NATIONAL BROADBAND NETWORKS OF MALAYSIA, INDIA, INDONESIA AND AUSTRALIA

A COMPARATIVE STUDY

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Abstract

This paper presents a comparison of national broadband networks (NBNs) of four different countries – Malaysia, India, Indonesia and Australia – by describing their rationale, scope, funding, technology and current status. The networks are analyzed for their cost effectiveness, demand stimulation, conduciveness for competition and technology. The networks are fiber based and are implemented by the incumbent as in Malaysia or a special purpose vehicle which is led by the incumbent as in India. Across the four countries, there are differences in terms of funding, implementation entity, point of access by the network, period of implementation and the objectives. The paper is expected to help policy makers in the developing world in devising plans that ensure open access to the networks and promote fair competition.

Keywords: Australia; broadband; competition; demand side stimulation; ecosystem; India; Indonesia; Malaysia; national broadband networks

1. INTRODUCTION

The voices in support of positive impact of broadband on national economy, productivity, employment and inclusion are plenty in both academic literature (for instance, Koutroumpis, 2009) and policy organizations (ITU, 2012; Katz, 2010; Qiang, Rossotto, & Kimura, 2009). An often quoted World Bank study of 120 countries for

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period 1980–2006 showed that for every ten percentage point increase in penetration of broadband services, there would be an increase in economic growth by 1.3 percentage points. Not surprisingly, there are skepticisms (for instance, Kolko, 2010), the extant efforts seem to be optimistic and in the positive direction (Katz et al., 2010). A more recent study by McKinsey on 57 aspiring nations including Malaysia and India showed that the Internet's impact on these economies is among the highest of the countries studied, at 4.1 and 3.2 percent of GDP respectively (Nottebohm, Manyika, Bughin, Chui, & Syed, 2012).

Largely encouraged by the empirical evidence from information and communication technologies led development domain (ICT4D), national governments are building the access to broadband or high speed internet by owning the responsibilities for the infrastructures. By creating these national broadband networks (NBNs), the governments are hoping to bridge the digital divide, create employment and enhance industrial productivity and overall economic development. Among all, the initiatives include constructing new fiber transmission/backhaul networks and implementation of fiber to the home (FTTH).

Some of these fiber networks are implemented by the incumbent as in Malaysia or by incumbent-led special purpose vehicles as in India and Australia. In particular, governments are investing directly or through universal service funding in the rollout of backhaul and local-access fiber. Fiber access rollout which is funded by telecom customers and operators (through Universal Service Taxation) or general public (from general taxation) but not accompanied by appropriate access regulation may adversely affect competitive operators' accessible market and substantially inflate costs. In the face of declining revenues from the fixed segment of the market, these government led fiber NBN initiatives are also seen as a way of supporting competitiveness of the fixed incumbent.

As multiple countries are either exploring or deploying NBNs, it is important to understand and examine the ongoing efforts. A comparative assessment of different countries and their statuses shall inform the policy makers of processes and prognosis of these networks, especially in the context of future policy discussions on optimal strategies for deployment of NBNs. The present paper examines four of the largest National Broadband Initiatives in the Asia Pacific Region, Malaysia, India, Indonesia and Australia. It will assess the pros and cons of each of these models. The authors have visited each of the countries to interview the key stakeholders of the NBNs including the regulators, implementers of the network, other operators and other key stakeholders, in addition to consulting the documents available publicly.

The paper is divided into six sections. The first four sections present the NBNs of Malaysia, India, Indonesia and Australia. Each of the NBNs is discussed under four sub-headings – rational, scope, technology and status. The fifth section compares all four NBNs under four themes, cost effectiveness, demand stimulation, conduciveness to competition and technology. The final concluding section offers some suggestions for policy makers.

2. HIGH SPEED BROADBAND NETWORK (HSBB) OF MALAYSIA

2.1. RATIONALE

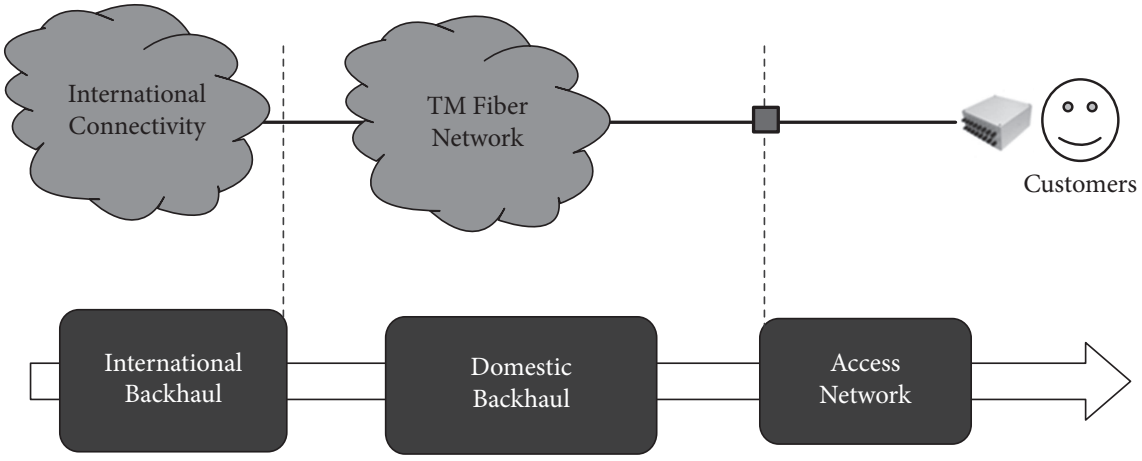
The Malaysian government has been considering broadband connectivity as an area of competitive concern since 2002, when discussions on the National Broadband Strategy commenced. The Malaysian National Broadband Plan (NBP) was approved in Oct 2004 (MCMC, KTAK, 2006). The objectives of the NBP were to generate adequate supply in terms of broadband infrastructure, stimulate demand explore various funding mechanisms and identify gaps in existing regulations.

With the objective of increasing broadband infrastructure, the Malaysian government agreed to grant MYR 2.4 billion (USD 750 million) to Telekom Malaysia (TM) in order to subsidize their High Speed Broadband (HSBB) Network in 2008. The Malaysian government saw improving broadband connectivity in industrial areas as a way of increasing national competitiveness and turning Malaysia into a communication and multimedia global hub.

