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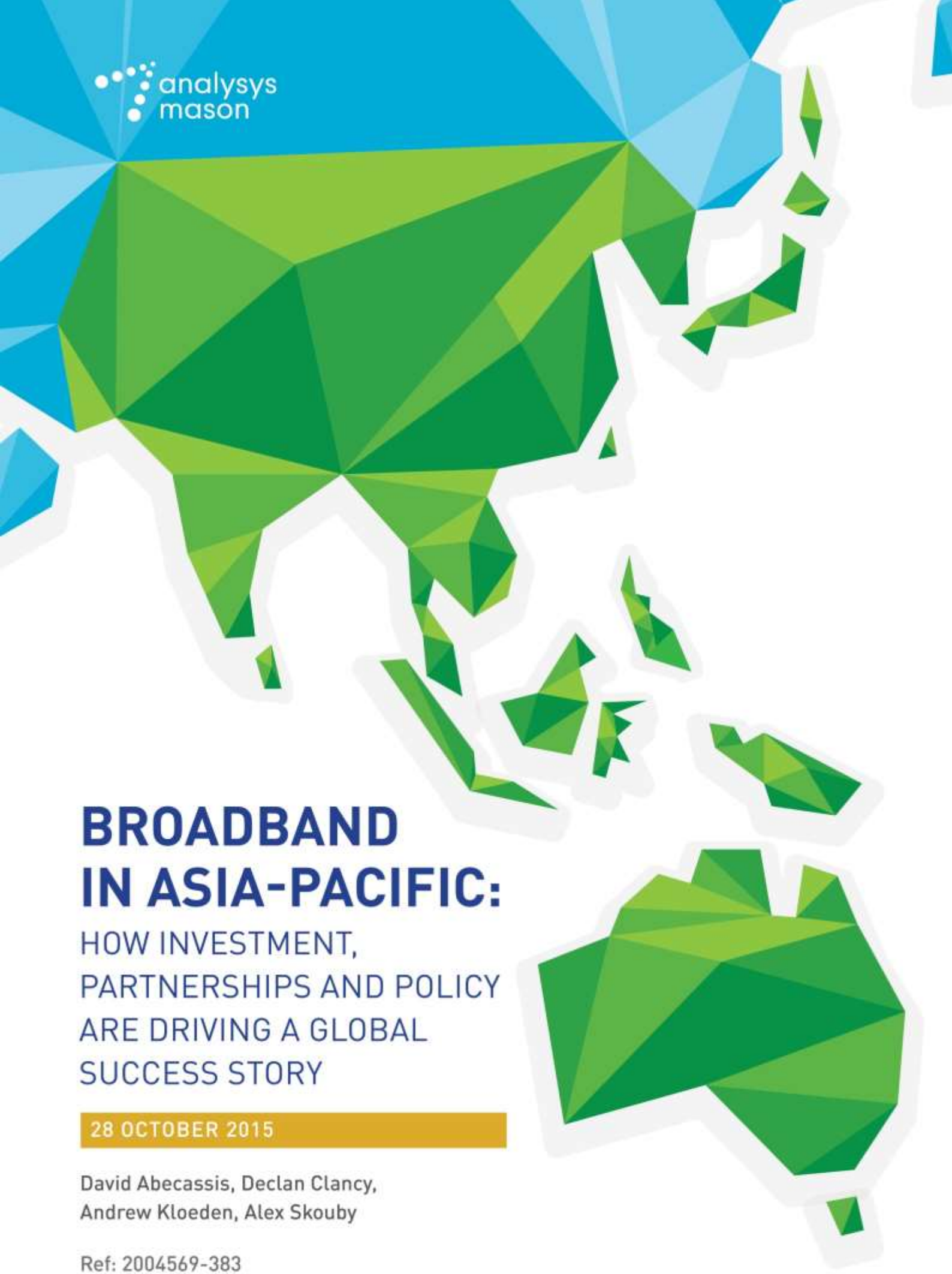

BROADBAND IN ASIA-PACIFIC:

HOW INVESTMENT, PARTNERSHIPS AND POLICY ARE DRIVING A GLOBAL SUCCESS STORY

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0 Executive summary

This report explores how the broadband ecosystem has developed in the Asia-Pacific region[1] over the past 15 years, and the opportunities that this has created for consumers and telecoms operators. Our research finds that:

- The growth of the broadband ecosystem has created opportunities for telecoms operators to thrive as Internet Access Providers (IAPs), and to develop new content and applications themselves;
- Content and application providers (CAPs) are helping to create growth opportunities for IAPs and other market participants; and
- A conducive policy environment is essential to the further growth of the Internet.

0.1 The rise of broadband Internet has created opportunities for Asia-Pacific telecoms operators to thrive

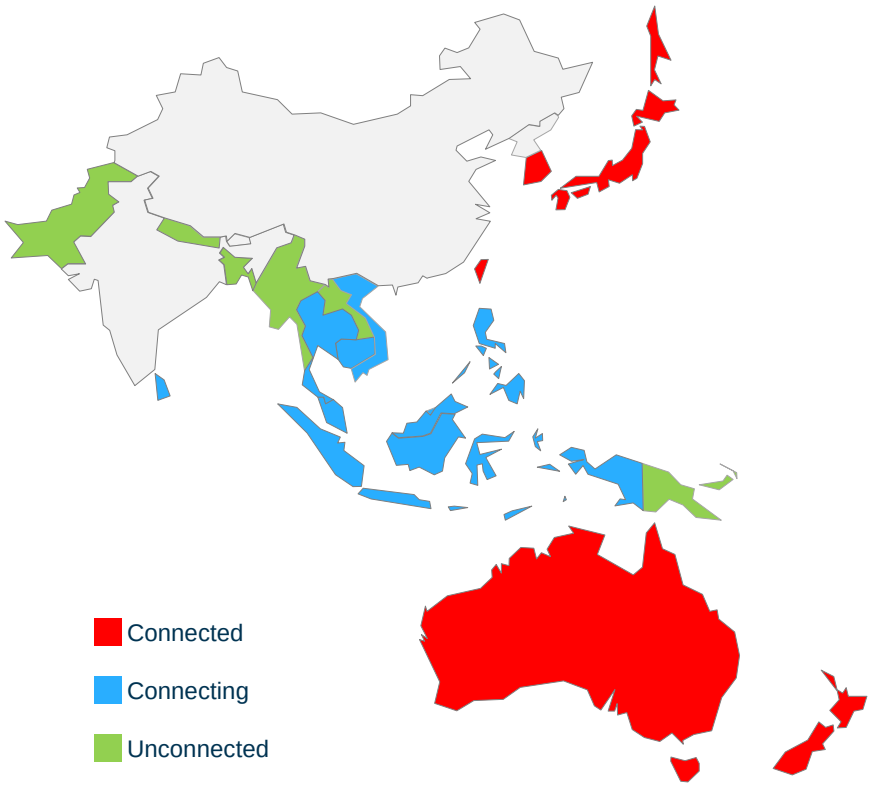
Internet markets in the region have seen strong growth. Take-up of broadband services has grown at 28% per annum since 2005, while usage of online applications and content has grown rapidly, at 28% per annum since 2012. Despite this strong overall growth, the level of development of the region's broadband markets varies widely. To reflect this, we have divided the 21 countries of interest into three 'clusters':

- *Connected* countries, which enjoy world-class connectivity, with near-ubiquitous coverage of 3G and 4G mobile and fixed broadband, high take-up, and high usage of advanced services. This includes Australia, New Zealand, Singapore, Hong Kong, Japan, Korea, and Taiwan.
- *Connecting* countries, which have high coverage, but moderate take-up of 3G and 4G mobile broadband, low coverage and take-up of fixed broadband, and increasing usage of advanced Internet services. This includes Malaysia, Thailand, Philippines, Indonesia, Brunei, Vietnam, Cambodia, and Sri Lanka.
- *Unconnected* countries, which have yet to develop advanced broadband services. They have very little coverage or take-up of either 3G mobile services or advanced fixed broadband services. This includes Papua New Guinea, Bangladesh, Pakistan, Nepal, Myanmar, and Laos.

These clusters are illustrated in Figure 0.1.

[1] We include the following 21 countries in our analysis of the Asia-Pacific region: Australia, Bangladesh, Brunei Darussalam, Cambodia, Hong Kong, Indonesia, Japan, Laos, Malaysia, Nepal, New Zealand, Pakistan, Papua New Guinea, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand and Vietnam. India and China are not covered in this report, their scale and diversity warranting separate reviews of their own.

Figure 0.1: Illustrative map of countries in each cluster [Source: Analysys Mason, 2015]



0.1.1 The current picture: broadband is replacing legacy services as the main revenue and profit driver for IAPs

This strong growth in broadband has resulted in growth in overall telco revenues since the introduction of advanced broadband. Figure 0.2 shows this revenue growth for all services since the introduction of advanced broadband.[2]

[2] Note that we exclude the 'unconnected' countries, as these have yet to develop advanced broadband.

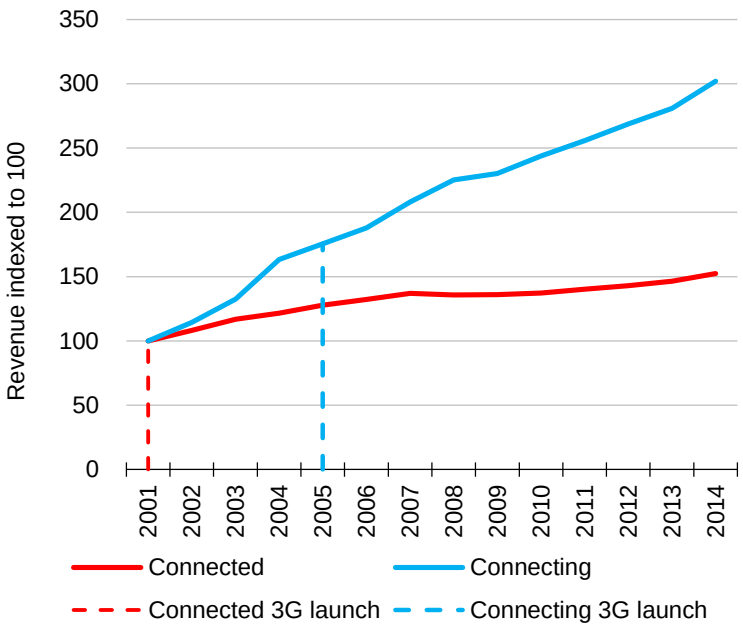


Figure 0.2: Overall IAP revenue, indexed to the year of 3G launch, 'connected' and 'connecting' clusters, using constant exchange rates [Source: GSMA, company data, ITU, TeleGeography, Analysys Mason, 2015]

In addition, the importance of data and Internet services within the IAP revenue mix has increased strongly. This is illustrated in Figure 0.3, from the year of 3G launch. 'Connecting' countries have rapidly caught up with 'connected' countries, demonstrating the importance of the Internet to the telecoms sectors of middle-income countries.

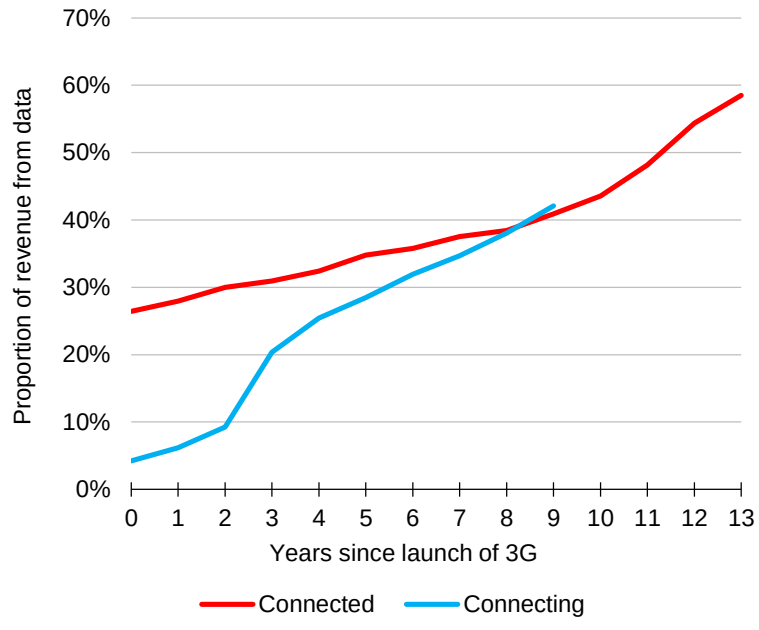


Figure 0.3: Proportion of total service revenue from data and internet services [Source: GSMA, company data, ITU, TeleGeography, Analysys Mason, 2015]

As revenue has grown and shifted from voice to data services, the source of IAPs' profitability[3] has also shifted, from legacy telephony services to new data services, including broadband Internet access. Over the period since the launch of 3G (broadly the last 10-15 years, depending on the market), total EBITDA has been constrained, but relatively stable in all countries in the region (reflecting many factors such as subsidies for high-end handsets).

With modern networks, IAPs are able to provide all their services with the same infrastructure. The shift in revenue towards data services, together with the low incremental cost of supplying them, implies that data services are now also a significant (and increasing) source of IAP profits. Key to this are developments in 4G networks, which are fundamentally data networks that allow spectrum and network resources to be shared seamlessly between services. Likewise the development of converged core networks allows all voice and data traffic to be carried seamlessly over an IP network. As a result, the profits made by IAPs are now mainly attributable to data services, a pattern that is set to continue for years to come.

Investments made in these modern networks have produced healthy returns. Overall industry returns, measured by the Return on Capital Employed (ROCE) ratio,[4] are illustrated below. These appear healthy overall, comparable to estimates of the cost of capital for telecoms operators (shown as the green band in Figure 0.4)[5] for mature markets and at a lower level for countries where overall expected economic growth is much faster, network upgrades are recent or under-way, and where equipment costs tend to be larger compared to their revenues.

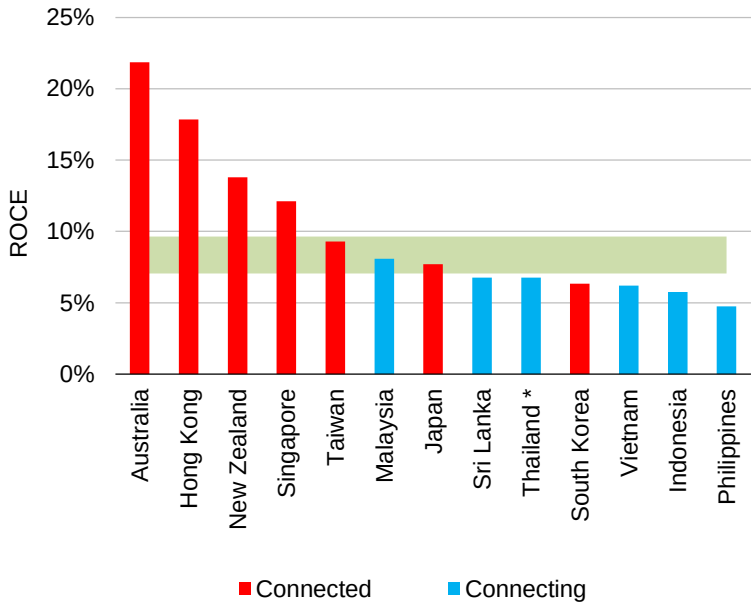


Figure 0.4: ROCE for IAPs in 'connected' and 'connecting' clusters [Source: Analysys Mason, company data, GSMA, TeleGeography, ITU, Aswath Damodaran (NYU Stern), 2015]

* The ROCE for Thailand is for mobile only.

3 We use earnings before interest, taxes, depreciation and amortisation, or EBITDA, as a proxy here

4 ROCE is defined as earnings before interest and tax divided by total capital employed

5 Compiled based on data by Aswath Damodaran, NYU Stern, 2015; the range shown is for telecom services and wireless providers, and comprises Global, Emerging markets and Japan values

0.1.2 Investing in the future: IAPs in Asia-Pacific are increasingly leveraging their customer relationships to drive adoption of innovative OTT services

In addition to these returns, IAPs have begun to invest in new OTT services. Investments have been made by IAPs in developing and developed countries, in a range of verticals. Whilst these initiatives are in their early stages, there is evidence of IAPs in the region achieving growth in these areas.

Examples of these investments in developing countries include:

- **Singtel's** investments the Amobee advertising platform and the Hooq OTT video service;
- **PLDT's** investments in its Smart Money payment app which allows overseas workers to send remittances back home, and its Smart Pinoy app which allows Filipinos overseas to send gifts to loved ones at home;
- **Grameenphone's** investment in 'WowBox', a zero-rated mobile content app;

Developed country examples include:

- **NTT DoCoMo's** investments in the 'dmarket' mobile application portal, which provides Japan-specific applications and content;
- **KDDI's** Smart Pass service, which allows access to the top 500 Android apps for a fee; and
- **Singtel's** partnership with Fetch TV, a subscription-based OTT television service, and its TV GO service in Singapore, which provides access to pay TV content to Singtel's existing TV subscribers.

In developing countries, IAPs are developing services that are tailored to specific audiences, in a way that is not easily doable for global CAPs. For example, PLDT is targeting overseas Filipino workers, and Grameenphone targets price sensitive prepaid customers. IAPs do this by taking advantage of their existing customer relationships and knowledge to provide a tailored service, seamless billing, and targeted advertising.

Consumers in developed markets already have access to advanced online content. IAPs therefore are using their customer relationships, sales channels, billing relationships, and networks to act as distributors of advanced content. They either do this as partners with CAPs (e.g. KDDI's Smart Pass, or Optus with Fetch TV) or over their own platforms (e.g. NTT DoCoMo's dmarket, Singtel's TV GO service).

These investments are at an early stage, but the fact that IAPs are committing significant sums to them speaks to the opportunities created by advanced broadband. As the Internet reaches more people in in the region, these opportunities are likely to increase further, particularly where IAPs have a unique position in understanding their customers and processing payments.

0.2 CAPs are helping to drive growth and opportunities for IAPs and other participants in the Internet value chain

0.2.1 Consumers take-up broadband services explicitly to access content and services from CAPs

For Internet adopters, online content and applications are the main drivers behind usage, the decision to upgrade their access and the value they get from the Internet

CAPs create content and services that cause consumers to sign up for broadband access. This is well documented. For example, research performed in 2013 for the Computer and Communications Industry Association (CCIA) found that European consumers using advanced services are more likely to upgrade their connection. 40% of those making video calls and 49% of those uploading video upgraded in the year preceding the study[6].

Likewise, new research commissioned for this study[7] found that there is strong latent demand for ever better services, linked to the usage of advanced content. We found that between 29% and 49% of fixed users and between 25% and 50% of mobile users responded that they would upgrade in order to receive a better user experience. In addition, a majority of current Internet users who stated that they would upgrade their fixed and mobile services ('upgraders') are significantly more likely to use advanced services such as video:

- **69%** of mobile upgraders use video several times a week or more, compared to **57%** of non-upgraders.
- **82%** of fixed upgraders use video regularly, compared to **76%** of non-upgraders.

The responses of fixed and mobile upgraders is shown in Figure 0.5 and Figure 0.6

6 http://www.ccianet.org/2013/09/new-research-shows-high-bandwidth-online-services-create-demand-for-faster-more-expensive-broadband/

7 Analysys Mason has commissioned primary research of Internet adopters in Australia, Indonesia, Singapore, Sri Lanka, and Thailand and non-adopters in Indonesia, Sri Lanka, and Thailand. For more details of the methodology and findings of this research, please refer to Annex A.

Figure 0.5: How often do you use your fixed Internet connection for the following services, asked of fixed upgraders[8] (n=1696) [Source: Analysys Mason, 2015]

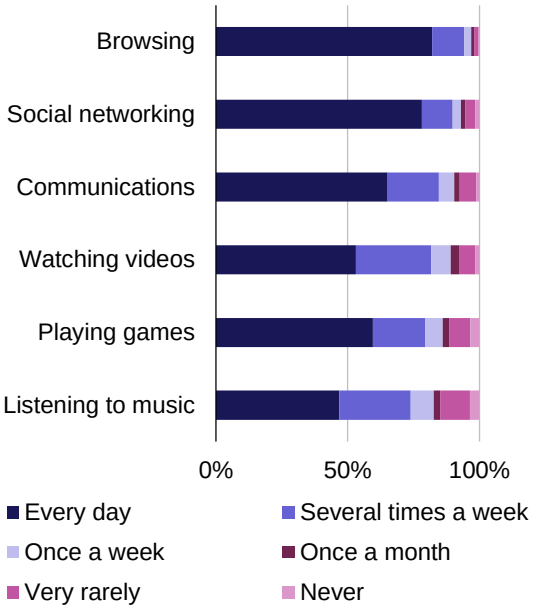
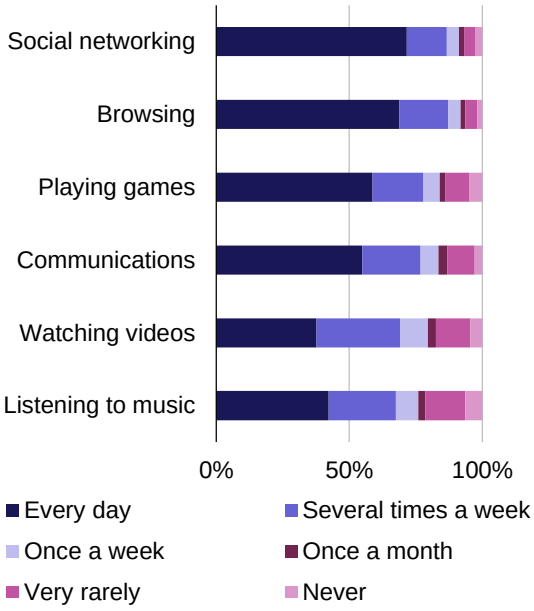


Figure 0.6: How often do you use your mobile Internet connection for the following services, asked of mobile upgraders[9] (n=2894) [Source: Analysys Mason, 2015]



Our research examined users' willingness to pay for Internet services, relative to what they currently pay (Figure 0.7). For fixed services, upgraders have a higher willingness to pay than non-upgraders, although this relationship is weaker for mobile users. This suggests that, at least for fixed users, the drive to upgrade, itself linked to usage of advanced services, is linked to a higher willingness to pay.

The research also shows that there appears to be significant untapped value in 'connecting' countries (here Thailand, Sri Lanka, and Indonesia). As shown in Figure 0.7, the willingness to pay of upgraders in these countries has a greater premium over non-upgraders when compared to 'connected' countries (Australian and Singapore). This suggests that if these countries could drive upgrades, they could unlock this high 'willingness to pay' to the benefit of both consumers and IAPs. We discuss initiatives and policies that can facilitate this in Section 0.3, notably by lowering barriers to network investments to expand coverage of faster networks and improve quality of service.

8 Fixed upgraders are defined as mobile users who gave a response other than "I don't want to upgrade", "I am already receiving the best connectivity available at my location", "Other", or "Don't know" to the question "What would make you consider upgrading the current fixed Internet service?"

9 Mobile upgraders are defined as mobile users who gave a response other than "I don't want to upgrade", "I am already receiving the best connectivity available at my location", "Other", or "Don't know" to the question "What would make you consider upgrading the current mobile Internet service?"

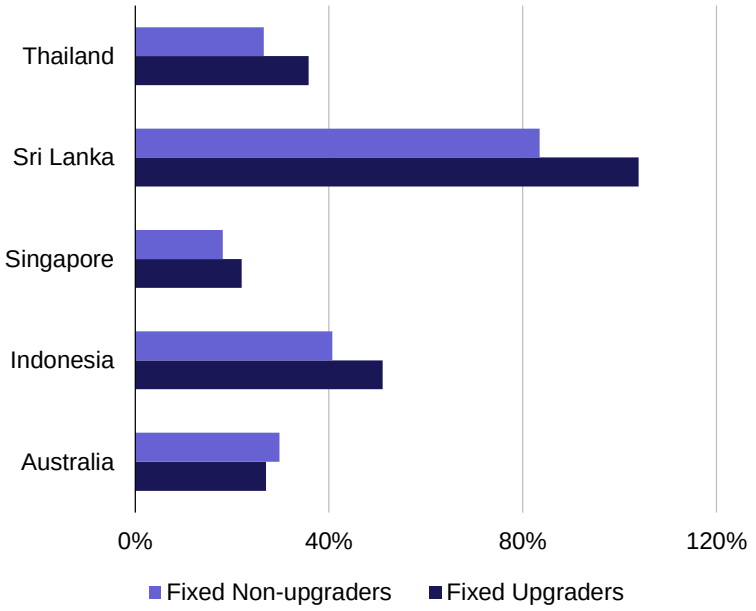


Figure 0.7: Fixed user willingness-to-pay premium above current price paid (Australia n=404, Indonesia n=297, Singapore n=520, Sri Lanka n=137, Thailand n=376) [Source: Analysys Mason, 2015]

Creating and raising awareness of content and applications relevant and accessible to non-adopters is the most important factor to improve Internet take-up

As part of our primary research programme, we spoke to 'non-adopters'[10] in Indonesia, Sri Lanka and Thailand to discuss their motivations and understand what they perceive as the main reasons not to adopt or use the Internet (Figure 0.8).

The most important reason cited was "awareness",[11] mentioned by 75% of respondents. This is a measure of whether consumers are aware of the benefits of consuming Internet content. Service availability (driven by access to a broadband network) was less important. Literacy, the lack of a connected device, and the availability of relevant content appear to be barriers for a significant minority of people.

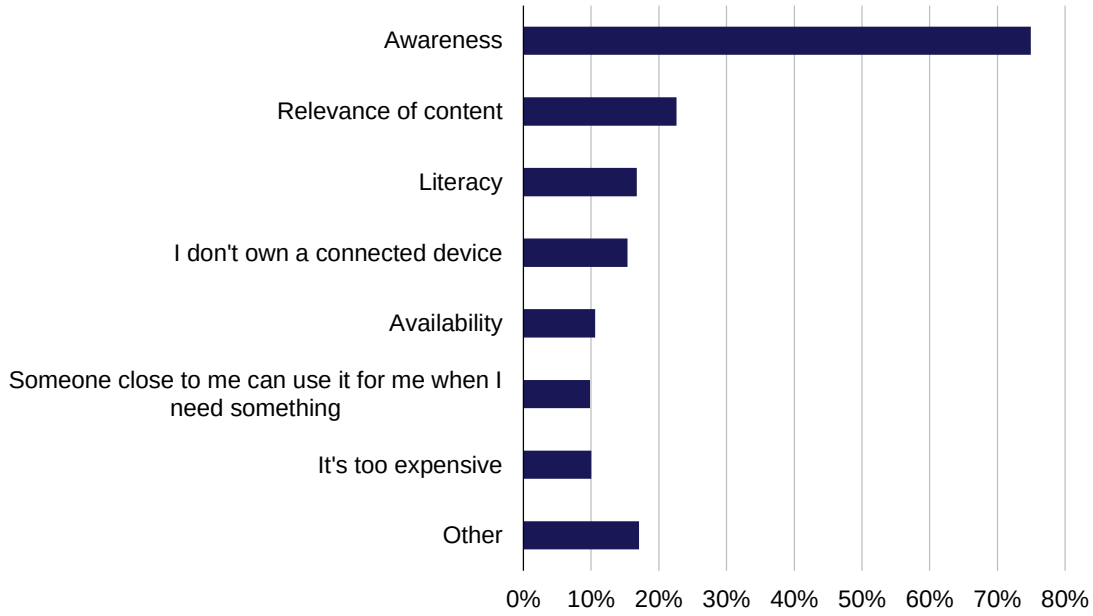
These results are also borne out by other research. Research conducted in Singapore in 2014 by the national regulatory authority, IDA[12], found that, of non-adopters, 55% said they did not need an Internet connection, and 30% said they did not know how to use the Internet, showing that awareness is also a problem for non-adopters in Singapore.

