income groups.

Governments are also major users of Internet technologies themselves, from simple mail services through to highly advanced cloud computing and Big Data analytics in areas such as environmental management, health services, and public service access and distribution.

Important initiatives have been undertaken across the ASEAN region, but in their diversity they also highlight the different stages of connectivity and interconnectivity development that the ASEAN economies are at, and they illustrate the importance of promoting interconnectivity. In some cases, such as Singapore where Internet connectivity is excellent, networks and systems are increasingly interconnected and interoperable, for example estimating and paying personal taxes online or online booking of hospital appointments, and progressively adopting these developments to e-government is an annual policy exercise, i.e. as each year passes additional services and wider reach are achieved.

Rather than run through examples from all ASEAN economies, three instances of e-government development have been selected across different income groups identified in Part 1 to illustrate the different stages of advancement. The three examples selected are Lao PDR to highlight the importance of achieving basic Internet connectivity in a low-income economy, the Philippines to the progression towards interconnectivity and interoperability and Malaysia which is moving towards a multichannel service delivery model via proactive use of mobile networks and social media.

Lao PDR

As a landlocked country and one of the least developed countries in ASEAN, Lao PDR faces a lot of barriers in e-government development. With high mountains, Internet connectivity is severely underdeveloped in remote rural areas, creating an additional barrier to the promotion of inclusive ICT strategies. Thus, it is not surprising that Lao PDR's rating on the Telecommunication Infrastructure Index is the weakest out of the three components of the e-government Development Index.[141]

Lao PDR started down the road to e-government in 2006 with the Lao E-government Action Plan with the aim to establish a National E-government Infrastructure, equip government departments with IT facilities, develop applications and to train and develop human resources. Figure 14 maps one of its latest E-government initiative, which to develop the National Portal.

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[141] The other two indexes used in the report are "the scope and quality of online services (Online Service Index, OSI), and the inherent human capital (Human Capital Index, HCI)"

Figure 14. Lao PDR E-government (2010-2015)
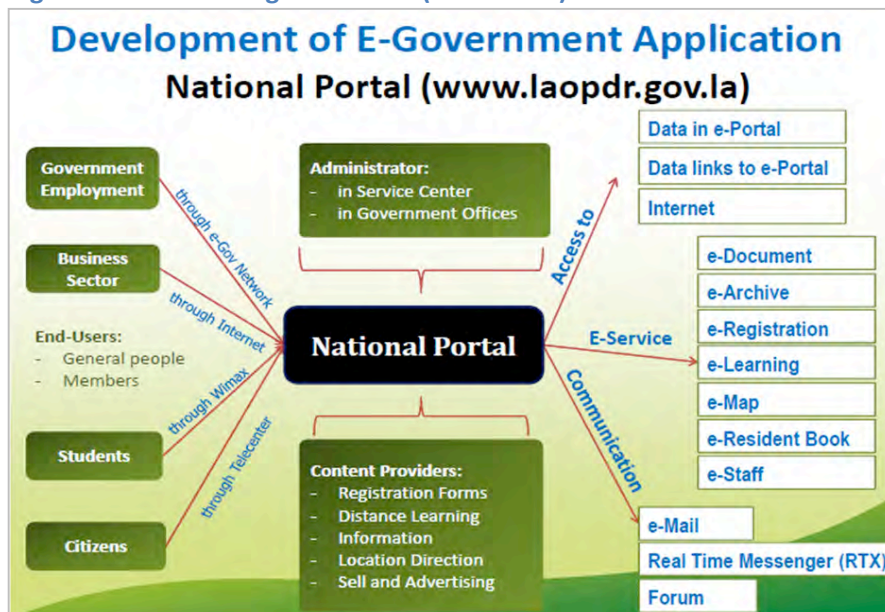
Source: C, Luanglath (2010), *Lao National E-government Project*,
http://unpan1.un.org/intradoc/groups/public/documents/UNGC/UNPAN043423.pdf

What is noteworthy are the means of connectivity shown on the left of the diagram; Government staff connect by means of an intranet, businesses by means of the Internet, students through wireless WiMAX Internet access, and citizens mostly through telecentres. The fact that only the business sector was connecting by computer or smartphone over the Internet shows that Internet connectivity has been a bottleneck in achieving greater public service delivery and social inclusion in Lao PDR.