2.2. SCOPE

Phase 1 of HSBB had a target of passing 1.3 million premises by 2012 with FTTH or VDSL2 for residential high rise buildings with connection speeds above 10Mbps. Phase 1 covers the industrial areas around Kuala Lumpur including inner Klang Valley, and Iskandar in Johor. International capacity was also to be increased as part of the project through the deployment of TM's first private international submarine cable system, Cahaya Malaysia (Singh, 2013). Figure 1 shows a diagram of the Malaysian HSBB network and what elements fall under the scope of the project.

Figure 1. Malaysian HSBB Network



Source: Authors.

The Malaysian government opted for a supply-driven HSBB network as they did not want to wait till there were speed bottlenecks before upgrading the network due to the time lag between identification of these bottlenecks and building the network.

2.3. FUNDING

A Private Public Partnership (PPP) agreement was signed between the Malaysian government and Telekom Malaysia (TM) to build a HSBB network at an estimated cost of MYR 11.3 billion (USD 3.5 billion). The government contributed MYR 2.4 billion (USD 750 million) on an incurred claims basis based on project milestones achieved by TM. The balance was to be funded by internally generated funds and borrowings by TM.

The Government's contribution was decided based on the HSBB project profitability analysis conducted by TM. It was mostly to make up for the lower net present value (NPV) of serving areas such as new housing estates and new industrial zones which, despite being in Malaysia's urban core, were nevertheless regarded as non-profitable by TM.

Just before the agreement was signed in 2008, High Speed Broadband Technology (HSBT), a fiber infrastructure provider (but not operator), proposed a cheaper alternative to the government. HSBT proposed a network costing MYR18 billion (USD 5.37 billion) over 10 years without government funding, with investment expected to come from Middle Eastern investors (Paul Budde Communication, 2013). As HSBT was not an operator, it would not have competed with the service providers who use the fiber network, and therefore would have been positioned to provide an open access network. At the time of writing the report, the author had not received any explanation on why this offer was rejected.

2.4. TECHNOLOGY

As the Malaysian government intended to implement a stable broadband network with speeds higher than 10Mbps and scalable up to 100Mbps, FTTH with VDSL2 (Very-high-bit-rate digital subscriber line) for high rise residential buildings was chosen (MNIC, 2010). TM also provided FTTH through GPON (Gigabit Passive Optical Network) topology (Telekom Malaysia, 2010).

2.5. CURRENT STATUS

One of the key success indicators of HSBB was to reach a target of 50 percent simple 'household' broadband penetration by 2010 from 11 percent in 2006. This target was achieved in 2010 with household broadband penetration reaching 55.6 percent. It is continuing to increase and as of June 2013, it has reached 67.1 percent.

According to MCMC, to date, UniFi has been made available in 102 areas nationwide with over 1.43 million premises passed surpassing the target of 1.3 million premises passed by 2012. The take up of HSBB was also impressive with over 600,000 subscriptions (i.e. 43% take up among homes / premises passed) by June 2013. Through the HSBB project TM has deployed 46,986 km fiber nationwide. International capacity has also increased from 682Gbps to 1.74Tbps by completing the international submarine cable system, Cahaya Malaysia (MayBank IB, 2013).

There has also been high take up of HSBB wholesale services as well. Maxis, Celcom, Packet1 and REDTone have signed up for HSBB access and 19 Companies have signed up for HSBB Transmission services for the carriage of data communications between transmission points with total bandwidth of 90Gbps for 232 links.

According to MCMC, one of the main challenges of increasing the take up of HSBB is that people who already have 1Mbps / 2Mbps connections are satisfied and do not feel the need to upgrade. TM CEO Datuk Sri Zamzamzairani Mohd Isa in an interview further reiterated this by claiming that over 90% of its UniFi base was on the 5Mbps line and that many customers are happy with the service level, and that this presents a tough challenge for TM to upsell its customers (Singh, Broadband Powers TM's Growth, 2013).

Other than HSBB, the government also implemented the Broadband for General Population (BBGP) project targeting other areas using ADSL and wireless Broadband with average speeds of 2Mbps. BBGP is funded by the Universal Service Provision (USP) fund as it focuses on the coverage of less profitable rural areas. Over 60 operators have bid and are implementing projects to provide connectivity in low access regions of the country under this project (Yardley, 2012).

3. NATIONAL OPTICAL FIBER NETWORK (NOFN) OF INDIA

3.1. RATIONALE

The Indian Broadband Policy was introduced in 2004. According to the preamble of the policy (Department of Telecommunications India, 2004), the government recognized the 'potential of ubiquitous Broadband service in growth of GDP and enhancement in the quality of life through societal applications including tele-education, tele-medicine, e-governance, entertainment as well as employment generation by way of high speed access to information and web-based communication'.

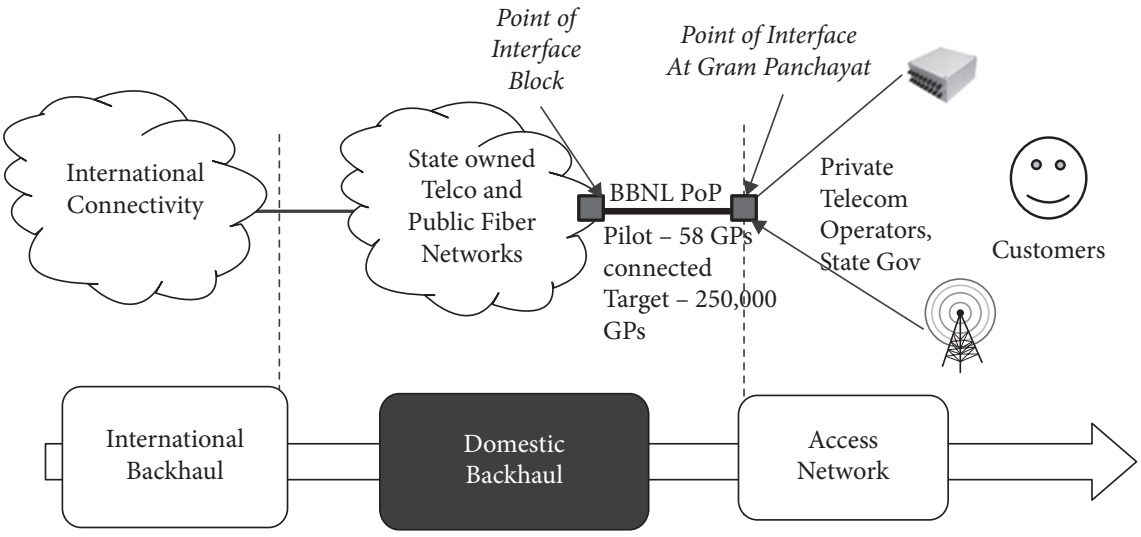
The international policy climate for broadband also served as an impetus for ushering broadband in India. In May 2010, the ITU and UNESCO set up the Broadband Commission for Digital Development as part of efforts to meet the Millennium Development Goals (MDGs). The Commission underlined that expanding broadband access in every country was vital to accelerating progress towards these MDGs by the target date of 2015 and sought commitments from all member countries to be actively

involved in the plans. As a continuation of this, the Office of Adviser to the Prime Minister, Public Information Infrastructure & Innovations under the leadership of Mr. Sam Pitroda released a 15 page white paper entitled, 'Broadband to Panchyats' (PIII, 2010). This paper outlined the need to extend high speed Broadband services to 250000 gram panchayats[1] in the country through an optical fiber network. This white paper seems to be the guiding post for the design and deployment of the NBN in India.