10 Defined as people who do not have either a personal mobile Internet service or a fixed Internet service at their place of residence

11 Defined as respondents who answered "I don't trust it / don't think it's safe", "I don't need it", "I don't know what the Internet is or what it does".

12 IDA Consumer Awareness and Satisfaction Survey, 2014

Figure 0.8:Reasons cited for non-adoption or non-usage of Internet services as stated by the interviewees in all countries [Source: Analysys Mason, 2015]



Notably, the majority of non-adopters have never even used the Internet before, at, for example, an Internet café, home of a friend or family member, or at work or an educational institution. This is the case for 66% of respondents in Indonesia, 82% in Sri Lanka, and 76% in Thailand. This lack of experience of the Internet is also likely to drive lack of awareness of its benefits.

In this context, future growth in adoption of Internet access services by current 'non-adopters' could be driven by awareness-raising initiatives and investments in content that is relevant and accessible to these new users. CAPs, potentially including some IAPs, will play a central role in this evolution.

0.2.2 Quality of service drives take-up and usage, and CAPs are investing alongside IAPs in network infrastructure that improves user experience of the Internet

Quality of service is linked to service upgrades for both fixed and mobile users

The quality of service received by an end user helps to drive users to upgrade their services. Indeed, users are more likely to upgrade their service if they have had a good experience of consuming advanced content. In our research, we asked respondents about the quality of their experience when watching video content. Both fixed and mobile upgraders were more likely than non-upgraders to be able to watch video with no degradation in quality at least most of the time. 83% of fixed upgraders received good quality video at least most of the time compared to 76% of fixed non-upgraders, with 69% of mobile upgraders against 56% of mobile non-upgraders receiving good video services most of the time.

CAPs are increasingly driving the quality of user experience that stimulates adoption, usage and upgrades of Internet access services

CAPs increasingly make investments in networks and infrastructure. This is in addition to the substantial investments IAPs are making in upgrading their core and access networks. CAPs are investing in many aspects of networks, from hosting to transport to the delivery of traffic to IAPs as close as possible to end-users.

A large part of the investment made by CAPs is in *hosting* infrastructure, including data centres, servers and storage devices. This hosts and processes the content and applications developed by CAPs, and houses nodes where content and applications are distributed and cached. Example Asia-Pacific investments include Google's data centres in Singapore and Taiwan, and Amazon Web Services (AWS) data centres in Singapore, Sydney, Tokyo and Beijing.

CAPs also invest in *transport* networks. These are long-distance submarine or terrestrial fibre-optic cables that carry Internet traffic around the world. Whilst IAPs and backbone operators are large investors in these, CAPs are now also major contributors. Example CAP investments in Asia-Pacific include APX-East (between Australia and the USA), FASTER (between Japan and the USA) and BBG (between South-East Asia, the Middle East and Europe).

Finally, CAPs invest in *delivery* infrastructure, which carries traffic from long-distance transport networks to IAP networks. This includes the points of interconnect where networks exchange traffic (either at Internet exchanges or private points of interconnect). It also includes *content delivery networks* (CDNs) that help to optimise traffic delivery, for example by shifting content to hosting infrastructure that is closer to end users.

These investments partly reduce the requirement for IAPs to invest themselves, for example to provide required network capacity to carry Internet traffic. Their main impact on IAPs is to reduce capital and operating costs.

They are also partly incremental. Incremental investments improve the quality of service that end users experience when consuming content and applications. CAPs make these investments to attract more users to their services, but the investments also benefit consumers and IAPs.

In a 2014 paper,[13] Analysys Mason estimated the magnitude of the global investments by CAPs in networks and infrastructure. We estimated global CAP investments to be USD33 billion per annum, of which USD7.7 billion was in Asia–Pacific.[14] Investments in submarine and terrestrial cable infrastructure were estimated to average USD2.7 billion per annum, of which USD700 million was in Asia–Pacific.

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13 See http://www.analysysmason.com/Research/Content/Reports/Content-application-provider-Internet-infrastructure-Sept2014/.

14 This figure includes the entire Asia-Pacific region

0.2.3 Challenges remain in bringing the benefits of broadband to more people and to 'unconnected' countries

We saw that a lack of awareness of the benefits of the Internet is one of the foremost drivers of non-adoption and non-usage. This creates risks associated with potential demand, which can deter investment in infrastructure, especially in 'unconnected' countries. IAPs may find it too risky to invest in new network coverage, given apparent demand for Internet services is low. Here we explore these other barriers, and the impact they have had on the 'unconnected' countries.

There are a wide range of barriers that can have an impact on broadband development outcomes

We have identified a wider range of barriers that can influence all aspects of broadband development, especially in the 'unconnected' countries. We can define drivers and barriers to development with reference to the outcome that they influence:

- The **availability of broadband services** determines whether end users are able to use these services at all. It includes the coverage access networks, backbone, hosting and other infrastructure
- The **take-up of services** reflects the extent to which consumers decide to become Internet users and sign up for services from fixed and mobile operators
- The **usage of services** refers to how much consumers actually use their Internet connections to access content and applications.

For each of these outcomes, we have identified a set of potential drivers (if they are present) or barriers (if they are lacking). An overview of these is set out in Figure 0.9.

Figure 0.9: Drivers and barriers related to availability, take-up and usage [Source: Analysys Mason, 2015]

Driver / barrier	Description
Drivers and barriers related to availability	
Business case	Is there an economic business case for rolling out broadband coverage somewhere new? Is there a policy case for it and the money to fund it? Roll-out requires fixed and mobile access networks, long-distance domestic and international backbone networks, and hosting and interconnection infrastructure. Two key factors play a role here: the *cost of inputs* such as land, equipment, spectrum and licences; and the *risk associated with demand* from consumers.
Availability of inputs	Are the key inputs required available at all? Scarcity of inputs affects three areas: • Radio spectrum and land are important for mobile networks (handled by governments and regulators) • Reliable electricity supply is important for networks and for users to recharge their devices • Existing networks that can be shared, including domestic networks and international connectivity, are important in minimising roll-out costs.
Policy and	In addition to competition and spectrum management, this includes economic regulation

Driver / barrier	Description
regulation	of telecoms networks and services. Obligations attached to telecoms licences are important drivers of roll-out. Also, policy makers increasingly include national broadband plans as a key policy plank to spur wider economic development. Finally, innovation in network roll-out is beginning to involve other areas of regulation. For example, Google's Project Loon (see Section 4) is increasing the relevance of aeronautical regulation.
Drivers and barriers related to take-up	
Cost and device availability	Does the cost to the consumer of a fixed or mobile Internet service make it unaffordable? Is the cost and payment schedule of a device a barrier to affordability? Are attractive devices available in the market? These aspects can be influenced by the market structure and strategy of device manufacturers, whether IAPs subsidise devices, and whether there are restrictive government policies or taxes (including import restrictions or duties).
Social factors	Are consumers able to use the Internet, driven by their education and awareness or by cultural restrictions? This include awareness of the benefits of Internet usage (which is influenced by both literacy and IT literacy); and whether the use of the Internet is deemed appropriate for all users in certain communities.
Drivers and barriers related to usage	
Means of access	How do consumers access the Internet? Is it on a PC at home or work, on a smartphone or tablet, or in an Internet café? This affects the content and applications that a consumer uses: for example, long videos are easier to consume at home.
Relevant, accessible content	Does interesting content exist in the local language, made by local or global CAPs?
Quality of service	Can the consumer receive content at sufficiently high bandwidths and with low enough latency? This is important for advanced content.
Trust	What is the perceived and actual level of security, driven by actual security and consumer awareness of security. Is Internet access broadly free and private? Monitoring and censorship can make consumers feel uncomfortable about accessing content freely.

'Unconnected' countries have poorer outcomes due to the greater impact of key barriers

'Unconnected' countries perform more poorly than the other clusters on all three outcomes discussed above. They have lower availability, with an average 3G coverage of 60%, and lower take-up, with a take-up of 3G and 4G services of just 3%[15]. Moreover, users in 'unconnected' countries who do take up Internet services also have substantially lower usage than users in other clusters: 17GB per annum per subscriber, compared to 157GB[16] per subscriber in connected countries.

15 Source: GSMA

16 Source: Analysys Mason

These poorer outcomes are in part driven by the greater impact of key barriers. We saw in above that a lack of awareness is a key barrier to take-up, and this is also the case in 'unconnected' countries. This barrier affects the business case for network roll-out as well. In addition, a number of other barriers apply to a greater extent in 'unconnected' countries than in other clusters:

- The cost of service plans and handsets acts as a barrier to take-up
- Low PC penetration affects the types of content that users can access at a reasonable quality
- There is less relevant content available in local languages.

CAPs and IAPs are aware of these barriers that exist in the 'unconnected' cluster. They are currently implementing an array of partnerships and programmes to address them. We explore these more fully in the next section.

0.3 Partnerships and a forward-looking policy environment are essential to unlocking further the benefits of the Internet

Here we explore how the barriers to further broadband growth in Asia–Pacific can be reduced or removed.

- CAPs are becoming essential partners in the development of broadband Internet opportunities. They are forming partnerships with IAPs and other organisations to help lower the barriers to Internet adoption and create new opportunities for mutual revenue growth.

- Proactive policy makers are implementing programmes that help to lower barriers to adoption, sometimes in partnership with IAPs or CAPs.

- Policy makers and regulators also play an essential role by ensuring that the environment they influence is as conducive as possible to investment and innovation, by IAPs, CAPs and others.

We discuss each of these in turn.

0.3.1 CAPs and IAPs are forming innovative partnerships to address these barriers

CAPs and IAPs are increasingly working together and with other industry partners to their mutual benefit to address barriers to Internet availability, take-up and usage. An overview of a number of example partnerships covered is provided in Figure 0.10, setting out the key barrier addressed, and a summary of the outcome.

Figure 0.10: Overview of example CAP partnerships [Source: Analysys Mason, 2015]

CAP	Overview	Barrier addressed	Outcome / beneficiaries
Partnerships that address availability			
O3B / Google	Satellite mobile backhaul provided by low earth orbit satellites at 8000km to IAPs	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for

CAP	Overview	Barrier addressed	Outcome / beneficiaries
			end users
Google	Project Loon, an innovative project to provide LTE coverage using atmospheric balloons in partnership with IAPs who provide radio spectrum	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Google	Titan Aerospace, which uses solar-powered aircraft to provide broadband capacity to end users	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Facebook	Provision of satellite broadband access coverage in sub-Saharan Africa in partnership with Eutelsat	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Facebook	Project Aquila which also uses solar-powered aircraft to provide broadband capacity to end users	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Partnerships that address take-up			
Mozilla	Low-cost smartphones using the open source Firefox operating system, made in partnership with local Asia-Pacific manufacturers	Device cost and availability	Lower costs for end users More customers for IAPs and CAPs
Google	Android One programme to develop low-cost smartphones in partnership with local Asia-Pacific manufacturers	Device cost and availability	Lower costs for end users More customers for IAPs and CAPs
Facebook	Free Basics programme to provide limited zero-rated Internet access in partnership with IAPs in the region	Social factors, including awareness	Greater awareness and lower costs for end users More take-up for IAPs
Partnerships that address usage			
Mozilla	Mozilla handset localisation programme, that provides local language handsets and content in Asia-Pacific countries	Relevant content in local languages	More relevant content for users Greater usage for CAPs
Google	Android carrier billing, which integrates the Google Play store with IAPs' billing systems, allowing customers to pay for apps and content on their mobile bill	Relevant content	Easier access to relevant content for users More usage revenue for CAPs and IAPs
Facebook	Partnership with Ericsson and Axiata to improve network quality of service in Indonesia	Quality of service	Better experience for users More usage revenue for CAPs and IAPs

0.3.2 Proactive policy makers are implementing innovative policy initiatives to lower barriers, often in partnership with IAPs or CAPs

Policy makers are also working to address barriers, often in partnership with IAPs or CAPs. Here, we present an overview of a number of policy initiatives that are lowering barriers in the Asia-Pacific region (shown in Figure 0.11), setting out a description of the barrier addressed and the outcome.

Figure 0.11: Overview of example policy initiatives [Source: Analysys Mason, 2015]

Country	Initiative	Barrier addressed	Outcome / beneficiaries
Initiatives that address availability			
Japan	Public funding for broadband roll-out	Business case for network roll-out	Increased take-up of fibre, benefiting IAPs, CAPs and users
South Korea	Public funding for broadband roll-out	Business case for network roll-out	Increased take-up of fibre, benefiting IAPs, CAPs and users
Singapore	Development of national broadband network	Business case for network roll-out	Increased take-up of fibre, benefiting IAPs, CAPs and users
Initiatives that address take-up			
South Korea	ICT education programme	Social factors, including awareness of the benefits of the Internet	Improved awareness for ~16 million people, potentially improving take-up and usage
Malaysia	1Malaysia netbook distribution programme	Affordability of connected devices	PC penetration increased to ~65%, lowering a key barrier for users to take up broadband
Initiatives that address usage			
Japan	Investments in e-government	Relevant accessible content	More efficient and relevant content and applications for users
Malaysia	Investments in e-government, e-education and e-health	Relevant accessible content	More efficient and relevant content and applications for users

0.3.3 Policy makers have an essential role to play in ensuring that barriers to innovation and investment are as low as possible

In addition to public interventions discussed above, policy makers play a crucial role in lowering Internet barriers by creating an attractive regulatory environment. Here we discuss how good public policy practices can help to achieve this. We draw lessons from the outcomes achieved by

countries in the 'connected', 'connecting' and 'unconnected' clusters, and from our discussion of key barriers in Section 3.3.[17]

We have identified four examples of good public policy practice.

Sector liberalisation and the encouragement of sustainable development

This includes a licensing regime that does not unnecessarily limit the number of new entrants and has few restriction on technology or services deployed. Scarce resources such as radio spectrum should be managed transparently, so that as much spectrum as possible is available to market participants including non-traditional users, to encourage innovation and new investment.

Effective competition regulation that stimulates investment

In many of the countries of interest in this study, consumers are enjoying a great amount of choice and operators are competing vigorously for customers. Competition regulation should strike a balance between encouraging competition, investment and innovation. Regulatory forbearance should be applied where competition issues are unclear or transitory. This is often the case for online content and platforms, which are enablers of content consumption and innovation, and for new, risky investment by established operators.

Attractive business conditions

Business and investment conditions should be conducive to investment. This includes low barriers to foreign direct investment, and a light administrative burden to starting and running a business. The tax burden on telecoms services and devices should not be excessive. Censorship and surveillance of Internet users and content providers can discourage investment.

Policies should be in place that lower barriers to the construction of fibre networks. This includes policies that encourage passive infrastructure such as ducts and poles to be shared, streamline construction permissions, and ensure newly installed ducts are large enough to be shared.

Carefully balanced data protection and localisation regulations

Data protection and localisation regulation should be carefully traded off against the encouragement of innovation. Requirements that strictly limit the purpose for which data can be used may inhibit innovation by preventing CAPs using hidden patterns in databases to create new services. Likewise limitations on the transfer of data between firms or countries may inhibit innovation by preventing firms from combining their capabilities to develop new services.

[17] This builds on work we have conducted for regulators and operators in the region (including the GSMA), and for NGOs and industry groups such as the Internet Society in Africa and Latin America.

Forced data localisation policies, such as those that require certain data to be held in-country, raise a number of concerns. They can have negative impacts on consumers and the Internet ecosystem, by raising costs and restricting access to services. They are difficult to implement through regulation, as they require substantial underlying infrastructure to be present in the first place to work in practice. These policies can also deter investment in other data-heavy industries, including banking and retail, which are essential to the development cycle of emerging economies.

Finally, they are also not very good at preserving privacy and security; in fact, local storage policies may be counter-productive if they increase the vulnerability of the data to cyber-attacks and reduce the resilience of services that rely on it.

A more-effective policy is to ensure that local market conditions are attractive for investment by providing high-quality, low-cost infrastructure, and following the good practices outlined here.

1 About this report

This report explores how the broadband ecosystem has developed in Asia–Pacific over the last 15 years, and the opportunities that this has created for consumers and telecoms operators throughout the region. It draws upon Analysys Mason's extensive experience of working in Asia–Pacific, for operators, policy makers, regulators and investors, as well as an original consumer survey conducted in five countries, spanning over 4000 respondents.

Our analysis covers 21 countries: Australia, Bangladesh, Brunei Darussalam, Cambodia, Hong Kong, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, New Zealand, Pakistan, Papua New Guinea, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand and Vietnam.[18] These countries are highly varied, ranging from the most advanced broadband markets in the world (Japan and South Korea) to the least advanced (e.g. Papua New Guinea, Bangladesh).

In Section 2 of this report, we show that the tremendous growth in broadband (28% annual growth since 2000) has created opportunities for the telecoms operators that provide these broadband services in the region. As convergence has moved from buzzword to reality, these Internet access providers (IAPs) have kept investing in modernising, upgrading and expanding their networks, generating returns that are now overwhelmingly driven by broadband services. They have also begun to take advantage of new opportunities created by the increasing spread of advanced broadband[19], by deploying more-advanced networks and innovating with services, including "over-the-top" (OTT) online content and services.

In Section 3, we highlight how Internet content and application providers (CAPs), whose core business is *content*, have helped to drive this growth and enable these new opportunities. Fundamentally, consumers take up broadband services in order to access advanced online content. This content exists because of the investments made by CAPs, both large and small. Likewise, the investments that CAPs have made in networks and infrastructure have helped to improve the experience of consumers when using the Internet. This also helps to drive broadband take-up.

Finally, in Section 4 we show how broadband take-up and usage throughout the region, including in the less connected countries, could be accelerated through innovative partnerships, good regulation and judicious public initiatives.

This report includes a number of annexes containing supplementary material:

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18 India and China are not covered in this report, as their scale and diversity means they warrant separate reviews of their own.

19 We define advanced mobile broadband as services delivered over either a 3G or 4G network. We define advanced fixed broadband as a service to a fixed location offering download speeds of 4Mbit/s or greater, based on the approximate connection speed required to watch a single standard-definition video stream. Other policy bodies have their own definitions. For example, the ITU defines broadband as a 2Mbit/s connection, based on the speed offered by primary-rate ISDN, while the FCC recently changed its definition of broadband from 4Mbit/s to 25Mbit/s.

- Annex A sets out the methodology of primary research we have conducted
- Annex B discusses the current state of the broadband ecosystem in the region
- Annex C describes the key barriers to broadband development in the region.

2 The rise of broadband Internet has created opportunities for Asia–Pacific telecoms operators to thrive

The rapid growth in take-up and usage of advanced broadband in Asia–Pacific has created opportunities for players across the value chain. Despite a shift in demand away from legacy voice services towards broadband Internet services, IAPs in particular have seen opportunities to make sustainably profitable investments in advanced networks. This shift has also created opportunities for IAPs to 'move up' the value chain, and make investments in new and innovative OTT services. In this section, we explain how IAPs are seizing these opportunities, generating sustainable returns and investing in future growth opportunities.

2.1 Broadband Asia-Pacific: a strong growth story, but wide variations remain

Internet markets in Asia–Pacific have seen strong growth over time, in terms of both take-up of broadband services and the use of online content and applications, as shown in Figure 2.1 and Figure 2.2.

Figure 2.1: Total 3G and 4G connections in Asia–Pacific [Source: GSMA, 2015]

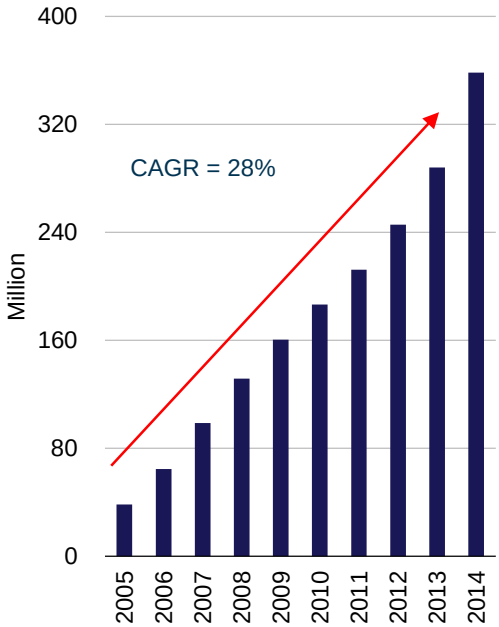
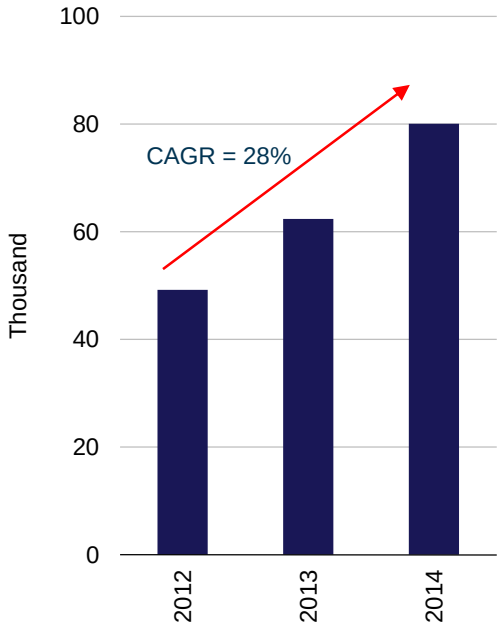


Figure 2.2: Total annual data usage (PB) in Asia–Pacific [Source: Analysys Mason, 2015]



Although the region as a whole has seen strong growth, the level of broadband development varies widely from one country to another. We have classified the 21 countries of interest into three groups, or 'clusters', reflecting varying stages of development:

- *Connected* countries. These countries are advanced, with near-ubiquitous coverage of 3G and 4G mobile and fixed broadband, high take-up, and high usage of advanced services. Countries

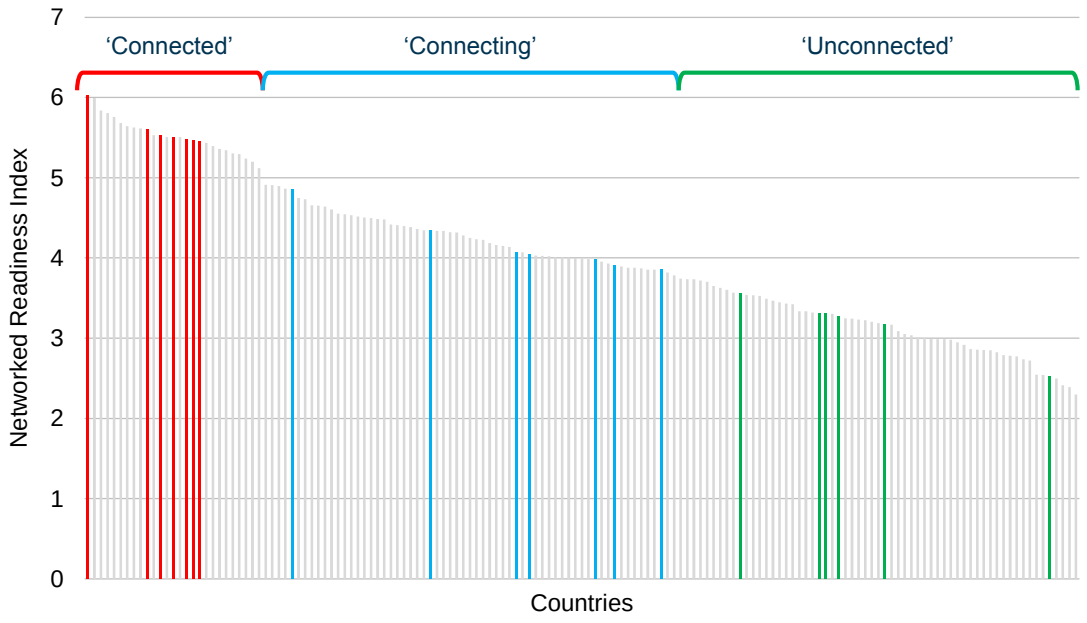
in this cluster are Australia, Hong Kong, Japan, New Zealand, Singapore, South Korea and Taiwan.

- *Connecting* countries. These countries have high coverage, but moderate take-up of 3G and 4G mobile broadband, low coverage and take-up of fixed broadband, and increasing usage of advanced Internet services. Countries in this cluster are Brunei Darussalam, Cambodia, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand, and Vietnam.

- *Unconnected* countries. These countries have yet to develop advanced broadband services. They have very little coverage or take-up of either 3G mobile services or advanced fixed broadband services. Countries in this cluster are Bangladesh, Laos, Myanmar, Nepal, Pakistan, and Papua New Guinea.

Figure 2.3 below shows where these countries sit in the Networked Readiness Index produced by the World Economic Forum[20].

Figure 2.3: Country clusters against Networked Readiness Index [Source: World Economic Forum, 2015]



For more detail regarding the broadband markets in these clusters, please refer to Annex B.

[20] This index measured the level of development of the ICT sector, and includes metrics such as the regulatory environment, quality of ICT infrastructure, usage by business and consumers, and social benefits of ICT.

2.2 The current picture: broadband is replacing legacy services as the main revenue and profit driver for IAPs

In this context of strong growth, the core business of IAPs has evolved from being voice- and private data-centric, to being focused on selling broadband access services. This has sometimes resulted from a shift in demand from existing narrowband services towards broadband, and indeed from other 'legacy' services such as voice telephony and SMS, which consumers can in part replace by over-the-top (OTT) services using a broadband connection.

Overall, IAPs in the region have seen their revenue grow as broadband has developed,[21] but this has not translated into higher profits always and everywhere, in part because of these shifts from old to new services and in part because of increased competition in many markets. To provide these new services, however, IAPs have continued to make investments and have managed to maintained a relatively stable rate of returns on these investments, avoiding commoditisation and price declines even as the industry matured. In addition, IAPs have begun to invest in innovative OTT services, which have offered opportunities for growth beyond the traditional network business. We explore those further in Section 2.3.

Asia–Pacific telco revenues have seen sustained growth since the introduction of broadband services

The impact on IAPs of the strong growth in broadband is clear from the sustained growth in overall telco revenues throughout the region since the introduction of advanced broadband, as shown in Figure 2.4. This shows total industry revenue growth from fixed and mobile services since the introduction of advanced broadband. It is clear that both 'connected' and 'connecting' countries have seen strong growth since the development of broadband began.

