

# Broadband Availability and Quality Report

December 2013



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## **1. Executive Summary**

The Australian Government has asked NBN Co, the company building the National Broadband Network (NBN), to prioritise the many Australians without adequate fixed line broadband in the rollout. To assist with the prioritisation of under-served areas, the Government asked the Department of Communications to undertake an analysis of broadband quality and availability in all areas of Australia.

Broadband services are delivered using a range of technologies to homes and businesses across the country. The infrastructure most often used to provide broadband includes asymmetric digital subscriber line (ADSL) technology over the copper access network, the 3G and 4G mobile networks, hybrid fibre coaxial (HFC) networks originally rolled out for subscription television, fibre to the node (FTTN) networks and fibre to the premises (FTTP) networks. In addition to these terrestrial networks, all Australian premises are covered by satellite broadband networks.

The findings presented in this document are based on a detailed spatial analysis of the coverage of broadband customer access networks, along with estimates of their likely performance given known constraints. This analysis uses the available information to measure broadband availability in terms of the infrastructure currently in place. It uses the possible speeds achievable over that infrastructure to measure quality. This methodology was determined after reference to international examples.

Overall the analysis found that there are areas of inadequate access to infrastructure across the country—approximately 1.4 million premises (13 per cent) are in areas where fewer than 40 per cent of premises can access a fixed broadband service. The premises in this category are typically located in regional or remote areas of Australia, or in small pockets of poor service in metropolitan and outer metropolitan areas. The key findings of the premises-level analysis of broadband availability and quality are:

### 1.1. Availability<sup>1</sup>

- > Approximately 9.9 million premises (91 per cent) have access to fixed line broadband services delivered via ADSL technology.
- > Approximately 3.1 million premises (28 per cent) have access to a high speed broadband platform (defined as including fibre to the premises, fibre to the node, hybrid fibre coaxial networks and fixed wireless networks).
- > Approximately 8.8 million premises (81 per cent) have access to 3G mobile broadband services and about 6.4 million premises (59 per cent) have access to 4G services.
- > All Australian premises are covered by satellite broadband, although there is a ceiling to the capacity of these services and therefore not all premises can access a service.



<sup>&</sup>lt;sup>1</sup> The total of this section exceeds 100 per cent because the majority of premises have access to multiple broadband technologies.

### 1.2. Quality

- > Approximately 3.1 million premises (28 per cent) have access to peak download speeds of between 25 megabits per second (Mbps) and 110 Mbps.
- > Approximately 7.1 million premises (65 per cent) are in areas that have access to peak median download speeds of less than 24 Mbps over the copper network.
- > About 0.7 million premises (6 per cent) are unable to access a fixed broadband service.
- Of premises with access to ADSL broadband services over copper, about 3.7 million are located in areas with an estimated peak median download speed of less than 9 Mbps, and 920,000 in areas with an estimated peak median download speed of less than 4.8 Mbps.



In summary, whilst there are Australian communities who have severely limited access to broadband services, the more significant national issue is the quality of services (Figure 1).

## Figure 1. Percentage of premises in each fixed broadband availability and quality band (see page 8 for fixed broadband availability rating scale and page 22 for quality rating scale)

In terms of the spatial distribution of broadband availability and quality, the analysis indicated that the Northern Territory, Tasmania and Western Australia have more areas with poor access to quality broadband services compared to the remaining states.

In each state or territory, broadband services are generally more available and of higher quality in metropolitan areas than in regional and remote areas. Although premises within regional and remote areas that are located close to local telephone exchanges typically have access to higher quality ADSL services, premises further away from exchanges generally do not. The analysis also identified many small metropolitan areas where there is limited availability of fixed broadband, and a large number of premises that can access a basic service only at download speeds less than 9 Mbps.

It is important to note that broadband availability and quality is affected by multiple factors. Key elements were considered in this analysis, but a range of factors may impact individual circumstances. In many locations there will be premises whose circumstances vary from the ratings for broadband availability and quality that their area receives in this analysis.

## 2. Introduction

In September 2013 the Australian Government asked the Department of Communications to prepare a report on broadband availability and quality. On 23 December 2013, the Minister for Communications, the Hon Malcolm Turnbull MP, released a national summary report of broadband infrastructure and performance. Production of maps and a website to provide consumers with the opportunity to search the results for their local area occurred in February 2014. The website is available at **www.communications.gov.au/mybroadband**.

This report is based on a spatial analysis of the coverage of broadband customer access networks, along with an estimate of their likely performance using known constraints. The analysis of broadband availability and quality considers three categories of broadband delivery separately: fixed broadband (including fibre to the premises (FTTP), fibre to the node (FTTN), asymmetric digital subscriber line (ADSL), hybrid fibre coaxial (HFC) and fixed wireless), mobile broadband (3G and 4G) and satellite broadband.

It is important to note that broadband availability and quality is affected by multiple factors. Key elements are considered in this analysis but there are other factors that will impact individual circumstances. The approach seeks to measure availability as a description of the infrastructure currently in place and the possible speeds achievable over that infrastructure as the measure of quality.

The analysis is a supply side picture of what broadband infrastructure is available and the speeds the technology is capable of supporting. It does not consider demand side factors such as the services purchased, which is the focus of the Australian Bureau of Statistics Internet Activity Survey where Internet Service Providers (ISPs) report the number of subscribers by the advertised download speed (in ranges) according to access technology.

- > The analysis has not assessed local or temporary variations in broadband infrastructure, services available or service quality, network dimensioning or other operational factors that are the responsibility of individual network owners. Other factors that impact on an end user's experience and perception of quality such as reliability, retail pricing, competition, value-added components to the service, weather events and mobility were also excluded from the analysis.
- > Broadband access networks that specifically address the communications requirements of the medium and large enterprise sector and tertiary education institutions are not the focus of this study, and have been excluded.

There are various options for undertaking an analysis of broadband availability and quality. The methodology adopted is set out in this report and feedback is sought on the approach taken. It is noted that telecommunications carriers continue to invest in infrastructure such that broadband availability and quality is dynamic. This analysis represents a snapshot of broadband access as at December 2013.

#### 2.1. What is the purpose of this work?

The purpose of the broadband availability and quality analysis is to describe broadband access across Australia and identify areas with poor broadband services.

The analysis has been provided to NBN Co which is required to consider those areas with a low rating when prioritising the NBN rollout. However, NBN Co will also need to consider the cost and logistics of prioritising deployment of the network to particular areas.

The highly distributed nature of the NBN project requires that a range of logistical factors must be considered to ensure that the project objectives of rolling out the NBN more quickly and in a cost-effective manner are achieved. The scale and location of underserved premises means that not all of these premises can be addressed first.

For instance, the analysis has found that there are areas of inadequate access to infrastructure across the country, including areas distributed as small pockets of poor service in metropolitan and outer metropolitan areas. It will be difficult for NBN Co to deploy in these areas but the objective is to prioritise the areas of greatest need where this is logistically and commercially feasible.

This approach is in line with NBN Co's recommended deployment scenario arising from the Strategic Review undertaken by the company between October and December 2013. The review assessed, among other things, the progress and cost of the rollout and the estimated cost and time of completing the rollout under a number of scenarios.

The Strategic Review included estimated costs to allow for areas with poorer current broadband service to be prioritised. It assumed prioritisation will take into account reasonable operational efficiency considerations, such as needing to rollout in contiguous work fronts and dealing with an area as a whole. The analysis and modelled scenarios included cost allocation for copper remediation and for upgrades to the HFC network to complete connections to premises and fill in gaps in the HFC footprint.

It is important to note that this study is a national overview and, as such, it is likely that there will be premises whose individual circumstances don't accord with the high or low rating for broadband availability and quality that their local area has received. For example, premises in multi-dwelling units may be unable to access a HFC connection due to a body corporate's decision not to allow a connection to be made.

#### 2.2. Broadband access technologies and service constraints

Broadband services are delivered across the country to homes and businesses using a range of fixed line and mobile technologies. There are also a small number of fixed wireless networks. In addition, all Australian premises are covered by satellite broadband networks.

Each access technology has different constraints. For example, broadband services may be limited in some areas over the copper access network due to the distance of a premises from the exchange. This is because achievable speeds over ADSL networks decline with distance from the exchange and therefore there is a distance beyond which an ADSL service is effectively not capable of being supplied. The condition of the copper line and customer premises wiring can also affect the service quality.

There are also technological barriers preventing access to broadband over the copper network such as pair gain systems. Pair gain systems (both small and medium) are equipment which allows multiple standard telephone lines to be carried over a single pair of copper wires. There are also large pair gain systems including remote integrated multiplexers (RIMS) which can typically deliver between 120 and 480 telephone services. Generally, ADSL services are not available to premises on the end of a small or medium pair gain system, although in some circumstances the network provider can re-use an available line for ADSL services. Many of the large pair gain systems have been upgraded to provide ADSL services although this depends on the type of pair gain system used and the port capacity within it.

Access to broadband services over the copper network may also be constrained due to there being no available ports at the exchange, including if the exchange is capped and no further equipment to support ADSL services can be installed.

Once connected to a service, broadband quality can be affected by customer equipment, interference from other devices, software, the broadband plan purchased, how each service provider designs its network (including congestion in the network) and the level of concurrent usage for technologies such as HFC, mobile and satellite (where limited bandwidth in the customer access component of the network can limit performance at peak times). Not all of these factors are within the control of the retail service provider or the network provider.