3.2. SCOPE

On October 25, 2011, the Union Cabinet approved the scheme to set up NOFN, which would primarily be used to provide broadband connectivity to village-level bodies called gram panchayats in order to increase rural broadband connectivity. In January 2012, the government formed a special purpose vehicle (SPV) to implement NOFN, called Bharat Broadband Network Limited (BBNL) and incorporated it as a Public Sector Undertaking (PSU) in February 2012 (Bharat Broadband Network Limited, 2014). BBNL was to be a wholesale bandwidth provider who would provide non-discriminatory access of the NOFN infrastructure to all Service Providers. BBNL was granted a National Long Distance Operating (NLDO) license by the Dept. of Telecommunications (DoT), Govt. of India. BBNL consist of Bharat Sanchar Nigam Ltd (BSNL) the fixed incumbent, RAILTEL, the telecom arm of the Indian Railways, Gas Authority of India Ltd's telecom arm GAILTEL and Power Grid Corporation as they are the public entities with existing fiber. Figure 2 shows the main elements of the Indian NOFN network.

Figure 2. Indian NOFN



Source: Authors' based on BBNL diagram.

[1] Gram panchayats are the local self-government body at the village or small town level in India. A population of 500 is required to have a gram panchayat. Sometimes two or three villages are combined to form a panchayat, hence the size varies from state to state (for more details, see Buch, 2012).

The NOFN was to connect 250,000 gram panchayats and aimed to deliver ICT based services to rural households by service providers. The scope of the project covered connectivity from block level (Planning & Development units of districts) up to which point fiber connectivity already exists to gram panchayat level.

The expected length of fiber to be deployed was estimated to be 301,000km (PIII, 2010).

3.3. FUNDING

NOFN is funded by the Universal Service Obligation Fund (USOF) of India. The cost of the total project has been estimated at INR 200,000 million (USD 4 billion) (Bharat Broadband Network Limited, 2014). In India, the USOF is financed by imposing approximately a five percent levy on operator revenues (Universal Service Obligation Fund, 2010).

Initially BBNL had been modeled as a PPP, but later it was decided that the project will be funded by the government as the private sector may not want to contribute in the early stages. It is not clear why the private players were not even considered to be a part of this infrastructure building exercise. One industry representative observed that the idea was helmed by Mr. Sam Pitroda, who is favor of government building the infrastructure. However this needs to be validated through further research. It should be noted that private players would have also contributed their expertise, management services and other non-monetary services which could have made the process more effective.

3.4. TECHNOLOGY

According to BBNL (2013), NOFN will use Gigabit Passive Optical Network Technology (GPON) (Bharat Broadband Network Limited, 2014) to provide the connectivity. This technology reduces the amount of fiber required from the Central Offices (CO) as compared to a point-to-point system. It is said that these splitters are inexpensive and do not use electronics, hence power supply is not required.

The project was to follow a technology neutral approach where any service provider can use the NOFN to provide access services to the consumers in the villages, via both wireless and wired technologies. There was a suggestion to use WDM-PON (wavelength division multiplexed-passive optical network) in the place of GPON, but rejected by the Govt. of India.[2]

[2] Please see here for details: http://articles.economictimes.indiatimes.com/2014–08–22/news/53112426_1_gpon-national-broadband-venture-gigabit-passive-optical-network.

3.5. CURRENT STATUS

NOFN was supposed to be a 24 month project i.e. to be completed by December 2012. Despite support from the top political leaders, the project has been delayed by more than two years due to the bureaucratic hurdles. It was also noted that the two year delay, included the time taken to set up the SPV BBNL which was only completed in 2012. Since then extensive planning and survey work has been done. The official position is that it is expected to be completed within the next two years. The procurement is underway, and the utilization of the existing fiber networks of BSNL, Railtel and Power Grid Corporation India Limited (PGCIL) will facilitate fast rollout. 22 states and 4 Union territories have agreed to provide Right of Way for this NOFN. Several pilots of e-services by both government and private sector establishments have been carried out and studies have been conducted to ascertain their viability, scalability and replicability across the country.[3]

BBNL has embarked on pilot projects in three blocks covering 58 gram panchayats in three different states. All participating Public Sector Undertakings (PSUs) (i.e. POWERGRID, RAILTEL, and BSNL) were asked to execute a pilot project in one Block each within 90 days. The target date for completing the Pilot Projects was 15/10/2012. Though delayed, this has been achieved with fiber laid out to all the gram panchayats and Electronic Equipment (OLT and ONT) have been tested for offering services. The pilots brought home ground realities to the participating PSUs and helped the concerned government departments plan the template for pilot testing of G2C services. It also helped address the interfacing of NOFN with access operators at gram panchayats and issues related to coordination between the three organizations for better execution. There were no private service players who are providing the last mile connection to the households.

As the government will be one of the major users in rural areas, they are in the process of formulating another project called the government user network (GUN) in order to deliver services such as e-governance, e-education and e-health.[4] This would make the government the anchor client and create enough mass demand to demonstrate the effects and how the lives of citizens are impacted through ICT. Even though the government was to be the anchor client, it was clarified that BBNL will continue to be a wholesale provider and will not be competing in the retail space except to provide access to these government institutions.

The biggest threat to the NOFN project is meeting the timeline and it becoming a "white elephant" which finds no operators to provide services to end consumers.

The interconnect agreements between the BBNL and the user Service Providers (SPs) are yet to be completed. Without any equitable service level agreements (SLAs) in place,

3 www.thehindubusinessline.com/features/some-hits-many-misses-in-tripura-pilot-project/article5753263.ece.