Note: 'unconnected' countries are excluded from this analysis, as these have yet to develop advanced broadband.

[21] In both real and nominal terms, i.e. growth has outstripped inflation

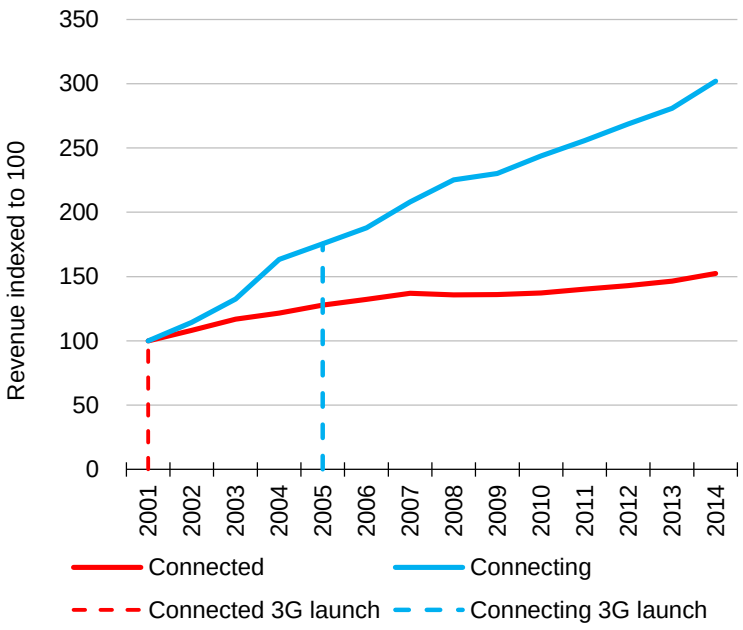


Figure 2.4: Overall IAP revenue in 'connected' and 'connecting' clusters, indexed to the year of 3G launch, using constant exchange rates [Source: GSMA, company data, ITU, TeleGeography, Analysys Mason, 2015]

In addition to an overall increase in revenue, IAPs have also seen a very marked increase in the importance of data and Internet services within their revenue mix. In all countries, the proportion of industry revenue from data and Internet services has increased significantly since the launch of advanced broadband services. This is illustrated in Figure 2.5 below, starting from the year of 3G launch. Connecting countries have rapidly caught up with 'connected' countries, demonstrating the importance of the Internet in the telecoms sectors of many middle-income Asia–Pacific economies.

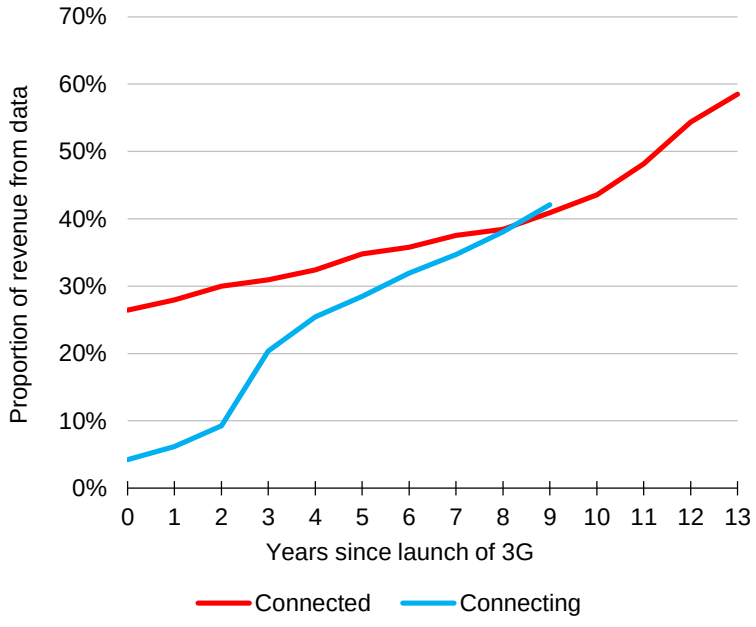


Figure 2.5: Proportion of total service revenue from data and Internet services [Source: GSMA, company data, ITU, TeleGeography, Analysys Mason, 2015]

Profit growth is now largely attributable to broadband

As revenue has grown and shifted from voice to data services (including Internet access), IAP profitability[22] has shifted from traditional services such as voice telephony to data services, including broadband Internet access and usage. Over this period, EBITDA has been constrained, but relatively stable in all countries in the region (reflecting many factors such as subsidies for high-end handsets). Figure 2.6 below shows growth in total industry EBITDA, for both fixed and mobile services, since the first introduction of advanced broadband networks.

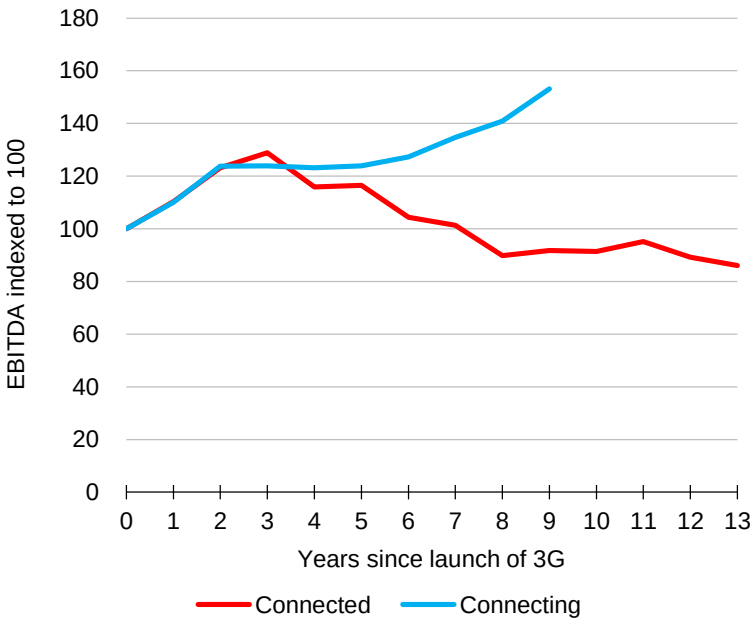


Figure 2.6: Total market EBITDA indexed to the year of launch of 3G [Source: GSMA, company data, ITU, TeleGeography, Analysys Mason, 2015]

With modern networks, IAPs are able to provide all their services over the same infrastructure, and so the shift in revenue towards data and Internet services implies that these are now a significant (and in some cases the dominant) source of IAP profits. Key to this are developments in 4G mobile access networks, which are fundamentally broadband data networks that allow spectrum and access network resources to be shared seamlessly between services. Likewise, the development of converged core networks allows all voice and data traffic to be carried seamlessly over an IP network.

This technical evolution has increased economies of scope by removing the need to have dedicated equipment for both voice and data services, and has also increased economies of scale by improving the utilisation of the shared equipment. As a result, the profits made by IAPs are now mainly attributable to data services, a pattern that is set to continue for years to come. Figure 2.7

[22] We use earnings before interest, taxes, depreciation and amortisation, or EBITDA, as a proxy here.

below illustrates very simply what profits from broadband could look like on the basis of their share of revenue.[23]

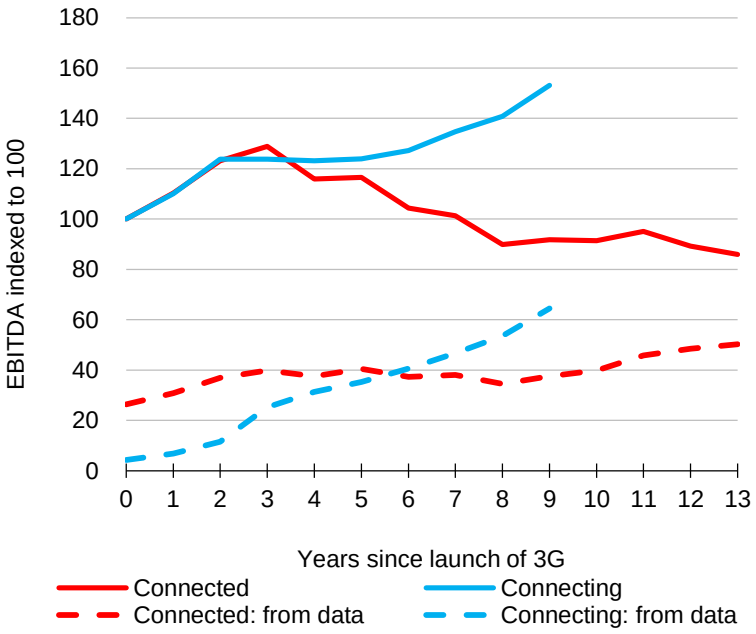


Figure 2.7: Illustrative EBITDA, overall and from data services, constant exchange rates [Source: GSMA, company data, ITU, TeleGeography, Analysys Mason, 2015]

Broadband investment opportunities and the returns on these investments have remained strong

To achieve this growth in data revenue and profit, IAPs have made significant investments in their networks. The majority of these investments have been in the access networks that connect to end users, as well as in core networks that can seamlessly handle all types of service. Mobile operators have made investments in rolling out advanced 4G networks. Fixed operators have invested in either upgrades to network equipment (in the case of cable operators and traditional telecoms operators investing in DSL networks) or the installation of new fibre links to end customers.

The magnitude of these investments is significant at between USD17 billion and USD19 billion per annum in the region over the past five years, as shown in Figure 2.8 below for the 'connected' and 'connecting' clusters.

[23] This is highly simplified, but in the context of converged, multi-services networks, it does provide a reasonable first-order estimate of profit allocation

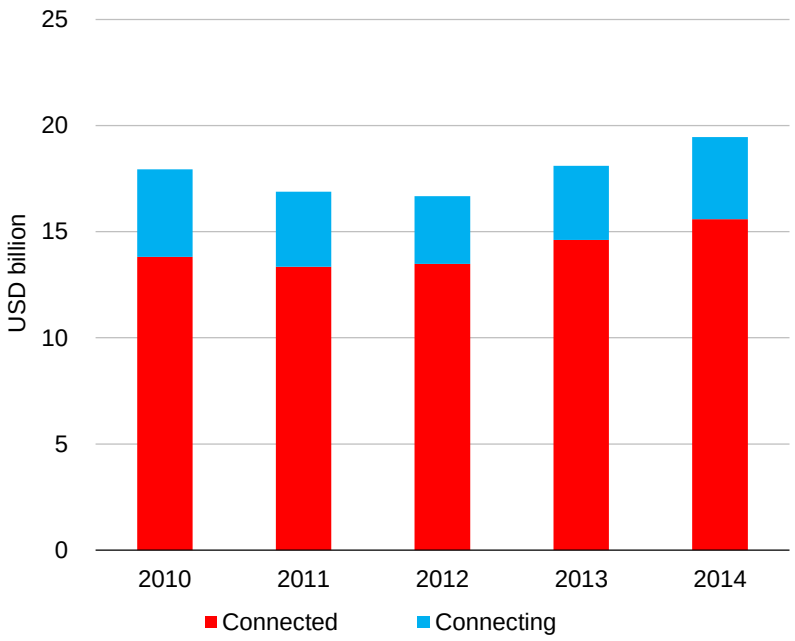


Figure 2.8: Total annual capital expenditure in 'connected' and 'connecting' clusters, at constant exchange rates [Source: Analysys Mason, company data, GSMA, TeleGeography, ITU, 2015]

These investments have continued to produce healthy returns, as profits from Internet and data services have held up well throughout the region. Overall industry returns, measured by the return on capital employed (ROCE) ratio,[24] are illustrated in Figure 2.9 below. These appear healthy overall for mature markets, comparable to estimates of the cost of capital for telecoms operators (represented by the green band in Figure 2.9).[25] Countries where network upgrades are recent or currently underway have a lower level of ROCE partly because equipment costs tend to be larger compared to their revenues.

24 ROCE is defined as earnings before interest and tax divided by total capital employed.

25 Compiled based on data by Aswath Damodaran, NYU Stern, 2015; the range shown is for telecoms services and wireless providers, and comprises Global, Emerging markets and Japan values.

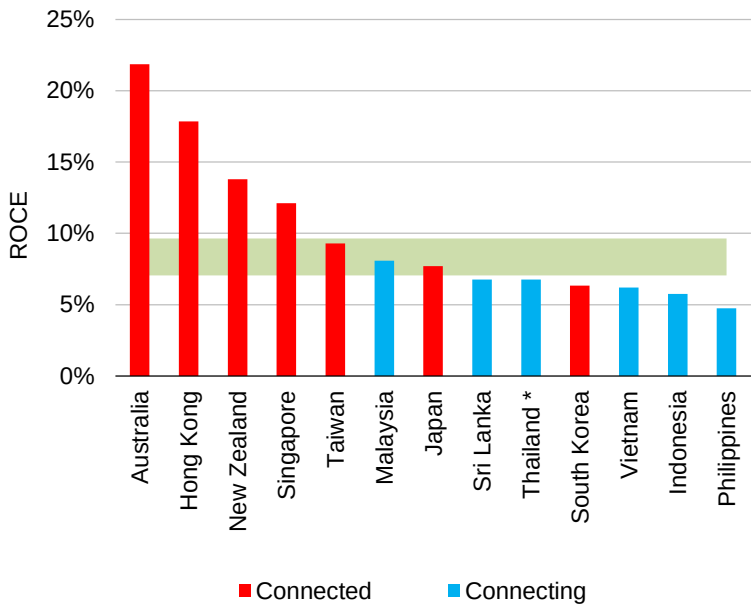


Figure 2.9: ROCE for IAPs in 'connected' and 'connecting' clusters [Source: Analysys Mason, company data, GSMA, TeleGeography, ITU, Aswath Damodaran (NYU Stern), 2015]

* The ROCE for Thailand is for mobile only.

2.3 Investing in the future: IAPs in Asia–Pacific are increasingly leveraging their customer relationships to drive adoption of innovative OTT services

In addition to the returns from investment in broadband networks, IAPs have begun to take advantage of the opportunities to invest in new and innovative OTT services. Investments have been made by IAPs in both developing and developed countries, in a range of verticals, including video and entertainment, financial services, advertising and broader applications platforms. Whilst these initiatives are in their early stages, there is evidence of IAPs in the region achieving growth in these areas.

OTT investments have been made by IAPs in both developing and developed countries, in a range of verticals, including video and entertainment, financial services, advertising and broader applications platforms. Examples from developing countries include:

- **Singtel's** investments in OTT services, including the Amobee mobile advertising platform and the Hooq OTT video service in Thailand, India, and the Philippines
- **PLDT's** investments in payment and remittance services, and in the Smart Pinoy app, which provides content and services to Filipinos overseas
- **Grameenphone's** investment in WowBox, a zero-rated[26] mobile content app aimed at prepaid users, funded by advertising.

[26] Content that is zero-rated does not attract usage charges from the IAP or deplete a customer's monthly usage quota.

Examples from developed countries include:

- **NTT DoCoMo's** investments in the 'dmarket' mobile application portal
- **KDDI's** Smart Pass service, which allows access to the top-500 Android apps for a monthly fee
- **Singtel's** partnership with Fetch TV, a subscription-based OTT television service, via its Australian subsidiary, Optus, and its TV GO service in Singapore.

We explore these in more detail below, looking at how the IAPs are leveraging their existing capabilities, such as their networks and relationship with a large customer base, and then discussing the role played by content and application providers (CAPs).

In developing countries, IAPs leverage their customer relationships and networks to reach customers underserved by global CAPs

In developing countries, IAPs are helping to bring online services and content that are highly tailored to specific audiences, in a way that is not easily doable for global CAPs. For example, PLDT is targeting overseas Filipino workers, and Grameenphone targets price sensitive prepaid customers with advertising funded content. In doing so, IAPs take advantage of their existing relationships with the vast majority of end-users in their markets. They are doing this in a number of ways:

- They leverage their customer relationships and marketing knowledge to provide seamless services targeted at specific national groups. For example, PLDT's Smart Money and Smart Pinoy services target overseas Filipino workers, a large group across Asia whose needs are not well served by either global CAPs or non-Philippine IAPs.
- They leverage their customer databases and billing relationships to provide targeted advertising services. Grameenphone's WowBox application and Singtel's Amobee mobile advertising platform are both examples of this.

It should be noted that CAPs are involved as partners in a number of these investments, where they provide capabilities or assets that IAPs do not have. For example, Singtel's Hooq service relies on content produced by major studios (Sony Pictures and Warner Bros), and IAP applications are promoted and distributed through online and mobile app stores.

An overview of selected OTT opportunities in developing countries is provided in Figure 2.10. This summarises how each opportunity leverages the existing capabilities of IAPs, and where relevant outlines the involvement of CAPs.

Figure 2.10: Selected OTT opportunities for IAPs in developing countries [Source: Company data, Analysys Mason, 2015]

Overview of opportunity	Leverage of existing IAP capabilities	CAP involvement
Singtel		
Amobee is a mobile advertising platform which provides real-time mobile ad serving, and detailed reporting and ad response analysis to advertisers	Leverages data from Singtel's large existing mobile customer base, allowing better targeting of advertising	N/A
The Hooq OTT video app allows video content to be streamed to any device on a Singtel or partner network. It has been launched in Thailand, India and the Philippines	Leverages existing customer base for marketing and billing relationship for ease of payments.	Content partnership with Warner Bros and Sony Pictures. Relies on app store for distribution
PLDT		
Smart Money is an electronic wallet which allows bill payment, money transfer to other Smart mobile subscribers, and remittances from overseas using a Smart mobile phone	Takes advantage of Smart's large mobile customer base in the Philippines (51 million), and the large numbers of Filipino overseas workers who send remittances back home	Smart Money is accepted in Apple's App Store and on iTunes
Smart Pinoy is an e-commerce platform targeted at overseas Filipino workers. It allows customers to send gifts to friends and family in the Philippines, as well as providing other services such as free calls to consulates	Takes advantage of Smart's brand strength among overseas Filipinos, as well as distribution networks in the Philippines	Smart Pinoy is distributed through CAP app stores
Grameenphone		
The WowBox app provides mobile content to prepaid users that is funded by advertising. Use of WowBox does not deplete users' prepaid balance	Allows Grameenphone's large, price-sensitive prepaid customer base to access Internet content free of charge	N/A

In developed markets, IAPs are distributing advanced content-rich OTT services, often together with CAPs but sometimes on their own platforms

Consumers in developed markets already have access to a wealth of advanced content and applications on their fixed and mobile devices. Because of this, IAPs are using their customer relationships, sales channels, billing relationships and networks to act as distributors of advanced content. They do this either by partnering with CAPs (e.g. KDDI's Smart Pass, or Optus with Fetch TV) or over their own platforms (e.g. NTT DoCoMo's dmarket, Singtel's TV GO service).

An overview of selected OTT opportunities in developed countries is shown in Figure 2.11.

Figure 2.11: Selected OTT opportunities for IAPs in developed countries [Source: Company data, Analysys Mason, 2015]

Overview of opportunity	Leverage of existing capabilities	CAP involvement
NTT DoCoMo		
The dmarket application platform comes pre-installed on NTT DoCoMo smartphones. It supports the download of content (e.g. anime, TV) and offers a variety of applications	Leverages NTT DoCoMo's large customer base and wide range of Japan-specific content and applications	dmarket competes with CAP application platforms
KDDI		
Smart Pass comes pre-installed on KDDI Android devices. It provides unlimited access to the top-500 Android apps for a monthly subscription fee	Uses KDDI's billing relationship with its customers to make it simpler for users to consume content and applications, thus helping to drive data usage	Service has been developed in partnership with Google / Android
Singtel		
Singtel's Australian subsidiary, Optus, offers Fetch TV on its fixed and mobile networks. Fetch TV is a subscription-based OTT TV service that provides TV channels in English and several Asian languages, as well as Netflix. It is viewed via a set-top-box or mobile app	Uses Optus's fixed and mobile broadband networks, and leverages its billing relationships with customers, and marketing and sales channels	Fetch TV is offered by a CAP that is backed by Malaysia's Astro (a major pay-TV operator)
Singtel TV GO is an OTT mobile video app. It is offered to Singtel's existing pay-TV subscribers free of charge	Uses Singtel's customer relationships, content deals and network to offer pay-TV customers a differentiated service	Singtel has deals with a number of content owners to distribute pay-TV content to fixed and mobile devices

IAPs can offer compelling OTT services where they can leverage their existing capabilities and assets

IAPs have a number of capabilities and assets that they can use to carve out a space in the rapidly growing market for OTT content and applications. In particular, they have a deep existing relationship with their existing customers, including sales channels, marketing knowledge and billing arrangements. In both developed and developing countries, there are examples of IAPs leveraging these capabilities in their OTT investments.

Despite the early-stage nature of most of the investments, the fact that IAPs are making them indicates the opportunities that are being created by the increased availability of advanced broadband. As the Internet reaches more people in the region, and the number of users continues to grow, these opportunities are likely to increase.

3 CAPs are helping to drive growth and opportunities for IAPs and other participants in the Internet value chain

CAPs create the content and services available on the Internet, and have been key drivers of growth and enablers of opportunities in the broadband world. This has benefited all players in the value chain by driving take-up and usage of broadband services.

Consumers take up or upgrade their broadband services in order to access advanced online content. When they do not take up a broadband service, the most significant factor is either a lack of content relevant to them, or a lack of awareness about this content. The content which exists does so because of the investments made by CAPs. In addition, the investments made by CAPs in networks and infrastructure have helped to improve users' experience of the Internet. This also helps to drive take-up of broadband services.

In 'unconnected' countries, there are further barriers to Internet development which have an arguably greater impact than that seen in the other clusters. These include affordability, a lack of local-language content, and PC/smartphone penetration, among others. CAPs large and small are already investing in trying to alleviate some of these barriers, and exploring partnerships with IAPs to address them (something we discuss in more depth in Section 4).

We discuss each of these issues below.

3.1 Consumers take up broadband services explicitly to access content and services created by CAPs

For adopters of broadband, online content and applications are the main drivers behind usage, the decision to upgrade their access and the value they get from the Internet

The main reason why consumers sign up for broadband access from IAPs is to use the content and services created by CAPs. For example, research conducted in 2013 for the Computer and Communications Industry Association (CCIA) found that European consumers who use advanced services are more likely to upgrade their connection: 40% of those making video calls and 49% of those uploading video upgraded in the year preceding the study.[27]

New research we commissioned as part of this study, focusing on Asia-Pacific, shows similar conclusions[28]. Fixed and mobile Internet subscribers in the five countries surveyed make very

[27] See http://www.ccianet.org/2013/09/new-research-shows-high-bandwidth-online-services-create-demand-for-faster-more-expensive-broadband/.

[28] Analysys Mason has conducted primary research among Internet adopters in Australia, Indonesia, Singapore, Sri Lanka and Thailand, and among non-adopters in Indonesia, Sri Lanka and Thailand. For more details of the methodology and findings of this research, please refer to Annex A.

frequent use of key Internet services offered by CAPs: 88% of fixed users (Figure 3.1) and 82% of mobile users (Figure 3.2) access social networks either every day or several times a week, and 80% of fixed and 66% of mobile users access video content daily or several times a week.

Figure 3.1: How often do you use your fixed Internet connection for the following services? (n=2202) [Source: Analysys Mason, 2015]

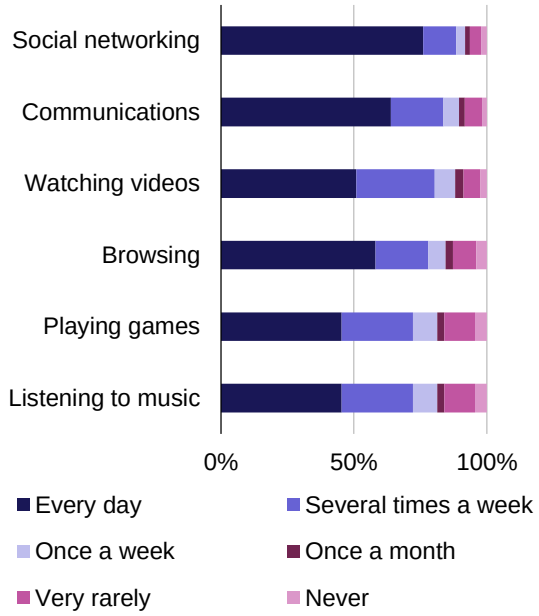
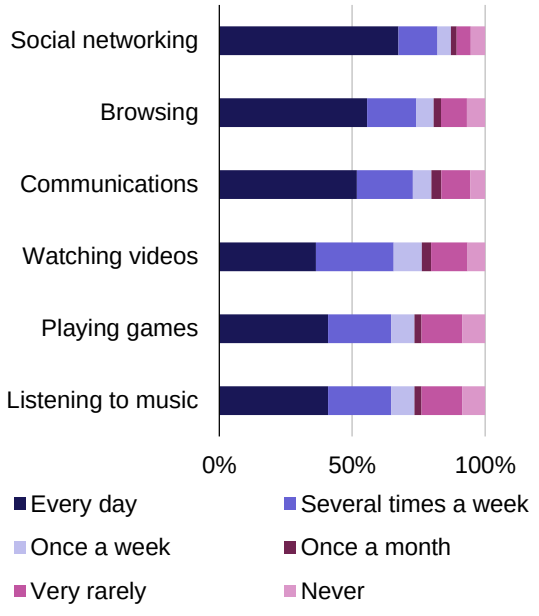


Figure 3.2: How often do you use your mobile Internet connection for the following services? (n=4100) [Source: Analysys Mason, 2015]



As people use the Internet, their appetite for richer content increases, which drives their interest in more-advanced broadband access services. We found that between 61% and 88% of fixed customers and between 52% and 87% of mobile customers would consider upgrading their services, for reasons of either price, quality or both (illustrated in Figure 3.3 and Figure 3.4.)