Appendix A provides further information on available broadband technologies and factors that impact data speeds.



## **3.** Findings

## 3.1. Fixed broadband availability

The analysis found that approximately 91 per cent of Australian premises have access to fixed line broadband services delivered over asymmetric digital subscriber line (ADSL) platforms. Approximately 28 per cent of premises have access to a high speed broadband platform including fibre to the premises (FTTP), fibre to the node (FTTN), hybrid fibre coaxial (HFC) and fixed wireless networks.

The primary unit of analysis for this report is the Telstra Distribution Area (DA). A DA is a network component of a Telstra Exchange Service Area (ESA) and typically comprises 100-200 premises. DAs are assessed against an A (highest) to E (lowest) rating scale for availability and quality, and the sum of the premises within those DAs is how premises figures are calculated. A measure for broadband availability for each DA was determined in accordance with the scale in Table 1.

#### Table 1. Fixed broadband availability rating scale.

Availability Rating		
Α	Highest availability rating: Between 80-100 per cent of premises in the DAs in this group have access to at least one fixed broadband technology.	
В	Between 60-80 per cent of premises in the DAs in this group have access to at least one fixed broadband technology.	
С	Between 40-60 per cent of premises in the DAs in this group have access to at least one fixed broadband technology.	
D	Between 20-40 per cent of premises in the DAs in this group have access to at least one fixed broadband technology.	
E	Lowest availability rating: Between 0-20 per cent of premises in the DAs in this group have access to at least one fixed broadband technology.	

Of 10.9 million Australian premises, approximately 9.2 million are in DAs assessed to have the highest availability rating of A. There are approximately 1.4 million premises assessed in the two lowest availability ratings, D and E (Figure 2).

#### Broadband availability profile: Band A

An availability rating of A, the highest rating, indicates that the vast majority of premises in a DA can access at least one form of fixed broadband. Most premises in this category typically have good access to ADSL services and many can access a variety of technologies including FTTP, FTTN, HFC or NBN fixed wireless services. 80 per cent of all DAs covering approximately 9.2 million premises (84 per cent of premises) achieve an A rating.

#### Broadband availability profile: Band B

An availability rating of B indicates that the majority of premises in a DA (between 60 and 80 per cent) have access to at least one form of fixed broadband. ADSL infrastructure is

typically widely deployed, although access may be constrained by pair gain systems and the areas may be served by exchanges that are capped or have low port availability.

High speed broadband technologies such as FTTP, FTTN, HFC and NBN fixed wireless services are available to small pockets of premises. Approximately two per cent of DAs covering almost 211,300 premises achieve a B rating for availability.

#### Broadband availability profile: Band C

An availability rating of C indicates that approximately half of the premises in a DA (between 40 and 60 per cent) have access to at least one form of fixed broadband. There is typically mixed availability of ADSL technology, as impediments such as pair gain systems are likely to constrain access to services. Few premises in this category can access high speed technologies such as FTTP, FTTN, HFC and NBN fixed wireless. Over one per cent of all DAs covering approximately 153,100 premises achieve a C rating for availability.

#### Broadband availability profile: Band D

An availability rating of D indicates that less than 40 per cent of the premises in a DA have access to fixed broadband. As high speed technologies such as FTTP, HFC, FTTN and NBN fixed wireless are available to less than 1 per cent of premises in this category, the availability rating is usually based on ADSL related factors. It often indicates major impediments to ADSL services such as capped exchanges, low port availability or large pair gain systems. In some instances, this rating reflects that ADSL infrastructure has not been enabled at the local exchange. Approximately nine per cent of all DAs covering approximately 954,800 premises achieve a D rating for availability.

#### Broadband availability profile: Band E

An availability rating of E, the lowest availability rating, indicates that 80 per cent or more of the premises in a DA have no access to fixed broadband. The vast majority of premises in this category cannot access ADSL services, and high speed platforms such as FTTP, FTTN, HFC and NBN fixed wireless are mostly not available. As such, many households in this category rely on mobile or satellite technology as their sole source of broadband access. Approximately eight per cent of all DAs covering almost 453,000 premises have the lowest availability rating.



Figure 2: Percentage of premises in each fixed broadband availability rating band

The map provided in Figure 3 represents the picture of fixed broadband availability across the country. It displays modelled results by Telstra Exchange Service Areas (ESA) assessed against the five-point fixed broadband availability rating scale (A to E).

In regard to interpreting the map, it is important to note that ESAs come in various shapes and sizes (circles, squares and irregular shapes), and the size of the ESA generally increases as premises density decreases. As such, ESA boundaries in regional and remote Australia are far larger than the towns they encompass, and the ratings of such areas are driven heavily by the availability and quality of services in the more densely populated areas of that ESA.

For example, the ESA for Coober Pedy in central South Australia is a rectangle shape which is much larger than the actual town boundary. This ESA is in category A as approximately 98 per cent of premises in Coober Pedy have access to a fixed line broadband service.

Similarly the circular ESA boundary encompassing Uluru, Yulara and Mutitjulu in the Northern Territory is far larger in size than the communities it encompasses. This ESA is in category A as approximately 98 per cent of premises within Yulara have access to a fixed line broadband service.

The three large ESA shapes in the Northern Territory are neighbouring ESAs which fall into the same category of fixed broadband availability and as such appear as a block together. Accordingly, these ESA boundaries should not be interpreted to mean that every premises within that area has access to broadband. Rather the communities within these ESAs will have a high proportion of premises with access to fixed line broadband. There will be premises on the fringe of communities and isolated locations that will not necessarily have access to any broadband or will have access to mobile or satellite broadband which is considered separately in this analysis and is not reflected in this map.

Additional detailed maps are provided in Appendix B.



Figure 3. National map of fixed broadband availability by Exchange Service Area

#### 3.1. (a) Fixed broadband availability - state and territory overview

A breakdown of fixed broadband availability ratings by state and territory is provided in Figure 4.



Figure 4. Percentage of premises in each fixed broadband availability band by state/territory

In general, states or territories with either a higher population density<sup>2</sup> or more urbanised<sup>3</sup> population were found to have a greater level of access to broadband services. For example, the more densely populated and urbanised Australian Capital Territory has the largest percentage of premises with the highest (A) broadband availability rating (94 per cent). Similarly the relatively densely populated states of Victoria and New South Wales also have generally high broadband availability ratings. In contrast the sparsely populated Northern Territory has the lowest percentage of premises with the highest with the highest broadband availability rating (60 per cent).

The analysis found that the Northern Territory, South Australia and Tasmania have comparatively poorer access to ADSL than other states or territories.

New South Wales and Victoria generally present similar scores on most metrics, which are also higher than the other states, largely driven by the availability of HFC across significant portions of metropolitan Sydney and Melbourne. New South Wales shows a marginally higher proportion of premises without access to ADSL, as compared with Victoria.

Figures 5a to 5h provide detailed information about the coverage of each broadband access technology for all states and territories.

<sup>&</sup>lt;sup>2</sup> Australian Demographic Statistics 2012, Australian Bureau of Statistics

<sup>&</sup>lt;sup>3</sup> As indicated by the percentage of population found within 'Major Cities', Regional Population Growth, 2012, Australian Bureau of Statistics

Figure 5a. Australian Capital Territory<sup>4</sup>



Technology	Coverage (premises)	Coverage (percentage)
Total premises	0.18 million	-
ADSL	0.17 million	94
3G mobile data	0.17 million	95
4G mobile data	0.12 million	66
FTTN or HFC	0.06 million	32
FTTP	0.02 million	13
NBN fixed wireless	0	0

Coverage

(premises)

3.38 million

3 million

2.9 million

2.2 million

0.91 million

0.1 million

7,900

Coverage (percentage)

-

90

84

64

27

3

<1

Technology

ADSL

FTTP

**Total premises** 

3G mobile data

4G mobile data

NBN fixed wireless

FTTN or HFC

#### Figure 5b. New South Wales



#### Figure 5c. Northern Territory



Technology	Coverage (premises)	Coverage (percentage)
Total premises	0.08 million	-
ADSL	0.07 million	88
3G mobile data	0.05 million	56
4G mobile data	0.03 million	34
FTTN or HFC	0	0
FTTP	2,800	3
NBN fixed wireless	1,900	2

#### Figure 5d. Queensland



Technology	Coverage (premises)	Coverage (percentage)
Total premises	2.2 million	-
ADSL	2 million	90
3G mobile data	1.7 million	77
4G mobile data	1.7 million	75
FTTN or HFC	0.6 million	26
FTTP	0.09 million	4
NBN fixed wireless	0.01 million	1

<sup>&</sup>lt;sup>4</sup> Coverage (premises) numbers have been rounded.



