The National Broadband Network

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AJTDE - Vol 6, No 1 - February 2018 [4]

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Abstract

We provide a bottom-up analysis of broadband availability in Australia without the NBN and with the NBN. For Australia without the NBN, we have assumed that broadband availability, in terms of access speed, would have continued to evolve; in particular, we have assumed that all DSL access would have been enhanced to ADSL2+. For Australia with the NBN, we concentrate on the Multi-Technology Mix version now being deployed in the fixed-line footprint. The NBN can make a difference both in terms of the geographical availability of broadband access and in the maximum access speeds provided. We consider both these aspects for the period after the current NBN has been fully deployed. Our analysis is based solely on publicly available information and census data from 2011. We find that the NBN will extend fixed-line broadband availability only marginally. In terms of access speed, we find that a further 17% of the population will have access to 10 Mb/s downstream and a further 65% of the population will have access to 25 Mb/s. Only a further 11% of the population will have access to 10 Mb/s and above upstream. The improvement in availability is particularly marked in outer suburban areas of the major cities and in regional centres.

Introduction

The concept of a National Broadband Network (NBN) was developed by the Australian Government in the period 2007-2009, culminating in a project for a wholesale only, open-access network based primarily on fibre to the premises (FTTP) technology. Initial deployments began in 2010. Following the change in governing party in 2013, the plan was changed to a Multi-Technology Mix, with some FTTP and a wider use of Fibre to the Node (FTTN), Hybrid Fibre-Coax (HFC), Fixed Wireless, and Broadband Satellite. The aim is to provide the capability for at least 50 Mb/s downstream (that is, towards the end user) access to 90% of premises, with the remaining 10% of premises having access to at least 25 Mb/s downstream. In the plan announced in 2014, deployment of the NBN was to be completed by 2019.

We have undertaken a study to examine the economic and other impacts of the NBN. As part of this study, we have estimated how much difference the NBN will make to broadband availability in Australia. The NBN can affect the availability of broadband in two ways. Firstly, it can improve the geographical availability: that is, areas otherwise not served by fixed broadband would be served. Secondly, it can improve the access speeds available: that is, an area served by ADSL2+ at up to 24 Mb/s downstream would have, with the NBN, FTTN delivering up to, say, 50 Mb/s. We consider both these aspects.

We have used only publicly available information in our analysis. For an understanding of NBN deployment plans, we have relied on public statements and reports by the Australian Government and NBN Co. (the government enterprise charged with deploying and operating the NBN), as well as information on current access networks in Australia. For effects on availability, we have started from census data from 2011. Our study uses a bottom-up methodology, estimating broadband changes in small geographical areas and building up a picture for regions and Australia as a whole.

We have concentrated on the time when the NBN has been fully deployed, that is, in the early to mid-2020s and we have restricted our analysis to the NBN fixed-line footprint ? that is, excluding areas served by NBN satellites.

Importantly, we have not assumed that fixed-line broadband access would have remained static without the NBN. Rather, we have assumed that there would have been some enhancement of access speeds in response to customer demands. Our exact assumptions are described later in this paper.

For access speeds, in this paper we have concentrated particularly on three breakpoints:

- 10 Mb/s and above downstream and 2.5 Mb/s and above upstream, because the Department of Communications (2013 [7]) had found that ?a large number of premises? had access to broadband below 9 Mb/s;
- 25 Mb/s downstream and 5 Mb/s upstream, because this is above the maximum access speeds available from ADSL2+;
- 25 Mb/s and above downstream and 10 Mb/s and above upstream, because this is above the maximum upstream access speeds available from FTTN and fixed wireless.

The next section provides an overview of existing broadband access technologies. We then describe our assumptions about broadband in Australia in the long term if the NBN had not happened. This provides a reference case for comparing broadband with the NBN, which is the subject of the following section. We then compare the two futures to determine where and in what way the NBN will make a difference to broadband access availability and access speeds. We summarise our findings in a conclusion.

Fixed Broadband Delivery

In 2013, the Department of Communications (2013 [7]) provided a snapshot of broadband access delivery in Australia. For fixed broadband, the most common means of delivery was ADSL over the copper telephony access. More than 90% of premises had access to DSL services; about half those premises had a DSL service in operation (Department of Communications, 2013 [7]; ACMA, 2014 [8]). An important characteristic of ADSL is that the delivered downstream (and upstream) speed of the service depends on the copper-cable distance between the DSL head-end (most often in a telephone exchange building) and the end customer?s premises. The Department?s premises-level analysis identified ?a large number of premises that can access a basic broadband service only at download speeds less than 9 Mbps?, and ?many small metropolitan areas where there is limited availability of fixed broadband? (Department of Communications, 2013 [7], p. 4).