Figure 3.3: What would make you consider upgrading your current fixed Internet service? (Australia n=529, Indonesia n=375, Singapore n=677, Sri Lanka n=194, Thailand n=427) [Source: Analysys Mason, 2015]

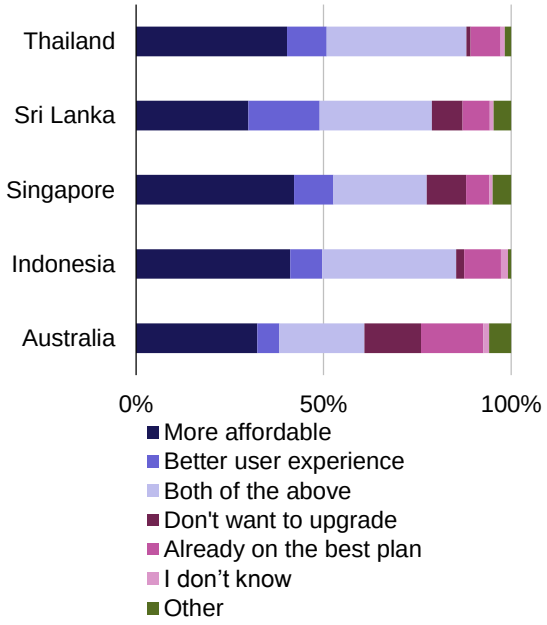
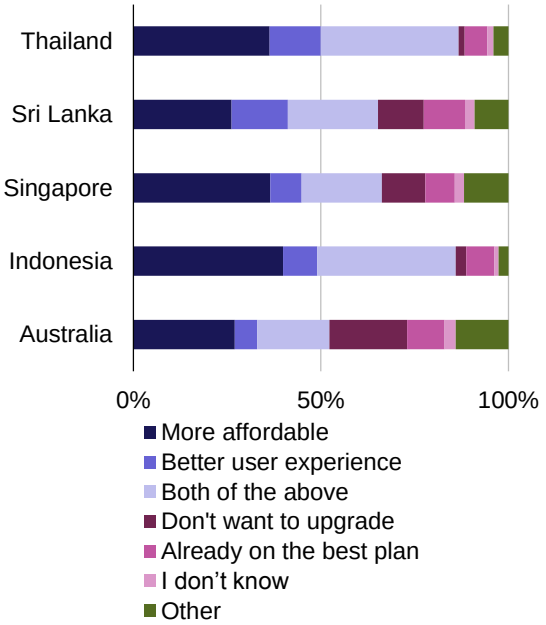


Figure 3.4: What would make you consider upgrading your current mobile Internet service? (Australia n=1000, Indonesia n=800, Singapore n=1000, Sri Lanka n=500, Thailand n=800) [Source: Analysys Mason, 2015]



This strong potential intention to upgrade suggests that there may be a latent demand for better services. Indeed, between 29% and 49% of fixed users and between 25% and 50% of mobile users responded that they would upgrade in order to receive a better user experience.

In addition, the majority of current Internet users who stated that they would upgrade their fixed and mobile services ('upgraders') are significantly more likely to use advanced services such as video:

- **69%** of mobile upgraders (Figure 3.5) use video several times a week or more, compared to **57%** of non-upgraders (Figure 3.6).
- **82%** of fixed upgraders (Figure 3.7) use video regularly, compared to **76%** of non-upgraders (Figure 3.8).

Figure 3.5: How often do you use your mobile Internet connection for the following services? (asked of mobile upgraders,[29] n=2894) [Source: Analysys Mason, 2015]

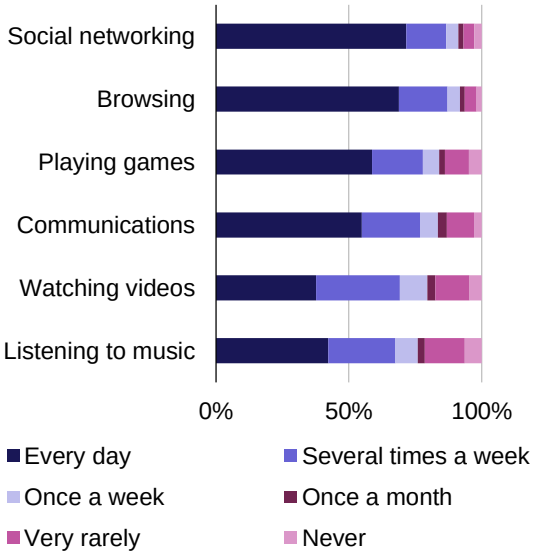


Figure 3.6: How often do you use your mobile Internet connection for the following services? (asked of mobile non-upgraders, n=1206) [Source: Analysys Mason, 2015]

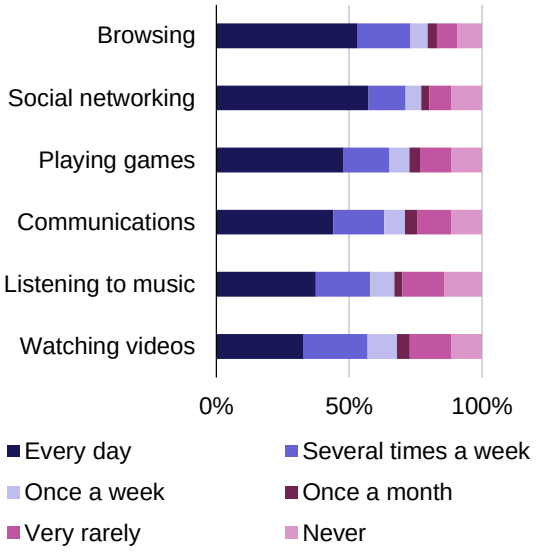


Figure 3.7: How often do you use your fixed Internet connection for the following services? (asked of fixed upgraders,[30] n=1696) [Source: Analysys Mason, 2015]

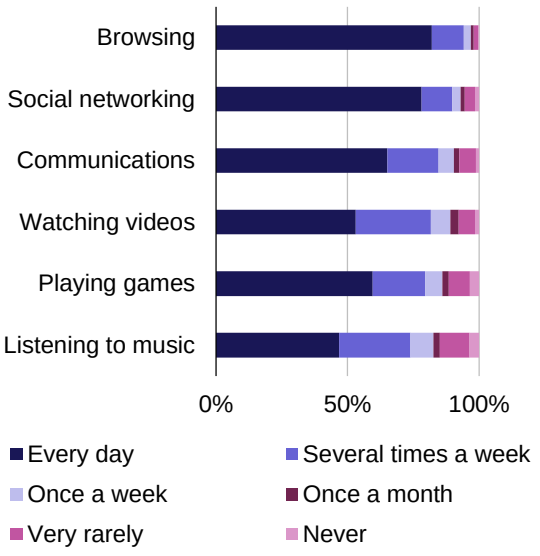
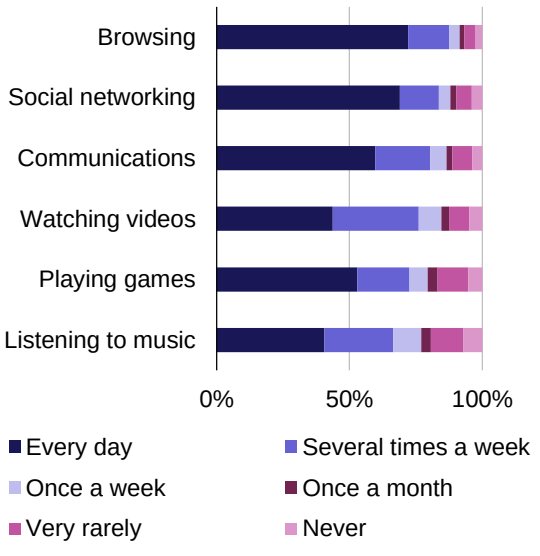


Figure 3.8: How often do you use your fixed Internet connection for the following services? (asked of fixed non-upgraders, n=506) [Source: Analysys Mason, 2015]



29 Mobile upgraders are defined as mobile users who gave a response other than "I don't want to upgrade", "I am already receiving the best connectivity available at my location", "Other", or "Don't know" to the question "What would make you consider upgrading the current mobile Internet service?".

30 Fixed upgraders are define as mobile users who gave a response other than "I don't want to upgrade", "I am already receiving the best connectivity available at my location", "Other", or "Don't know" to the question "What would make you consider upgrading the current fixed Internet service?".

This usage of online content and services delivers value to users. Users receive value (known as 'consumer surplus') from a service if the maximum amount they would be prepared to pay (their 'willingness to pay') is greater than the market price for the service.

In our research we examined users' willingness to pay for Internet services, relative to what they currently pay (Figure 3.9). For fixed services, we found that upgraders have a higher willingness to pay than non-upgraders, although this relationship is weaker for mobile users. This suggests that, at least for fixed users, the drive to upgrade, itself linked to the use of advanced services, is linked to a higher willingness to pay.

In addition, it appears that the willingness to pay of upgraders in 'connecting' countries (here Thailand, Sri Lanka, and Indonesia) has a greater premium over non-upgraders when compared to 'connected' countries (Australian and Singapore). This means that if these countries could drive upgrades, potentially by lowering barriers to network investments that could improve quality of service, there could be significant value created by unlocking this willingness to pay. We discuss initiatives and policies that can achieve this in Section 4.

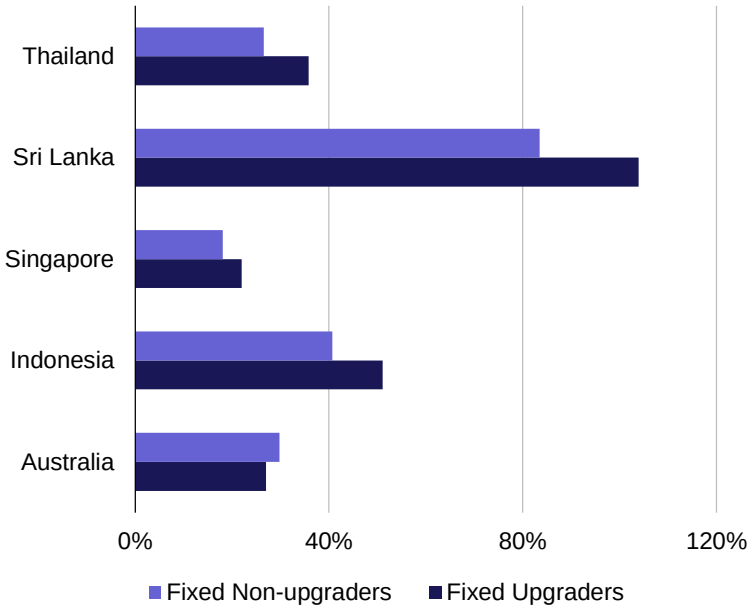


Figure 3.9: Premium that fixed users are willing to pay, above the price they currently pay (Australia n=404, Indonesia n=297, Singapore n=520, Sri Lanka n=137, Thailand n=376) [Source: Analysys Mason, 2015]]

If we look at the average price paid for narrowband mobile services (before the introduction of broadband 3G and 4G networks), and see how it has changed as customers have shifted to broadband, and also look at how customer numbers have grown, we can gain an understanding of whether overall consumer surplus has increased. Looking at Figure 3.10 and Figure 3.11 below, it is evident that prices have decreased substantially as subscriber numbers have grown. As willingness-to-pay for broadband is significantly higher than for narrowband, thanks to a richer user experience, 'consumer surplus', a key measure of economic welfare, has increased significantly.

Figure 3.10: Weighted average ARPU, pre- and post-broadband, at constant exchange rates, countries in all clusters [Source: GSMA, 2015]

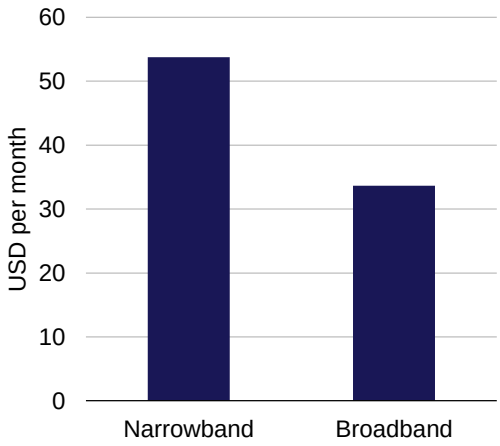
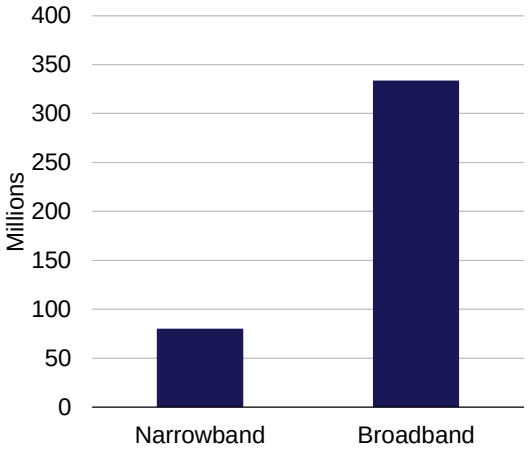


Figure 3.11: Total mobile Internet subscribers, pre- and post-broadband, countries in all clusters [Source: Analysys Mason, 2015]



Creating and raising awareness of content and applications that are relevant and accessible to non-adopters is the most important factor in improving Internet take-up

As part of our primary research programme, we spoke to 'non-adopters'[31] in Indonesia, Sri Lanka and Thailand to discuss their motivations and understand what they perceive as the main reasons why they do not adopt or use the Internet (Figure 3.12).

The most important reason cited was ''awareness'',[32] mentioned by 75% of respondents. This is a measure of whether consumers are aware of the benefits of consuming Internet content.[33] Service availability, which is driven by access to a fixed or mobile broadband network, was substantially less important. Literacy and the lack of a connected device were less important than awareness, but did appear to be a barrier for a significant minority of people. The availability of relevant content was also a barrier for a significant minority.

These results are also borne out by other research. A 2014 in Singapore by the national regulatory authority, IDA[34], found that, of non-adopters, 55% said they did not need an Internet connection, and 30% said they did not know how to use the Internet.

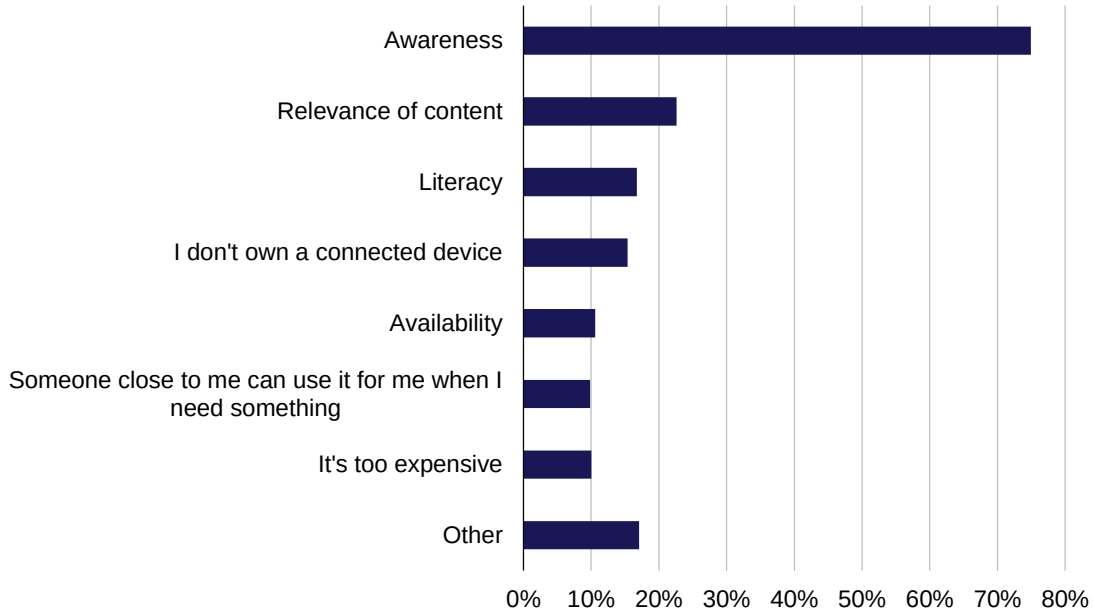
31 Defined as people who have neither a personal mobile Internet service nor a fixed Internet service at their place of residence.

32 Defined as respondents who provided one of the following answers: "I don't trust it / don't think it's safe", "I don't need it" or "I don't know what the Internet is or what it does".

33 It is possible that well informed people may not want the Internet. Evidence from connected countries, however, which have near-ubiquitous take-up, shows that this group is small.

34 IDA Consumer Awareness and Satisfaction Survey, 2014

Figure 3.12: Reasons cited for non-adoption or non-usage of Internet services as stated by the interviewees in all countries [Source: Analysys Mason, 2015]



Notably, the majority of non-adopters have never even used the Internet before, even at an Internet café, at the home of a friend or family member, or at work or an educational institution (Figure 3.13). This lack of experience of the Internet is also likely to be associated with a lack of awareness of its benefits.

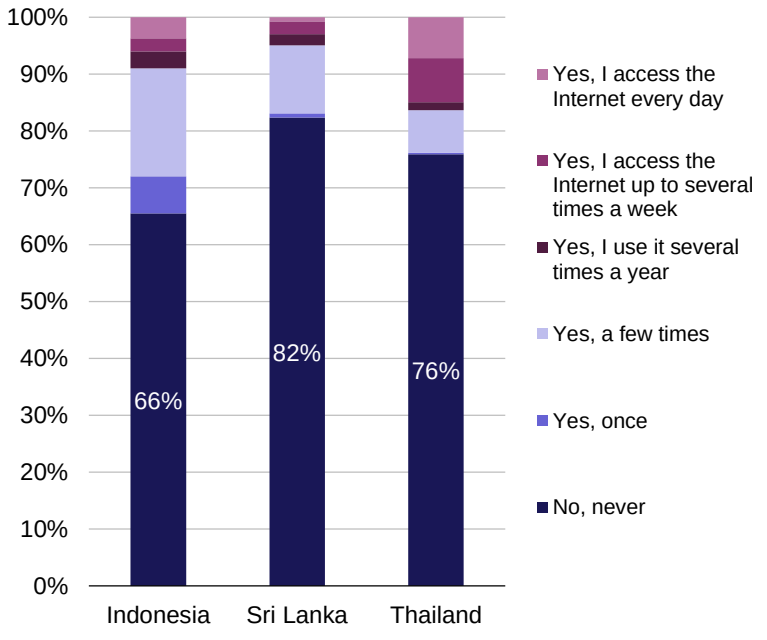


Figure 3.13: Responses from non-adopters on their use of an Internet service (Indonesia n=400, Sri Lanka n=402, Thailand n=415) [Source: Analysys Mason, 2015]

Although most people would try the Internet if it were free (Figure 3.14), a surprisingly large proportion of people who responded that they do not need the Internet said they would not be

prepared to try it even if it were offered free of charge. This reinforces the need for better awareness and relevant content.

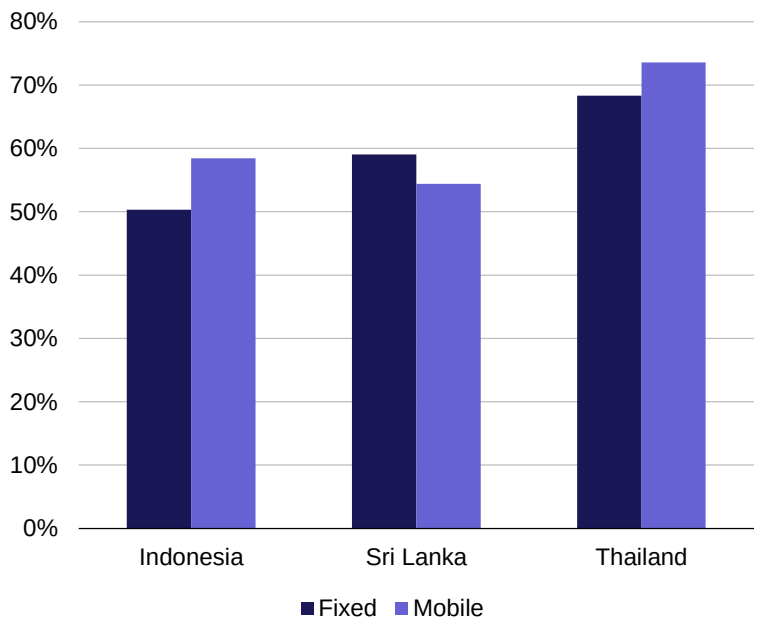
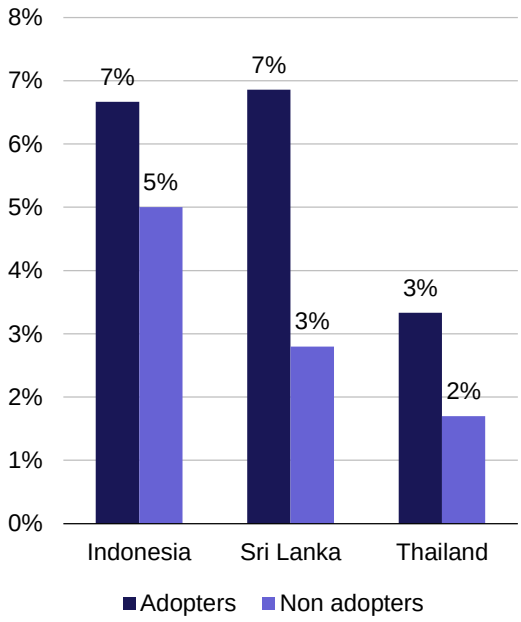


Figure 3.14: Respondents interested in trying a free Internet service, among those who answered "I don't need it" as their reason for not adopting the Internet (Indonesia fixed n=165, mobile n=130; Sri Lanka fixed n=232, mobile n=239; Thailand fixed n=262, mobile n=242) [Source: Analysys Mason, 2015]

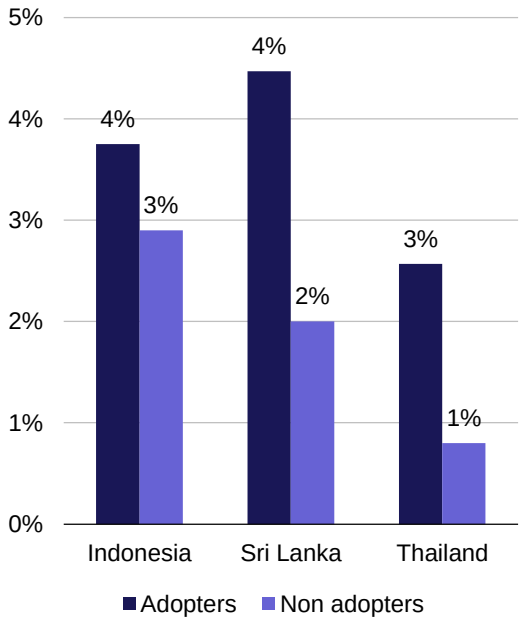
As a result, although cost is not necessarily seen as a barrier, even amongst very low-income respondents, it is likely to be a secondary barrier to adoption in many cases once relevance can be addressed and demand materialises. This is also visible from the gap between how much adopters and non-adopters are willing to pay for an Internet service (Figure 3.15 and Figure 3.16). This confirms that non-adopters are substantially more price sensitive, and/or see less value in Internet services, than adopters.

Figure 3.15: and Figure 3.16 : Proportion of household expenditure spent in Internet access services by adopters and median of the maximum proportion of household expenditure that an Internet service could cost for fixed non-adopters to take up the service [Source: Analysys Mason, 2015]

Fixed broadband (Indonesia, non-adopters n=41, adopters n=338; Sri Lanka, non-adopters n=73, adopters n=169; Thailand, non-adopters n=21, adopters n=380)



Mobile broadband (Indonesia, non-adopters n=29, adopters n=677; Sri Lanka, non-adopters n=39, adopters n=386; Thailand, non-adopters n=25, adopters n=660)



In summary, awareness of the benefits of consuming Internet content is a key factor, both for people who do not take up an Internet service, and for people who have never used it. Either interesting and relevant content is not available, or people are unaware of the benefits of the content that is available. Price may be a secondary consideration once people have been persuaded to try the Internet, but network availability is not seen as an issue, reflecting the fairly high coverage of mobile broadband services in the countries surveyed.

In this context, future growth in the adoption of Internet access services by current 'non-adopters' could be driven by awareness-raising initiatives and investment in content that is relevant and accessible to these new users. CAPs, potentially including some IAPs, will play a central role in this evolution.

3.2 Quality of service drives take-up and usage, and CAPs are investing alongside IAPs in network infrastructure to improve the user experience of the Internet

Quality of service is linked to service upgrades for both fixed and mobile users

The quality of service received by an end user is a key aspect of their enjoyment of the Internet, and it also helps to drive users to upgrade their services. Indeed, users are more likely to upgrade their service if they have had a good experience of consuming advanced content. In our research,

we asked respondents about the quality of their experience when watching video content. Both fixed and mobile upgraders were more likely than non-upgraders to be able to watch video with no degradation in quality at least most of the time. This is illustrated in Figure 3.17 for fixed and Figure 3.18 for mobile.

Figure 3.17: Can you watch video on your fixed connection without degradation, asked of fixed upgraders and non-upgraders (Upgraders n=1696, Non-upgraders n=326) [Source: Analysys Mason, 2015]

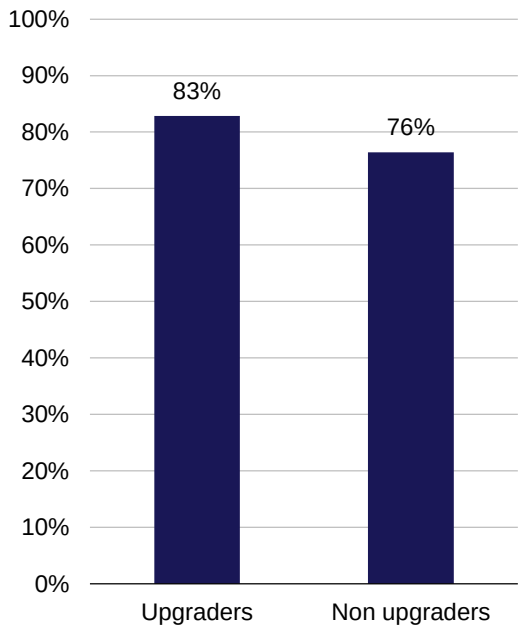
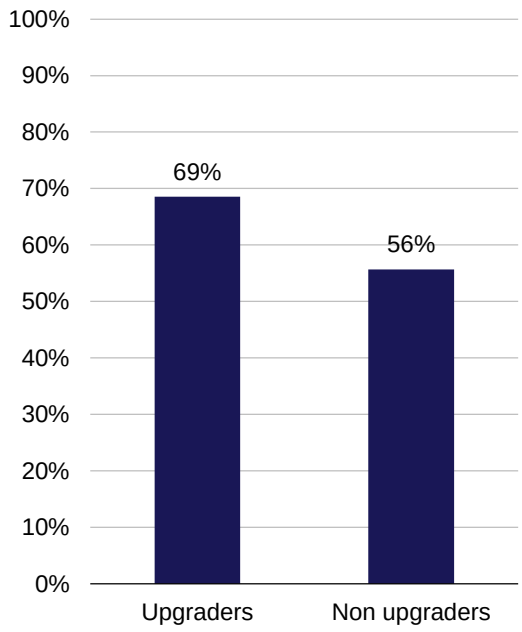


Figure 3.18: Can you watch video on your fixed connection without degradation, asked of mobile upgraders and non-upgraders (Upgraders n=2894, non-upgraders n=787) [Source: Analysys Mason, 2015]

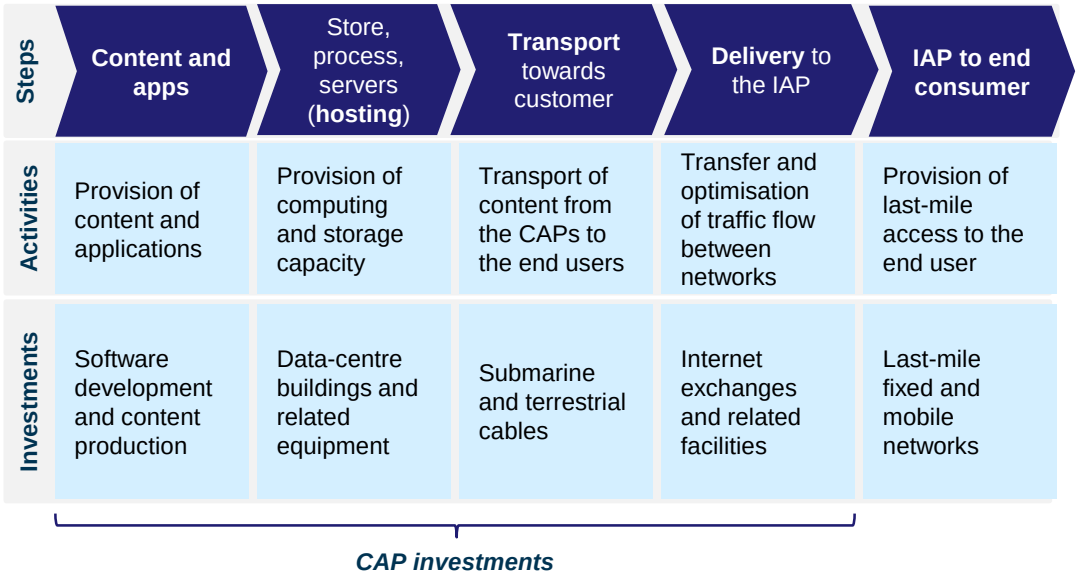


CAPs are increasingly improving the quality of user experience, which stimulates adoption, usage and upgrades of Internet access services

As well as creating content and applications, CAPs increasingly make investments in their own networks and infrastructure. This is in addition to the substantial investments that IAPs are making in upgrading their core and access networks.