4 This was verbally told in a discussion meeting by a government representative with key stakeholders including TRAI, DoT and BBNL.

private e-service providers are unwilling to venture into rural areas. The tariff policy has been published on the website, and the policy is to provide the tariff at the lowest possible price. This tariff will be provided to all the operators on a non-discriminatory basis.

Though the mission and intentions are indeed creditable, several weaknesses are apparent in this grand plan. The project is already behind schedule. Many argue that while the government has delivered the supply push, little has been done to create a demand pull. In the e-Governance space, many of the government bodies that have to deliver the services electronically are still not ready. In essence a national capacity building plan has not been defined. As of now, BBNL is only responsible for creating the infrastructure, and not for identifying or creating and supporting a cohesive all-encompassing broadband enabled ecosystem. Without such a championing nodal agency, there is a danger of the optical fiber not being harnessed for any active use.

The success of NOFN is dependent on timely implementation, active participation by the private players and creation of complementary assets to realize the potential. There should be sustained political support till the completion of the project.

4. NATIONAL BROADBAND NETWORK OF INDONESIA

4.1. RATIONALE

The Indonesian government has realized the importance of Broadband to drive economic development and prepared the Indonesian Broadband Plan (IBP) 2013 which provides policies and strategies as well as targets to be achieved by 2017. The document was prepared through collaboration between the government, private sector, and civil society. Several Public consultations have also been held on the Indonesia Broadband Plan.

The Indonesia Broadband Plan (IBP) aims to promote broadband as an engine for growth and ultimately to increase the quality of life of Indonesian citizens in the future.

One of the greatest challenges in providing universal broadband connectivity in Indonesia is that it consists of over 17,000 islands with disparity in economic development and connectivity between islands. The western islands including Java and Sumatra are relatively more developed and already have connectivity provided by private operators. But the eastern islands have a lack of connectivity and the Indonesian Palapa Ring project has been set up to provide connectivity to those islands.[5]

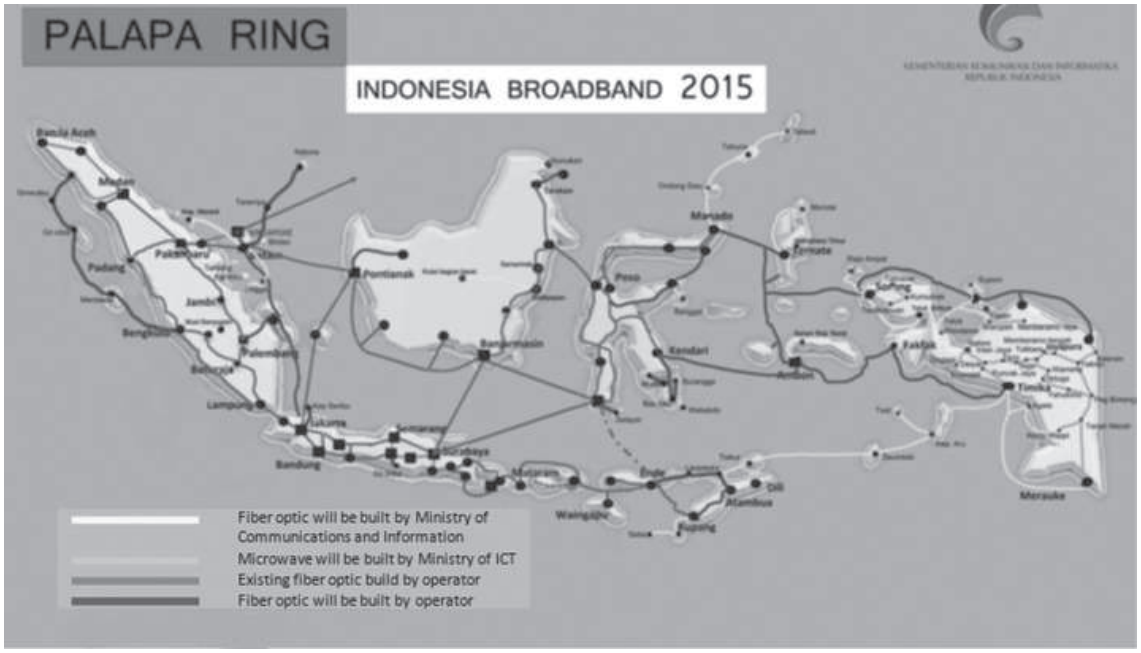
4.2. SCOPE

The Palapa Ring aims to connect all the islands with fiber connectivity. Under this 497 cities in Indonesia will be connected, with 51 of the least commercial cities mainly in the Eastern section being connected by government subsidies. The additional 446 will

5 Based on stakeholder interviews.

be connected by the government incumbent PT Telkom as a PPP. At this stage the conditions of the PPP have not been finalized. The Palapa Ring Project is to be completed by 2015. The government plans to ensure 100% connectivity in schools, hotels, and hospitals by 2017.

Figure 3. Phases of the Palapa Ring Project



Source: Ministry of Communication and Information Technology of Republic of Indonesia.

The different stages of the Palapa Ring project can be seen in Figure 3. The first stage has been deployed mainly in the western part of Indonesia where 90% are owned by private companies. The second stage consists of microwave connection that will be built by the government (MCI), the fiber optic which will also be deployed by the government at non-commercial areas and other fiber optic connections to be built by PT TELKOM.

The targets to be achieved are: 50% of all buildings to have 1Gbps connectivity by 2017 and 75% of the population to be connected via mobile broadband with connection speeds of 1Mbps or higher by 2017. Currently Internet penetration is 16.1% according to ITU.

4.3. FUNDING

According to the Indonesian broadband plan the government will spend around USD 1 billion to implement the National Broadband Network of Indonesia. The financing will be sourced from the USO fund and licensing fees. The Indonesian USO fund is collected by 1.25 percent of operators' revenue. With regards to the Palapa Ring Project, as it is a PPP, PT TELKOM will also be contributing funds for the implementation. PT TELKOM has budgeted USD 229 million for broadband infrastructure development, which includes the Palapa Ring project (SUBANDRIO, 2011).

4.4. TECHNOLOGY

The aim of the Palapa Ring project is to deploy a fiber optic backbone connecting all Indonesian islands. The scope only covers the backhaul network, and the policies mention open access, but at this stage the access conditions have not been finalized (Sutadi, 2013).