In 2013, more than 3 million premises (approximately 28%) had access to fixed-line broadband services other than ADSL. The most widely deployed of these alternatives was cable modem service over the hybrid fibre-coax (HFC), pay-TV networks. HFC has been deployed in the suburbs of major cities and some regional centres. The two largest networks, deployed by Optus and Telstra, overlapped up to about 80% and collectively passed approximately 2.7 million unique premises in metropolitan areas across Adelaide, Brisbane, Gold Coast, Melbourne, Perth and Sydney. An additional 0.7 million premises were in the geographic area bounded by these networks, but were currently not passed (NBN Company, 2013a [9]).

The other fixed broadband technologies had limited deployments. Fibre to the premises (FTTP) was available in central business districts, major business hubs and some recent housing estates; and it continues to be deployed in many new housing estates. Telstra had deployed some Fibre Access Broadband and TransACT had deployed an extensive FTTP network in some Canberra suburbs. The only large-scale deployment of FTTN was the TransACT network in other Canberra suburbs. There were niche deployments of Fixed Wireless (other than for the NBN), mainly for business services.

Broadband satellite services were and are available to all Australian premises, but they are of limited capacity and are not the most cost-effective way of providing broadband service in metropolitan areas or in most cases where a terrestrial alternative is available. NBN Co. will use broadband satellites to provide service for about 400,000 premises (less than 4% of the total). In our analysis, we have concentrated only on the NBN fixed-line footprint. This will to a small extent underestimate the effects of the NBN.

To build up a picture of broadband availability (with and without the NBN), we have started from ?mesh blocks?: a ?mesh block? is the smallest geographical unit defined by the Australian Statistical Geography Standard (ASGS) for which census data are available from the Australian Bureau of Statistics (ABS, 2013 [10]). There were 347,600 mesh blocks covering all of Australia for the 2011 census with a population count of 21.5 million residents. The size of the mesh blocks generally increases as population density decreases. Because of their generally small size, it is possible in many cases to assume that customer premises in a mesh block have access to the same standard of broadband service, except for mesh blocks that cross exchange boundaries, as described below. For each mesh block, there are two data items: the ?census population? (hereafter ?Residents?), the count of people where they usually live; and the ?dwelling counts?, the count of structures that are intended to have people live in them and that are habitable. The structure of the ASGS has six hierarchical levels starting from the mesh block up to State and Territory. Each level directly aggregates to the level above and covers all of Australia. That is, a Statistical Area Level 1 (SA1) is an aggregate of Mesh Blocks and SA1s aggregate to Statistical Area Level 2 (SA2), *etc*. Digital boundaries are available for all statistical areas as ?Shapefiles? from the ABS (2010 [11]).

For the telephony network, we also had data from 2008 of Exchange location points and the boundaries of Exchange Serving Areas (ESAs) and Distribution Area (DAs), available as ?Shapefiles? from ExchangeInfo Australia (ExchangeInfo [12]). An ESA defines the area that is served by at least one telephone exchange. The more than 5,000 ESAs come in various shapes and sizes and their areas in regional and remote Australia are much larger than the towns they encompass. An ESA is divided into a number of DAs. Within a DA, which typically covers 100-200 premises, copper cables radiate from a single point (the pillar point) to serve every premises. All geographical information was entered into and processed in QGIS (QGIS Development Team, 2009 [13]).

Unfortunately, mesh blocks can cross ESA boundaries. Where a mesh block straddled two or more ESAs, we split it into detailed mesh blocks, one in each ESA. We ended up with 411,400 detailed mesh blocks, in each of which we assumed there would be uniform broadband service delivery. The census data from the original mesh block was divided in proportion to the area of each detailed mesh block. We have allocated other data to the detailed mesh blocks to estimate, for example, how many businesses could benefit from new services and new ways of working that are enabled by the NBN, which is not discussed in this paper.

Once we have established what broadband capabilities will be delivered to each detailed mesh block, we can aggregate up the data to regions, cities or all of Australia.

Fixed broadband availability in the future without the NBN

The NBN incremental availability is subject to broadband access in the long term without the NBN. As before, telecommunications carriers continue to invest in infrastructure. In a future without the NBN, we have assumed that ADSL availability will continue to improve, with all current telephone exchanges equipped with DSLAMs (DSL head-ends) and all planned DAs in Telstra?s ?top-hat? program being upgraded to ADSL2+, the fastest option. We expect low incentives for telecommunications carriers to expand the footprint of the HFC network, or to significantly increase fibre to the premises and fibre to the node. In particular, we assumed HFC cable networks will be upgraded over time to match the access speeds of the HFC network in the future with the NBN. We also assumed that the access speeds of broadband access technologies such as FTTN and FTTP in their respective coverage will be the same with or without the NBN. In the long term without the NBN we assume no noticeable increase in the coverage of fixed-line broadband access technologies from their pre-NBN actual coverage.

On the basis of the above assumptions, we conducted a spatial analysis of the coverage of the broadband access networks, along with an estimate of the number of residents with access to the access speeds described above.