The Philippines

The Philippines has implemented the first stages of e-government, and is now setting out the path from basic connectivity towards interconnectivity and interoperability of systems. In this regard, the Philippines' E-government Master Plan (EGMP), which is "a blueprint for the integration of ICTs for the whole of government" ticks all the boxes. "It is based upon an assessment study of E-government development conducted in 2012 … with the intent to operationalize the E-government thrust of the Philippine Digital Strategy (2011-2016)… it presents the ICT foundation for making an *integrated and interoperable e-Governance* system linking all government agencies possible."[142]

The EGMP assessment notes that in terms of the government network infrastructure, for example, the Philippines is looking at over 90% of connectivity to the Internet of the national and local agencies. However, the EGMP also note that much of the e-government initiatives falls into departmental siloes, which do not interconnect and are seldom conceived collaboratively across agencies with similar data needs.

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[142] DOST-ICTO (2013), *E-Gov Masterplan*, http://i.gov.ph/pegif/wp-content/uploads/2014/03/eGovMasterPlan_Final-Version.pdf

For example, Figure 15 shows the front-end information systems and human resource/financial services comprise the majority of the existing e-government system. While the functionalities needed by all the agencies would invariably have commonalities, each agency appears to have its own system for each service.

Figure 15. Number of Existing Systems per Modules/Functionality
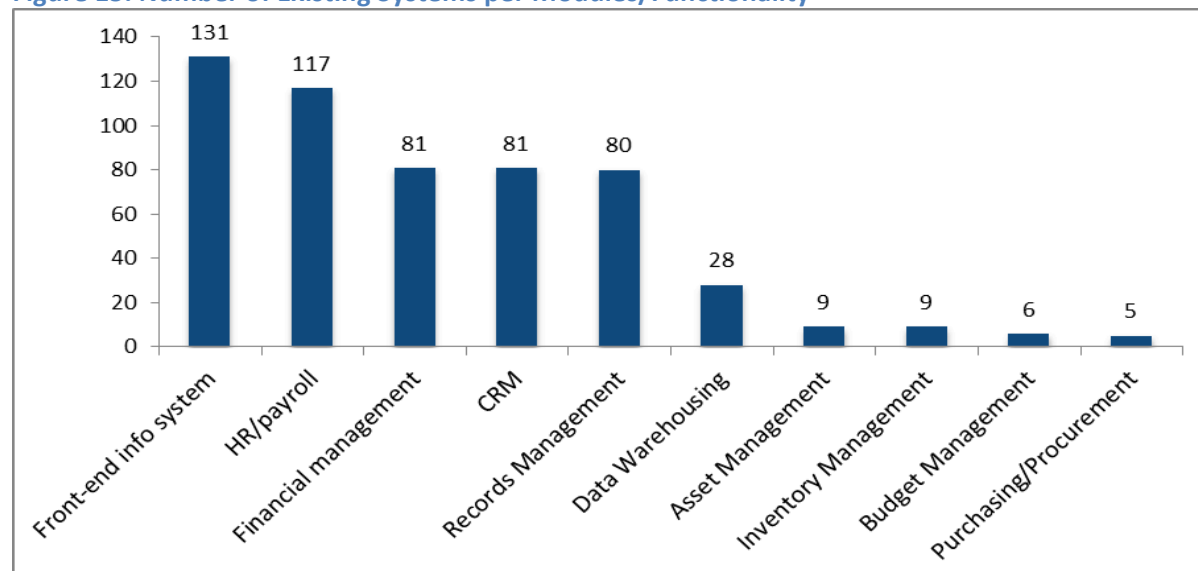
Source: DOST-ICTO (2013), E-Gov Masterplan

Consequently, one of the priorities the EGMP has identified is "to *interconnect government agencies* for better online coordination and enhanced public service."[143] The repeated references to interconnectivity are telling. One important application in this respect is the Government Online Payment System, which "is an Internet-based electronic payment facility and gateway that will enable citizens and businesses to remit payments electronically to government agencies."

A reading of the EGMP indicates that the focus in the Philippines has been very much on the front and backend systems and connectivity but is on the verge of achieving a more comprehensive and connected e-government system.