While the NBP mentions wireless broadband targets, the main focus seems to be on providing fixed broadband. There seems to be a contradiction considering that in Indonesia mobile broadband is much more popular, and considering that the rural areas of the country consist of over 17,000 islands, FTTx is not a very feasible option.

4.5. CURRENT STATUS

While the second phase of the Palapa ring was initiated in 2009 to cover the non-commercial areas, the construction still has not started. A concern arising from this study is why PT Telkom is the only operator implementing the Palapa Ring. One explanation offered is that due to revenue decline, it is not feasible for private operators to invest in such high cost, long term revenue yielding projects. There also seems to be skepticism whether there is enough demand in the Eastern region to warrant a high cost high speed broadband network.

The second phase of the Palapa Ring project will be mainly funded by the government through the USO fund. However, the USO fund is currently under scrutiny following suspicion of corruption concerning the procurement of an internet service center. This has led to the delay in the second phase of the Palapa Ring tender. As these cases are currently being investigated by the court, the ministry of ICT also decided to reassess the program (Kementerian Komunikasi dan Informatika, 2013).

The Palapa Ring projects are not an integrated national broadband network as in the other countries discussed in this report, but an accumulation of number of private and government infrastructure development projects. The IBP through Palapa Ring aims at increasing the national welfare as the ultimate goal, but the synchronization between the existing projects and new projects may face problems.

Due to the lack of electricity, broadband development is currently facing issues. While access to electricity is available in urban areas, several rural areas are still lacking this basic need. Less than 60 percent of rural areas are covered with electricity in some less-developed provinces.

The utilization of ICT at the regional level is still limited because of the lack of awareness of its benefits.[6] While the Broadband Plan mentions a capacity building program to accelerate the adoption of broadband technology, so far nothing has been implemented.

6 Based on stakeholder interviews.

5. NATIONAL BROADBAND NETWORK (NBN) OF AUSTRALIA

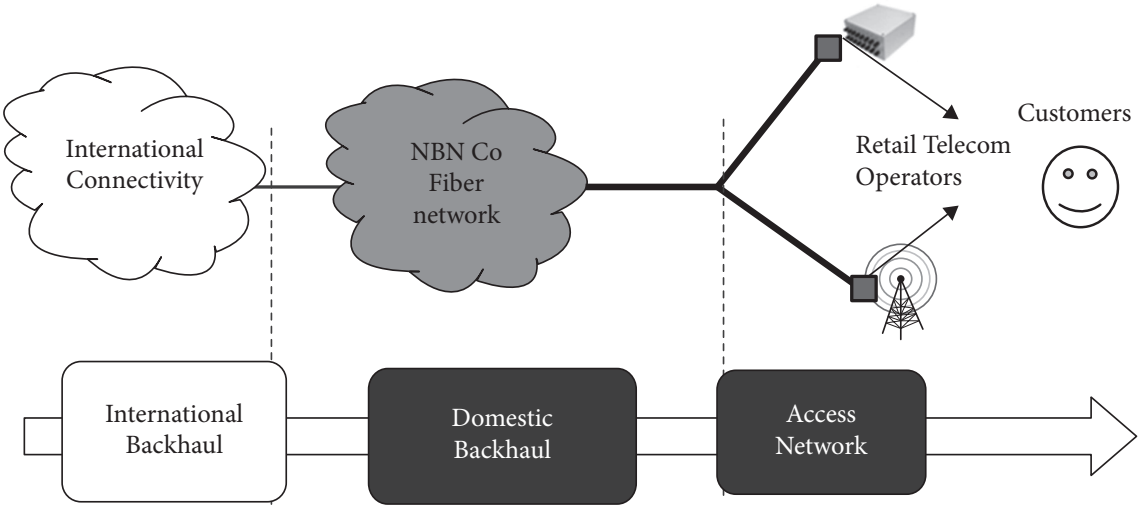
5.1. RATIONALE

In April 2009, the Rudd Government (Labor Government) announced its commitment to build a National Broadband Network (NBN). The motivation was to deliver significant improvements in broadband quality, to address the lack of high speed broadband in Australia, particularly outside the metropolitan areas, and to restructure the telecommunications sector.[7]

5.2. SCOPE

The National Broadband Network (NBN) of Australia was initiated by the labor government in 2009 to provide the whole country with Broadband connectivity. At the time it was envisaged as a wholesale open access high speed broadband network connecting 93 percent of Australia using Fiber to the Premises (FTTP) technology with the balance 7 percent in rural and regional Australia to be connected via a combination of wireless and satellite technology. NBN Co (a new company) was established in 2009 to design, build and operate the NBN. NBN Co was to operate as a wholesale-only special purpose vehicle, providing retail telecom service providers with access to the NBN. During the NBN rollout the Government was to retain full ownership of NBN Co, it would sit within the portfolio of the Department of Communications and will report to two shareholder Ministers (the Ministers for Finance and Communications).

Figure 4. Australian NBN



7 *Statement of Expectations* released on 20 December 2010.

5.3. FUNDING

Initially, the National Broadband Network (NBN) Australia was envisaged to provide high-speed broadband access to all Australian homes and businesses through a mix of three technologies: fiber optic, fixed wireless and next-generation satellite. The NBN was estimated to cost A$ 43 billion (USD 41 billion) over an estimated 10-year period. NBN Co, a government-owned corporation, was established to design, build and operate the national broadband network of Australia (NBN Co, 2014). Funding was to be sourced from government equity until NBN Co had sufficient cash flows to function without government support.[8]

5.4. TECHNOLOGY

While the original implementation was to be FTTH, the change in government after the September 2013 election triggered a re-assessment of the NBN. The current Government favors a multi-technology approach which is expected to reduce costs and facilitate completion by 2019. The "multi technology" approach would combine fiber to the node, fiber to the premises, fixed wireless, satellite as well as any future advances in telecommunications technology.

5.5. CURRENT STATUS

Construction began with trial rollout in Tasmania (2009); first services went live in July 2010.

As part of the NBN's review process, NBN Co completed a Strategic Review of the NBN in December 2013. It was found that based on existing NBN plans, the earlier completion date will be delayed by 3 years (June 2024 vs December 2021) and would cost A$ 73 billion (USD 67 billion) to complete. The Coalition government's response was to adopt a multi-technology approach that would reduce costs from an estimated $73 billion (USD 67 billion) to $41 billion (USD 40 billion) and facilitate completion by 2019. The government has stated that they will utilize the network that has been built already under the NBN and that the rest will follow the multi-technology approach.