Asymmetric Digital Subscriber Line 2+ (ADSL2+)

Information about general DSL availability was available from Telstra, including lists of ESAs with telephone exchanges containing a DSLAM (Telstra Wholesale, 2013a [14]), DAs with street cabinets containing a DSLAM (Telstra Wholesale, 2013b [15]), and Telstra?s TopHat IP DSLAM Rollout Schedule (Telstra Wholesale, 2013c [16]).

We did not have data on the detailed cable distances to premises. Instead, we have assumed a circular area around an exchange site can be served by DSL at a specified minimum download speed. The radius of this circle varies depending on characteristics such as the ratio of road length to number of addresses and is calculated in two parts. First, the maximum cable distance for the specified minimum download speed is determined from the notional access-speed-versus-distance profile of expected ADSL2+ performance of Telstra?s copper network (Clark, 2013 [17]). The resulting distances are then reduced to corresponding geographical distances that account for cabling laid in trenches along roads subject to region-specific characteristics by using a formula described by the Australian Competition and Consumer Commission (ACCC, 2008 [18]). We have adopted the parameters for this function from Analysys (2008 [19]) estimated for ESAs that share the same common characteristics. We then used the calculated cable lengths as the radius of the circular coverage area from an exchange in QGIS. This has resulted in smaller and bigger circular coverage areas for all exchange sites depending on the region-specific characteristics. Figure 1 shows examples of circular coverage areas that can be served by DSL at the minimum download speed of 10 Mb/s, which corresponds to a maximum cable distance of 1.7 kilometres.

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Figure 1: Estimated DSL availability with access to 10 Mb/s and above downstream

Figure 1 shows digital boundaries imported and displayed in QGIS for ESAs in dash lines highlighted in red, and DAs in black solid lines. Locations of exchange sites Greenbank (left bottom corner), Park Ridge (east of Greenbank) and Browns Plains (north of Park Ridge) are displayed in light blue dots. Using the formula with the parameters described by the ACCC, the estimated cable distances and radii for the circular areas around the exchange sites indicated in Figure 1 for the specified minimum download speed are:

? 1.1 km (1.7 km / 1.61) for Greenbank;

? 1.3 km (1.7 km / 1.34) for Park Ridge; and

? 1.6 km (1.7 km / 1.07) for Browns Plains.

In areas where telephone lines are routed via a street cabinet containing a DSLAM, the cable length from the DSLAM in the cabinet to the customer?s premises is the critical parameter. Exact locations of Telstra street cabinets were not available for this paper. To approximate the locations of cabinets, we used the central point of DSL-enabled DAs instead. We have used the calculated cable lengths as the radius of the circular coverage area from the approximate location of the street cabinets. This may have led to a number of inaccurate circular coverage areas and affected the estimated number of mesh blocks we have identified as a result. We expect the overall effect to be only marginal for two reasons. First, the TopHat upgrades were deployed only in a few cases for a first-in ADSL installation (Telstra Wholesale, 2013c [16]). Second, the parameters of the mesh blocks that unintentionally overlap with incorrectly modelled circular coverage areas will be partly offset by parameters of the mesh blocks that should be included but are not.

For certain upload speeds, to estimate the maximum distance between the customer?s premises and the location of the DSLAM, we assumed the download to upload ratio of 4:1 and referred to the practical ADSL2+ download-speed-versus-distance profile from Clark (2013 [17]). That is, the estimated cable distances for a minimum upload speed of 2.5 Mb/s will be the same as estimated for a minimum download speed of 10 Mb/s (4 x 2.5 Mb/s) (as in the example above).

We have identified the mesh blocks that intersect with the estimated coverage of the ADSL2+ access network for the minimum access speeds specified above through the use of spatial queries in QGIS. Customer premises in overlapping mesh blocks were treated as having access to the same standard of broadband service as inside the estimated coverage area.

In 305 out of 5069 ESAs, ADSL-enabled DAs were missing from the ExchangeInfo geospatial datasets from 2008. For the 305 ESAs that are affected, we have assumed that ADSL services are available at the maximum access speed throughout the entire ESA. An additional parameter was added to each mesh block indicating whether or not it intersects with any of the 305 ESAs that are affected. Our assumption results in a marginal underestimate of NBN incremental availability outside metropolitan areas, predominantly in the rest of Victoria and Queensland, and Tasmania. It has no effect above ADSL2+ access speeds.

Fibre-to-the-premises (FTTP)

Detailed information of the Telstra Development Sites for Fibre Access Broadband (FAB) was available from Telstra (Telstra Wholesale, 2013d [21]). We have assumed that the FAB as of 15 October 2013 will stay unchanged in the reference case. To identify mesh blocks overlapping Telstra FAB sites in QGIS, we have reduced FAB sites to a single point. That is, we have assumed that the area of a single mesh block overlapping the single point that approximates the location of an FAB site can be served by FTTP. From the report which details the Telstra Development Sites where FAB is available, we extracted the state the FAB site resides in, the FAB site name and respective Call Collection Area. We then entered these details for each FAB site in an address-to-a-single-point conversion website. The resulting single points were imported into QGIS to identify the overlapping mesh blocks in a spatial query.