Malaysia

According to the UN E-government Development Index (EGDI), Malaysia is the only other country among ASEAN economies that is considered to be in the high EGDI group (above 0.50 of EGDI score) outside Singapore.[144] Malaysia's e-government plan (Figure 16), indeed, shows that it is a step further down the road from the Philippines and several steps ahead of Lao PDR in the direction of a fully integrated e-government system to support the objectives of a digital society. One example of this is the importance attached to mobile access to the Internet and social media as channels through which to connect to, and communicate with, citizens. This multichannel approach of e-

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[143] DOST-ICTO (2013), *E-Gov Masterplan*, http://i.gov.ph/pegif/wp-content/uploads/2014/03/eGovMasterPlan_Final-Version.pdf

[144] UNPACS (2014), *UN E-Government Survey* 2014, ch.1, http://unpan3.un.org/egovkb/Portals/egovkb/Documents/un/2014-Survey/Chapter1

government is an advanced form of service delivery and can greatly extend the reach of e-government to citizens of all walks of life and in most geographical areas.

Figure 16. Malaysian Public Sector ICT Strategic Plan 2011-2015

Source: MAMPU Public Sector ICT Strategic Plan 2011-2015,
http://www.mampu.gov.my/documents/10228/11682/ISPplan2011.pdf/f746793c-b6f2-45a9-9f57-b841163fe6ed

The snapshot portrayed above again shows disparity among ASEAN economies in terms of e-government developments and where they are in achieving interconnectivity and interoperability across public services for all citizens and enterprises. Even when basic Internet connectivity has been accomplished, the task of interconnecting networks and creating interoperable systems is never a simple, straightforward or easy one.

The opportunities for developing countries are also clear. With little or no legacy in infrastructure or online processes, there is a potential to leapfrog by leveraging the benefits of the burgeoning wireless infrastructure including mobile broadband that is being deployed particularly in developing countries. The EGDI shows that national income does not guarantee e-inclusion in a digital society but commitment and sound policies do.

Conclusion

ASEAN, while a region of diversity, can be divided into three clusters by Internet penetration. The report findings show that while the level of economic development is an important contributory factor in determining the extent of Internet connectivity, other market drivers can often be at least as important, as evidenced by some of the high and low performers within these clusters.

- The first cluster consists of Singapore, Brunei and Malaysia. However, only Singapore stands out as a regional hub with excellent connectivity and easily affordable Internet prices. Aside from Internet penetration, Brunei and Malaysia fall behind in terms of affordability, bandwidth and speed, and Malaysia still suffers from underserved areas.
- The second cluster comprises Thailand, the Philippines and Vietnam. Here the basic levels of international and domestic network coverage and connectivity are relatively good, although there are still under-served rural areas, and Internet prices are moderate.
- The third cluster consists of Indonesia, Cambodia, Myanmar and Lao PDR. Indonesia would otherwise be expected to fall into cluster 2 given its income development level and with international and national connectivity on par with, for example, the Philippines. But coverage is a much greater challenge across the archipelago, and Internet penetration rates continue to lag. The three low-income countries have sparse international connectivity, and are all highly dependent upon cross-border landlines, with incomplete national connectivity that leave remoter regions of these countries either unserved or seriously under-served. Internet penetration rates are very low and access and usage is expensive – in some cases prohibitively so.

In all these countries, mobile phone usage has long overtaken fixed line usage and as the cost of smartphones plummets there is a clear trend toward an even greater use of mobile phones. Mobile devices are generally becoming the principal means of access and usage of the Internet in poorer economies. This has two-sided implications. On the one hand, the need to hand-off high volumes of data traffic requires investment in local backhaul and national backbone networks. This is especially true as telecom and MNOs shift gear towards offering multi-platform content and apps which can be accessed by a variety of different devices, thereby widening the scope of the market and generating even more traffic. On the other hand, the increasingly ubiquitous nature of mobile networks and the growing demand for wireless communications means that governments have new ways to provide services to citizens, such as basic public information, applying for appointments at health clinics or filing taxes. And this can potentially lower the costs service delivery and increase reach and return. In some cases dramatically.