The legislation establishing the regulatory framework for the NBN was passed in 2011 with encompasses policy commitments made by the Labor Government when it announced the NBN initiative in 2009. This legislation provides the governance, ownership and operating arrangements for NBN Co to build and operate the NBN and establishes an access regime subject to oversight by the Australian Competition and Consumer Commission (ACCC). Currently, as part of the reassessment process of the NBN, a cost benefit analysis of broadband policy and a review of the regulatory

8 *Statement of Expectations* issued 17 Dec 2010.

arrangements for the NBN is being undertaken. The final report is expected in June 2014. This is expected amongst other things to assess the overall effectiveness of the legislative provisions in the context of the new NBN direction (i.e. multi technology model).

The current legislative framework for the NBN is underpinned by two acts, the NBN Companies act and the NBN Access Act. Essentially, these arrangements establish NBN Co to operate as a wholesale only company, providing retail level telecommunications service providers with access to the NBN on an open and non-discriminatory basis. Key elements of the Companies Act provide a broad definition for the entity responsible for the design, construction and operation of the NBN and limit its activities to the supply of wholesale services. The Access Act aims to ensure that services required by wholesale customers are available and that information about those services' terms and conditions in relation to the supply of those services are transparent and that there is open, non-discriminatory access to those services.

In order to ensure fair competition, The NBN Access Act also introduced the "anti-cherry picking" provisions into Parts 7 and 8 of the Telecommunications Act 1997. These provisions require carriers who build or upgrade fixed-line superfast access networks to provide services on the same conditions and price as the NBN (layer 2 bit stream service on a wholesale basis). This would avoid other potential providers from undercutting NBN Co in metropolitan areas, as NBN Co cross-subsidizes provision of rural areas with the lower cost metropolitan areas.

6. COMPARISON

Table 1 gives a brief overview of each of the NBNs of India, Malaysia, Australia and Indonesia discussed earlier in the paper. These four countries differ from each other in terms of geographic coverage, ICT penetration, population density and proposed use of optical fiber. Nevertheless, a cross comparison offers policy insights that are essential for future course of action.

6.1. COST EFFECTIVENESS

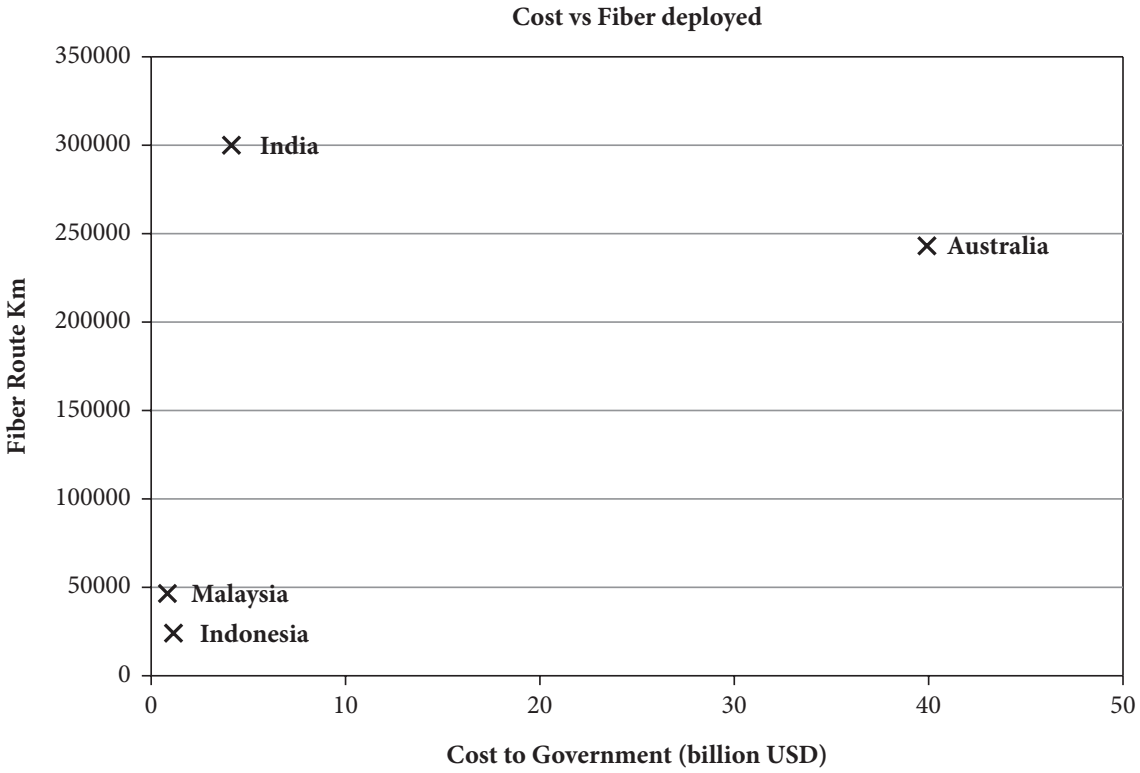
Figure 5 is a graphical representation of high level cost vs fiber km deployed in each of these networks. Looking at the figure, India seems to be the most cost effective and Australia stands out as the least cost effective, with less fiber deployed than India at ten times the cost. Of course this is a very high-level comparison, as there may be many other factors that are not covered in the study, but this gives a view on cost effectiveness. Fiber deployed is being used as a proxy for the population being served, as some networks such as India is only providing backhaul connectivity, and most governments give their targets in number of fiber km deployed rather than population served.

Table 1. Comparison of NBNs

Country	Cost to Government (billion USD)	Implementation Entity	Scope of Project	Open Access	Timely implementation
India	4	BSNL SPV	Fiber Connectivity from Block to 250,000 Gram Panchayat	Conditions being discussed, Tariff on web	Delayed (expected completion 2016)
Malaysia	0.75	TM (selected with no tender process, other operators not considered) PPP	FTTH in high industrial areas only	No transparent conditions or pricing, but other operators have signed up	Phase 1 Completed on time in 2010. High take-up of 43% by 2012
Australia	40	NBN Co Wholesale only SPV	Multi-technology connectivity of whole country through FTTx, FTTH, fixed wireless and satellite	Clear legislation on non-discriminatory open access and transparent pricing	Delayed (expected completion 2019)
Indonesia	1	PT Telekom (no tender process)	Fiber backhaul connectivity of Eastern non-commercial cities	Conditions have not been agreed	Delayed (expected completion 2015)

It is also important to note that India is only providing fiber to the gram panchayat level and not to the premises. This possibly could be a reason for the cost effectiveness, as customer premises equipment deployment is not part of the project. It is left for the retail service providers. The high cost of the Australia network could largely be due to the challenges in laying fiber across a vast geographic land space. It is worth noting that according to the strategic review of the Australian NBN held in Dec 2013, it was estimated that the project would cost A$ 73 billion (USD 67 billion) to complete if it continued to be implemented as planned as an FTTH network and the implementation would have continued until 2021. With the Coalition government's multi-technology approach, it is expected to be completed for A$ 41 billion (USD 40 billion) and completed by 2019. The Strategic Review findings attributed the higher funding requirement of $73 billion to an underestimation of the costs of physical construction as well as an overestimation of potential revenues. The multi technology approach on the other hand would include existing technologies and combine fiber to the node, HFC, fiber to the premises, fixed wireless, satellite as well as any future advances in technology.