We have also taken the TransACT/iiNet FTTP access network in the Australian Capital Territory into consideration in the reference case. We have assumed that the geospatial datasets of active and ?in build? fibre serving area modules (FSAMs) as of December 2013 from myNBN.info [1 [22]] include the coverage of the TransACT/iiNet FTTP network in Canberra that was acquired by the NBN Company in November 2013 (NBN Company, 2013b [23]). We then ran a spatial query in QGIS to identify the mesh blocks that intersect with the geospatial datasets of the NBN FTTP network in Canberra.

Hybrid Fibre-Coax (HFC)

HFC network coverage maps were only publicly available for the Optus HFC network (Leong, 2001 [24]). Since the Telstra and Optus HFC networks overlap up to about 80% (NBN Company, 2013a [9]), we have used the coverage maps provided in Leong (2001 [24]) for an initial estimate of the coverage of the HFC networks in the reference case. We factored in additional coverage described further below. We have imported screen captures of areas covered by the Optus HFC network provided in Leong (2001 [24]) into QGIS.

The results of our spatial analysis suggest that, in 2011, more than 6 million people usually lived in less than 2.5 million dwellings that were in the geographic area of mesh blocks covered by the Optus HFC network in Sydney (1.1 million), Melbourne (1 million) and Brisbane (0.4 million). As of 2013, the Telstra and Optus HFC networks collectively pass around 2.7 million premises (NBN Company, 2013a [9]). An additional 0.7 million premises are in the geographic coverage area of the HFC networks, but currently not passed (NBN Company, 2013a [9]). Therefore, we have assumed that, in the geographic area of mesh blocks covered by the Optus HFC network, only about 80% (2.7/(0.7+2.7)) of premises are passed. This corresponds roughly to the actual 2 million households covered by the Optus HFC network according to Leong (2001 [24]).

As of 2001, coverage of the Telstra HFC network spanned 2.5 million homes including areas in Perth (Western Australia), Adelaide (South Australia) and the Gold Coast (Queensland) that had no coverage of the Optus HFC access network (Leong, 2001 [24]). Given our assumption that most parts of the Optus and Telstra HFC networks overlap in Sydney, Melbourne and Brisbane, about 0.5 million dwellings (2.5 million dwellings covered by the Telstra HFC network minus 2 million dwellings covered by the Optus HFC network) are passed by the Telstra HFC network in Perth (Western Australia), Adelaide (South Australia) and the Gold Coast (Queensland). To estimate the additional 0.5 million dwellings covered by the Telstra HFC network in those areas, we made reference to the coverage information of HFC by state and territory provided by the Department of Communications (2013 [7]).

The Department?s analysis found that the number of premises covered by either FTTN or HFC in Western Australia, South Australia and Queensland was 0.1 million, 0.2 million and 0.6 million, respectively (Department of Communications, 2013 [7]). Since the only large-scale deployment of FTTN was located outside these three states, we can safely assume that the stated numbers of premises are covered by HFC only. Results from our spatial analysis suggest that about 0.4 million dwellings are located in the geographic area of mesh blocks covered by the Optus HFC network in Brisbane (Queensland). We therefore assumed that 0.2 (0.6-0.4) million dwellings were covered by the Telstra HFC access network in the Gold Coast. The geographic areas by statistical area level 3 (SA3) which we assumed to be covered by the Telstra HFC network in Perth, Adelaide and the Gold Coast are shown in Table 1. Our selection of SA3 was guided by relevant postings in the Australian discussion forums, such as Whirlpool [2 [25]], and the estimated total number of dwellings covered by the Optus HFC network.

Table 1: Selected statistical areas (level 3) indicating coverage of HFC access networks in the reference case in Perth, Adelaide and the Gold Coast

Gold Coast	Adelaide	Perth
Broadbeach - Burleigh	Adelaide Hills	Belmont - Victoria Park
Coolangatta	Burnside	Cottesloe - Claremont
Gold Coast - North	Campbelltown (SA)	Melville
Gold Coast Hinterland	Charles Sturt	South Perth
Mudgeeraba - Tallebudgera	Holdfast Bay	
Nerang	Marion	
Ormeau - Oxenford	Mitcham	
Robina	Norwood - Payneham - St Peters	
Southport	Port Adelaide - East	
Surfers Paradise		

In our estimated coverage of HFC access networks in the reference case, we have not included HFC networks in Mildura, Ballarat, Bendigo, Albury-Wodonga, Darwin and Perth (Ellenbrook) because of the comparatively small number of dwellings covered by these networks. This may result in a marginal overestimate of the regional impact of the NBN.