Figure 5e. South Australia



Technology	Coverage (premises)	Coverage (percentage)
Total premises	0.8 million	-
ADSL	0.7 million	86
3G mobile data	0.6 million	79
4G mobile data	0.4 million	52
FTTN or HFC	0.2 million	23
FTTP	7,600	1
NBN fixed wireless	0	0

Figure 5f. Tasmania



Figure 5g. Victoria



Figure 5h. Western Australia



Technology	Coverage (premises)	Coverage (percentage)
Total premises	0.27 million	-
ADSL	0.22 million	84
3G mobile data	0.18 million	68
4G mobile data	0.1 million	36
FTTN or HFC	0	0
FTTP	0.03 million	10
NBN fixed wireless	9,400	4

Technology	Coverage (premises)	Coverage (percentage)
Total premises	2.8 million	-
ADSL	2.6 million	93
3G mobile data	2.4 million	85
4G mobile data	1.7 million	61
FTTN or HFC	0.92 million	33
FTTP	0.09 million	3
NBN fixed wireless	0.02 million	1

Technology	Coverage (premises)	Coverage (percentage)
Total premises	1.2 million	-
ADSL	1.1 million	91
3G mobile data	0.9 million	78
4G mobile data	0.47 million	41
FTTN or HFC	0.1 million	8
FTTP	0.03 million	3
NBN fixed wireless	1,100	<1

Examining high speed broadband technologies alone, there are significant differences in the availability of these platforms across states (Figure 6). Currently, the only large scale deployment of FTTN is located in the Australian Capital Territory. HFC networks are available in most states, but have not been deployed in the Australian Capital Territory, Tasmania or the Northern Territory. FTTP availability is proportionally highest in the Australian Capital Territory and Tasmania, particularly compared to Western Australia and South Australia.



Figure 6. Proportion of premises in each state or territory that can access a high speed broadband platform (FTTP, FTTN, and HFC).

#### 3.1. (b) Impediments to ADSL availability in each state and territory

For the majority of Australian premises, ADSL broadband technology is the way in which the internet is accessed. Figure 7 illustrates the availability of ADSL services across the states and territories.



Figure 7. Proportion of premises in each state or territory that can access ADSL technology.

The Australian Capital Territory has the highest level of access to ADSL (94 per cent), with Queensland, Victoria and Western Australia found to have approximately 90 per cent or higher coverage by ADSL networks. Tasmania has the lowest level of ADSL availability

(84 per cent) and New South Wales, the Northern Territory and South Australia have lower rates of ADSL availability of below 90 per cent.

While reasonable levels of performance can be provided using this platform, a number of factors may reduce the ability of individual premises to access such services. The tables below provide information about the nature and scope of major impediments to ADSL availability in each state and territory.

#### ADSL services not enabled

The delivery of ADSL services requires installation of specialised equipment at the relevant telephone exchange or equipment cabinet (DSLAM infrastructure). The analysis has found there are approximately 384,000 premises with a connection to the copper network that are unable to access ADSL services, as no DSLAM infrastructure has been deployed in the local exchange.

#### Excessive cable distance

There is a distance beyond which ADSL services either cannot be supplied or function at an extremely low quality as a result of the impact of cable length. This distance depends on a number of factors including the copper grade (that is, the physical thickness of the copper), the local condition of the copper and the level of electro-magnetic interference.

ADSL availability is typically significantly impaired from an average distance of 5 kilometres or more between a premises and the exchange<sup>5</sup>. Table 2 contains a state breakdown of the number of premises that were found to be an excessive distance from the exchange and in this analysis are assumed to be unable to access an ADSL service.

Excessive Cable Distance	Number of Premises	Percentage of Premises	
ACT	2,800	1.5	
NSW	84,000	2.5	
NT	1,800	2.2	
QLD	76,000	3.4	
SA	26,000	3.3	
TAS	20,000	7.5	
VIC	78,000	2.8	
WA	18,000	1.6	
Total	307,000	2.8	

#### Table 2. Number and proportion of premises in each state affected by excessive cable distance

<sup>&</sup>lt;sup>5</sup> It is recognised that rural areas are often serviced with heavier gauge cable that is capable of supporting ADSL services as far as 8.6 kilometres for 0.9mm cable.

#### Port constraints and capped exchanges

ADSL services may be unavailable due to a shortage of available ports at the exchange, including if the exchange is capped and no further equipment to support ADSL services can be installed. Not all premises served by capped exchanges or those with limited ports are unable to access ADSL services. Rather, due to these conditions, a proportion may be unable to access a service. It should be noted that port constraints are dynamic and change as customers make alterations to their service orders. For the purposes of this analysis, DAs in ESAs where there were fewer ports than would be required to support an increase in demand of 2 per cent<sup>6</sup> of the number of services in operation as at June 2013, were considered to have limited ports (Table 3).

Limited Ports	Number of Exchange Service Areas	Number of DAs	Premises in these DAs
ACT	4	116	26,400
NSW	216	1,862	246,600
NT	7	138	24,300
QLD	177	1,593	222,000
SA	47	259	36,700
TAS	20	179	29,500
VIC	171	2,262	316,300
WA	72	1,165	191,300
Total	714	7,574	1,093,100

#### Table 3. Number of ESA, DAs and premises affected by limited port availability

A carrier may retail ADSL services by installing its own DSLAM in an exchange building and using it in conjunction with purchased wholesale access to the individual copper line (Unconditioned Local Loop Service - ULLS), or purchased wholesale access to the non-voice frequency spectrum on a copper line (Line Sharing Services - LSS). To install this equipment, a carrier needs to access physical space in a Telstra exchange and electrical equipment racks (Telstra Equipment Building Access (TEBA) space, as well as space on the Main Distribution Frame (MDF) which provides the interface between the DSLAM and the copper line to a premises). Premises may be unable to access an ADSL service if there is no free space in the exchange (TEBA) or on the MDF. Table 4 sets out those DAs affected by these constraints.

<sup>&</sup>lt;sup>6</sup> Based on the Australian Bureau of Statistics Internet Activity Survey 2013, and the number of services in operation in each exchange service area as at 30 June 2013.



 Table 4. Number of ESAs, DAs and premises served by capped exchanges

Capped Exchange	Number of Exchange Service Areas	Number of DAs	Premises in these DAs
ACT	-	-	-
NSW	1	9	7,400
NT	-	-	-
QLD	8	220	33,200
SA	1	19	2,800
TAS	-	-	-
VIC	7	351	53,000
WA	3	48	6,500
Total	20	647	102,900

#### Pair gain systems

Pair gain systems allow multiple standard telephone lines to be carried over a single pair of copper wires. They are typically used to ensure the timely delivery of voice services in outer metropolitan areas or new estates. There are a variety of types of small, medium and large pair gain systems at exchanges across Australia today, including a remote integrated multiplexer (RIM) which, for example can typically deliver between 120 and 480 telephone services. Some pair gain systems can support the delivery of ADSL services, whereas others cannot, or at least require additional network remediation before such services can be delivered (refer Appendix E for more detail).

It should be noted that not all premises within each DA will be affected by pair gains—only a proportion of premises will experience ADSL service constraints as a result of a pair gain system. Additionally, the impediment created by these systems may be temporary, where the specific system is considered to be 'recoverable'<sup>7</sup>. That is, an ADSL service could be connected to the premises by a process of transpositioning.

The impediment to access ADSL services caused by the presence of these systems has been incorporated into the calculation of broadband availability ratings which are reduced in proportion with the number of premises affected in each DA. Table 5 provides a breakdown of the total DAs affected by large pair gain systems (where at least one premises in a DA is prevented from accessing an ADSL service).

<sup>&</sup>lt;sup>7</sup> Telstra has advised that many small and medium pair gains systems can be remediated upon receipt of an ADSL service request from a fixed line voice customer.



Large pair gains	Percentage of total DAs in each state/territory affected by a large pair gain system
ACT	4.0
NSW	6.6
NT	5.5
QLD	4.1
SA	6.0
TAS	1.9
VIC	1.7
WA	2.8

Table 5. The state/territory distribution of DAs affected by large pair gains

Small and medium pair gain systems are also included in calculation of fixed broadband availability ratings. Table 6 provides a further breakdown of the premises with existing voice services that would currently not be able to access an ADSL service due to the presence of small or medium pair gain systems.

Table 6.	The state/territory	distribution of	premises affected by	small/medium pair gains
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Small and medium pair gains	Percentage of premises affected
ACT	0.1
NSW	1.1
NT	1.5
QLD	1.0
SA	1.5
TAS	2.5
VIC	0.7
WA	1.2

While there is only a small proportion of premises affected by small and medium pair gain systems at the state/territory level, a small number of ESAs are more significantly affected than others. Most of these ESAs consist of a geographically dispersed population, to which this technology type would be well suited to delivering voice services. However, some small towns are also affected, for example, approximately 60 per cent of premises in Mungar in Queensland are currently unable to access an ADSL service as their voice service is delivered via a small or medium pair gain system.

#### 3.1. (c) Fixed broadband availability by remoteness classification

The analysis considered differences in broadband availability and quality between metropolitan, regional and remote Australia as defined by the Australian Statistical Geography Standard Remoteness Areas (2011). These definitions, adopted by the Australian



Bureau of Statistics (ABS) and various government agencies to classify Australia into regions that share common characteristics of remoteness (Figure 8).



Figure 8. Australian Bureau of Statistics - Map of the Australian Standard Geographic Classification Remoteness Structure (2011)

Each DA was allocated to a remoteness class: Major Cities of Australia, Inner Regional Australia, Outer Regional Australia, Remote Australia or Very Remote Australia. The shaded map<sup>8</sup> illustrates the geographical distribution of remoteness classes.

Figure 9 illustrates the findings of this analysis that there is a significant difference in the availability of broadband between major cities and remote areas. Many of the premises in the D or E fixed broadband availability bands are located in regional or remote parts of Australia.



<sup>&</sup>lt;sup>8</sup> ABS Remoteness Structure (2011): www.abs.gov.au/websitedbs/d3310114.nsf/home/remoteness+structure



## Figure 9. Major cities and inner regional areas have proportionally higher broadband availability than outer regional and remote areas.