CAPs are investing at all levels of their networks. Figure 3.19 illustrates the activities of CAPs involved in the Internet value chain, and their corresponding investments.

Figure 3.19: Illustrative Internet value chain [Source: Analysys Mason, 2015]



A large part of the investment made by CAPs is in *hosting* infrastructure, including data centres, servers and storage devices. This infrastructure hosts and processes the content and applications developed by CAPs, and houses nodes where content and applications are distributed and cached. CAPs are increasingly making this investment in Asia–Pacific. For example, Google has built data centres in Singapore and Taiwan, and Amazon Web Services (AWS), the cloud-computing arm of Amazon, has data centres in Singapore, Sydney, Tokyo and Beijing. Meanwhile, Facebook is reported to be investigating Asia–Pacific data-centre sites to add to its assets in the USA and Europe.

CAPs also invest in *transport* networks. These are long-distance submarine or terrestrial fibre-optic cables that carry Internet traffic around the world. Whilst IAPs and backbone operators are large investors in these, CAPs are now also major contributors. Indeed, CAPs are investing in major new cables in Asia–Pacific, including APX-East (between Australia and the USA), FASTER (between Japan and the USA) and BBG (between South-East Asia, the Middle East and Europe).

Finally, CAPs invest in *delivery* infrastructure, which carries traffic from long-distance transport networks to IAP networks. This includes the points of interconnect where networks exchange traffic (either at Internet exchanges or private points of interconnect). It also includes *content delivery networks* (CDNs) that help to optimise traffic delivery, for example by shifting content to hosting infrastructure that is closer to end users.

Some of the key infrastructure that CAPs contribute to in the region is shown in Figure 3.20. This shows key data centre locations and the routes of the three submarine cables discussed above.

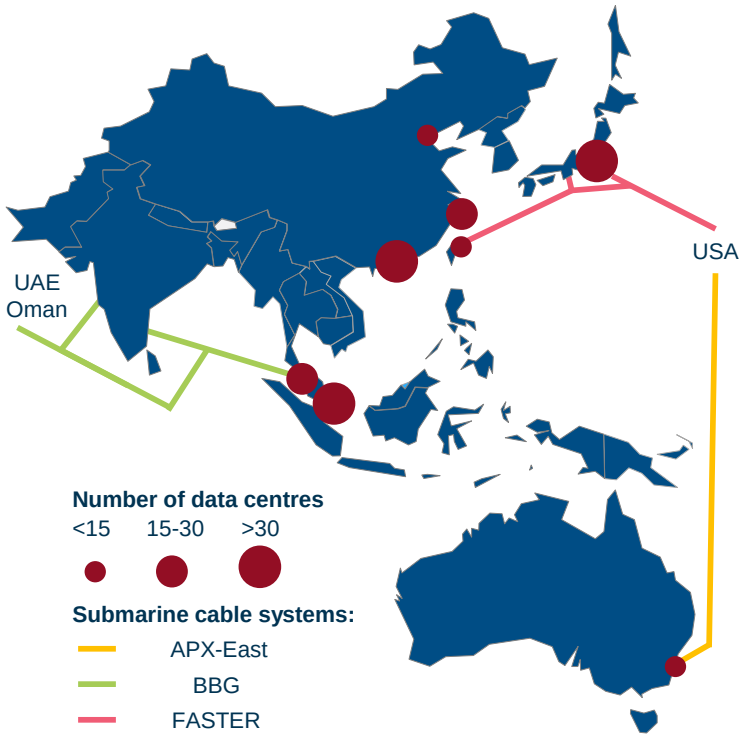


Figure 3.20: Map with locations of key infrastructure [Source: Analysys Mason, 2015]

CAP investments have an impact on IAPs in two ways:

- The investments are partly substitutional: these investments that CAPs make replace investments that would otherwise need to be made by IAPs. These investments provide network capacity that is required for the successful operation of the Internet. Their main impact on IAPs is to save them money, by removing the need for IAPs to make the investments themselves.

- The investments are partly incremental: these improve the quality of service that end users experience when consuming content and applications. CAPs make these investments to attract more users to their services, but the investments also benefit various other parties:

  – Consumers benefit from the ability to consume content and applications at a high quality of service, which increases consumer willingness to pay for Internet services, and thus increases overall demand
  – IAPs benefit from this growth in demand for their services
  – CAPs also benefit, as they attract customers because their content and applications are available at a high quality of service.

In a 2014 paper,[35] Analysys Mason estimated the magnitude of the global investments by CAPs in networks and infrastructure (made up of hosting, transport and delivery infrastructure). We estimated global CAP investments to be USD33 billion per annum, of which USD7.7 billion was

35 See http://www.analysysmason.com/Research/Content/Reports/Content-application-provider-Internet-infrastructure-Sept2014/.

in Asia–Pacific. Investments in submarine and terrestrial cable infrastructure were estimated to average USD2.7 billion per annum, of which USD700 million was in Asia–Pacific.

3.3 Challenges remain in bringing the benefits of broadband to more people and to 'unconnected' countries

We have established in Section 3.1 that a lack of awareness of the benefits of the Internet is one of the foremost drivers of non-adoption and non-usage. This creates risks associated with potential demand, which can deter investment in infrastructure, especially in 'unconnected' countries. IAPs may find it too risky to invest in new network coverage, given apparent demand for Internet services is low. Here we explore these other barriers, and the impact they have had on the 'unconnected' countries

There are a wide range of barriers that can have an impact on broadband development outcomes

In addition to the barriers discussed in Section 3.2, which apply largely in 'connecting' countries, we have identified a wider range that can influence all aspects of broadband development. We can define drivers and barriers to development with reference to the outcome that they influence:

- The **availability of broadband services** determines whether end users are able to use these services at all. It includes the coverage of advanced fixed and mobile access networks, as well as the backbone, hosting and other infrastructure that must exist for content and applications to be consumed at a high quality of service
- The **take-up of services** reflects the extent to which consumers decide to become Internet users and sign up for services from fixed and mobile operators
- The **usage of services** refers to how much consumers actually use their Internet connections to access content and applications.

For each of these outcomes, we have identified a set of potential drivers (if they are present) or barriers (if they are lacking), on the basis of how IAPs address their respective markets, how governments and regulators define and implement broadband policy, and how users decide to subscribe to and use broadband services.

We set out an overview of the key barriers and drivers we have identified for each outcome in Figure 3.21.

Figure 3.21: Drivers and barriers related to availability, take-up and usage [Source: Analysys Mason, 2015]

Driver / barrier	Description
Drivers and barriers related to availability	
Business case	Is there an economic business case for rolling out broadband coverage somewhere new? Is there a policy case for it and the money to fund it? Roll-out requires fixed and mobile access networks, long-distance domestic and international backbone networks, and

Driver / barrier	Description
	hosting and interconnection infrastructure. Two key factors play a role here: the *cost of inputs* such as land, equipment, spectrum and licences; and the *risk associated with demand* from consumers.
Availability of inputs	Are the key inputs that required available at all? Scarcity of inputs affects three areas: • Radio spectrum and land are important for mobile networks (handled by governments and regulators) • Reliable electricity supply is important for networks, and for users to recharge their devices • Existing networks that can be shared, including domestic networks and international connectivity, are important in minimising roll-out costs.
Policy and regulation	In addition to competition and spectrum management, this includes economic regulation of telecoms networks and services. Obligations attached to telecoms licences are important drivers of roll-out. Also, policy makers increasingly include national broadband plans as a key policy plank to spur wider economic development. Finally, innovation in network roll-out is beginning to involve other areas of regulation. For example, Google's Project Loon (see Section 4) is increasing the relevance of aeronautical regulation.
Drivers and barriers related to take-up	
Cost and device availability	Does the cost to the consumer of a fixed or mobile Internet service make it unaffordable? Is the cost and payment schedule of a device a barrier to affordability? Are attractive devices available in the market? These aspects can be influenced by the market structure and strategy of device manufacturers, whether IAPs subsidise devices, and whether there are restrictive government policies or taxes (including import restrictions or duties).
Social factors	Are consumers able to use the Internet, driven by their education and awareness or by cultural restrictions? This include awareness of the benefits of Internet usage (which is influenced by both literacy and IT literacy); and whether the use of the Internet is deemed appropriate for all users in certain communities.
Drivers and barriers related to usage	
Means of access	How do consumers access the Internet? Is it on a PC at home or work, on a smartphone or tablet, or in an Internet café? This affects the content and applications that a consumer uses: for example, long videos are easier to consume at home.
Relevant, accessible content	Does interesting content exist in the local language, made by local or global CAPs?
Quality of service	Can the consumer receive content at sufficiently high bandwidths and with low enough latency? This is important for advanced content.
Trust	What is the perceived and actual level of security, driven by actual security and consumer awareness of security. Is Internet access broadly free and private? Monitoring and censorship can make consumers feel uncomfortable about accessing content freely.

'Unconnected' countries have poorer outcomes due to the greater impact of key barriers

'Unconnected' countries[36] perform worse than the other clusters on all three outcomes discussed above. As illustrated in Figure 3.22, they have lower availability (as measured by 3G coverage) and lower take-up (as measured by 3G and 4G penetration). Moreover, users in 'unconnected' countries who do take up Internet services also have substantially lower usage than users in other clusters (as shown in Figure 3.23).

Figure 3.22: 3G coverage and 3G/4G take-up by cluster [Source: GSMA, Analysys Mason, 2015]

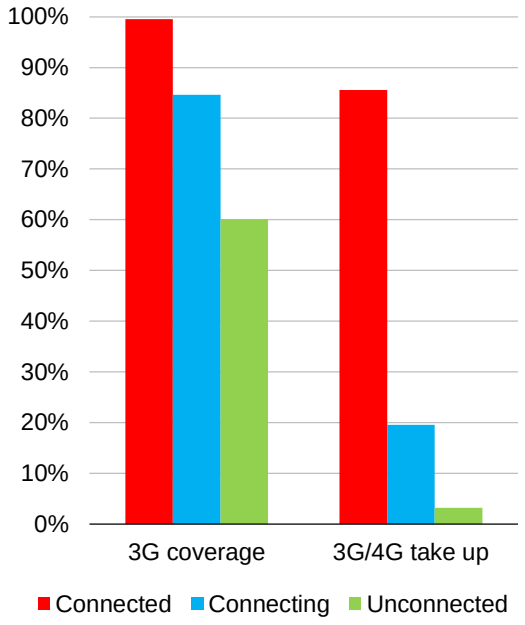
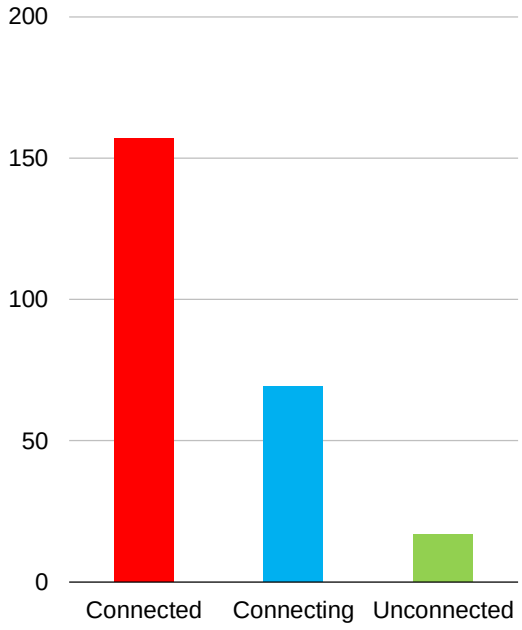


Figure 3.23: Annual data usage per Internet subscription, GB per year [Source: Analysys Mason, 2015]



These poorer outcomes are in part driven by the greater impact of key barriers. We saw in Section 3.1 that a lack of awareness is a key barrier to take-up, and this is also the case in 'unconnected' countries. This barrier affects the business case for network roll-out as well. In addition, a number of other barriers apply to a greater extent in 'unconnected' countries than in other clusters:

- The cost of service plans and handsets acts as a barrier to take-up
- Low PC penetration affects the types of content that users can access at a reasonable quality
- There is less relevant content available in local languages.

Here we explore the extent to which these barriers are a more significant factor in the 'unconnected' countries. Further details of the extent of the full set of barriers in all three clusters can be found in Annex C.

[36] That is, Papua New Guinea, Bangladesh, Pakistan, Nepal, Myanmar and Laos.

As discussed in Section 3.1 earlier, cost was not the primary barrier in 'connecting' countries. In 'unconnected' countries, however, affordability of service plans does act as a barrier to take-up, as shown in Figure 3.24 and Figure 3.25 (based on the cheapest entry-level fixed and mobile packages in the three clusters relative to gross national income).[37]

Figure 3.24: Price of a 500MB prepaid handset-based mobile broadband package as a % of GNI per capita [Source: ITU, 2014]

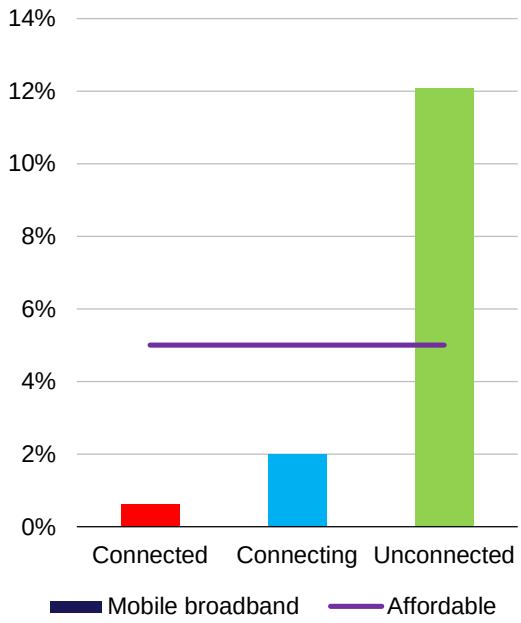
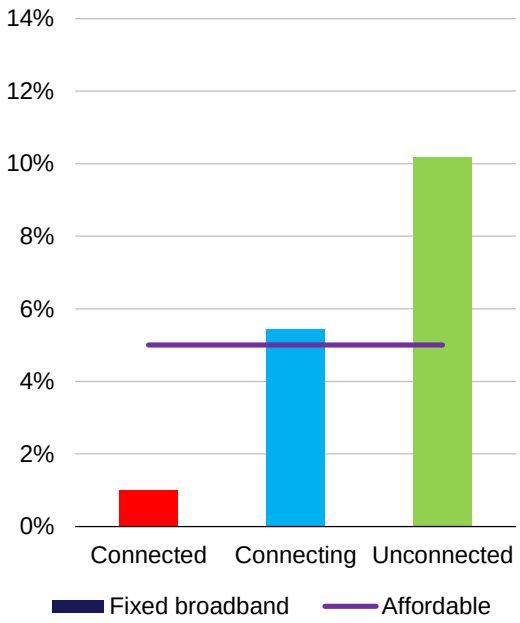


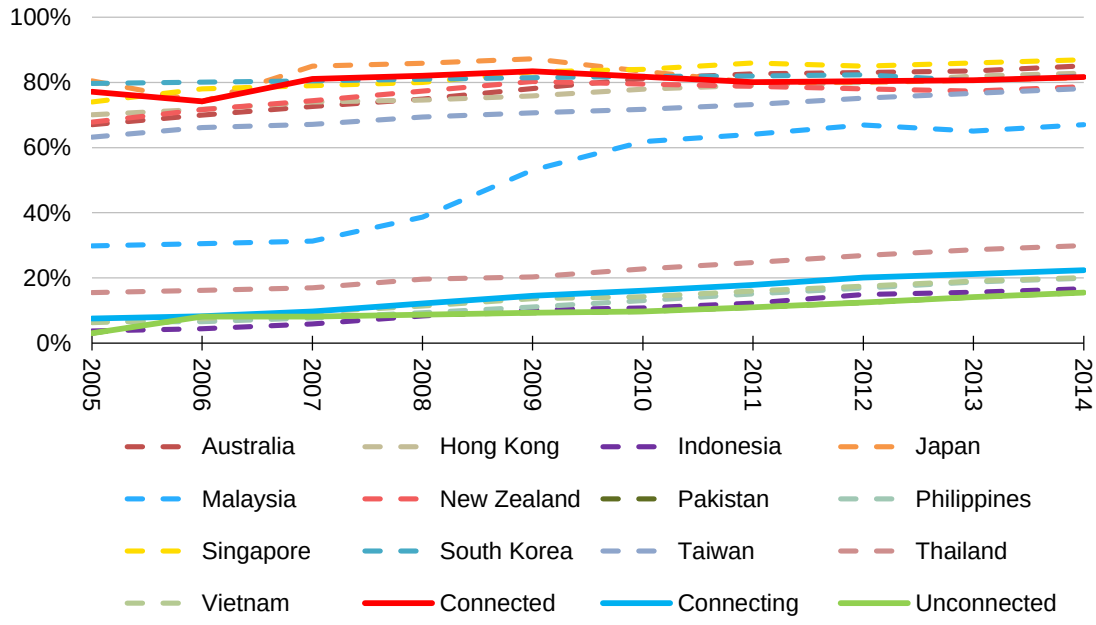
Figure 3.25: Price of an entry-level fixed broadband package as a % of GNI per capita [Source: ITU, 2014]



PC and smartphone penetration affect how users can access the Internet. The rate of PC penetration can also suggest how many multi-device Internet users there are. High PC penetration indicates that many users can access the Internet through their PC, but these users may also have access through a smartphone. However, low PC penetration means that most users in a country, if they are accessing the Internet at all, are likely only to be able to do so through a mobile device. As illustrated in Figure 3.26, PC penetration is low in the 'unconnected' cluster, suggesting that a lack of multiple-device users may constrain usage.

[37] The Broadband Commission for Digital Development, a Paris-based body formed by the ITU and UNESCO, views broadband as affordable if it costs less than 5% of gross national income.

Figure 3.26: PC penetration of households [Source: Analysys Mason, Euromonitor, 2015]



Finally, a lack of relevant content may be a more significant barrier in 'unconnected' countries. The most relevant content is that which is in the local language, either developed by local CAPs or by international CAPs but optimised for local language and context. It appears that a lack of local-language content acts as a more significant barrier in 'unconnected' countries. This is shown in Figure 3.27.

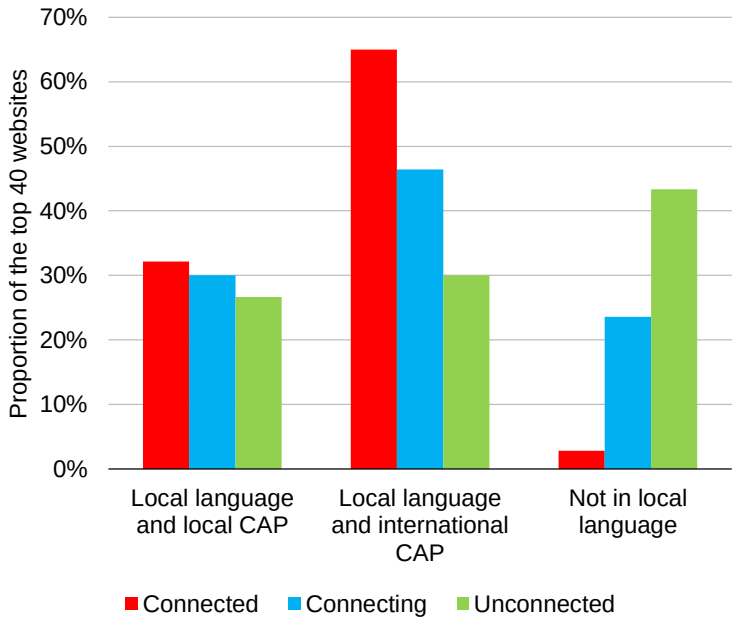


Figure 3.27: Proportion of the top-40 websites that are in local languages [Source: Alexa, Analysys Mason, 2015]

CAPs and IAPs are aware of these barriers that exist in the 'unconnected' cluster. They are currently implementing an array of partnerships and programmes to address them. We explore these more fully in the next section.

4 Partnerships and a forward-looking policy environment are essential for unlocking further the benefits of the Internet

In this section we explore how the barriers to further broadband growth in Asia–Pacific can be reduced or removed.

- CAPs are becoming essential partners in the development of broadband Internet opportunities. They are forming partnerships with IAPs and other organisations to help lower the barriers to Internet adoption and create new opportunities for mutual revenue growth.
- Likewise, certain policy makers in the region are implementing innovative programmes that help to lower barriers to adoption, sometimes in partnership with IAPs or CAPs. This is helping to drive the adoption of broadband services, particularly in challenging environments and less-developed countries.
- In addition, policy makers and regulators also play an essential role by ensuring that the environment they influence is as conducive as possible to investment and innovation, by IAPs, CAPs and others. Sustainable competition is essential, as is a regulatory framework that provides timely and transparent support for initiatives to accelerate the availability, take-up and usage of the Internet.

4.1 CAPs and IAPs are forming innovative partnerships to address these barriers

CAPs and IAPs are increasingly working together to address barriers to Internet availability, take-up and usage. This is to their mutual benefit, as it creates new opportunities for IAPs to sell access to their networks, and for CAPs to expand their user base. A number of examples of these partnerships in Asia–Pacific are presented below, in the form of case studies. An overview of the partnerships covered is provided in Figure 4.1.

Figure 4.1: Overview of example CAP partnerships [Source: Analysys Mason, 2015]

CAP	Partnership	Barrier addressed	Outcome / beneficiaries
Partnerships that address availability			
O3B / Google	Satellite mobile backhaul	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Google	Project Loon	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Google	Titan Aerospace	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Facebook	Satellite broadband access coverage in partnership with Eutelsat	Business case for network roll-out	Lower roll-out costs for IAPs Better availability for end users
Facebook	Project Aquila	Business case for	Lower roll-out costs for IAPs

CAP	Partnership	Barrier addressed	Outcome / beneficiaries
		network roll-out	Better availability for end users
Partnerships that address take-up			
Mozilla	Low-cost smartphones	Device cost and availability	Lower costs for end users More customers for IAPs and CAPs
Google	Android One programme to develop low-cost smartphones	Device cost and availability	Lower costs for end users More customers for IAPs and CAPs
Facebook	Free Basics programme to provide limited zero-rated Internet access	Social factors, including awareness	Greater awareness and lower costs for end users More take-up for IAPs
Partnerships that address usage			
Mozilla	Mozilla handset localisation programme	Relevant content in local languages	More relevant content for users Greater usage for CAPs
Google	Android carrier billing	Relevant content	Easier access to relevant content for users More usage revenue for CAPs and IAPs
Facebook	Partnership with Ericsson and Axiata to improve quality of service in Indonesia	Quality of service	Better experience for users More usage revenue for CAPs and IAPs

We discuss the partnerships relevant to each outcome below. For each initiative, we examine the nature of the barrier addressed, how this has been achieved (including a look at some of the key enablers), and the desired outcome (including an assessment of who the main beneficiaries are).

IAPs and CAPs are working together to lower the cost of network availability

The partnerships we have identified that lower barriers to availability focus on improving the business case for network roll-out, especially in challenging, high-cost locations.

Google's Project Loon is a very new and innovative example of CAPs partnering with IAPs to improve availability. It focusses on lowering the cost of network roll-out in very remote areas, improving the IAPs' business case. Project Loon uses balloons that travel at high altitudes to provide high-speed wireless broadband in partnership with local carriers.

Project Loon relies on a number of enablers for its success. First, it requires an IAP partner. This is typically a mobile operator who provides the necessary radio spectrum, and owns the relationship with the end customer. It also relies on a conducive regulatory environment, in particular the ability to use radio spectrum to communicate with the balloons. Aeronautical regulation is also relevant, since a large network of balloons will need to coordinate with other users of the airspace regularly.

Project Loon is currently in its early stages, with plans to test it further in the Asia-Pacific region (in Sri Lanka, for example). However, if successful, it will benefit end users, who will gain better

mobile coverage, IAPs, whose business case will be improved, and CAPs, who will be able to address a larger population of Internet users.

In addition to Project Loon, Google has acquired **Titan Aerospace**, which aims to provide Internet access through light-weight solar-powered aircraft. These can provide bandwidth to a targeted area on the ground, complementing Project Loon: the balloons could provide wide area coverage, and the Titan aircraft could provide extra capacity to localised areas.

Titan relies on a number of factors for its success. It relies on IAP partners who provide the service to end customers on the ground. It also relies on a conducive regulatory environment, in a similar way to Project Loon.

Titan would also benefit end users in remote areas, who can gain extra Internet capacity when needed. This is especially the case in natural disaster areas, such as areas hit by earthquakes, as these have been identified as a key target area for the initiative.

O3B (backed by Google and a number of financial investors) is also partnering with IAPs to improve availability. It also focuses on lowering barriers to a successful business plan. It does this by reducing the cost of backhaul links from mobile towers. O3B uses low-Earth-orbit satellites (at an altitude of 8000km) to provide mobile backhaul to IAPs.

For its success, it relies on demand from and partnerships with mobile operators. It also requires radio spectrum to operate, although O3B acquires the licences for this itself rather than relying on an IAP partner.