Fibre-to-the-node (FTTN)

Large-scale deployments of FTTN in 2013 only existed in the Australian Capital Territory (Department of Communications, 2013 [7]). We have imported screen captures of areas in QGIS covered by FTTP and FTTN networks in Canberra and surrounding areas published by the Department of Communications (2013 [7]). We have assumed that the geospatial datasets of the NBN FTTP network in Canberra from myNBN.info [1 [22]] comprise the TransACT/iiNet FTTP network, which NBN Company had acquired in November 2013. We have also assumed that the rest of the imported screen captures comprise the geographic area covered by the FTTN network.

We ran a spatial query in QGIS to identify the mesh blocks that intersect with our estimated coverage of the FTTP and FTTN networks in the Australian Capital Territory. We excluded the mesh blocks that intersect with the geospatial datasets of the NBN FTTP access network in the Australian Capital Territory from the results of the spatial query described above. We assumed that the remaining mesh blocks are covered by the FTTN network in the Australian Capital Territory.

The findings from our spatial analysis of fixed broadband availability in the future without the NBN described in this section feed into a spatial database we have developed for this purpose. For each mesh block, we have included fields for mesh block parameters and access network coverage. In the following section, we describe our spatial analysis of the coverage of the NBN?s fixed broadband access networks under the proposed multi-technology approach.

Fixed broadband availability in the future with the NBN

The NBN is being delivered through a mix of existing and future access mechanisms. The NBN fixed-line footprint assumed in this paper comprises the following access mechanisms:

- fibre to the premises where it already exists or was planned as of December 2013;
- hybrid fibre-coax where it already exists and with full coverage of businesses and an expansion to a further 0.7 million premises passed to fill in ?black spots?;
- fibre to the node with VDSL running on short copper lengths between the ?node? and the customers? premises; and
- fixed wireless in less densely populated areas.

Under the proposed multi-technology approach, existing broadband access networks will be upgraded or overbuilt by the NBN. ?The eventual mix of technologies will be determined by decisions taken over time for each distribution area, accounting for relevant factors? (NBN Company, 2013a [9], p. 112).

At the time of our analysis, NBN Company had published (up to June 2014) plans for its fixed-line footprint. Within this footprint, we have assumed that telephone exchange areas not covered by plans for FTTP, HFC or fixed wireless access will be enhanced with FTTN.

Similar to ADSL, the capabilities of FTTN and fixed wireless access depend on transmission distance. For FTTN, we assume that the copper-cable lengths will be short enough to deliver at least 25 Mb/s downstream and up to 10 Mb/s upstream. For fixed wireless access, we assume up to 25 Mb/s downstream and no more than 5 Mb/s upstream.

The spatial analysis we have conducted to estimate the coverage of the above broadband access networks is described in the remainder of this section. Our analysis relied on a wide variety of data. Not all of this information refers to the same technology mix. Where reliable data was missing or related to diverging technology mixes, we made assumptions to the best of our knowledge at the time of our analysis.

Hybrid Fibre-Coax (HFC)

The proposed multi-technology approach assumes capacity investments and completing construction of the HFC network to connect all premises within the geographic area that the Telstra and Optus HFC networks cover, that is, 3.4 million total potential HFC premises (NBN Company, 2013a [9]). This includes 0.7 million premises that are in the geographic coverage area of the HFC networks, but currently not passed (NBN Company, 2013a [9]). We have adopted our estimates of the Optus and Telstra HFC networks in the reference case described in the previous section. In these estimates, we had assumed only about 80% of residences were passed in the coverage areas. For the NBN, we assume that the remaining 20% (0.7/3.4) of residences are covered, and hence the additional 20% of the relevant residential parameters of intersecting mesh blocks account for the NBN impact on service delivery.

Fibre-to-the-premises (FTTP)

Under the proposed multi-technology approach, FTTP could cover between 20% and 26% of premises in the fixed line footprint(NBN Company, 2013a [9]). To estimate the coverage of the NBN FTTP network, we conducted a spatial analysis of geospatial datasets of current and planned FTTP deployments as of December 2013 from myNBN.info [1 [22]]. We have assumed that the coverage of the NBN FTTP network is the geographic area of the mesh blocks that intersect with the NBN FTTP geospatial datasets, excluding the geographic area of the mesh blocks covered by HFC deployments. Since we have used data from various sources over a time period in which the proposed technology mix of the NBN has changed several times, we have excluded FTTP coverage areas where they overlap with our estimated coverage area of HFC.

Fibre-to-the-node (FTTN)

Under the proposed multi-technology approach, most of Telstra?s copper network will be overbuilt by FTTN covering about half of all premises in the fixed-line footprint (NBN Company, 2013a [9]). The originally proposed fixed-line footprint was defined by NBN Company by a list of localities that would have received some fibre coverage (NBN Company, 2010 [26]). We have assumed that the originally proposed fixed-line footprint is identical to the one proposed under the multi-technology approach. We took the list of localities and identified each locality?s geographic location. To do this, we relied on a mapping of place names to geography. The naming convention in the lists of localities best matches the one used for the statistical areas of 2006 Urban Centres and Localities (ABS, 2007 [27]). We then assumed that the ESAs in these locations would be covered by FTTN, but we excluded any areas already identified as receiving FTTP or HFC deployments.