As noted previously, 80 per cent of all DAs covering approximately 9.2 million premises achieve an A rating for availability. These premises are primarily concentrated in major cities (73 per cent), followed by regional (26 per cent) and remote Australia (1 per cent).

Of the 2 per cent of DAs covering almost 211,300 premises that achieve a B rating for availability, the majority are located in major cities and inner regional areas (76 per cent), followed by outer regional (22 per cent) and remote parts of Australia (1 per cent).

A further 1 per cent of all DAs (covering 153,100 premises) achieve a C rating for availability The majority of these premises are located in regional Australia (65 per cent), while a third (33 per cent) are located in major cities and 2 per cent are located in remote Australia.

In the 9 per cent of DAs (954,800 premises) that achieve a D rating for fixed broadband availability, 47 per cent are located within major cities and 49 per cent in regional Australia. 5 percent of DAs achieving a D availability rating are in remote Australia.

8 per cent of all DAs covering almost 453,000 premises have the lowest availability rating. These premises are primarily concentrated in regional areas (72 per cent), although significant proportions are in major cities (17 per cent) and remote areas (11 per cent).



Access to ADSL services decreases with remoteness, but more than two thirds of premises in remote and regional areas are estimated to have access to ADSL (Figure 10).

Figure 10. The proportion of premises in each remoteness class that can access ADSL services

## 3.2. Fixed broadband quality

The analysis found that approximately 3.1 million premises have access to fast or very fast broadband speeds (25 Mbps download and 5 Mbps upload and above). The remaining 7.1 million premises with access to fixed broadband services can access speeds below 24 Mbps and many of these are experiencing speeds significantly below this level.

There are a range of definitions used internationally as to what constitutes broadband. For example, the Organisation for Economic Co-operation and Development (OECD) uses services with an advertised download speed of at least 256 kbps. This reflected the basic entry-level broadband service that was available at the commercial launch of cable and

ADSL services in the 1990s. The United States adopted a minimum speed threshold of 4 Mbps download and 1 Mbps upload under its National Broadband Plan (2010).

Setting a specific level was not adopted in this analysis as it was preferable for the analysis to make an assessment against the range of quality that is currently available. This analysis does not use a defined speed as a definition of broadband, but instead considers the range of speeds available to premises over each technology. As for the availability assessment, an A to E quality rating scale was used. An explanation for this is set out in Table 7.

Areas where a high proportion of premises have full access to FTTP will be represented in the highest quality band (A), while areas with limited access to high speed platforms (FTTP, HFC and FTTN) will be represented in lower quality bands.

There will be premises within DAs where the overall rating is based on a combination of fixed broadband platforms<sup>9</sup>. However, the number of DAs where a combination of these platforms determines the overall rating is generally low, and is generally located on the border between areas of FTTP deployment, and those surrounding the HFC footprint found in the major metropolitan centres of Brisbane, Sydney, Melbourne, Adelaide and Perth.

Quality Rating		
A	Highest quality rating: Typically premises in this group have very good access to high quality services available by FTTP or HFC or FTTN networks. ADSL services are generally available.	
В	Typically premises in this group have good access to high quality services available by FTTP or HFC or FTTN networks. A small proportion of premises may only have access to ADSL services.	
C	Typically a larger proportion of premises are likely to have access to ADSL services, while remaining premises may also have access to high quality services available by FTTP or HFC or FTTN networks. A small proportion of premises may have access to fixed wireless networks.	
D	Typically the majority of premises in this group are likely to have access to ADSL services only, while some of the remaining premises will also have access to high quality services available by FTTP or HFC or FTTN networks. A small proportion of premises may have access to fixed wireless networks.	
E	Lowest quality rating: Typically premises will only have access to ADSL services. This rating also includes regions that have no access to any form of fixed broadband service. A small proportion of premises may have access to fixed wireless networks.	

#### Table 7. Fixed broadband quality rating scale.

#### Broadband quality profile: Band A

DAs in the higher end of the highest quality band (A) include areas where FTTP networks have already been rolled out. Places such as Ellenbrook WA, Keysborough VIC, Blacktown

<sup>&</sup>lt;sup>9</sup> Although access to multiple platforms at an individual premises offers no advantage as only the highest quality network available at each premises is used to form the aggregate fixed broadband rating at the DA level.

NSW, Crace ACT, Willunga SA, Launceston South TAS, Palmerston NT and Oxenford QLD, have several DAs where fibre has been connected to all premises in the DA. These are typically areas where NBN Co has deployed its fibre network or newer housing estates with fibre deployed by private companies. ADSL services are usually also available in DAs where FTTP has been deployed in established suburbs and towns such as Armidale NSW, Townsville QLD, Brunswick VIC, and South Hobart TAS.

DAs in the middle range of this band generally have a mix of technologies available, for example where part of the DA has been included in an FTTP rollout, but there is also coverage by ADSL and possibly HFC, such as areas of Brunswick VIC, Robina QLD or Auburn NSW.

DAs in the lower part of this band are more likely to have good coverage from only one high speed technology, such as FTTP or HFC. For example some parts of Jindalee WA and Dandenong South VIC have a small amount of FTTP available, but very good coverage by HFC. ADSL is generally available to these premises, although there are areas where ADSL impediments exist.

Band A is made up of approximately 2,000 DAs (3 per cent of all DAs) containing approximately 343,000 premises (3 per cent of total premises).

- > Nearly all premises in the A band have access to FTTP or HFC, with the majority being served solely by FTTP (approximately 219,000 premises or 64 per cent of the A band).
- Approximately 58,300 premises (17 per cent of premises) in the A band cannot access ADSL services.
  - Of these, 30,900 are located in around 200 DAS that have no access to ADSL. These DAs are primarily located in developments where no copper infrastructure was deployed, such as parts of Sanctuary Cove QLD, Eynesbury VIC and Dayton WA.
- > Of the premises located in the highest quality band, approximately:
  - o 245,200 are located in metropolitan areas
  - o 97,100 are located in regional Australia
  - 1000 are located in remote Australia the majority of these are in northern Western Australia.

#### Broadband quality profile: Band B

DAs in the higher end of Band B (the second highest quality band) include areas where there is complete coverage by HFC or FTTN, in the case of some DAs in the ACT. Areas such as parts of Collingwood VIC and Homebush NSW have coverage from both FTTP and HFC, but fewer than 80 DAs in this band have multiple high speed technologies available. ADSL is generally available.

In the middle and lower ends of this band, DAs are more likely to have partial coverage of FTTP, FTTN or HFC. For example, parts of Waverly NSW are not completely covered by HFC. There are also larger areas where ADSL access is limited because of technological impairments.

Band B is made up of approximately 23,900 DAs (31 per cent of all DAs) containing approximately 3.6 million premises (33 per cent of total premises).

- - > All the DAs in this band have either complete coverage or a high proportion of premises with access to at least one high speed technology, FTTP, FTTN or HFC.
  - > Approximately 193,600 premises (5 per cent of premises) in the B band cannot access ADSL services.
    - Of these, 32,500 are located in approximately 200 DAs that have no access to ADSL.
  - > The majority of premises in this band are located in metropolitan areas, with approximately 73,300 premises (2 per cent of the B band) located in regional and remote areas.

#### Broadband quality profile: Band C

About 3 per cent of DAs in this band have some FTTP available and a handful of DAs have partial coverage from both FTTP and HFC. The vast majority though have some coverage from HFC or FTTN, such as Crawley WA, Glenelg SA or Weston Creek ACT.

Band C is made up of approximately 2,400 DAs (3 per cent of all DAs) containing approximately 379,300 premises (3 per cent of total premises).

- All DAs in this band have partial coverage from at least one high speed technology, FTTP, FTTN or HFC.
- Approximately 21,500 premises (6 per cent of premises) in the C band cannot access ADSL services.
  - Of these, 3,600 are located in approximately 20 DAs that have no access to ADSL.
- > Of the premises located in the middle quality band, approximately:
  - o 346,300 are located in metropolitan areas
  - o 32,900 are located in regional Australia
  - 90 are located in remote Australia these are located in northern Western Australia in areas with partial FTTP coverage.

#### Broadband quality profile: Band D

There are fewer DAs in this band with any coverage from a high speed technology, with coverage being for a smaller proportion of the DA. This includes places such as Surfers Paradise QLD, Craigieburn VIC and Redfern NSW. ADSL availability continues to be fairly widespread but more areas are likely to have technological impairments.

Band D is made up of approximately 10,000 DAs (13 per cent of all DAs) containing approximately 1.4 million premises (13 per cent of total premises).

- Approximately 1,700 DAs have partial access to at least one high speed technology, FTTP, FTTN or HFC.
- > Approximately 35,000 premises (2 per cent of premises) in the D band cannot access ADSL services. These are located in approximately 1,600 DAs that have less than full access to ADSL services.
  - Of these, 7,300 are located in approximately 90 DAs that have no access to ADSL services.
  - ADSL services are generally available across the remaining DAs.



- > Of the premises located in this quality band, approximately:
  - o 884,800 are located in metropolitan areas
  - o 527,100 are located in regional Australia
  - 34,600 are located in remote Australia these locations have good access to ADSL services.