Figure 5. Cost vs Fiber deployed



6.2. IMPLEMENTATION TIME

Figure 6. Implementation time vs fiber deployed

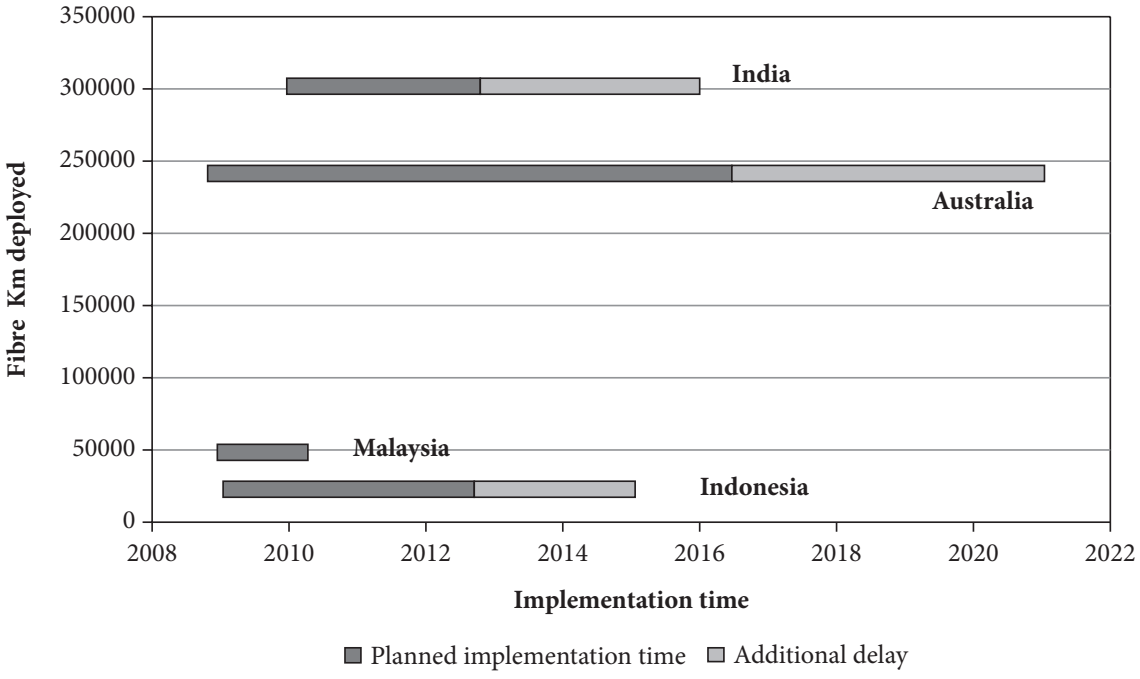


Figure 6 shows implementation time estimated currently against the implementation time that was originally planned vs fiber km. Australia stands out as the project which is expected to take the longest time to implement. This has been attributed to optimistic costs and revenue requirements. In addition, the development of the overall policy and regulatory framework for the NBN, contract negotiations related to the rollout amidst an environment of polarized opinion was a difficult and often lengthy process. Arguably, the slow roll out rates could also be due to NBN Co not shifting their focus fast from the project development stage to the project implementation stage.

In the case of India, it was also mentioned that part of the delay was caused by the time taken to set up the SPV BBNL which was only completed in 2012. The Cabling and trenching (C & T) work by BSNL, POWERGRID and RAILTEL has been delayed, as their initial funds to deploy manpower and pay salaries of executive staff are yet to be cleared by the cabinet, in Feb 2014. However, delays in implementation of major infrastructure projects are common due to bureaucracy in India.

It seems that creating new implementation entities take a longer time, and possibly one of the reasons that the Malaysian HSBB was implemented on time was that the incumbent was chosen as the implementer and no new organization had to be set up. But in Malaysia's case one of the major issues was that it was not carried out competitively since there was no transparent tender process before selecting the implementer.

6.3. DEMAND STIMULATION

The main components of the Internet Ecosystem, covers not only Infrastructure availability but also user friendliness, device availability and affordability, ICT literacy, and attractive, useful local content.

Many countries do not seem to have paid much attention to this aspect, and seem to be under the impression that if there is enough supply of high speed broadband, demand will be automatically created. But this does not seem to be the case in many developed countries which have already implemented FTTH networks. In most European countries there is less than 50 percent take up of services (Marcus & Elixmann, 2014).

Malaysia is one country where MCMC seems to have taken some solid steps towards demand-side stimulation using the USP fund. In order to increase awareness, broadband carnivals, broadband and ICT training and promotional campaigns through mass media have been organized. In order to make broadband more attractive to the public, e-government, e-health, e-education and e-commerce initiatives have been introduced. My1Content portal has been implemented to encourage content development and commercialization of creative content by the Multimedia Development Corporation of Malaysia (MDeC). The government has also tried to ensure device affordability by the distribution of 1Malaysia Netbooks to secondary

school children and through the introduction of affordable Broadband packages. The Government has also introduced a tax rebate for broadband consumers.

6.4. CONDUCIVE TO COMPETITION

While the Australian Network has been delayed and is very expensive, one area where they seem to have paid a lot of attention is on ensuring that the NBN will be conducive to competition. In order to ensure fair competition, they had introduced the 'anti-cherry picking provision' into the Australian telecom bill amendment which makes it legal for commercial parties to compete with NBN Co. But according to this provision, other potential providers are required to have open access and charge similar prices to avoid them undercutting NBN Co in metropolitan areas, as NBN Co cross subsidizes provision of rural areas with the lower cost metropolitan areas.