Fixed Wireless

The proposed multi-technology approach assumes that about 6% of premises outside the NBN fixed-line footprint will be covered by fixed wireless and satellite technologies. Our estimates of the coverage of the NBN fixed wireless network relied on three data sources. First, we used geospatial datasets of active and ?in build? Wireless Serving Areas as of December 2013 from myNBN.info [1 [22]] to find all mesh blocks that are fully or partially in the serving areas. At the edges, for any mesh block that is only partially covered by the serving area, we included the parameters in proportion to the covered area as a fraction of the total area of the mesh block. This has resulted in 226,478 residents in the estimated area covered by fixed wireless, or about 46% of the 494,515 total residents in the area of overlapping mesh blocks. We use this ratio below to estimate the coverage effect of fixed wireless.

When processing the geospatial datasets in QGIS, we found that the average coverage of NBN Wireless Serving Areas spans approximately the average size of an SA2. We therefore assumed that the SA2 with a matching name among the localities in the updated list of Wireless Serving Areas published on the independent NBN tracking website (Finder.com.au [28]), our second data source, corresponds to the coverage area of the NBN fixed wireless access. Our third data source was a list of localities that would have received some wireless coverage under the originally proposed wireless footprint defined by NBN Company (2010 [26]). We took the list of localities and identified each locality?s geographic location similar to the approach described above. We then assumed that the ESAs in these locations would also be covered by fixed wireless. Using our estimated ratio calculated above, however, we have assumed that only about 46% of the parameters associated with mesh blocks that overlap the selected SA2s and ESAs are included in our estimate of the effects of the NBN fixed wireless deployments. In all cases, we have excluded any areas already identified as receiving FTTP, HFC or FTTN deployments.

Comparison of Futures with or without the NBN

In this section, we determine where and in what way the NBN will make a difference to fixed broadband access availability and access speeds compared to the future without the NBN. For the comparison of futures with or without the NBN, we have aggregated up the estimated number of residents in geographical regions with access to selected downstream and upstream speeds to greater capital city statistical areas (GCCSAs). GCCSAs do not cover just the built-up edge of the city but also include people who live in small towns and rural areas surrounding the city but who regularly socialise, shop or work within the city, according to the 2011 Census travel-to-work data. The area not defined as being part of the Greater Capital City within each State and Territory is represented by a Rest of State region. Table 2 shows the estimated number of residents in geographical areas with access to 10 Mb/s and above downstream and 2.5 Mb/s and above upstream in the futures with or without the NBN.

Table 2: Estimated number of residents in geographical areas with access to 10 Mb/s and above downstream and 2.5 Mb/s and above upstream

Region	Access with no NBN (No. of residents)	Improvement with the NBN (No. of residents)	Improvement with the NBN (% of all residents)
Greater Sydney	3,699,864	593,853	13.5%
Rest of New South Wales	1,807,639	533,334	21.2%
Greater Melbourne	3,155,074	790,888	19.8%
Rest of Victoria	932,876	311,546	23.2%
Greater Brisbane	1,717,295	325,799	15.8%
Rest of Queensland	1,886,756	257,014	11.4%

Greater Adelaide	[illegible]	[illegible]	[illegible]
Rest of South Australia	[illegible]	[illegible]	[illegible]
Greater Perth	1,452,299	270,637	15.7%
Rest of Western Australia	348,023	86,007	17.1%
Tasmania	263,359	206,654	41.8%
Northern Territory	159,116	31,504	15.0%
Australian Capital Territory	289,111	549	0.2%
Total	**16,968,451**	**3,664,463**	**17.1%**

The second column in Table 2 shows the estimated number of residents in geographical areas with access to the selected access speeds in the future with no NBN. In accordance with the findings from the Department of Communications that ?a large number of premises? had access to broadband below 9 Mb/s, our results suggest that almost 80% of all residents would have had access to relatively modest access speeds in the absence of the NBN. This can be explained by the large number of premises with access to DSL services and our assumption that ADSL availability will continue to improve, resulting in all current telephone exchanges equipped with DSLAMs and all planned DAs in Telstra?s ?top-hat? program being upgraded to ADSL2+. Our results shown in the third and fourth columns in Table 2 suggest that the improvement in the future with the NBN in most regions is less than 20% except in rest of New South Wales, rest of Victoria, rest of South Australia and Tasmania (where more than 40% of residents benefit from the NBN).

Figures 2 and 3 show the geographical areas of improvement in availability and access speeds compared to the future with no NBN in Greater Melbourne and Greater Sydney. The geographical areas highlighted in yellow show the improvement in broadband availability and access speeds with the NBN. The geographical areas highlighted in yellow and black dots indicate the improvement with the NBN in the HFC footprint for a proportion of residents. The Greater Capital City boundaries are shown by the red dash line.