Like Project Loon, if successful O3B would bring benefits to end users, IAPs and CAPs. O3B has reportedly already struck a number of partnerships in the region, including in Papua New Guinea, Pakistan and Brunei Darussalam.

Facebook's partnership with Eutelsat to offer satellite broadband access services to end users in Sub-Saharan Africa. This project uses the Ka-band AMOS-6 satellite, and also provides gateways and terminals on the ground.

It is not clear, at the time of writing, what the exact business model will be. However, in all cases the success of this partnership will rely on access to satellite capacity, and the smooth distribution of terminals to on the ground customers in potentially difficult to reach places.

Like Project Loon, if successful this partnership would bring benefits to end users, IAPs and CAPs. These benefits would be felt in Sub-Saharan Africa, but the project could also provide a model for remote parts of Asia.

Finally, **Facebook's Aquila** unmanned aerial vehicle programme, which could work in a similar way as the Titan Aerospace programme (see above), envisages solar powered drones to provide Internet access services to customers on the ground. The drones will communicate with end users using free space optical signals.

Project Aquila is expected to rely on IAPs to service the end customers on the ground as it provides capacity to these IAPs on a wholesale basis. Its success will be dependent on enabling regulation being in place (including both in the telecoms and Aerospace areas), given the need to coordinate with other users of airspace.

Beneficiaries of Project Aquila would include end users who would receive better coverage, IAPs who would gain access to more customers at a lower cost, and CAPs, who would have access to more end customers for their content and applications.

CAPs are developing partnerships that encourage non-adopters to take up broadband packages

CAPs are entering into partnerships that address barriers to take-up. These seek to address the issues of cost and availability of handsets, and social factors related to awareness of the usefulness of the Internet.

Mozilla, the CAP behind the Firefox Internet browser, is working to lower barriers to smartphone affordability. It is doing this by developing a smartphone based on its Firefox open-source operating system.

Mozilla's core partners are device manufacturers such as Cherry Mobile in the Philippines and Symphony in Bangladesh to manufacture its devices. It also relies, in part, on IAPs to sell and distribute handsets to end users, and to include them in service plans. Finally, given the low cost nature of the smart phones, low taxation on devices is crucial.

The key beneficiaries of this partnership are price-sensitive consumers in developing markets. IAPs also benefit, as the project helps to extend mobile penetration to new market segments. Finally, CAPs benefit from having a larger population of Internet users who can access their content and applications.

Google is also working to lower barriers to smartphone affordability through its Android One project. It is working with regional manufacturers to develop an Android handset targeted at cost-conscious consumers in the developing world.

Manufacturing partners include Cherry Mobile, Spice, Symphony, Karbonn and Micromax. As for Firefox Mobile, success for Android One will also rely in part on IAPs to distribute the devices. Its success is also sensitive to the taxation attracted by mobile devices.

The beneficiaries of this project are also price-sensitive consumers in developing markets, including those in Indonesia, Bangladesh, Myanmar, Nepal, Sri Lanka and Pakistan where the project has been launched. IAPs and CAPs also benefit, as the population of potential customers increases in these markets.

Facebook is working to improve awareness of the benefits of the Internet in developing markets through its Free Basics initiative. It is working with IAPs to provide "zero-rated" access to certain Internet content (e.g. Wikipedia, Facebook, health and medical sites and local news sites). The

hope is that, once price-sensitive users have experienced a limited selection of Internet content, they will be more willing to take up a full Internet access service.

Free Basics is implemented in partnership with IAPs, and relies on them for its success. The incentive for IAPs is that in return of forgoing usage revenue from a certain set of customers in the short term, they will gain future revenue from greater take up of full service plans.

Key beneficiaries of Free Basics are the end users themselves, who gain low-cost access to certain content. These users also benefit if they decide to take up a full service plan. This behaviour also benefits IAPs. Finally, Facebook benefits by signing up new users to its service. In Asia–Pacific, Free Basics has launched in the Philippines, Indonesia, and India.

CAPs and IAPs are working to drive usage among under-served customers

CAPs and IAPs are forming partnerships that address barriers to usage. In particular, they are targeting barriers to the development and usage of relevant content, and barriers associated with the quality of the user experience.

Mozilla is addressing barriers to relevant content in local languages through its Localisation Project. This involves translating its Firefox operating system into over 90 languages, and encouraging local-language content developers to distribute content through the Firefox Marketplace.

This project relies on two sets of partners for its success. First, IAPs must distribute Firefox handsets. In addition, it is important that local developers create enough content for the Firefox Marketplace to make it successful. For example, Firefox-based applications such as OLAcabs and Bikroy are popular in Bangladesh, and Easy Taxis and OLX classifieds are popular in the Philippines.[38]

This project potentially benefits users who speak languages that are poorly served by the Internet. It also benefits the CAPs which develop apps for the Firefox marketplace, and IAPs which gain new customers due to the desire to access local content.

Google is addressing barriers to the payment for relevant content and applications through its carrier billing partnerships. These integrate the Google Play store with IAP billing systems, allowing customers to purchase apps and content and have the cost charged to their mobile account. It helps users who have no bank account by removing the requirement for a credit card, and drives usage among the wider user base by increasing the convenience of content purchases.

The project relies on IAP partners as key enablers. It involves substantial IT integration work to connect IAP billing systems with the Google Play store, which requires a high level of trust from the IAPs. It also shifts the responsibility for credit checks and cash management to the IAPs.

[38] See https://blog.mozilla.org/blog/2014/12/16/firefox-os-expands-to-nearly-30-countries/.

This partnership has wide benefits: end users gain easier access to a wide range of content; IAPs can differentiate their services and gain more revenues from higher data usage; and CAPs can sell more applications and content. These benefits have been experienced across the region, with partnerships set up in Australia, Hong Kong, Indonesia, Japan, South Korea, New Zealand, the Philippines, Singapore, Taiwan and Thailand.

Facebook is partnering to improve the quality of service experienced by its end users in Indonesia. It is working with Ericsson and XL Axiata to develop a new methodology to improve quality of service, especially for those customers who access the Internet on a 2G connection.

The project is enabled by a close working partnership among the three entities involved. In particular, it relies on XL Axiata giving access to its network to engineers from Facebook. This means it is a deep partnership that relies on significant trust between the parties.

If the project is implemented throughout the XL Axiata network, it will benefit customers by giving them a better experience of the Internet. It will also benefit XL Axiata, which will be able to differentiate its service due to the quality improvement. Finally, it will drive Facebook usage.

4.2 Some policy makers are implementing innovative policy initiatives to lower barriers, often in partnership with IAPs or CAPs

As discussed above, policy makers are also working to address barriers to Internet availability, take-up and usage, often in partnership with IAPs or CAPs. In this section we again take a case-study based approach to examining these policy initiatives, presenting a number of examples targeted at each of the three outcomes. For each initiative, we examine the nature of the barrier addressed, how this has been achieved, and the outcome (including an assessment of who the main beneficiaries are). An overview of the policy initiatives covered is shown in Figure 4.2.

Figure 4.2: Overview of example policy initiatives [Source: Analysys Mason, 2015]

Country	Initiative	Barrier addressed	Outcome / beneficiaries
Initiatives that address availability			
Japan	Public funding for broadband roll-out	Business case for network roll-out	Increased take-up of fibre, benefiting IAPs, CAPs and users
South Korea	Public funding for broadband roll-out	Business case for network roll-out	Increased take-up of fibre, benefiting IAPs, CAPs and users
Singapore	Development of national broadband network	Business case for network roll-out	Increased take-up of fibre, benefiting IAPs, CAPs and users
Initiatives that address take-up			
South Korea	ICT education programme	Social factors, including awareness of the benefits of the Internet	Improved awareness for ~16 million people, potentially improving take-up and usage
Malaysia	1Malaysia netbook	Affordability of	PC penetration increased

Country	Initiative	Barrier addressed	Outcome / beneficiaries
	distribution programme	connected devices	to ~65%, lower a key barrier for users to take up broadband
Initiatives that address usage			
Japan	Investments in e-government	Relevant accessible content	More efficient and relevant content and applications for users
Malaysia	Investments in e-government, e-education and e-health	Relevant accessible content	More efficient and relevant content and applications for users

These initiatives tend to blend fixed and mobile broadband access, recognising the different roles that each technology plays in different contexts. For example, although Singapore has been at the forefront of fixed fibre broadband rollout, it is also investing significantly in ensuring its wireless infrastructure remains world-class. Examples include timely and proactive release of spectrum for mobile use, as well as a world-leading position in the field of TV White Spaces (TVWS), where it has shown leadership by hosting detailed trials and issuing usage rules alongside the USA and the UK.

We discuss each of these initiatives in more detail below.

Government financial support can lower barriers to availability when it is transparent and enhances competition

Governments in Asia–Pacific have made public investment in advanced broadband access and core networks. These programmes have addressed barriers to a successful business case for network construction, by contributing to the cost of large-scale access network roll-outs. In Singapore, Japan and South Korea, this has helped to create some of the most advanced networks in the world. As a result, this has benefited end users, as well as IAPs which have received funding or gained access to advanced networks at regulated wholesale rates, and attracted extra customers. In all of these cases, investments have been transparent and have promoted competition. In South Korea and Japan, financing was provided to all IAPs. In Singapore, the new network is open access at both the retail and wholesale levels.

An overview of these three programmes is set out below.

South Korea: public investment in fibre access networks

Beginning in 1999, South Korea made investments in fibre access networks in partnership with IAPs. Between 1999 and 2005, the government made USD 1.8 billion in low-cost loans available to all fixed IAPs. In partnership with this, the private sector invested USD 14.5 billion over the same period. In addition, the government has also invested USD24 billion in the construction of a national backbone network.

Japan: public investment

From 2000, the government of Japan provided financing to IAPs for fibre broadband by offering zero-interest loans, and by providing debt guarantees.

in fibre access networks

The government also provided tax incentives, by allowing IAPs to depreciate one third of the cost of these fibre broadband investments in the first year of deployment. Funding was available to all IAPs which were prepared to invest.

Singapore: investment in national broadband network

In 2006, Singapore announced plans to invest in a nationwide fibre-to-the-home (FTTH) network, known as the NGNBN. At the time, the two main fixed IAPs, SingNet (with a DSL network) and StarHub (with cable) had near-ubiquitous coverage. The network was structured to be open access, with a regulated operator (NetCo) providing duct and dark fibre to a number of operating companies (OpCos) who install active electronics and provide wholesale services to a number of retail service providers (RSPs).

Figure 4.3 shows the impact of these investments. Since the launch of publicly supported fibre networks, take-up of fibre broadband services has increased rapidly, with the majority of Japanese and South Korean subscribers on a fibre connection, and close to half of Singaporean subscribers.

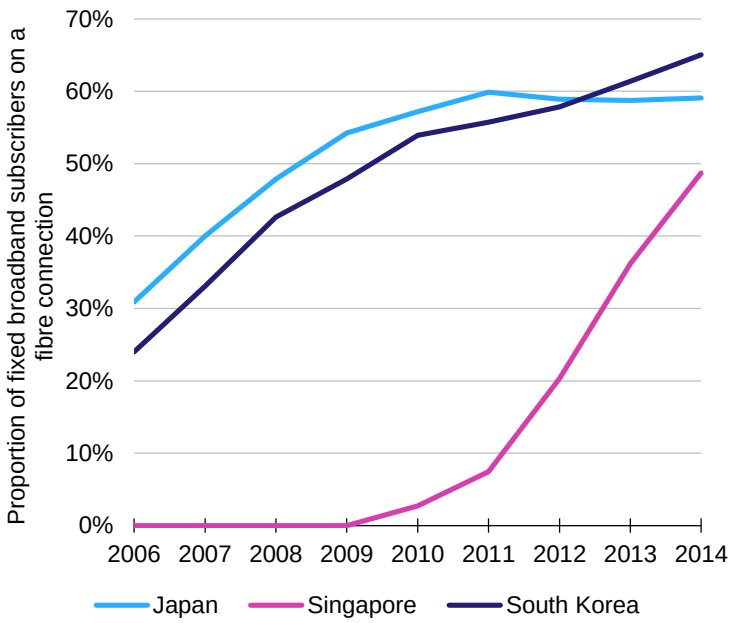


Figure 4.3: Proportion of fixed broadband subscribers in Japan, Singapore and South Korea with a fibre connection [Source: TeleGeography, 2015]

A number of large-scale programmes and partnerships have been successful in lowering barriers to take-up in the region

The governments in South Korea and Malaysia have had some success in lowering barriers to take-up through large-scale policy programmes. In South Korea, an education programme helped to lower the social barriers to take-up, by improving awareness of the benefits of the Internet among under-served social groups. The key beneficiaries of this were the Internet users themselves, but also IAPs and CAPs which received new customers as a result of improved awareness. In Malaysia, the government, in partnership with major device manufacturers, has increased PC penetration to levels seen in much more advanced countries. This has benefited the

end users who received computers, as well as IAPs and CAPs which attracted new customers as a result of the lowering of this barrier. An overview of these programmes is set out below.

South Korea: IT education programme

In South Korea**,** the government implemented a series of national IT training programmes. The first was organised for 10 million people in 2000. In addition to this, IT literacy programmes were offered to marginalised groups such as low-income households, farmers, fishermen, housewives, the disabled, the elderly and prisoners. 5.8 million people attended these programmes over 2000 and 2001. Tailored educational tools were used to reach the various groups, involving a combination of distance learning and house calls for those less able to leave home.

Malaysia: 1Malaysia netbook distribution programme

The Malaysian government implemented a large-scale programme to increase PC penetration in remote and rural areas. The 1Malaysia netbook distribution programme provided 1.6 million laptops free of charge to inhabitants in rural areas. For consumers who were not eligible for this, in the 2008 budget the Malaysian government announced that broadband and consumer access device equipment was to be exempt from import and sales taxes. Although there has been some controversy regarding the quality of the laptops provided, the programme helped to increase PC penetration in Malaysia from approximately 31% to 67% of households over the five-year period to 2012, to a level similar to that seen in more-advanced countries.

These programmes have had an impact on South Korean broadband penetration, helping to drive take-up, and Malaysian PC penetration, as shown in Figure 4.4.

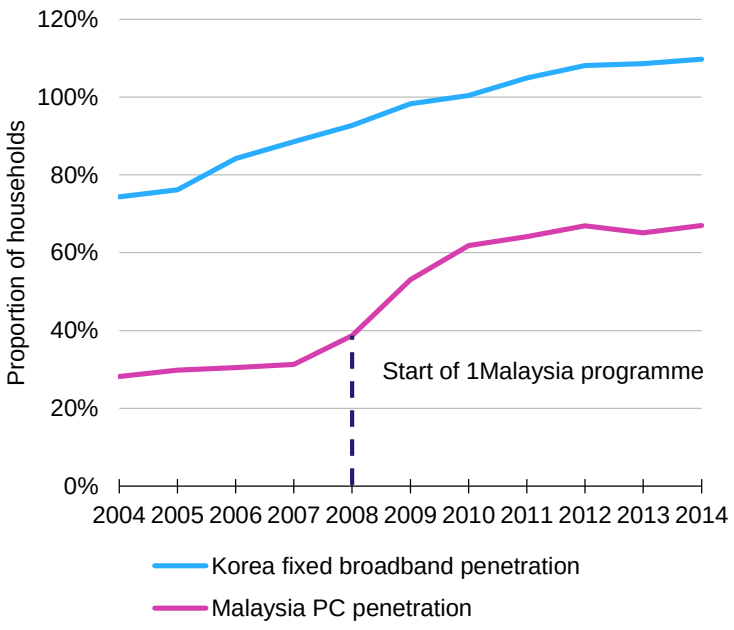


Figure 4.4: Fixed broadband penetration in South Korea [Source: TeleGeography, Euromonitor, 2015]

Governments have sought to lower barriers to usage by encouraging local content creation

The governments in Singapore and Malaysia have taken steps to encourage local content creation and usage. The Singapore government promotes local content production and distribution, and the Malaysian government has invested in e-government, e-health and e-education. This is of benefit to users, who gain access to more relevant, localised content, and to the providers of content themselves.

Japan's investment in e-government

The government of Japan has invested in putting the majority of government services online, in order to make government processes more efficient and drive internet usage. This investment happened relatively early in the development of the Internet. By 2005, 95% of government forms and notifications were online.

Malaysia: investment in e-government, e-health and e-education

The Malaysian government has set up a programme to make government, health and learning services available online. As of 2014, over 70% of government services were available online. It has set further targets in 2015, aiming to implement e-health applications in 200 health facilities. The government has also set targets for greater utilisation of online government services. Finally, the government is also developing an e-learning portal, entitled the Virtual Leaning Environment (VLE), which has learning resources for students, teachers and parents. As part of this programme, the Ministry of Education has deployed over 100 000 laptops in schools.

4.3 Policy makers have an essential role to play in ensuring that barriers to innovation and investment are as low as possible

In addition to public interventions in demand and supply, directly and through public-private partnerships as discussed in Section 4.2, policy makers play a crucial role in lowering Internet barriers by creating an attractive regulatory environment. Here we discuss how good public policy practices can help to achieve this. We draw lessons from the outcomes achieved by countries in the 'connected', 'connecting' and 'unconnected clusters, and from our discussion of key barriers in Section 3.3[39].

Examples of good public policy practice include:

- Sector liberalisation and the encouragement of sustainable competition, including a non-restrictive licensing regime and spectrum policy that ensures underutilised radio spectrum can be freed up for innovative use.

[39] This builds on work we have conducted for regulators and operators in the region (including the GSMA), and for NGOs and industry groups such as the Internet Society in Africa and Latin America.

- Effective regulation that strikes a balance between encouraging competition and stimulating investment and innovation

- Business conditions conducive to private investment locally, including ensuring it is easy to do business, that taxation on Internet access services and devices is not excessive, and policies that lower the cost of network construction are in place; and

- Carefully balanced data protection and localisation regulations that foster trust and preserve the fundamental rights of users, whilst encouraging innovation and enabling international content and applications to be delivered to end-users.

Liberalising the regulatory regime can lower barriers by encouraging competition and investment

Since the development of competitive telecoms markets in the 1990s, the benefits of sector liberalisation have been well known and understood. Allowing investment by new entrants with minimal restrictions can encourage competition and investment. However, once the sector has been officially liberalised, market outcomes are influenced by good policy regarding licensing and the allocation of scarce resources such as radio spectrum. Best practice regarding the provision of licences to IAPs reflects the following principles:

- Limits to the number of licences available can constrain competition and investment. Except where justified by the scarcity of resources such as radio spectrum, licences should be easy to obtain and rights they imply should be easy to exercise.

- Providing separate licences for infrastructure and service provision can lower barriers to entry and encourage competition. For example, even if there are a limited number of submarine cable landing licences, allowing any licenced operator to access the landing station can increase competition. This is common practice in many markets, including Singapore for example, with separate licenses for Facilities Based Operators and Service Based Operators.

- The conditions and obligations attached to the licences themselves should not be overly onerous. For example, they should be, where possible, technology neutral and allow the licensee to offer a wide range of services. This is key to enabling innovative deployment strategies, such as those involving aeronautical vehicles and techniques (e.g. balloons, satellite and drones), as by definition they do not easily fit within existing licence types.

- Where possible, exemptions from the requirement to obtain a specific licence can encourage investment. An example of good practice in this respect is the European Union, which has a general authorisation regime. Telecommunications operators do not need a licence, but instead must inform the national regulatory authority of their intention to operate[40]. Class licences go

[40] Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services (Authorisation Directive)

some way to enabling a light licensing regime, but in many cases it may be possible for licenses to be dispensed with entirely (for example for online content).

- Where resources are currently scarce, regulators should first seek to expand supply, for example by releasing underutilised spectrum for new uses; in assigning these resources, regulators should also follow a transparent process that encourages innovation and investment. Governments should ensure abundant access to both licensed and unlicensed spectrum at high, medium, and low frequencies. Finally, new models of spectrum sharing that allow dynamic and efficient use should be encouraged. For example, technologies and practices could be encouraged that allows spectrum to be shared dynamically with new users when not in use by existing users.

Effective regulation strikes a balance between encouraging competition and stimulating investment and innovation

Most consumers in Asia-Pacific are enjoying unprecedented choice for Internet access services, often at prices that are remarkably low by global standards. Choice and low prices are hallmarks of successful competition, which regulators and policy-makers must continue to nurture, whilst ensuring a flexible approach that stimulates and rewards investment in innovative approaches to broadband connectivity. Competition remedies should:

- focus on clearly defined markets where competition issues can be proven to exist.
- be proportionate, i.e. a regulator should apply the least burdensome remedy that achieves the desired outcome
- be transparent and non-discriminatory, applying to all access seekers equally.

Importantly, best practice regulation also implies forbearance where competition issues are not clear or are likely to be transitory. In new markets related to the delivery of online content and applications, market conditions continue to evolve too fast for policy-makers and regulators to risk intervening in the wrong way, and therefore many advanced regulators have taken a wait-and-see approach, arguably to the benefit of innovation and consumers.

This is particularly relevant both to IAPs, who continually need to invest in expanding and improving their networks, and to CAPs who operate the platform and services that attract end-users to the Internet.

Platforms are a major enablers of content discovery and demand aggregation online. Accordingly, they have an important role to play in reducing the difficulty and costs of rolling out relevant content to end-users, and enabling the monetisation of this content, often in partnerships with IAPs (e.g. through carrier billing).

Effective regulation should seek to encourage, and not deter or hinder, the rollout of networks in more risky areas and of large-scale platforms to the benefit of end-users and of local CAPs,

particularly in 'unconnected' and 'connecting' countries, where they can help bring relevant and accessible content to drive adoption of broadband services.

Providing an attractive investment environment can encourage long-term investment

Given the long-term and capital-intensive nature of investments in broadband infrastructure, a local environment that is attractive for private investment is linked to positive outcomes in the broadband market. There are four main aspects to this.

- The overall attractiveness of the investment environment, including the barriers to foreign direct investment, the ease of starting a business, enforcing contracts, obtaining permits, and other key business inputs;
- The level of sector-specific taxation, which, if excessive, can distort investment decisions and discourage take-up and usage;
- The level of censorship and the monitoring of end users, which should be kept to a minimum; and
- Policies that lower barriers to the construction of fibre access, backhaul, and backbone networks.

There is wide variation in the attractiveness of the investment environments of the countries in Asia–Pacific. The World Bank publishes an index that ranks countries according to their ease of doing business, which has a major impact on foreign direct investment. This covers metrics such as how easy and transparent it is to start a business, obtain a construction permit, pay tax, enforce contracts and resolve insolvency. 'Connected' countries in Asia–Pacific consistently achieve a high ranking in this index (as shown in Figure 4.5).

Cluster	Average rank, World Bank ease of doing business index
Connected	8.33
Connecting	83.25
Unconnected	144.5

Figure 4.5: Average rank, World Bank ease of doing business index [Source: World Bank, 2015]

Indonesia is noteworthy in this respect. The government maintains a "negative list" of industries that are subject to some form of control on foreign direct investment. In many cases, foreign ownership is restricted, or must be obtained in conjunction with a local partner. Currently, telecommunications network providers are limited to 65% foreign shareholding.[41]

The level of taxation on the sector is also important. Whilst there is a trade-off between government revenue-raising and reduced investment, take-up and usage, the burden of taxation

[41] Source: Baker & McKenzie, Client Alert, May 2014, Indonesia Foreign Investment, New Negative List

that falls on the broadband sector should not be greater than elsewhere in the economy. Where possible, lowering the overall burden will encourage investment and take-up.

The GSMA, with Deloitte, publishes research on the level of taxation attracted by mobile devices, as a proportion of the cost of the device, as illustrated in Figure 4.6. There is a link between the level of broadband development and lower levels of taxation, with better outcomes associated with lower tax rates.

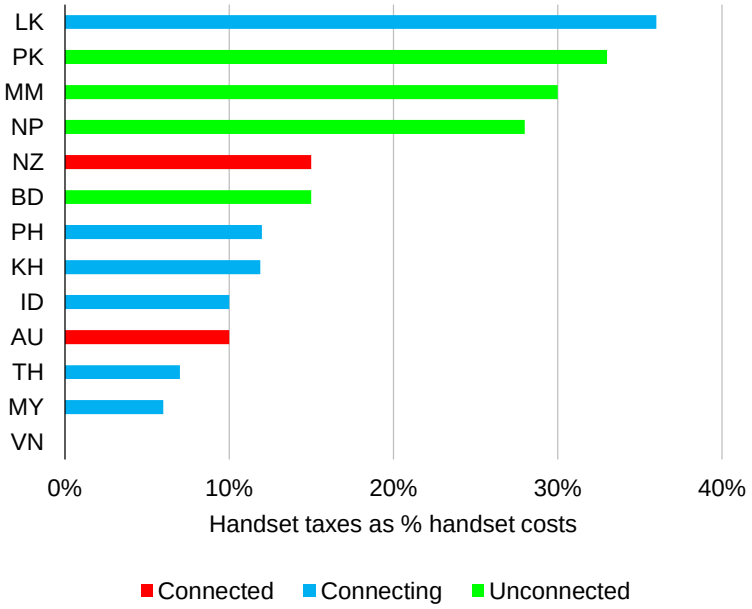


Figure 4.6: Taxes attracted by mobile devices as a proportion of handset cost [Source: GSMA, Deloitte, 2015]

In addition, investment in the Internet thrives when censorship and the monitoring of end users is kept to a minimum. Freedom house publishes the Freedom of the Net Index (shown in Figure 4.7) which measures, amongst other things, limits on content including technical blocking, regulation and self-censorship. It also measures violations of users rights, such as monitoring and surveillance. Generally, 'connected' countries are freer than 'unconnected' countries.

Figure 4.7: Freedom of the Net Index rating of study countries [Source: Freedom of the Net Index, 2014]

Freedom of the Net	Connected	Connecting	Unconnected
Free	Australia Japan	Philippines	
Partly free	Singapore South Korea	Cambodia Indonesia Malaysia Sri Lanka	Bangladesh Indonesia
Not free		Thailand Vietnam	Pakistan

Finally, policies should be in place that lower barriers to the construction of fibre networks. This includes access networks, but also backhaul networks required to connect mobile base stations and

fixed network nodes, and the long distance backbone networks that carry Internet traffic around the world. The following policies can help to achieve this:

- Sharing of passive infrastructure, such as poles and ducts (owned by telecoms operators, utilities, or other parties) should be encouraged as much as possible. This could be through regulation or other incentives.

- Regulations and practices regarding access to non-telecoms infrastructure, such as roads (for trenching) should be balanced and transparent. A completely open and low-cost approach may result in disruption due to repeated digging. More appropriate is a transparent, non-discriminatory approach, which treats all users (e.g. utilities, telecoms operators) equally. Likewise, conditions that maximise sharing of trenches and co-ordination of dig times can minimise cost and disruption. For example, a "dig once" policy, which requires the installation of a single oversized duct which can then be shared, can reduce roll-out costs

- Construction permission processes should be streamlined and made as efficient as possible. For example, if both national and local permissions are required, these could be consolidated into a single "one-stop shop" decision making processes.