#### Broadband quality profile: Band E

A detailed examination of the lowest quality band (E) isolates a group of 40,000 DAs (51 per cent of all DAs) containing approximately 5.2 million premises (47 per cent of total premises). This includes places as dispersed as Tenterfield and Albion Park NSW, Acacia Ridge and Charters Towers QLD or Port Lincoln and West Adelaide SA. This group has the following characteristics:

- > Approximately 6,900 premises within around 800 DAs (less than 1 per cent of the E band) have partial access to FTTP, FTTN or HFC technologies.
- > Approximately 21,500 premises within around 800 DAs (less than 1 per cent of the E band) have access to NBN fixed wireless services.
- > Approximately 750,200 premises (14 per cent of premises) in the E band cannot access ADSL services. Of these:
  - o Of these, 328,200 premises are located in 5,000 DAs that have no access to ADSL
  - o 422,000 premises are located in DAs that have only partial access to ADSL
  - Where ADSL services are available, the median ADSL speed is low.
  - o 479 DAs fall within exchange serving areas with capped exchanges.
- > Of the premises located in the lowest quality band, approximately:
  - o 2.3 million are located in metropolitan areas
  - o 2.6 million are located in regional Australia
  - o 183,500 are located in remote Australia.

In contrast to the results of the availability modelling which found that most premises have access to a fixed broadband service and therefore achieve an A rating for availability, the quality results show a much broader dispersion against the A to E rating scale. Figure 11 provides the distribution of fixed broadband quality results against the five categories.



#### Figure 11. Percentage of premises in each fixed broadband quality band

The distribution of areas likely to have access to higher quality services is generally associated with the capital cities and some larger regional towns. A national map therefore provides limited information when displaying fixed broadband quality results. However, it is provided in Figure 12 as a comparison to the national fixed broadband availability map in Figure 3.



Figure 12. National map of fixed broadband quality band by Exchange Service Area



#### 3.2. (a) Fixed broadband quality – state and territory overview

The analysis found significant variations in the geographical distribution of fixed broadband quality across the states and territories as provided in Figure 13.



Figure 13. Percentage of premises in each fixed broadband quality band by state/territory

There are approximately 23,000 premises in the Australian Capital Territory in the highest quality band (A), and 52,000 premises in band B, reflecting the availability of an FTTN network which has been deployed to approximately 32 per cent of premises in the territory, and FTTP delivery in the Australian Capital Territory. Tasmania also has a relatively high proportion of premises in band A (7 per cent), which is mainly due to FTTP deployment.

The analysis indicated that Victoria, New South Wales, the Australian Capital Territory and Queensland have a relatively high proportion of premises in the second highest band (B) for quality (42, 35, 29, 34 per cent respectively), which is influenced by the deployment of HFC networks in Melbourne, Sydney and Brisbane, combined with the generally high quality level of ADSL service that can be accessed.

The Australian Capital Territory and Victoria have a similar proportion of premises in DAs that achieve the lowest quality rating (35 and 36 per cent respectively).

In contrast, the Northern Territory, Tasmania, and Western Australia have comparatively more premises that fall into the lowest band (E) for quality, primarily due to reduced likelihood that high speed broadband technologies are available in those states, although Perth has some access to HFC services.

Groups of DAs make up an Exchange Serving Area (ESA), with the number of DAs in an ESA ranging from 1 up to approximately 200. ESAs in metropolitan areas can have DAs spread across several rating bands, while regional ESAs are more likely to be homogenous.

The analysis found that there are a number of ESAs with marked differences in the quality of services across the DAs connected to that exchange. For example, the Inala exchange serving area in south-west Brisbane QLD has approximately 120 DAs, around half of which have quality ratings in the top two quality bands (A and B). This is mainly due to good coverage of HFC, with a few DAs in new development areas that have FTTP coverage. The other half of the ESA falls into the bottom two bands (D and E). The premises in these DAs only have access to ADSL services, which are generally of reasonable quality.

In New South Wales, the Minto exchange serving area which covers suburbs in southwest Sydney has about a third of its approximately 100 DAs in the top two bands. Again this is due to the presence of HFC and small pockets of FTTP deployment. However, the majority of the DAs are in the lowest band. ADSL services to these DAs have been impacted by technological impairment or distance from the exchange which reduces the overall quality rating.



Figures 14a to 14h combine the availability and quality ratings for each state and territory.

Figure 14a. Percentage of premises in each fixed broadband availability and quality band for the Australian Capital Territory



Figure 14b. Percentage of premises in each fixed broadband availability and quality band for New South Wales



Figure 14c. Percentage of premises in each fixed broadband availability and quality band for the Northern Territory.



Figure 14d. Percentage of premises in each fixed broadband availability and quality band for Queensland



Figure 14e. Percentage of premises in each fixed broadband availability and quality band for South Australia



Figure 14f. Percentage of premises in each fixed broadband availability and quality band for Tasmania



Figure 14g. Percentage of premises in each fixed broadband availability and quality band for Victoria



Figure 14h. Percentage of premises in each fixed broadband availability and quality band for Western Australia

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#### 3.2. (b) Fixed broadband quality by remoteness classification

The disparity between regional and metropolitan areas is also highlighted by the distribution of quality ratings by remoteness classification (Figure 15).



Figure 15. Percentage of premises in each fixed broadband quality band by remoteness classification

As with availability, there is a correlation between population density and quality of services available. Major cities have a greater spread of DAs across the ratings bands indicating the broad spread of higher quality services in those areas.

DAs in remote and very remote areas generally fall into the lowest two bands, which would be due to both lower population density and increased DA size. Premises in large DAs are more likely to be further away from the exchange, meaning ADSL services would not be available or would have lower median download speeds. Additionally, Figure 16 indicates that more remote areas are less likely to have access to high speed broadband technologies.



Figure 16. Major cities and regional Australia have much greater access to high speed broadband platforms including FTTP, FTTN, HFC and NBN fixed wireless than remote Australia



### 3.2. (c) ADSL Quality

The most common form of fixed broadband access is provided by ADSL technology. This analysis used the estimated cable length, based on the location of the nearest exchange or equipment cabinet, combined with a rolling median peak speed achievable over that distance to calculate the peak speeds achievable at each premises. A median peak speed for each DA was then calculated.

Figure 17 summarises the approximate percentage of premises with access to ADSL that are likely to receive particular ADSL median peak download speeds, as predicted by the line distance model.



Figure 17. Percentage of premises in each band of modelled median peak download speeds

The distribution of modelled median ADSL speed is similar across each of the states and territories, although Figure 18 indicates a higher proportion of premises in the Australian Capital Territory, South Australia and Queensland have access to ADSL services with modelled speeds of 9 Mbps or below compared to the other states and territories, which is indicative of the relative availability of ADSL compared to ADSL2+ services.



Figure 18. Percentage of premises in each band of modelled median peak download speeds

Access to ADSL services is lower in more remote areas than inner regional areas and major cities. However, of those premises that can access ADSL services, there is generally little difference in the distribution of modelled median speeds across each of the remoteness categories, reflecting the observation that premises within regional and remote areas that are located close to local telephone exchanges will be able to access higher speed ADSL services. The analysis has also identified a number of small metropolitan areas where there is limited availability of fixed broadband and a large number of premises that can access a basic service at download speeds that are less than 9 Mbps.

Broadband availability and quality is affected by multiple factors. Key elements are considered in this analysis, but a range of factors may impact individual circumstances. In many locations there will be premises whose circumstances vary from the ratings for broadband availability and quality that their area receives in this analysis.

### 3.3. Mobile broadband

Mobile voice coverage is available to more than 99 per cent of the population, but fewer premises can access a broadband service that provides an effective data service in addition to voice services<sup>10.</sup> This analysis estimates that nationally approximately 81 per cent of premises have access to an effective 3G mobile broadband service and 59 per cent of premises have access to a 4G service.

The analysis suggests that approximately 318,000 premises fall outside the ADSL footprint, but can access a 3G or 4G service.

The extent of mobile broadband coverage across the states and territories varies considerably. The Northern Territory has the lowest coverage of mobile broadband services with 56 per cent of premises having access to 3G services. By comparison, the Australian Capital Territory has the highest proportion of 3G broadband coverage (approximately 95 per cent), with Victoria (85 per cent) and New South Wales (84 per cent) both having higher coverage than the national average.

3G and 4G are depicted separately for each state and territory in Figure 19 as 4G network coverage typically overlaps 3G coverage, yet will provide the end user with a higher quality broadband service. Although the Australian Capital Territory has a high degree of 3G coverage, the percentage of premises coverage by 4G networks is less than or similar to Queensland, New South Wales and Victoria. Each of these states and the territory has proportionally higher coverage by 4G networks than the national average of 61 per cent, whereas the remaining states and the Northern Territory have less 4G coverage. Queensland has the highest level of good 4G coverage, yet 3G coverage is not as extensive as most of the other states or territories.

<sup>&</sup>lt;sup>10</sup> Telstra's website, <u>www.telstra.com.au/mobile-phones/coverage-networks/networks</u>, notes that 66 per cent of the population can typically access 4G download speeds of 2-50 Mbps in the download and 1-10Mbps upload. Outside 4G coverage areas, Telstra's fastest available 3G speeds include 1.1-20 Mbps in the download and 550 kbps-3 Mbps in the upload across 80 percent of the population. In remaining coverage areas speeds are lower. Telstra has subsequently announced the extension of its 4G network coverage to 85 per cent of the population, see <u>http://www.telstra.com.au/aboutus/media/media-releases</u>.