The first part of this report identified the important issue of basic Internet connectivity as the foundation for an Internet economy. However, as illustrated in Part 2, there is a big difference between an Internet economy that contributes to GDP growth and social welfare, and an all-embracing digital economy which relies upon the interconnection of networks and the interoperability of systems, such as payment systems. It might be summed up as the shift from economies of scale, where the Internet helps to grow a business, and the economies of scope, where interconnection and interoperability broaden-out markets, create new synergies between goods and services across sectors. The Internet economy can be confined to selected lines of business, whereas the digital economy involves all sectors of business and all stages of the business

supply chains and networks in which the Internet has become embedded as an underlying technology.

The successful launch of the AEC in late 2015 will depend heavily upon the ability of ASEAN nations to interconnect with each other. Without better interconnectivity and interoperability, the growth of e-commerce, for example, will be muted, and the ultimate aim of a digital economy and society – meaning a society in which Internet-based digitally delivered services are able to achieve inclusiveness and empowerment of those at the margins of society – will be forestalled. As such interconnectivity represents something of a new, or extended, challenge to the digital divide between ASEAN countries.

An example of this challenge is the general absence of carrier-neutral IXPs within the ASEAN region. This is not a technical issue but an issue of business strategy by incumbent carriers. Without effective carrier-neutral IXPs smaller ISPs can be forced to trombone their traffic, adding to cost, latency and a loss of competitiveness so consumers suffer. In some cases, for example in Vietnam and in Thailand, governments have either tried to regulate interconnection between ISPs or set up IXPs with the expectation that ISPs would each connect to them, but these policies proved ineffective. What needs to be appreciated here is that governments have options. For example, they can encourage third-party carrier-neutral IXPs and, if necessary, assist with start-up costs or ongoing capital costs with safeguards in place to end such subsidies once critical mass is achieved. Such measures are more likely to be effective if accompanied by policies that help to bring down costs of Internet access and usage. Similarly, where for example bank and mobile payments networks are not interconnected and interoperable, governments should at least begin by examining the reasons why *not* as these are increasingly vital to the health of a digital economy and society. If low-income citizens are able to transfer and receive funds from friends and relatives in distant places who may not have a bank account and who subscribe to a different mobile network, then their chances of participating in, benefitting from, and contributing to financial services increases.

The second part of this report therefore examined how far ASEAN economies are in making the transition from basic connectivity and the Internet economy, to a digital economy and society that is fully networked by interconnecting and interoperable systems. In theory the Internet is a means of interconnecting everything and everyone to every other thing and person; developments such as cloud computing and the Internet of Things are good examples of this. In practice, however, not all IP-enabled networks are interconnected. Some for very good security reasons, some because they are designed to serve a closed user group, but many public networks are not interconnected and the applications running over them are not interoperable for purely commercial reasons. It is always the role of governments to consider the balance of public interests between the free play of markets, in which investment is accompanied by risk, and the benefits of interconnection to the public. The ideal way for policy aims to be achieved is through creating the right incentives for the private sector to respond, and the ultimate self-interest of industry in the digital economy is that through the economies of scope markets are grown. Setting up sector-specific industry working groups to examine the best ways to match public and private interests is one policy option, especially in low-income developing economies where there may be a lack of competition and the potential benefits to the economy are therefore all the greater.

Governments themselves have the opportunity to show a leadership role in the way digital services can be delivered, either in a very targeted way or in a holistic manner. This report identifies progress being made in e-government developments around the ASEAN region, including health, education and disaster risk management services. Empowerment of persons often marginalised in society has long been an objective of governments and NGOs using digital networks to spread the benefits of the Internet. The report examines what is being done in these areas for the empowerment of women, but notes there is still a tendency to marginalise the issues.

In conclusion, there are clearly steps governments can take to encourage and accelerate the shift from basic connectivity for Internet access towards a more fully-interconnected and interoperable digital economy. The benefits of a shift from the economies of scale of an Internet economy to the economies of scope of a digital economy will be transformative.