Figures 2 and 3 show that the improvement in availability and access speeds is particularly marked in outer suburban areas between the exchanges around the circular coverage areas of ADSL2+ access networks in the future without the NBN.

Our estimated numbers of residents in geographical areas with access to downstream and upstream speeds above the maximum available from ADSL2+ are shown in Table 3.

Table 3: Estimated number of residents in geographical areas with access to 25 Mb/s downstream and 5 Mb/s upstream

Region	Access with no NBN (No. of residents)	Improvement with the NBN (No. of residents)	Improvement with the NBN (% of all residents)
Greater Sydney	2,266,008	2,013,932	45.9%
Rest of New South Wales	401	2,250,005	89.5%
Greater Melbourne	1,821,904	2,113,784	52.8%
Rest of Victoria	-	1,141,018	84.8%
Greater Brisbane	760,945	1,267,102	61.3%
Rest of Queensland	402,678	1,652,720	73.3%
Greater Adelaide	409,504	790,409	64.5%
Rest of South Australia	-	285,776	77.6%
Greater Perth	212,467	1,508,464	87.3%
Rest of Western Australia	314	398,417	79.3%
Tasmania	-	458,606	92.8%
Northern Territory	-	161,344	76.8%
Australian Capital Territory	221,291	612	0.2%
Total	**6,095,513**	**14,042,189**	**65.4%**

[29]The numbers in the second column of Table 3 show the numbers of residents who, without the NBN, could access broadband via HFC, FTTN or FTTP. This is less than 40% of all residents of Australia. The estimated improvement in the future with the NBN is significant in most regions except Australian Capital Territory where a comparatively large number of residents is concentrated in geographical areas served by FTTP or FTTN in the future with no NBN.

Figure 2: Estimated improvement in availability and access speeds in geographical areas in Greater Melbourne with access to 10 Mb/s and above downstream and 2.5 Mb/s and above upstream

[30]

Figure 3: Estimated improvement in availability and access speeds in geographical areas in Greater Sydney with access to 10 Mb/s and above downstream and 2.5 Mb/s and above upstream

Figures 4 and 5 show the geographical areas of improvement in availability and access speeds compared to the future with no NBN in Greater Melbourne and Greater Sydney.

[31]

Figure 4: Estimated improvement in availability and access speeds in geographical areas in Greater Melbourne with access to 25 Mb/s downstream and 5 Mb/s upstream

[32]

Figure 5: Estimated improvement in availability and access speeds in geographical areas in Greater Sydney with access to 25 Mb/s downstream and 5 Mb/s upstream

Figures 4 and 5 show the consistent improvement in availability and access speeds in Greater Melbourne and Greater Sydney, affecting approximately half of the regions? population.

Our estimated numbers of residents in geographical areas with access to downstream and upstream speeds above the maximum available from ADSL2+, FTTN and fixed wireless are shown in Table 4.

Table 4: Estimated number of residents in geographical areas with access to 25 Mb/s and above downstream and 10 Mb/s and above upstream [revised July 2018âsee Endnote 3 [33]]

Region	Access with no NBN (No. of residents)	Improvement with the NBN (No. of residents)	Improvement with the NBN (% of all residents)
Greater Sydney	2,266,008	687,499	15.7%
Rest of New South Wales	401	118,991	4.7%
Greater Melbourne	1,821,904	603,367	15.1%
Rest of Victoria	-	43,558	3.2%
Greater Brisbane	760,945	248,512	12.0%
Rest of Queensland	402,678	231,683	10.3%
Greater Adelaide	409,504	148,078	12.1%
Rest of South Australia	-	0	0.0%
Greater Perth	212,467	74,545	4.3%
Rest of Western Australia	314	13,246	2.6%
Tasmania	-	116,175	23.5%
Northern Territory	-	39,732	18.9%
Australian Capital Territory	37,859	0	0.0%
Total	**5,912,081**	**2,325,386**	**10.8%**

While less than 40% of residents have access to higher access speeds in the future without the NBN, the improvement in availability and access speeds with the NBN is only about 11% of all residents. The improvement is comparatively small because the proposed mixed technology approach of the NBN includes FTTN and fixed wireless access networks that do not meet higher access-speed requirements. In particular, a relatively large number of premises in the NBN fixed-line footprint is served by the FTTN access network. ADSL is ?asymmetric? in that data rates are higher in the downstream direction (toward the end-user) compared to the upstream direction (toward the network). FTTN does provide 25 Mb/s and above downstream but does not provide 10 Mb/s and above upstream. A large number of residents in regional and urban areas therefore do not have access to higher upstream speeds with the NBN.

Figures 6 and 7 show the geographical areas of improvement in availability and access speeds compared to the future with no NBN in Greater Melbourne and Greater Sydney.