Figure 19. Percentage of premises in each state/territory with access to 3G or 4G mobile broadband services

Importantly, the quality of a mobile broadband service can be affected by a range of variables that were not considered in this analysis (Appendix A), including the distance between the premises and a transmission point, the specific device being used to access a mobile broadband service, and whether the device is being used in or outdoors (including via the use of an externally mounted antenna which may improve the level of performance).

This report is based on analysis of mobile coverage footprints provided by carriers early in the fourth quarter of 2013. Investment in the mobile market is dynamic and mobile coverage, particularly 4G coverage, is rapidly expanding. As such, the results of this analysis reflect a point in time only.

### 3.4. Satellite broadband

In general, all Australian premises are covered by satellite broadband networks although there is a limit to the capacity of the satellites currently in orbit, and they are not the most cost effective approach to the delivery of services in metropolitan areas.

Access to a connection can be affected by physical characteristics of the surrounding environment, in particular tree foliage which can mean a signal cannot be established.

Due to the nature of the technology, broadband delivered over satellite is affected by latency (signal delay) between the ground station and the user because geostationary satellites are located in space at an orbital distance of approximately 36,000 kilometres above the earth's surface.

The quality of the satellite connections in terms of speeds offered is typically peak speeds of up to 6 Mbps (downstream) and up to 1 Mbps (upstream). Quality of a satellite broadband service is also affected by a range of variables that were not considered in this analysis, including signal quality during heavy rain (also known as rain fade), signal interference from adjacent satellites or ground transmitters and end user equipment (Appendix A).

## 4. Methodology

The approach used produced a supply-side snapshot of current broadband infrastructure and the quality of the services available in terms of speed. The modelling approach was designed following a review of similar projects conducted in the United Kingdom, USA, Canada, Germany and recently, the European Union (Appendix C). The analysis had regard to various academic publications<sup>11</sup> on implementing appropriate broadband quality metrics. In addition, global and regional analyses of broadband metrics, such as the Cisco Visual Networking Index, the Akamai State of the Internet Report and various OECD publications, were considered before formulating the approach. The existing analyses leverage a broad range of data sources and methodologies, each of which has its strengths and weaknesses. The approach used in this report was adopted after considering the available data and the goal of identifying areas where there are broadband access infrastructure based constraints to broadband availability and quality. Alternative analyses based on surveys, censuses or end to end network performance measurement, are likely to produce different results.

This analysis of broadband availability and quality considered three categories of broadband delivery separately: fixed broadband (FTTP, FTTN, ADSL, HFC and NBN fixed wireless), mobile broadband (3G and 4G) and satellite broadband.

The analysis of fixed broadband was based on a spatial model incorporating the coverage of the fixed technologies that deliver broadband services, in combination with the factors that may constrain access to a service or affect the quality of a service. Separate availability and quality ratings for each technology were calculated on a standalone basis. Figure 20 describes the high level structure of the fixed broadband model. A more detailed version of the model is described in Appendix D.



Figure 20. The structure of the model converts network coverage and impediment information in a geospatial model to derive broadband availability and quality ratings.

### 4.1. Telstra Distribution Area – geographical building block

The fixed broadband analysis used Telstra Distribution Areas (DA) for assessment and comparison of broadband at a local level primarily because a number of underpinning data are available at the DA level.

The DA is a network component of a Telstra Exchange Service Area (ESA) although exceptions exist where an ESA has no DAs. Each DA typically comprises 100-200 premises,

<sup>&</sup>lt;sup>11</sup> Including 'Measurement and Assessment of Broadband Availability', Lehr and Smith-Grieco 2009
but in some cases, a single DA may comprise several thousand premises. DAs vary in geographical coverage, generally increasing in size as population or premises density decreases. In cases where ESAs are geographically large and no DAs have been defined, the analysis used a series of proxy DAs (of which 7,410 contain premises) based on suburb boundaries defined by the Australian Bureau of Statistics. To improve the validity of data, all DAs with up to 10 premises (approximately 12,000) were removed from the analysis.

The use of a geographical building block in combination with the location of each premises within each DA boundary provided the basic mechanism by which fixed broadband network coverage information was converted into measures of broadband availability or quality:

- > where a fixed network provides 100 per cent coverage to a DA, in the absence of any impediments or model weightings, that DA received 100 per cent for that metric (corresponding to an availability rating of A).
- > where half the premises are covered, the appropriate availability score was 50 per cent (corresponding to an availability rating of C).
- > where impediments to particular fixed broadband services were included, these either reduced the overall number of premises that can access a given service in a DA, or were used as scaling factors where the impact could not be readily localised to a specific DA.

### 4.2. Broadband availability calculation

The calculation of a fixed broadband availability rating was based on the proportion of the premises in a DA that are serviceable by a given fixed network. The aggregate measure of fixed broadband availability was also derived from the combined coverage by any of the fixed networks assessed in the model. However, overlapping coverage of different fixed networks was not aggregated, with only a single network considered at each premises to provide a maximum of 100 per cent broadband availability. As such, while many premises do have access to multiple technologies, a high availability rating does not necessarily result in strong competition or choice for consumers.

For example, Figure 21 depicts three DAs, each containing four premises. Although the DA on the left would receive a fixed broadband availability measure of zero (corresponding to a rating of E), the two remaining DAs would both receive a score of 50 per cent (leading to a rating of C). As such, the aggregate measure of fixed broadband availability represents a technology-agnostic measure of the degree to which consumers in a given area can access a broadband service.



Figure 21. The broadband availability model would rate the left example as having no availability (Band E), and the centre and right examples as having 50 per cent availability (Band C) as a broadband platform is available to half of the premises.

Broadband availability ratings were also calculated for each fixed technology platform. These reflected the relative coverage of each technology within a DA and, where appropriate, considered various impediments to obtaining a service over a given network.

For FTTP networks, the model assumed full coverage for premises within the fibre footprint with some limited exceptions. This was assumed because existing (non-NBN) FTTP networks have generally been rolled out in new housing development estates and therefore all premises in the footprint can access the network, although there are some exceptions. While NBN Co's FTTP footprint was included in the modelling, service class zero premises (passed by fibre but unable to access a service) were not counted towards FTTP availability calculations.

For the HFC networks, the model scaled the coverage to reflect that not all premises within the HFC footprint are able to access a service.

In the case of ADSL services, availability was limited within the model where:

- > the ESA or DA does not support ADSL services,
- > excessive cable length is identified,
- RIM or other pair gain devices have not been remediated to allow provision of ADSL services,
- > the availability of spare ports at the exchange is low, or
- > capacity at the relevant exchange has been capped.

In the case of the first three variables, the model estimated a specific number of premises within the DA that were prevented from accessing an ADSL service.

For the latter two variables, the specific number of premises constrained from accessing a service is dependent on dynamic factors including the current level of take-up and demand for additional services. No data were available for these factors. However, in recognition that these are impediments to accessing a service, a weighting was applied where ports



were low<sup>12</sup> or the exchange was capped. More information about factors that affect ADSL is outlined in Table 8 and Appendix E.

Table 8. Barriers to accessing a DSL broadband service

Distance from the exchange	ADSL signals degrade over distance of the copper and therefore there is a distance beyond which an ADSL service is effectively not capable of being supplied. Although this cable distance can depend on the local condition of the copper, the degree to which it is isolated from electro-magnetic interference and the locally used copper grade, the level of signal loss at around 5 kilometres provides a practical limit to the areas beyond which a premises generally cannot access an ADSL service.
	It is recognised that rural areas are often serviced with heavier gauge cable that is capable of supporting ADSL services as far as 8.6 kilometres for 0.9mm cable. However, as the analysis was conducted at the DA level, there is only a small proportion of DAs where the distance is larger than five kilometres and as such there is minimal effect on the results from adopting the five kilometre limit.
Pair gain systems	Pair gain systems (small and medium) allow multiple standard telephone lines to be carried over a single pair of copper wires. There are also large pair gain systems including a RIM—a remote integrated multiplexer which can typically deliver between 120 and 480 telephone services. These systems were traditionally used to ensure the timely delivery of voice services in outer metropolitan areas or new estates where it was not deemed to be economically feasible to upgrade existing copper plant.
	Generally ADSL services are not available to those on the end of small or medium pair gain systems, although in some circumstances a network provider can re-use an available line for ADSL services. Many large pair gain systems have been upgraded to provide ADSL services, although this depends on the type of pair gain system used and the port capacity within it.
Port availability	ADSL services may be unavailable due to a shortage of available ports at the exchange, including if the exchange is capped and no further equipment to support ADSL services can be installed.
Transpositioning	Typically more copper cables have been deployed to a large pair gain system than are needed to deliver the number of voice services it can supply. Under a process known as 'transpositioning' a premises seeking access to an ADSL service that is not supported by the large pair gain system can be re-allocated to one of the additional copper cables that connect directly to the exchange.

### 4.3. Broadband quality calculation

In terms of fixed broadband quality, the model assessed the capability of the access network infrastructure available in the DA, with a higher weighting being placed on platforms capable of delivering higher speed services.

For the purposes of this analysis, FTTP was considered as the best-in-class platform given its existing capability to offer services of 1 gigabit per second (Gbps) and its scalability to offer even higher speed services.