- Policy should facilitate interconnection and international connectivity. Regulatory and licensing restrictions to the construction of new submarine cable landing stations should be removed to encourage new investments. Likewise, there should be minimal restrictions to the establishment of new Internet Exchanges.

Data-protection and data-localisation policy that balances innovation, trust and the rights of users can encourage usage and investment

A final area of policy that is highly relevant to the development of a dynamic, healthy and content-rich Internet ecosystem relates to what happens to online content and in particular data.

Data-protection and data-localisation policy, whilst providing certain benefits related to trust and privacy, needs to be carefully traded off against the encouragement of innovation. Data-protection policy should aim to balance trust and the fundamental rights of users. It should also seek to enable innovation at as low a compliance cost as possible.

In particular, certain data-protection regulations or restrictions may, while going some way to establish trust, have a limiting impact on innovation and investment. It is important for governments to be realistic about this as they balance their competing policy aims.

Requirements that strictly limit the purpose for which data is used may inhibit innovation. This is because finding hidden patterns in data, and developing uses for these, is a fundamental source of CAP innovation. This often involves the combination of databases gathered for various purposes, which may well be different from that of the new service being developed.

Limitations on the transfer of data between firms or internationally may also inhibit innovation. Often, new services are created by combining technical capabilities or databases from different firms, which may also be in different countries. This type of innovation can be harmed by data-transfer limitations.

Data-localisation policies, such as those that require certain data to be held in-country, are often defended on the basis of privacy and the need to ensure local data protection policies are enforceable. Although in some cases this may be a desirable goal in principle, in practice data localisation policies have significant downsides:

- They can have negative impacts on consumers and the ecosystem. CAPs do naturally seek to cache their content and data close to end users, as this improves the quality of service. Indeed, where regulatory and investment conditions and infrastructure are conducive, this process can happen organically as CAPs optimise their networks.

- They are difficult to implement, and even more so to mandate. For these policies to be at all possible, sufficient underlying infrastructure must be present. For example, data centres used by CAPs need reliable and low-cost access to power, and access to competitive providers of domestic and international connectivity. If this is not the case, data-localisation requirements may prevent CAPs from offering their services. This will be to the detriment of consumers, who will have a lower choice of innovative services.

- They can have unintended consequences that undermine the very rationale for them. Distributed storage of data in numerous data centres can be more secure than local storage. This is because of the additional redundancy, and potentially better security of larger, professional, centralised data centres.

- In emerging economies where many industries are developing concurrently, strong data localisation policies can discourage investment by businesses in many industries, including banking, financial services, manufacturing, and retailing, who store data globally. If these businesses are forced to store data locally, it is likely to increase their costs and decrease their investment.

A more-effective way of achieving data-localisation aims is to ensure that local market conditions are attractive for investment. This means providing high-quality, low-cost infrastructure, and also following the good practices outlined in this section.

5 Conclusion

The research presented in this report demonstrates clearly, in our view, the impact of the growth of advanced broadband in Asia-Pacific has had on IAPs and the contributions made by CAPs.

In particular, the tremendous growth of broadband take-up and usage in the region has helped to create opportunities for profitable investments for IAPs. They have made investments in advanced networks in order to serve this demand. This has been accompanied by significant top line revenue growth, a rapid increase in the importance of data and internet services to both revenues and profits, and healthy returns on the investments made. In addition, new opportunities to invest in innovative OTT content and services have been unlocked.

CAPs, for their part, are a key driver of growth in broadband take-up and usage. Consumers adopt broadband access services specifically to use the content and applications produced by CAPs. In addition, the use of advanced content drives consumers to upgrade their broadband services. Finally, they are making investments in the physical infrastructure of the Internet that improve the quality of user experience and save costs for IAPs.

Finally, partnerships between CAPs, IAPs, and other parties, are helping to lower barriers to Internet development and drive further growth in the region. This, in conjunction with a conducive policy environment and well placed specific policy interventions can drive future broadband growth in the region.

Annex A Primary research programme

A.1 Introduction

To gain an in-depth understanding of consumers' attitudes, and drivers and barriers related to Internet adoption and usage, we commissioned two end-user surveys in several Asian markets in August 2015:

- **'Mobile survey':** a survey of mobile users in five markets (Australia, Indonesia, Singapore, Sri Lanka and Thailand) conducted on survey participants' mobile telephones (smartphones and higher-end feature phones). All participants in this survey were mobile Internet users, and a proportion of them also subscribed to a fixed Internet connection.

- **CATI research programme:** computer-assisted telephone[42] interviews (CATI) with people in three emerging Asia–Pacific markets (Indonesia, Sri Lanka and Thailand). All participants in this survey were full non-adopters of the Internet, i.e. none of them subscribes to either a mobile Internet service or a fixed Internet service.[43]

The reason for carrying out these two different types of primary research programme was to reach both adopters of the Internet[44] in the target markets and full non-adopters of the Internet,[45] particularly in the three emerging markets[46] covered by our primary research programme.

We achieved a robust sample size of more than 5000 people. Figure A.1 provides detailed information on the sample sizes by country and survey type:

Figure A.1: Mobile and CATI survey sample sizes [Source: Analysys Mason, 2015]

	Mobile survey	CATI survey	Total sample
Australia	1000	0	1000
Indonesia	800	400	1200
Singapore	1000	0	1000
Sri Lanka	500	402	902
Thailand	800	415	1215

42 Although CATI refers to telephone interviewing, some of the interviews in Thailand and Sri Lanka were actually conducted in person. This is because we wanted to be able to reach both urban and rural non-adopters of the Internet, and rural non-adopters often do not have regular access to landline telephones.

43 Please note that some of the CATI survey participants do use the Internet on a regular basis, but none of them actually pays to receive any Internet service.

44 We were certain that all participants in the mobile survey were Internet adopters, as in order to be able to complete the survey a person accesses it on their personal mobile device, via a mobile Internet connection.

45 A sufficiently large sample of full non-adopters could not be achieved via an online survey, since a large segment of non-adopters are also non-users of the Internet, particularly in rural areas. Telephone and face-to-face interviews were more appropriate for this population.

46 Indonesia, Sri Lanka and Thailand.

	Mobile survey	CATI survey	Total sample
Total	**4100**	**1217**	**5317**

While our samples were not fully representative of the populations of the five markets included in the research, each country-level sample comprises a reasonably balanced range of people from different age groups, genders and socio-economic groups. In the following two sections we provide more information about this and other important aspects of the two surveys.

A.2 Mobile survey

We conducted an online survey of 4100 people in Australia, Indonesia, Singapore, Sri Lanka and Thailand in August and September 2015. The survey was specifically designed for mobile devices,[47] although a small number of survey participants[48] completed the survey on a desktop computer. Most survey participants completed the survey on their smartphone and tablet devices, while 20 participants used their feature-phones.[49]

The mobile survey consisted of 28 questions, most of which were closed-ended multiple-choice questions. For three of the questions[50] we asked the participants to type in a value.[51] Four of the questions were 'grid' questions, which required participants to select an answer from a drop-down menu for each of the questions. The survey was conducted in local languages. In the case of Sri Lanka, survey participants were given the choice of completing the survey in either English or Sinhala.

We surveyed 1000 people in each of Australia and Singapore, 800 in each of Indonesia and Thailand, and 500 in Sri Lanka. The gender distribution was equal[52] in Australia, Singapore, Indonesia and Thailand, but in Sri Lanka we were unable to recruit more than 20% of women.

We only surveyed people aged 18 years and above. Most of the survey participants were between 18 and 35 years old, with around 25% of the sample above 35 years of age. As expected, it was particularly difficult to recruit mobile Internet users aged more than 65 years in the target countries, which is why this population is underrepresented in our sample (see Figure A.2).

47 Analysys Mason commissioned "On-Device Research Ltd" to conduct the survey.

48 Only a total of 14 survey participants in Indonesia.

49 Only advanced feature-phones that can connect to the Internet

50 The questions asked how much the participants paid for their current mobile and/or fixed Internet service subscription; we also asked non-adopters of the fixed Internet how much the service would have to cost in order for them to consider subscribing to it.

51 To ensure that the values typed in by participants made sense, we limited the range of answers which would be accepted. Furthermore, the validity of this data was later cross-checked against responses to the question regarding the total monthly household expenditure. Around 5% of all entries were excluded from further analysis after this cross-checking exercise. We replaced the excluded entries with newly completed responses and rebalanced the sample.

52 That is, 50% men and 50% women.

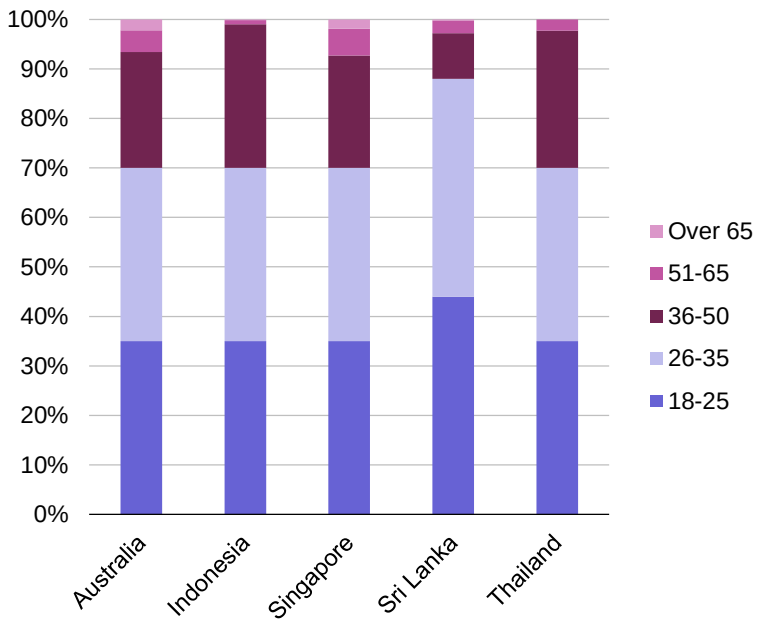


Figure A.2: Age distribution of the mobile survey participants [Source: Analysys Mason, 2015]

Most of the mobile survey participants came from urban environments. This was expected, as in the mobile survey we targeted Internet adopters who were also smartphone, tablet or high-end feature-phone users; that is, a demographic profile which is more typical of urban environments. Figure A.3 provides more information on the rural and urban split of the samples.

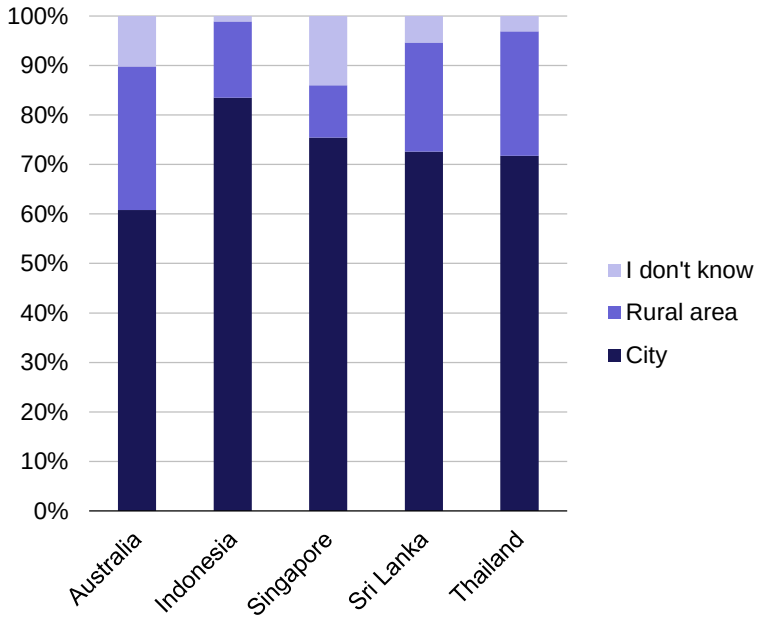


Figure A.3: Rural and urban split of the mobile survey participants [Source: Analysys Mason, 2015]

Finally, in the profiling questions of the mobile survey we also asked participants to provide information on their monthly household expenditure.[53] While we did not impose strict quotas on

[53] More specifically, we asked: 'Approximately, how much are your monthly family expenses for daily needs, exclude expenses for recreation, clothes, shoes, and credit payment (e.g. home, car, electrical things, etc.)'. We opted to ask about the monthly household expenditure levels rather than the income levels of the participants, as consumption is

various expenditure levels when recruiting survey participants, we asked this question to ensure that we reached at least some people at both ends of the socio-economic spectrum. Furthermore, we used this information to check the validity of responses to the open-ended questions about total spend on Internet services.[54]

A.3 CATI research programme

In addition to the mobile survey described above, we also conducted a CATI[55] primary research programme with more than 1200 people in August 2015. The main objective of the CATI research was to understand the key barriers to adoption of the Internet, which is why we exclusively interviewed non-adopters of the Internet[56] across the three markets. The share of non-adopters of the Internet is fairly small in Australia and Singapore, which is why we limited the CATI research to the three emerging markets covered by this study – Indonesia, Sri Lanka and Thailand.

The interviews were conducted in interviewees' native language, either by telephone or in person. The interview questionnaire consisted of 20 questions. 18 questions were closed-ended, and 2 were open-ended, with interviewees being asked to state the approximate hypothetical price at which they would consider subscribing to mobile and fixed Internet services. In addition, we asked participants who selected the answer "other" to three multiple-choice questions to explain what was meant by "other".

Within the CATI survey we interviewed 415 non-adopters of the Internet in Thailand, 402 in Sri Lanka and 400 in Indonesia. The gender distribution was fairly balanced in Indonesia and Sri Lanka, and skewed towards males in Thailand.[57] Please see Figure A.4 for more information on the gender distribution of the CATI samples.

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usually the preferred welfare indicator, particularly in developing markets. The World Bank states that "consumption is conventionally viewed as the preferred welfare indicator, for practical reasons of reliability and because consumption is thought to better capture long-run welfare levels than current income." For further discussion of this point, see http://documents.worldbank.org/curated/en/2000/09/17408018/world-development-report-20002001-attacking-poverty.

54 As explained in footnote 49.

55 Analysys Mason commissioned "2-morrow" (Vienna, Austria) to conduct primary research in Indonesia, Sri Lanka and Thailand, using both computer-assisted telephone interviewing and face-to-face interviews. 2-morrow conducted the field research in cooperation with three local primary research partners.

56 We interviewed people who do not pay for either a fixed or mobile Internet service. Some of these people still use the Internet at work, school, university etc. but none subscribes to an Internet service plan.

57 Please note that we did not impose any quota on gender, as recruiting full non-adopters of the Internet who are at least 18 years old was already a challenging task. In fact, in the case of Thailand, our local partner had to contact over 3000 people in order to recruit 400 full non-adopters of the Internet.

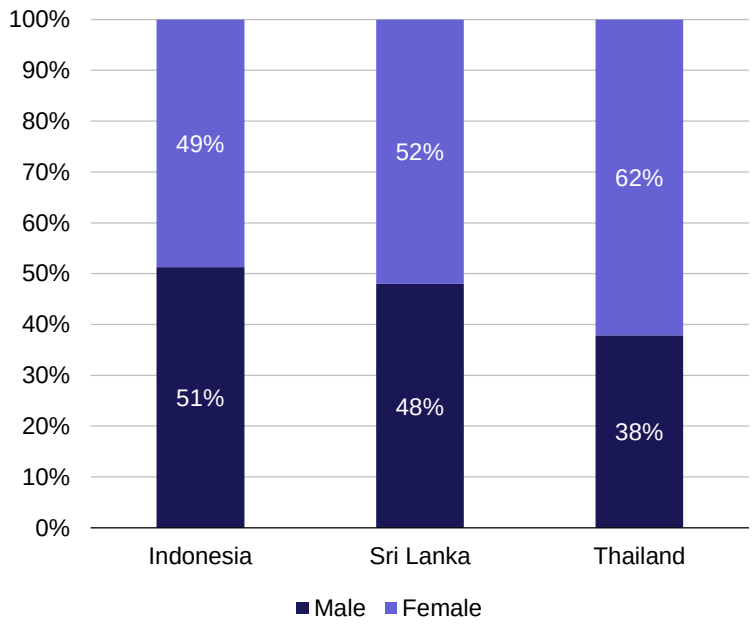


Figure A.4: Gender distribution, CATI [Source: Analysys Mason, 2015]

We only interviewed people who were aged 18 years or more. Most of the interviewees were between 26 and 50 in Indonesia and Sri Lanka, and between 36 and 65 in Thailand. See Figure A.5 for more information on the age distribution of the CATI samples.

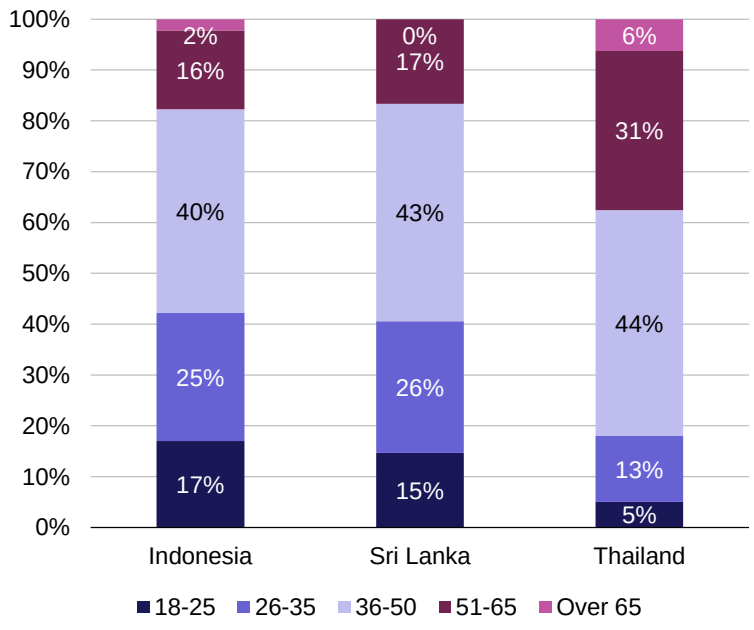


Figure A.5: Age distribution, CATI [Source: Analysys Mason, 2015]

As mentioned in the previous section, the rural and urban split of the samples was more balanced in the CATI research programme than in the mobile survey. In the case of CATI research, we imposed a minimum 30% quota on both rural and urban categories in the samples. Similar to the situation for gender and age distribution, Thailand's sample was again somewhat skewed, this time in favour of participants from an urban environment (see Figure A.6).

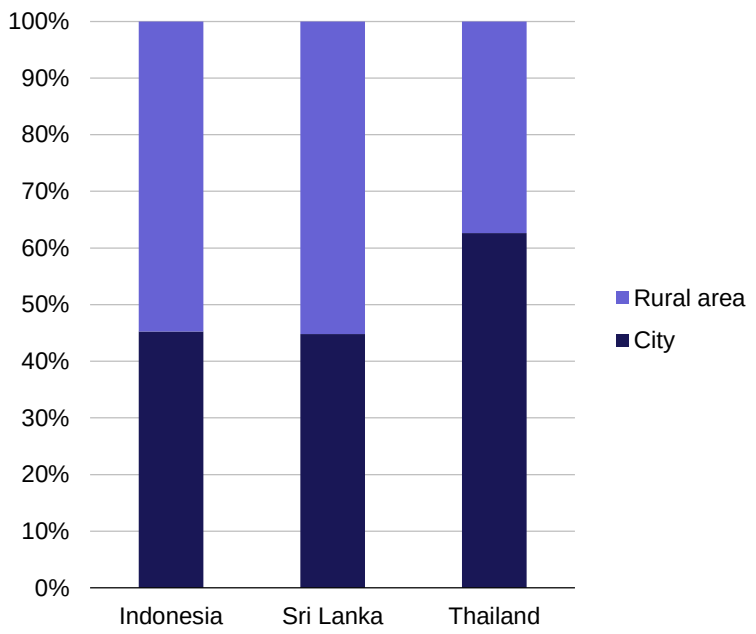


Figure A.6: Rural and urban split of the samples, CATI[58] [Source: Analysys Mason, 2015]

As with the mobile survey, we asked interviewees about their monthly household expenditure levels, to ensure that we interviewed people from the full range of socio-economic groups. Interviewees were asked to select one of seven ranges of expenditure level: about 50% of samples in Thailand and Indonesia and 70% of the Sri Lankan sample fell into one of the three options that lay in the middle of the overall range.[59]

58 While we gave an option for the participants to say that they did not know whether they lived in rural or urban environments, none of the CATI interviewees selected this option. It is likely that the interviewers assisted the interviewees who may have been in doubt, an aid which was of course not available to the mobile survey participants.

59 Please note that we did not impose quotas on expenditure levels.

Annex B State of the broadband ecosystem in Asia–Pacific

The Asia–Pacific broadband ecosystem is characterised by rapid growth and variation between countries. In this annex we provide further details of the broadband ecosystem in the 21 countries of interest to this report.

B.1 The Asia–Pacific Internet picture is one of high growth and wide variations

The Asia–Pacific region makes up a significant part of the world's population and economy, and is hugely diverse. In this section we provide further information on the region's economic and market performance.

Asia–Pacific has enjoyed rapid, yet uneven, economic growth over the last ten years

The 21 countries studied here carry significant weight in the world economy, representing 18% of the world's population and 16% of global GDP.[60] Economic and population growth have been relatively rapid in the last ten years (see Figure B.1 and Figure B.2). Real economic growth rates averaged 4% per annum (excluding Japan, which drags the overall average down to 2%) and population growth averaged 1.3% per annum (also excluding Japan).

Figure B.1: Real GDP for Asia–Pacific, constant 2005 US dollars [Source: EIU, 2015]

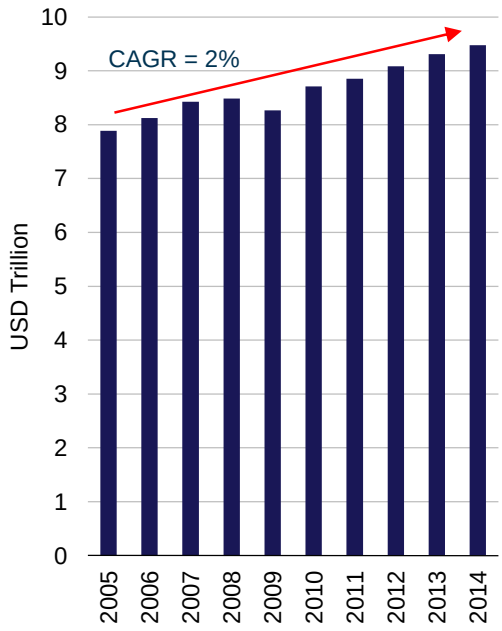
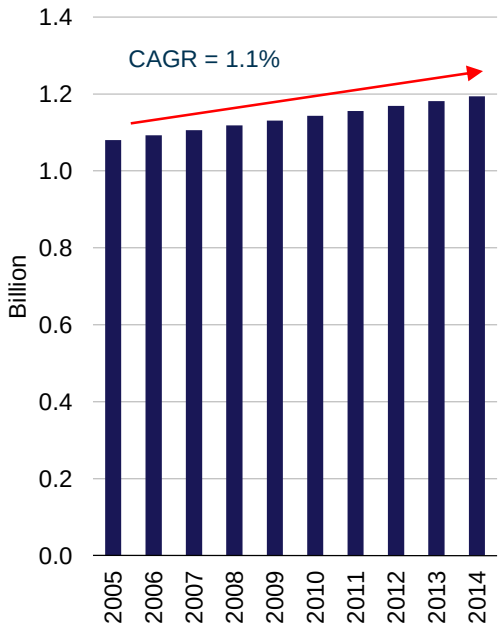


Figure B.2: Total population, Asia–Pacific [Source: EIU, 2015]



60 This is equivalent to half of the world's population and 29% of the world's GDP, if we include India and China.

The region has established itself as a global leader in broadband Internet

As discussed in Section 2.1, Internet markets in Asia–Pacific have seen strong growth. Take-up of access services has grown by 28% per annum over the last ten years, and usage of online content and applications grew by 28% per annum over the last three years.

Although overall data usage has grown more slowly than in some other parts of the world (chiefly North America and Europe – see Figure B.3), there has been very rapid growth in the use of international bandwidth for Internet services (see Figure B.4), as the region hosts several of the most important hubs of the global Internet (in Singapore, Hong Kong and Tokyo).

Figure B.3: Annual data usage (PB) in Asia–Pacific and worldwide [Source: Analysys Mason, 2015]

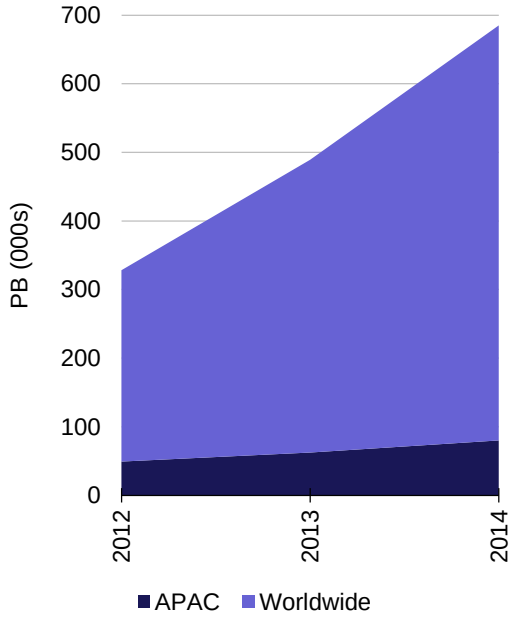
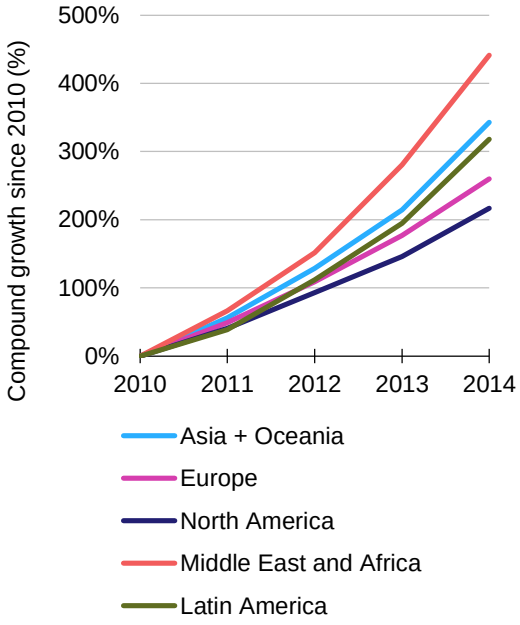


Figure B.4: Growth in usage of international Internet bandwidth by region (indexed to 2010) [Source: TeleGeography, 2015]



B.2 Three clusters emerge: highly connected world leaders, ambitious broadband newcomers, and deeply unconnected markets

As discussed in Section 2.1, above, we have classified the 21 markets covered in this report into three broad clusters: 'connected' countries, 'connecting' countries and 'unconnected countries'. We present further detail on these clusters below, comparing infrastructure, take-up and usage of broadband services across the clusters.