The legislative framework for the NBN is underpinned by two acts, the NBN Companies act and the NBN Access act. Essentially, these arrangements establish NBN Co to operate as a wholesale only company, providing retail level telecommunications service providers with access to the NBN on an open and non-discriminatory basis. Key elements of the Companies act provide a broad definition for the entity responsible for the design, construction and operation of the NBN and limit its activities to the supply of wholesale services. The Access act aims to ensure that services required by wholesale customers are available and that information about those services terms and conditions in relation to the supply of those services are transparent and that there is open, non-discriminatory access to those services.

Both India and Indonesia has mentioned the importance of encouraging competition but so far nothing concrete has come out of it. In practice, it may be difficult for India, since BBNL the SPV is led by BSNL. India could have involved private players in the deployment of infrastructure. The last mile connectivity needs to be enabled by the private players who have not shown much interest in the pilot stages. In the case of Indonesia, it seems that PT Telkom are the main service providers in the Eastern region and the regulators may have to include regulations on open access and transparency to ensure healthy competition.

It is stated by MCMC that the HSBB network will be shared on an open access basis (MCMC, 2013). Yet, there is no public document setting out the terms and conditions of access or implementation of which the cost-orientation of prices and non-discrimination terms between TM's retail arm and other competitive providers. Prices are commercially negotiated between TM and service providers. In addition TM received government funding due to their consideration of urban areas as not very profitable in spite of HSBT offering to implement the project at no cost to the Government. This highlights the issue that other competitors were not given the chance to compete for this grant.

There were also some complaints regarding HSBB as a way of breathing life into a dying incumbent. It was noted that TM showed dramatic improvements both in terms

of Market Capitalization and ROE from 2010 onwards. Reports suggest that this might be attributable to the launch of HSBB in 2010 and the continued growth of sales among other reasons such as its attractive dividend policy (InsiderAsia, 2012).

6.5. TECHNOLOGY

While many countries are currently working on FTTP networks, there are a number of studies that question the need for super-fast broadband vs basic connectivity (Kenny & Kenney, 2011), (Marcus & Elixmann, 2014). It is clear that access to Internet is highly beneficial (Qiang, Rossotto, & Kimura, 2009), but none of these studies have shown the benefits of having super-fast FTTH broadband vs mobile broadband or any other technologies. Considering that most people in developing countries have mobile access, it raises the question of why governments are so keen on providing FTTH.

According to a study on FTTH in Europe one of the major problems is low take up of FTTH services (which is often below 50%), for example Denmark – 32.8% Finland – 41.7% Hungary – 38.7% Slovakia 30.9% – and Sweden – 48.4% (Marcus & Elixmann, 2014). The same study mentions that while consumers may want high speed broadband, they are only willing to pay a very small incremental amount to move from fast to super-fast broadband. For example, a survey in US showed that while people were prepared to pay $45.10 to upgrade their connection from slow to fast, they were only prepared to pay USD 3 more to upgrade further to super-fast (i.e. FTTH speeds) (Marcus & Elixmann, 2014).

In Malaysia, providing only 20Mbps speeds through FTTH has been questioned. The reason given is that while the network deployed was capable of delivering speeds above 100Mbps, due to lack of demand for higher speeds, currently only 20Mbps is offered, but the fiber infrastructure implemented is future proof.

Currently LTE services have already been introduced in many countries including Malaysia with average speeds of 10–30 Mbps. It is also expected that with newer technologies such as cognitive radio, release of digital dividend etc., mobile broadband will be able to provide higher speeds and better quality of service in the future. This questions whether Malaysian HSBB could have been implemented as a fiber backbone with mobile networks providing the access layer as customers don't seem to be demanding higher speeds.

It is also important to note that both Malaysia and India are using GPON technology which is not very conducive to competition and the other operators who lease TM fiber do not have control of the fiber unlike if they were leasing dark fiber.

Proponents argue that FTTH is a future proof technology, but this seems to ignore the possibility that a better technology might be possible, as well as the possibilities of mobile broadband reaching even faster speeds with new technologies such as cognitive radio.

7. CONCLUSION

The four case studies have led to the following findings and recommendations.

Demand-side stimulation is equally important as supply-side stimulation when it comes to encouraging broadband. Awareness initiatives at the grass root level would have to be urgently formulated and undertaken. While the mobile revolution has done much in bringing home the benefits of technology to rural citizens and rendering it as a people-friendly tool, accepting e-services in place of traditional "touch and feel" modes would require a socio-cultural change.

It is not only critical that broadband access becomes available to the users but should be affordable and acceptable to them. The inclusion of civil society organizations in this effort along with the administration, duly guided by a central nodal agency of the government, would help to achieve the necessary outreach. In addition availability of attractive local content would also encourage more users to get online. The many demand-side initiatives taken by Malaysia may be the reason for the high take-up of services and increased household Internet penetration which is currently 67 percent.

In order to encourage further deployment of broadband, governments should adopt a transparent process which is technology neutral. This is based on considerations that wireless technologies are advancing and there is still no real demand for high-speed packages. In the case of Malaysia, if the government followed a more technology neutral approach to the boundaries / uses of technology at different points of broadband network implementation where only network parameters such as speed, quality of service levels etc. were defined for different stages of the network such as Access, Transmission and all interested service providers were asked to bid for the project, this could have ensured a more efficient, effective and less costly HSBB. Once the implementer was selected through such a transparent process, the government funding in the form of a PPP with quarterly disbursements tied to implementation would have ensured the implementation was not delayed. While HSBB has been described as an open access network, there is no price regulation; prices are commercially negotiated between TM and service providers. But it is important to note that four major operators have signed up for HSBB access services, and 19 have signed up for HSBB transmission services.

Australia seems to have concentrated more on ensuring that the NBN is conducive to competition by creating NBN Co which is a wholesale provider of broadband that would not compete with existing operators. They have also set up Acts, to ensure that the process is transparent and non-discriminatory.

Both India and Indonesia seem to be following a more technology neutral approach, where the NBN is only providing the fiber backbone and service providers are free to choose the technology to provide broadband services to the end consumers. But as both of these networks have not been operationalized yet, exact conditions are unknown. Currently there does not seem to be much interest from Private operators to provide services to end users in either network.

Being late starters in the telecom scenario, both India and Indonesia have the advantage of using the latest technology and so is in a better position when compared to many other countries as far as introduction of next generation networks is concerned. On the other hand, prolonged delays in deployment could bring technology closer to obsolescence casting doubts over its maintenance and requiring replacement.

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