<sup>&</sup>lt;sup>12</sup> Australian Bureau of Statistics Internet Activity Survey 2013 suggests that demand for connections is increasing approximately 2 per cent per annum. This rate of increase was applied to the number of services in operation in each ESA to determine the number of ports theoretically required to support demand for one year.

While HFC networks support services with peak download speeds approaching 110 Mbps, these networks were weighted lower than FTTP due to the lower upload speeds available and the current contention ratios for shared infrastructure which can limit the potential for these networks to deliver high speed services to a large number of premises simultaneously.

FTTN networks were weighted in line with HFC networks. While FTTN networks currently offer lower speeds than HFC networks, there is a well-defined technology roadmap for the base infrastructure used to deploy FTTN to deliver speeds in excess of 100 Mbps.

NBN Co's fixed wireless network was weighted below HFC and FTTN, but higher than ADSL services as services delivering peak download speeds of 25 Mbps are currently available.

ADSL networks were given a lower weighting than FTTP, HFC, FTTN and fixed wireless due to the maximum theoretical speeds that can be offered. The weighting was based on the median speed achievable within a DA, itself primarily a factor of cable length, and the specific ADSL technology deployed. Cable length was estimated by calculating the shortest street distance between each individual premises and either the exchange or cabinet at which the infrastructure providing broadband access is located.

A factor of 10 per cent was added to the calculated distance from the exchange to account for coils of excess cable that are typically stored in communication pits to facilitate local fault repairs. These distances were then used to predict the likely ADSL download speed by comparing them with a speed versus distance relationship based on empirical data of actual broadband signal loss and cable distance. The empirical dataset comprised 20,000 samples of ADSL2+ download sync speeds and associated cable loss. The cable loss (in Decibels, dB) was used to estimate line length using the industry accepted average loss of 13.8 dB per kilometre for 0.4mm diameter copper cable.

Data points were then grouped according to line lengths of 100 metre increments, and a calculation of the median speed at each distance was made. The observed relationship between the measured signal loss and estimated cable length was applied to the estimated line length for every premises with ADSL access in the DA and the median speed for each DA was determined. The median was considered to provide a more accurate representation of likely speeds experienced by end users in the DA than average speed. As such, while individual premises within each DA will experience a range of speeds, the modelled median peak speed provides a reasonable indication of the speeds achievable in the DA and provides a measure for comparison with other DAs.

It should be noted that some exchange service areas are served by multiple exchanges (subexchanges) due to the number of premises in the area. In calculating distance to the exchange, the assumption was made that a premises was served by the closest exchange infrastructure. It will be the case that some premises in the exchange service area are not served by the closest exchange infrastructure. As such, the analysis may overstate the median peak speed achievable in those areas.

There are approximately 90 ESAs that fall into this category<sup>13</sup>. Table 9 shows the distribution of these exchanges across the states and territories.

<sup>&</sup>lt;sup>13</sup> This figure excludes large exchange services areas where individual exchanges are more than 12 km apart.



Table 9. Distribution of ESAs with multiple exchanges

	Distribution of ESAs
ACT	2
NSW	21
NT	7
QLD	9
SA	2
TAS	1
VIC	19
WA	33
Total	94

Narre Warren in the south eastern outskirts of Melbourne is an example of one of these ESAs. It has approximately 130 DAs and about 40 per cent of these are in the top two bands for quality. This is due to the good coverage of HFC in the area. The majority of the DAs are in the lower two quality bands, which indicates that there is access to ADSL services. Those services may be of variable quality, and based on the modelling conducted for this analysis, provide a median peak download speed of between 1.5Mbps and 24 Mbps. However, in a number of cases, areas of Narre Warren are not connected to the nearest exchange such that the cable length can be too long to support the provision of an ADSL service.

To accommodate situations where multiple network coverage footprints are present in a DA, the model maximised the potential quality rating by determining the best performing technology available to each premises. For example, for the premises depicted in Figure 22 with coverage from both HFC and ADSL networks, the model would derive the quality measure from HFC coverage. It would assess this DA to have a quality rating in the D category, where most premises are likely to have access to ADSL services only, while the remaining premises may have access to high quality services available by HFC, FTTP or FTTN.



Figure 22. The model derives a fixed broadband quality rating from (a) the weighting associated with HFC performance for the premises with both HFC coverage and ADSL because HFC is preferred over the lower performing ADSL technology, and (b) the weighting associated with the ADSL for the remaining premises.



### 4.4. Data Inputs

This analysis makes use of the following data inputs:

- > Current network coverage data from all major telecommunications carriers and a number of smaller players with customer access networks,
- > Data from the Telstra Wholesale website,
- Empirical ADSL usage observations comprising 20,000 real world measures of ADSL download sync speeds, associated cable loss, and the location and number of small, medium and large pair gains, and
- > Locations and numbers of premises from the Geocoded National Address File (G-NAF).

All data sources are the most current available, dating from July 2013 to October 2013. It is important to note that telecommunications carriers continually invest in infrastructure, and broadband availability and quality is therefore dynamic<sup>14</sup>. This analysis was finalised in December 2013. Further detail is provided in Appendix F.

The analysis considered including a broader range of factors than those in the final model including competition, faults, backhaul provisioning, infrastructure age and technology refresh cycles and user experience testing for broadband platforms other than ADSL. These factors were not included in the final model either because data sources were not available, or the factors were considered to add minimal value to the overall analysis.

## 5. More information

For more information about broadband quality and availability in your area, you can visit the new MyBroadband website at **www.mybroadband.communications.gov.au**.

If you have any questions about this material, please email **mybroadband@communications.gov.au**.

<sup>&</sup>lt;sup>14</sup> Investment in the mobile market is resulting in expanding coverage, particularly in 4G coverage. Telstra announced on 18 December 2013 its 4G network coverage had expanded to reach 85 per cent of the population. Optus has dual 4G networks and aims to expand its 4G coverage to over 70 per cent of the population in metropolitan areas by April 2014.

# Appendix A – Broadband technologies explained

Broadband Technology	Description	Factors impacting data speeds
Dial-up	Dial-up is a technology that uses copper telephone lines to establish a low bit- rate connection to an internet service provider. The typical dial-up modems have a maximum theoretical transfer speed of 56 kilobits per second. While dial-up technology can be used to access the internet it is a basic technology and is not considered to be a broadband technology. As such, dial-up was not assessed in this study.	• Limitations of the technology and the modem capability.
ADSL (Asymmetric Digital Subscriber Line)	A technology designed to give basic broadband performance over copper telephone lines, allowing more data to be sent than with dial-up internet. Downstream data speeds for ADSL are up to 8 Mbps and up to 1.3 Mbps upstream.	<ul> <li>Limitations of the selected technology associated with its technical standard (8 Mbps for ADSL)</li> <li>Service plan</li> <li>Copper line length</li> <li>Signal interference</li> <li>Quality of the copper line</li> <li>Retail Service Provider's (RSP) network and backhaul provisioning</li> <li>Home wiring</li> <li>End user equipment and software</li> </ul>
ADSL2+	An enhancement to ADSL that uses a wider frequency range to achieve substantially faster speeds over relatively short distances. ADSL2+ speeds reach up to 24 Mbps downstream and up to 3.3 Mbps upstream.	<ul> <li>Limitations of the selected technology associated with its technical standard (24 Mbps for ADSL2+)</li> <li>Service plan</li> <li>Copper line length</li> <li>Signal interference</li> <li>Quality of the copper line</li> <li>RSP's network and backhaul provisioning</li> <li>Home wiring</li> <li>End user equipment and software</li> </ul>
Mobile broadband	3G mobile networks typically offer speeds between 1-20 Mbps downstream and 550 kilobits per second to 3 Mbps upstream. 4G mobile networks typically offer speeds between 2-50 Mbps downstream and 1-10 Mbps upstream. However, mobile networks are shared	<ul> <li>Limitations of the selected technology associated with its technical standard (GSM, WCDMA, LTE)</li> <li>Service plan</li> <li>Cell site congestion/usage</li> <li>Backhaul capacity at cell site</li> </ul>

	networks such that when multiple users are accessing the network at the same time the speed performance will reduce.	<ul> <li>Interference</li> <li>End user equipment and software</li> <li>Signal coverage (in-building, topography)</li> </ul>
HFC (Hybrid Fibre Coaxial cable)	A network utilising both optical fibre and coaxial cable for the delivery of Pay TV, internet and voice services. Speeds of up to 110 Mbps downstream and 2.4 Mbps upstream are available on the Australian HFC networks. HFC is a shared technology and speeds can vary depending on usage on the network. It is noted that HFC networks are technically capable of upstream speeds of 26.5 Mbps and there is an upgrade path for HFC networks to DOCSIS 3.1 which offers increased downstream and upstream speeds.	<ul> <li>Limitations of the selected technology associated with its technical standard (DOCSIS 2.0 or 3.0)</li> <li>Service plan</li> <li>Contention (the number of premises served by an optical node)</li> <li>RSP's network and backhaul provisioning</li> <li>End user equipment and software</li> </ul>
FTTP (fibre to the premises)	Fibre to the premises describes the installation of optical fibre from a point of interconnect to the network all the way to a premises (residential or business). A common FTTP technology that is employed in residential scenarios is GPON – gigabit passive optical network (selected by NBN Co). GPON delivers 2.5Gbps downstream and 1.2Gbps upstream shared between a maximum of 32 premises in the NBN FTTP deployment. Typically retail products over FTTP networks offer speeds up to 100 Mbps downstream and 40 Mbps upstream, although higher speeds services such 1 gigabit service downstream and 400 Mbps upstream services are available.	<ul> <li>Limitations of the selected technology associated with its technical standard (GPON, 10GPON)</li> <li>Service plan purchased by the end user</li> <li>Contention (the number of premises served by an optical node)</li> <li>RSP's network and backhaul provisioning</li> <li>End user equipment and software</li> </ul>
FTTN (fibre to the node)	Fibre to the node describes the installation of optical fibre from a point of interconnect (or exchange) to a distribution point (a node or street cabinet) in a neighbourhood that serves a few hundred customers within a radius of about 1 kilometres. The connections from the node to the customer premises use the copper connection and one of the Digital Subscriber Line (xDSL) standards to deliver broadband. The only Australian FTTN network delivered at scale is in the ACT. This network offers	<ul> <li>Limitations of the selected technology associated with its technical standard (for example VDSL or VDSL2)</li> <li>Service plan</li> <li>Copper line length</li> <li>Signal interference</li> <li>Quality of the copper line</li> <li>RSP's network and backhaul provisioning</li> <li>Home wiring</li> <li>End user equipment and software</li> </ul>