Recommendations

1. **Prioritise Access to Wireless Networks …**

   Countries with bandwidth constraints need investment to acquire more international bandwidth, but to justify the investment, measures to stimulate demand, much of which is latent, also need to be in place. Policy makers and industry need to work together on the two major determinants of demand: accessibility and affordability. In practical terms, for most citizens this means gaining access to wireless networks. The most direct way to stimulate demand is *to encourage the extension of wireless networks to unserved and under-served areas.*

2. **… and Affordability of Network Access …**

   To ensure affordability of access, ISPs and other service providers who need to lease bandwidth should do so at competitive prices. But wholesale prices can only be brought down if there is a more plentiful supply of bandwidth available on an equal access basis. If ownership of bandwidth is monopolized then steps need to be taken to ensure it is available on fair commercial terms to maximize consumer welfare. One of the most effective ways to reduce the cost of IP transit traffic is to promote carrier-neutral IXPs. Different models to ensure affordability of network access exist such as regulations on the dominant carrier, an independent third party wholesale model, or targeted state-investment. *It is important that whatever the model, policy makers in ASEAN make affordable network access a priority.* By removing the bandwidth bottleneck, the full economic and social benefits of the Internet economy can be achieved and the path towards a fully developed digital economy embarked upon.

3. **… as well as Affordability of Devices.**

   The counterpart to reducing network access prices is to increase access to affordable access devices. In the first instance this means removing obstacles to the supply of such devices. This extends to policies towards imports and equipment type approval procedures. *ASEAN countries should seriously consider, for example, ways to accelerate relevant MRAs (Mutual Recognition Arrangements) that simplify and speed up certification of imports.* Policy makers should also ensure that the device distribution and retail networks are fully competitive, and carefully review any tie-in arrangements imposed by carriers that might be considered discriminatory and therefore anti-competitive.

4. **Promote Infrastructure Sharing and Equal Access …**

   Where facilities are dominated by one or two carriers, equal access should be required, with regulator-approved reference interconnection offers (RIOs) to protect weak new entrants. *There should be support for the sharing of scarce resources such as towers and ducts to maximize services competition; as well as the sharing of certain radio spectrum* (or dynamic spectrum assignment) to utilize frequencies in bands of under-used or unused spectrum.

5. **… along with the Transition to IPv6**
   The assignment of IPv6 addresses will become increasingly important as a multitude of Internet-connected devices proliferate. Within ASEAN, only Malaysia and Singapore score significantly in terms of IPv6 adoption; both economies focused upon building smart cities and applications, including M2M connections such as smart meters and environmental sensors. This is an issue that ASEAN governments need to take seriously – ahead of the onset of a shortage of IPv4 addresses in their respective countries. ***ASEAN governments should clearly timetable the expected transition in their economies to IPv6.***

6. **Interconnectivity Needs to be Proactively Promoted by Government …**
   Most economies in the region are only at the beginning of the growth curve of Internet interconnectivity. And while most public carrier networks do interconnect, in cases where incumbents impose excessive charges, regulators need to consider the use of RIOs to ensure fair competition; while in non-carrier proprietary networks, such as third party payment networks, ***governments need to work with industry to find ways to maximize the social and economic benefits of interconnection to users***. Various models of good practices exist, ranging from voluntary agreements to state-supported clearance systems and it is important that policy makers and the industries concerned are aware of the mutual advantages of interconnectivity to grow the Internet economy as a bridge to the digital economy.

7. **… while Interoperability Needs to be Built into all Services Delivery**
   The essence of a digital economy are applications that work seamlessly across different networks, support productivity, and are essential to the wider provision of services such as health and education. ***In public sector services and applications, interoperability, especially of apps across mobile networks, should be built into all future planning requirements***, with the ultimate focus on end-user services. Interoperability would be difficult to achieve without full consideration into openness of standards. Open Internet standards allow devices, services, and applications to work together across a wide and dispersed network without falling into the traps of commercial tie-ins or backward compatibility and ultimately foster innovations to arise. In the private sector, policy makers should work with the industry in cases where interoperability would significantly enhance public welfare. The financial services and payment systems sectors are a case in point.

8. **Governments Need to Lead in Using ICTs to Extend Inclusion …**
   Governments themselves have the opportunity to show a leadership role in the way digital services can be delivered, either in a very targeted way or in a holistic manner. This report identifies progress being made in e-government developments around the ASEAN region, including health, education and disaster risk management services. The report also identifies the vast potential for extending financial, health, and educational inclusion to otherwise marginalized communities given the ubiquity of mobile devices and the growing availability of smart mobile devices, even at the bottom of the pyramid. ***But with many of these populations still considered 'uneconomic' by the private sector, governments need to play a leading role in extending inclusion to these communities.*** This may be one of the most important initiatives for addressing the digital divide and attacking poverty and illiteracy across ASEAN.