Infrastructure: ranging from ubiquitous in 'connected' countries to poor in 'unconnected' countries

The breadth and quality of broadband infrastructure varies significantly between the three clusters. 'Connected' countries have ubiquitous 3G coverage and access to very-high-speed fixed

connections (over 1Gbit/s in countries such as Singapore and Japan). 'Connecting' countries also have good 3G coverage, but have lower fixed broadband speeds available. Although 3G coverage of 'unconnected' countries is improving, they have lower breadth and quality of infrastructure. This is illustrated in Figure B.5 and Figure B.6.

Figure B.5: 2014 3G coverage as a proportion of population, by cluster [Source: GSMA, 2015]

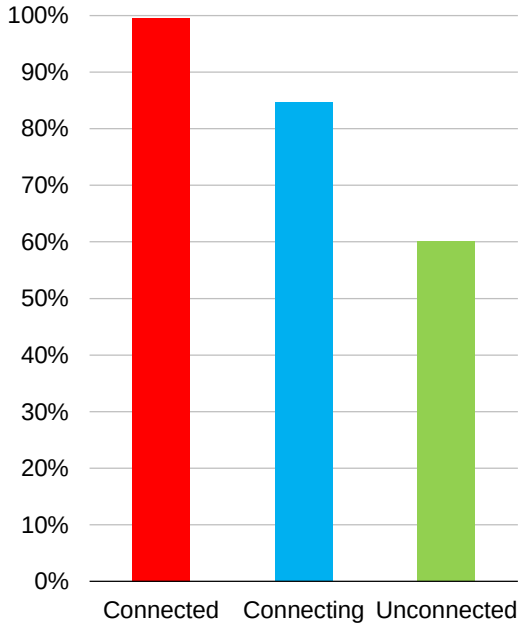
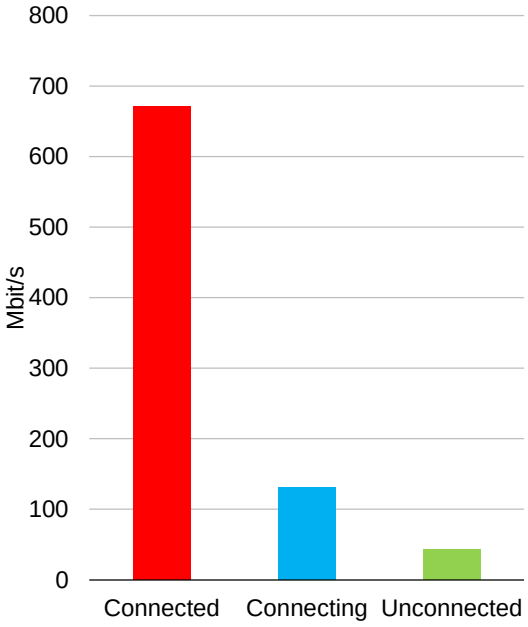


Figure B.6: 2014 Maximum fixed broadband speed available, averaged by cluster [Source: TeleGeography, Analysys Mason, 2015]



'Connected' countries also have far superior international connectivity, as shown in Figure B.7 below.

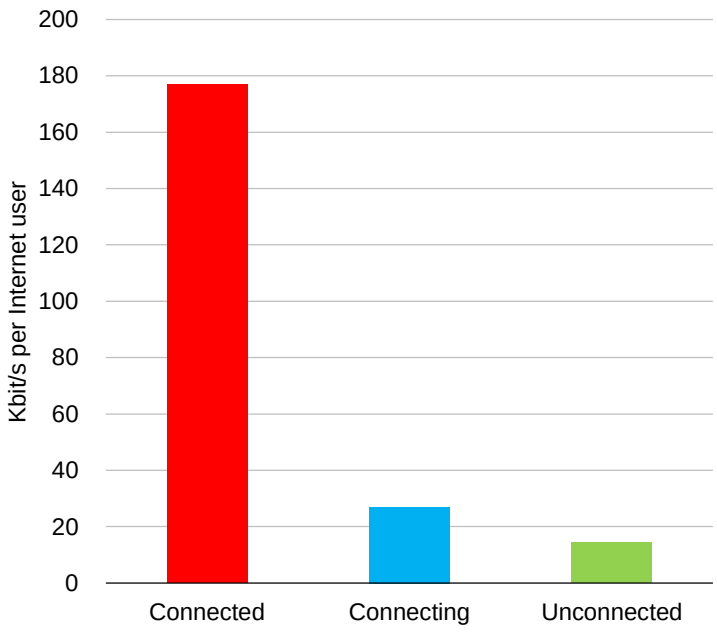


Figure B.7: International Internet bandwidth per Internet user by cluster [Source: TeleGeography, World Bank, 2015]

Take-up: ubiquitous in 'connected' countries, mobile-dominated in 'connecting' countries, and very low in 'unconnected' countries

'Connected' countries have higher take-up of both fixed and mobile broadband services. The 'connecting' cluster has lower, but growing take-up, reflecting later mobile network roll-outs and lower fixed broadband speeds. Take-up in 'unconnected' countries remains very low. This is shown in Figure B.8 and Figure B.9. Together with coverage differences discussed above, these discrepancies in take-up, show that 'connecting' and 'unconnected' countries suffer from low take-up even in areas where broadband is available.

Figure B.8: Current 3G and 4G mobile penetration of population by cluster [Source: GSMA, 2015]

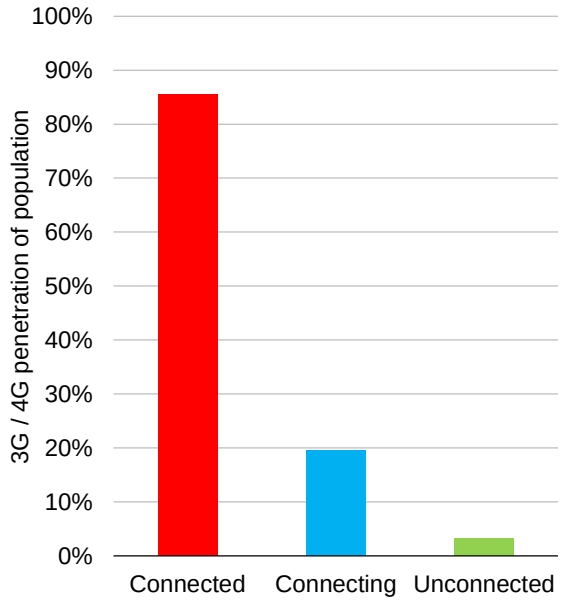
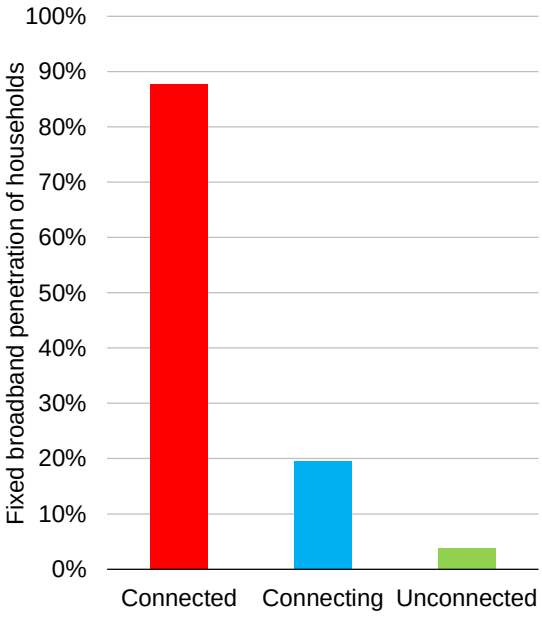


Figure B.9: Current fixed broadband penetration of households by cluster [Source: TeleGeography, 2015]



Usage: ranging from high usage of sophisticated content to very little usage at all

'Connected' countries have higher overall usage than the other two clusters, driven by their higher fixed take-up, access to high speeds and the availability of more-sophisticated content. Figure B.10 shows annual Internet traffic per capita and Figure B.11 shows the proportion of the top-40 websites that contain sophisticated content.

Figure B.10: Annual Internet and data traffic (GB) per capita by cluster [Source: Analysys Mason, 2015]

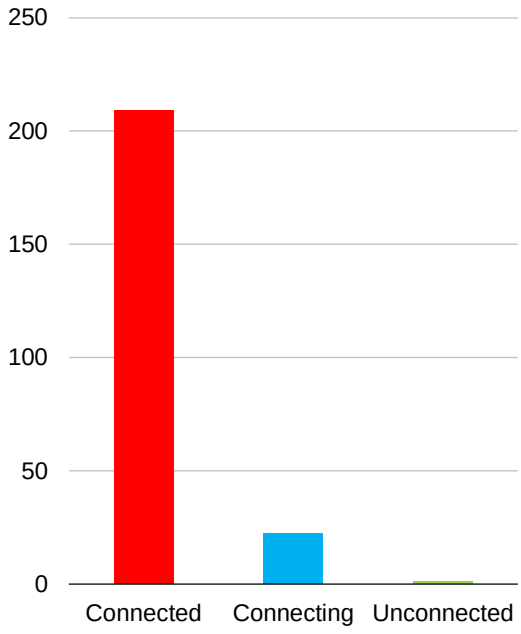
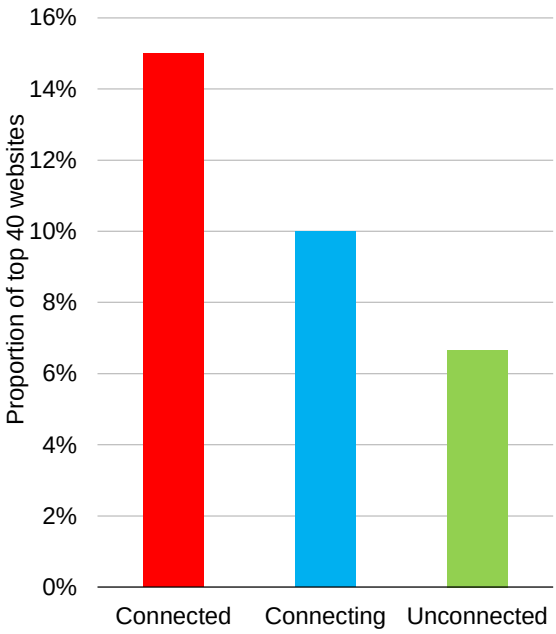


Figure B.11: Proportion of the top-40 websites that contain sophisticated content[61] [Source: Analysys Mason, 2015]



This difference in traffic is driven largely by Internet take-up. Looking at the usage per subscriber, a more-nuanced picture emerges: for fixed users (see Figure B.12), each subscriber consumes more data in 'connected' than in other markets; while for mobile (3G and 4G) subscribers (see Figure B.13) usage per connection is quite similar in 'connected' and 'connecting' markets, but much lower in 'unconnected markets', which suggests that international connectivity and access network capacity are much more constrained in 'unconnected' markets.

[61] We define sophisticated content as that which needs an advanced broadband connection. It includes video, gaming and image-heavy websites.

Figure B.12: Annual fixed data traffic (GB) per fixed broadband subscriber by cluster [Source: Analysys Mason, 2015]

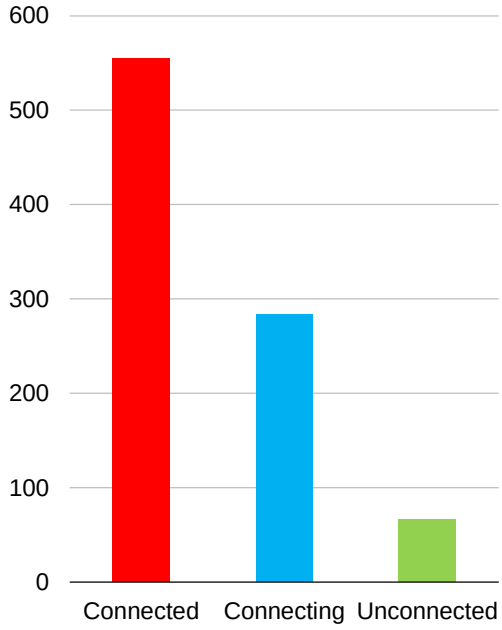
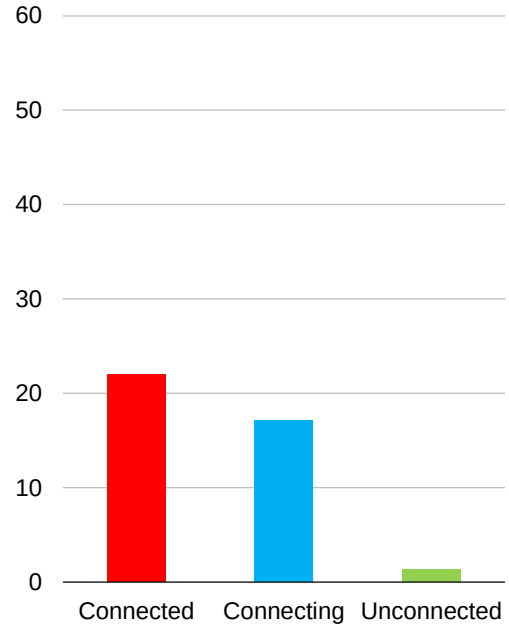


Figure B.13: Annual mobile data traffic (GB) per 3G/4G mobile connection by cluster [Source: Analysys Mason, 2015]



Annex C Key barriers to broadband development in Asia–Pacific

In this annex we provide further details of the significance of the barriers identified in Section 3.3 in each of the three clusters. We discuss each of the barriers that were not covered in the main report.

C.1 Availability of broadband requires network deployment to be attractive for operators, for which policy and regulation play a major enabling role

Here we examine the barriers to availability, and the extent to which they have an impact on Asia–Pacific markets. The three major barriers identified are:

- the business case for network roll-out
- the availability of key inputs such as radio spectrum and electric power
- the policy and regulatory environment (not covered here, as it was discussed in Section 4.3 earlier).

C.1.1 Business case

The drivers of a successful business case are the cost of inputs, and the country-specific investment risk. We can compare data that can act as a proxy for each.

The cost of inputs is largely driven by the cost of the access network. This is heavily influenced by the density of demand. To understand this density of demand, we can examine the number of Internet users per square kilometre. To examine the country-specific investment risk, we can look at the index compiled by the World Bank on the 'ease of doing business'. These are shown in Figure C.1 and Figure C.2.

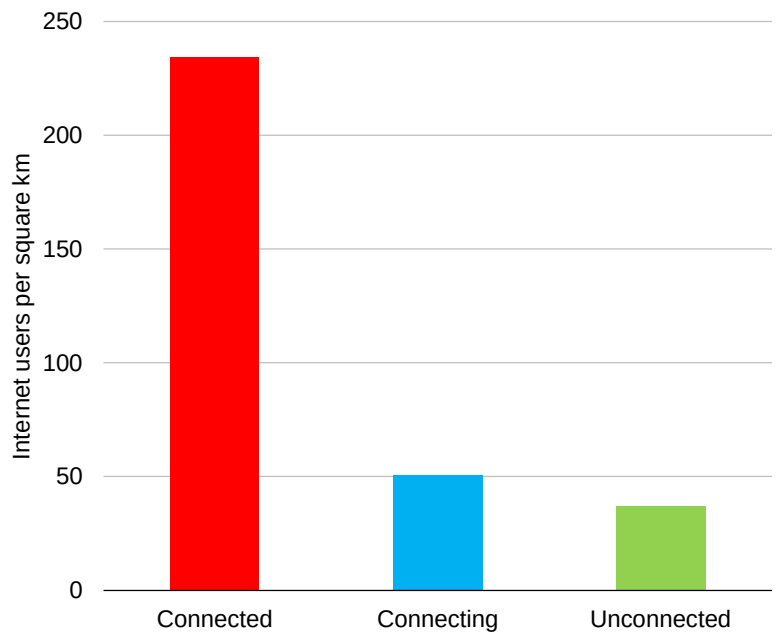


Figure C.1: Internet users per square kilometre [Source: World Bank, 2015]

Cluster	Average rank, World Bank ease of doing business index
Connected	8.33
Connecting	83.25
Unconnected	144.5

Figure C.2: Average rank, World Bank index of 'ease of doing business' [Source: World Bank, 2015]

We can see from the above that 'connected' countries have a significant advantage over countries in the other clusters in both the density of demand, and the overall business environment.

C.1.2 Availability of key inputs

The key inputs which we have identified as potentially creating barriers to availability are:

- the availability of electricity
- radio spectrum
- the availability of passive network inputs such as duct and telephone poles to investors in access networks (discussed in Section 4.3).

To some extent, the availability of inputs does appear to be a barrier in 'connecting' and 'unconnected' countries. Although the level of electrification does not appear to be a barrier (at above 60% in all three clusters), significantly more radio spectrum has been made available in 'connected' countries. These two metrics are shown in Figure C.3 and Figure C.4 below.

Figure C.3: Electrification as a proportion of population [Source: World Bank, 2015]

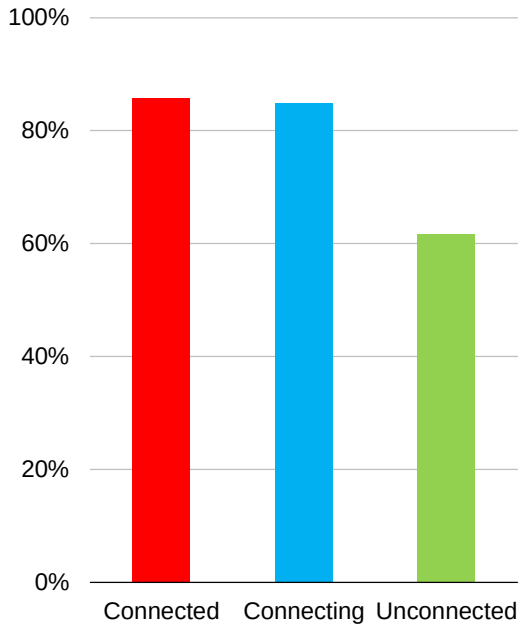
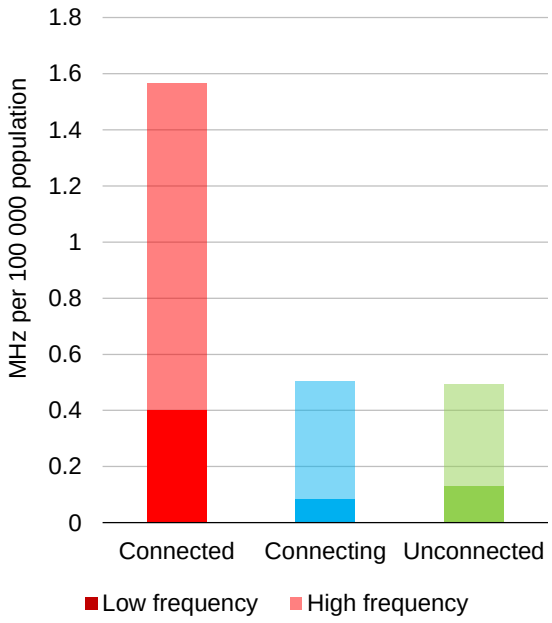


Figure C.4: Average frequency available, MHz per 100 000 population [Source: National regulatory authorities, TeleGeography, Analysys Mason, 2015]



C.2 Take-up relies partly on affordable devices and services, but also on social factors and perception

The barriers we have identified to take-up are the cost and availability of devices and service plans (which we discussed in Section 3.1 and 3.3), and social factors such as education and awareness, and the appropriateness of Internet services in the local context.

C.2.1 Social factors

Social factors that influence take-up include levels of education and awareness (both general literacy and awareness of the benefits of the Internet), and the social and cultural acceptance of accessing Internet content. Awareness is not covered here, as it was discussed in Section 3.1.

Overall literacy rates are high in both ‘connected’ and ‘connecting’ countries, indicating that basic levels of education are not a major barrier in these countries. In all clusters, more than 60% of the population is literate (see Figure C.5).

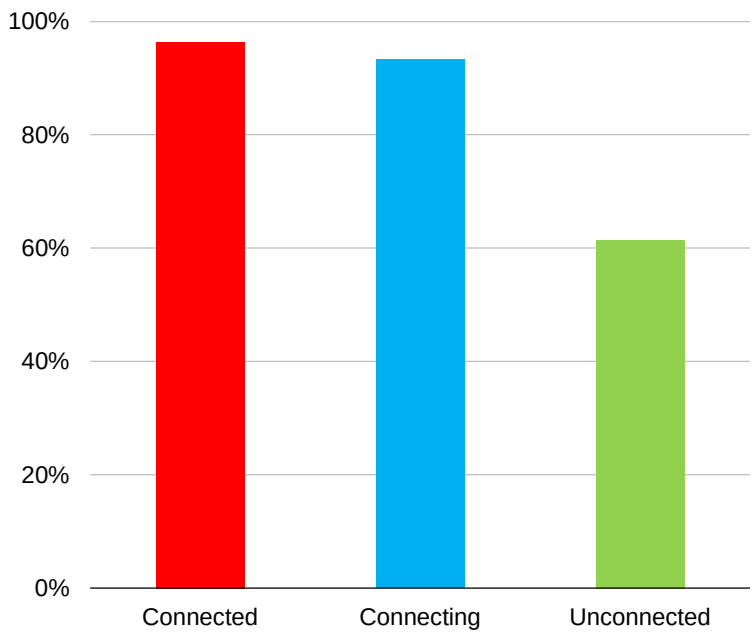


Figure C.5: Average literacy rate among adults (aged 15+) [Source: World Bank, 2015]

In addition, a key factor in take-up is that it must be deemed socially or culturally appropriate or acceptable to use the Internet. Gender is one example of a social barrier to Internet use. According to a 2012 study,[62] there is a 'gender gap' in Internet access. The study estimated that 33% fewer women in South Asia had access to the Internet than men, while the gender gap was smaller in the East Asia and Pacific region (at 20%). Worldwide, the study calculated that 23% fewer women than men are online in developing countries.

C.3 Usage is spurred by trust and the availability and accessibility of relevant content, on suitable devices and high-quality networks

The barriers we have identified to the usage of Internet content and applications are the means of access, the availability of relevant content (both of which were discussed in Section 3.3), the quality of service experienced by end customers, and the level of trust consumers have in the Internet (both of which are discussed here).

C.3.1 Quality of service

Quality of service (that is, the actual technical performance received by the end user when consuming content), can have an impact on Internet usage levels. If quality is degraded when consuming content, an end user will consume less content. Quality of service includes the actual bandwidth received, as well as other factors such as latency. Akamai, the world's largest commercial CDN provider, records actual bandwidths achieved by end users connected to its network. Whilst it does not collect data for the 'unconnected' countries, we can see that users in

62 *Women and the web: Bridging the Internet gap*, Intel and Dalberg Global Development Advisers, 2012.

'connected' countries experience higher bandwidths significantly more often than those in 'connecting' countries (shown in Figure C.6 for fixed and Figure C.7 for mobile).

Figure C.6: Unique IP addresses connecting to Akamai from a fixed network at an average speed of over 4Mbit/s [Source: Akamai, 2015]

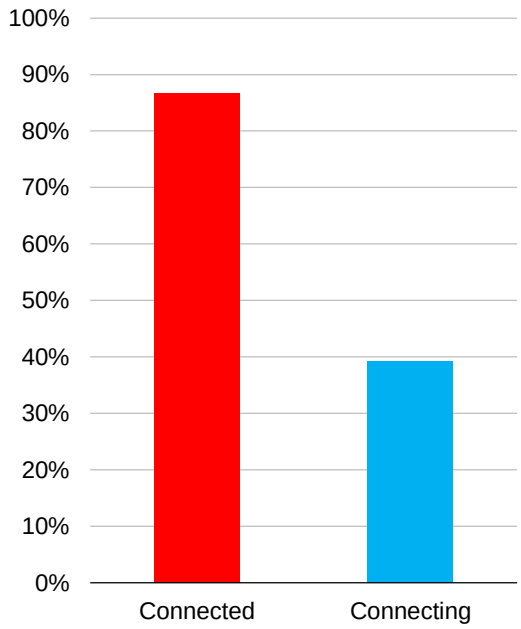
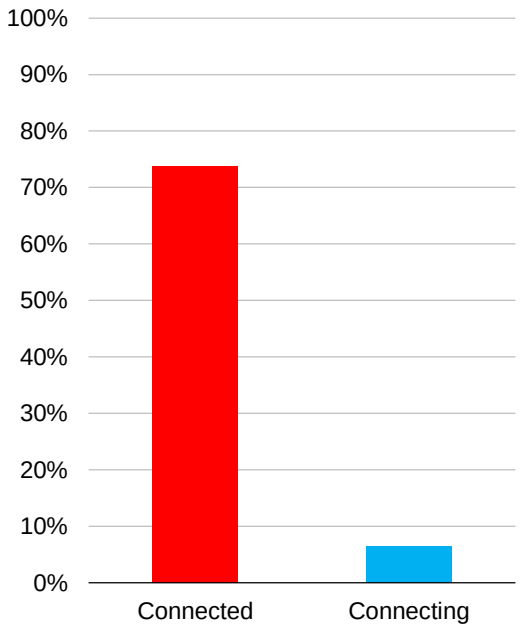


Figure C.7: Unique IP addresses connecting to Akamai from mobile network providers at an average speed of over 4Mbit/s [Source: Akamai, 2015]



C.3.2 Trust

Internet users will have a higher level of trust in the Internet if they feel that they are unlikely to be the victims of cybercrime or be exposed to inappropriate content, or are free from fear of penalties from the government for accessing certain content.

Freedom House, a think tank, produces an annual "Freedom of the Net" index to assess government censorship and control of the Internet. Of the 14 countries included in our study that are reviewed by the Freedom of the Net Index, 8 were judged to be on a downward 'overall trajectory', indicated a decline in freedom of the Internet, whilst only 3 were perceived to have improved their position on this measure between 2013 and 2014.[63] The Internet Society's review of Asia–Pacific in 2014 highlighted the introduction of stricter Internet legislation in the Philippines, Vietnam, and Laos, continued 'heavy Internet oversight' in Myanmar, and content filtering and blocking in South Korea, Pakistan, Thailand, Malaysia and Indonesia.[64] As Figure C.8 shows, a large proportion of the countries in this study that appear in the Freedom of the Net Index are rated 'partly free', and three are rated 'not free'. This implies that censorship could indeed be a barrier for certain countries in the region, across all three clusters.

63 *Freedom of the Net 2014*, Freedom House, December 2014.

64 *APAC: The Year that Was*, The Internet Society, 23 December 2014.

Figure C.8: Freedom of the Net Index rating of study countries [Source: Freedom of the Net Index, 2014]

Freedom of the Net rating	Connected	Connecting	Unconnected
Free	• Australia • Japan	• Philippines	
Partly free	• Singapore • South Korea	• Cambodia • Indonesia • Malaysia • Sri Lanka	• Bangladesh • Indonesia
Not free		• Thailand • Vietnam	• Pakistan