[34]

Figure 6: Estimated improvement in availability and access speeds in geographical areas in Greater Melbourne with access to 25 Mb/s and above downstream and 10 Mb/s and above upstream

[35]

Figure 7: Estimated improvement in availability and access speeds in geographical areas in Greater Sydney with access to 25 Mb/s and above downstream and 10 Mb/s and above upstream

Figures 6 and 7 show that the improvement in availability and access speeds is significantly smaller and concentrated in the HFC footprint and geographical areas served by the FTTP access network.

For a regional example, Figure 8 shows the improvement in availability and access speeds compared to the future without the NBN in Tamworth, New South Wales, highlighted in yellow. The city of Tamworth is located in Inner Regional Australia and is served by a mix of NBN Wireless Serving Areas and FTTN access network. The boundary of the Tamworth ESA is shown with a red dotted line. The improvement in availability and access speeds with access to 10 Mb/s and above downstream and 2.5 Mb/s and above upstream is shown on the left, 25 Mb/s downstream and 5 Mb/s upstream in the middle, and 25 Mb/s and above downstream and 10 Mb/s and above upstream on the right.

[36]

Figure 8: Estimated improvement in availability and access speeds in geographical areas in Tamworth, New South Wales

Our results suggest that with the NBN the improvement in availability and access speeds of 10 MB/s and above downstream and 2.5 Mb/s and above upstream shown on the left affects more than half of the population served by the Tamworth exchange. All residents benefit from the improvement in availability and access speeds above the maximum available from ADSL2+, shown in the middle. There is no improvement in availability and access speeds of 25 Mb/s and above downstream and 10 Mb/s and above upstream with the NBN, shown on the right.

Conclusions

The study presented in this paper is based on results of a spatial analysis of fixed broadband availability in the futures with or without the NBN. We have used the smallest geographical unit for which census data are available. Our assumptions about broadband in Australia in the long term if the NBN had not happened provide a reference case for comparing broadband with the NBN.

In the period after the current NBN has been fully deployed, the NBN makes only a marginal improvement in the availability of *any* fixed-line broadband. This is because, even without the NBN, more than 90% of premises have access to DSL.

The picture for access speeds, however, is different and the NBN will provide a significant enhancement. The improvement in access speeds is particularly marked in outer suburban areas between the exchanges around the coverage areas of ADSL2+ access networks in the future without the NBN. Even for the relatively modest 10 Mb/s downstream, which could be provided by ADSL2+, the NBN will make a difference: a further 17% of the population will have access to 10 Mb/s downstream in most regions and in particular regional areas of New South Wales, Victoria, South Australia and Tasmania. A further two-thirds of the population will have access to speeds above the maximum access speeds available from ADSL2+.

The improvement in access speeds in the upstream direction (toward the network) is significantly hampered by asymmetric access networks with limited capabilities in terms of data rates. Only a further 11% of the population will have access to 10 Mb/s and above upstream.

While the maximum access speeds available in the fixed-line footprint might be sufficient for telework and telehealth services, the availability of services requiring 10 Mb/s and above upstream will be limited with the Multi-Technology Mix version now being deployed. To meet the speed requirements of advanced cloud computing services, for example, FTTN could be upgraded in the future, providing potential economic benefits to business (KPMG, 2012 [37]).

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Endnotes

[1] Copies of digital boundaries for all Fibre and Fixed Wireless footprints active and in build as of December 2013 received from the creator and developer of the independent tracking website www.mynbn.info [56] which has moved to the websitewww.finder.com.au [57] in February 2016.

[2] For a discussion on Telstra HFC network coverage in Perth, see, for example, the website under the following link (last accessed on 26 February 2017): https://?forums.whirlpool.net.au/?archive/1931824 [58].

[3] This paper was revised in July 2018 to correct the values for the number of residents with âAccess with no NBNâ in Tables 3 and 4.

Article PDF:
141-article_text-1346-1-11-20180328-revised5jul2018.pdf [59]

Cite this article as:

Sascha Suessspeck, Leith Campbell, Kerry Hinton. 2018. *The National Broadband Network*. ajtde, Vol 6, No 1, Article 141. http://doi.org/10.18080/ajtde.v6n1.141 [61]. Published by Telecommunications Association Inc. ABN 34 732 327 053.https://telsoc.org [62]

NBN [63] fixed broadband [64] spatial analysis [65] National Broadband Network [66] upstream [67] downstream [68] National Broadband Network [66]

Comments

An interesting analysis which [69]

Tim Herring

- 07/05/2018 at 13:09

An interesting analysis which puts numbers to what we could all have guessed and for that it is valuable. This provides data and analysis to an area badly lacking facts, but rife in opinions.

One of the interesting issues is that I see from the References that no information is referenced from NBN Co since 2013! This underlines one of the major issues with the NBN and that is the lack of information that is publicly available since the MTM was introduced.

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