9. **… by Recognizing the Importance of Mobile First**

    ASEAN is effectively a mobile-first group of economies with many first time users now increasingly coming online via mobile devices at the outset. And with the growing access to low-cost smartphones becoming ubiquitous across the region, this trend will only grow. ***Governments need to recognize the mobile centricity of their populations and adjust their Internet access and national digital economy plans accordingly, along with developing mobile first programmes.*** Existing applications designed for the desktop can no longer be simply 'retro-fitted' on to the mobile; while that may have been palatable in the past, applications and processes now need to be designed and made for mobile platforms – natively, if they are to work securely and intuitively.

10. **… and Promoting Capacity Building as a Key Part of Empowerment**

    Empowerment of persons often marginalised in society has long been an objective of governments and NGOs, using digital networks to spread the benefits of the Internet. The Internet offers unprecedented opportunities for women and PWDs to break out of social silos and for economies to embrace otherwise undervalued resources. The Internet offers important ways to empower people who are marginalized due to gender or disability by offering the means of communication and inclusion, but also ICT skillsets whereby they can play a full and productive part in society. However, the evidence suggests that many ASEAN countries still have a long way to go in building these objectives into their ICT planning provisions to address the social inequalities that persist. ***Policy makers are urged to not only involve women and PWDs directly in the consultation and planning processes, and give such policies a more prominent place in national priorities, but to also focus on the distribution of resources and the capacity building that enables both access and participation.*** The exclusion of so many from the social mainstream is a major loss to the economy.

In conclusion, there are clearly steps governments can take to encourage and accelerate the shift from basic connectivity for Internet access towards a more fully-interconnected and interoperable digital economy. The benefits of a shift from the economies of scale of an Internet economy to the economies of scope of a digital economy will be truly transformative.

Appendix

There is a growing body of studies that shows empowerment of women through access to the Internet and employment with ICTs will make a major contribution to sustainable economic development. Selected examples of the recent studies are as follows:

- Women and Web by Intel and Dalberg[145]
  This Intel-commissioned study found that access to the Internet (a) boosts women's income and income potential; nearly half of respondents used the web to search for and apply for a job, and 30% had used the Internet to earn additional income; (b) increases women's sense of empowerment; more than 70% of Internet users considered the Internet "liberating" and 85% said it "provides more freedom"; and (c) increases women's sense of equity; nearly 90% of women Internet users surveyed said access to Internet should be part of human rights.

- Doubling Digital Opportunity by the Broadband Commission[146]:
  - Worldwide, women are on average 21% less likely to own a mobile phone– representing a mobile gender gap of 300 million, equating to USD13 billion in potential missed revenues for the mobile sector.
  - By 2015, it is estimated that 90% of formal employment across all sectors will require ICT skills, yet women now account for fewer than 20% of ICT specialists. The report emphasizes the importance of encouraging more girls to pursue ICT careers.

- Women and Mobile: A Global Opportunity[147]
  - A study on the mobile phone gender gap in low and middle-income countries commissioned by the GSMA Development Fund and the Cheryl Blair Foundation for Women highlights that on average globally, a woman is still 21% less likely to own a mobile phone than a man, and that figure grows in poorer societies.

The report findings are important to ASEAN for two reasons: first, access to a mobile phone means access to the Internet for a growing number of people; second, mobile phone and social media networks are of growing importance for the delivery of e-government information and services, including at times of emergencies and early warnings. They can also provide women with an added sense of security.

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[145] Dalberg (2013), *Women and the Web, Bridging the Internet Gap and creating new global opportunities in low and middle-income countries*, Intel report, http://dalberg.com/documents/Women_Web.pdf
[146] ITU/UNESCO (2013), *Doubling Digital Opportunities: Enhancing the position of Women and Girls in the Information Society,* A Report by the Broadband Commission Working Group on Broadband and Gender http://www.broadbandcommission.org/Documents/working-groups/bb-doubling-digital-2013.pdf
[147] Vital Wave Consulting (2010), *Women & Mobile: A Global Opportunity: A Study on the Mobile Phone Gender Gap in Low and Middle-income Countries*, GSMA and Cherie Blair Foundation for Women report, http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/01/GSMA_Women_and_Mobile-A_Global_Opportunity.pdf