	downstream speeds of up to 60 Mbps and upstream speeds of 5 Mbps and above. Depending on the technical standard utilised FTTN networks are capable of up to 100 Mbps downstream and 50 Mbps upstream. There is an upgrade path for FTTN networks to G.fast, which is capable of achieving access speeds of hundreds of megabits per second over existing copper wire within 250 metre range of a distribution point.	
NBN Fixed Wireless	NBN Co's fixed wireless network uses wireless technology commonly referred to as LTE (long term evolution) or 4G. The NBN service is engineered to deliver fixed wireless services to a fixed number of premises within a coverage area. Speeds of up to 25 Mbps downstream and 5 Mbps upstream can be delivered.	<ul> <li>Limitations of the selected technology associated with its technical standard (GSM, WCDMA, LTE)</li> <li>Service plan</li> <li>Cell site congestion/usage</li> <li>Backhaul capacity at cell site</li> <li>Interference</li> <li>End user equipment and software</li> </ul>
Satellite	Retail satellite broadband products over existing Ku-band satellite networks for home users and small businesses offer speeds up to 6 Mbps downstream and up to 1 Mbps upstream. Next generation satellites (such as the NBN Co long term satellite solution which will be launched in 2015) will offer home user and small business satellite customer speeds of up to 25 Mbps downstream and up to 5 Mbps upstream.	<ul> <li>Limitations of the selected technology associated with the technical standard</li> <li>Latency (signal delay) between the ground station and satellite affects end user experience especially for real time applications</li> <li>Signal quality during heavy rain (also known as rain fade)</li> <li>Service plan</li> <li>Satellite congestion/usage</li> <li>Backhaul capacity at cell site</li> <li>Interference</li> <li>End user equipment and software</li> </ul>

### Appendix B - Broadband quality and availability maps

#### Contents

- 1. Overall fixed broadband quality by capital city
- 2. ADSL quality by capital city
- 3. Non-ADSL fixed broadband coverage by capital city
- 4. Overall fixed broadband availability by regional centre
- 5. ADSL quality by regional centre

#### Notes on interpreting the maps provided:

The maps provided in this section are prepared at the Distribution Area (DA) level. DAs come in various shapes and sizes, and the size of the DA generally increases as premises density decreases. As such, DA boundaries in regional and remote Australia are far larger than the towns they encompass, and the ratings of such areas are driven heavily by the availability and quality of services in the more densely populated areas of that DA.

It should be noted that the focus of this study was on broadband availability and quality for homes and small businesses. Broadband access networks that specifically address the communications requirements of the medium and large enterprise sector and tertiary education institutions were not included in this study. As such, the maps don't show very high quality levels in capital city CBDs or business park locations as the large fibre networks that exist in these locations did not form part of the analysis and are therefore not reflected in the mapping of results. Equally, the fibre networks serving many individual premises such as schools, or precincts such as hospitals or universities are not displayed on these maps.

#### 1. Overall fixed broadband quality by capital city



Figure 1.1. Overall fixed broadband quality in Sydney and surrounding areas.



Figure 1.2. Overall fixed broadband quality in Melbourne and surrounding areas.



Figure 1.3. Overall fixed broadband quality in the Adelaide and surrounding areas.



Figure 1.4. Overall fixed broadband quality in Brisbane and surrounding areas.



Figure 1.5. Overall fixed broadband quality in Perth and surrounding areas.



Figure 1.6. Overall fixed broadband quality in Darwin and surrounding areas.



Figure 1.7. Overall fixed broadband quality in Hobart and surrounding areas.



Figure 1.8. Overall fixed broadband quality in Canberra and surrounding areas.

#### 2. ADSL quality by capital city



Figure 2.1. ADSL quality in Sydney and surrounding areas by Distribution Area.



Figure 2.2. ADSL quality in Melbourne and surrounding areas by Distribution Area.



Figure 2.3. ADSL quality in Adelaide and surrounding areas by Distribution Area.



Figure 2.4. ADSL quality in Brisbane and surrounding areas by Distribution Area.



Figure 2.5. ADSL quality in Perth and surrounding areas by Distribution Area.



Figure 2.6. ADSL quality in Darwin and surrounding areas by Distribution Area.



Figure 2.7. ADSL quality in Hobart and surrounding areas by Distribution Area.

Current as at December 2013 ADSL QUALITY CANBERRA Jacka Bonner Wallaroo Sutton Bywong Amaroo Gungahlin Vicholls Fraser-Charnwood Franklin Crace Parkwood Evatt Giralang Mitchell Gearys Gap Latham Holt Florey Watson Kaleen Higgins Belconnen Downer Bruce Hawker -Wamboin O'Connor Murrumbidgee River Aranda Ainslie Fairlight Tumer Mount Majura CANBERRA Molongio Valley Campbell Coree Uriarra Village Yarralumla, Parkes Barton Shannons Flat Pialligo Kowen Weston Creek Deakin Forrest Mount Stromlo Coombs **Blundells Flat** Curtin A Griffith Hughes Duffy \_ Narrabundah Lyons Beard Garran Rivett Symonsten **Broadband ADSL** Queanbeyan Chilley O'Malley Chapman Quality by **Distribution Area** Isaacs Karabar Farrer D5 (20-24 Mbps) Riverlea Hume Jerrabomberra Kambah E1 (16-20 Mbps) Oakey Creek Fadden Environa E2 (12-16 Mbps) E3 (8-12 Mbps) Monash Chisholm E4 (4-8 Mbps) Tralee Richardson Bonython E5 (0-4 Mbps) Cotter River Googong Exchange Service Snowy Corner Theodore Area Conder Limited data are available for some areas. These areas appear Banks as white on the map.

Figure 2.8. ADSL quality in Canberra and surrounding areas by Distribution Area.





Figure 3.1. HFC, FTTP and Fixed Wireless broadband coverage in Sydney and surrounding areas.



Figure 3.2. HFC, FTTP and Fixed wireless broadband coverage in Melbourne and surrounding areas.



Figure 3.3. HFC, FTTP and Fixed Wireless broadband coverage in Adelaide and surrounding areas.



Figure 3.4. HFC, FTTP and Fixed wireless coverage in Brisbane and surrounding areas.



Figure 3.5. HFC, FTTP and Fixed wireless broadband coverage in Perth and surrounding areas.



Figure 3.6. FTTP and fixed wireless broadband coverage in Darwin and surrounding areas.



Figure 3.7. FTTP and fixed wireless broadband coverage in Hobart and surrounding areas.



Figure 3.8. FTTP and FTTN broadband coverage in Canberra and surrounding areas.





Figure 4.1. Fixed broadband availability in the area surrounding Geelong, VIC.



Figure 4.2. Fixed broadband availability in the area surrounding Newcastle, NSW.


Figure 4.3. Fixed broadband availability in the area surrounding the Gold Coast, QLD.



Figure 4.4. Fixed broadband availability in the area surrounding Wollongong, NSW.



Figure 4.5. Fixed broadband availability in the area surrounding the Sunshine Coast, QLD.

## 5. ADSL quality by regional centre



Figure 5.1. ADSL quality in the area surrounding Geelong, VIC.



Figure 5.2. ADSL quality in the area surrounding Newcastle, NSW.





Figure 5.3. ADSL quality in the area surrounding the Gold Coast, QLD.



Figure 5.4. ADSL quality in the area surrounding Wollongong, NSW.



Figure 5.5. ADSL quality in the area surrounding the Sunshine Coast, QLD.

# Appendix C - International examples of broadband assessment

A number of international jurisdictions have conducted analyses of broadband availability and/or quality, including the United Kingdom, USA, Canada and Germany.

## UK

In November 2011, the UK telecommunications regulator Ofcom published its first Communications Infrastructure Report. This report was published pursuant to legislation, which provides Ofcom with a statutory duty to report every three years on the state of the UK's communications infrastructure<sup>1</sup>. Ofcom has recently provided its 2013 update of communications infrastructure, which it compiles on an annual basis, and covers fixed line, mobile broadband and telephony, as well as services and infrastructure associated with the broadcasting sector.

The output of its ongoing study comprises both written accounts of the state of the communications sector, as well as availability maps and a data cube of the underlying inputs against a specific geospatial unit.

Currently five metrics are assessed (average sync. speed, percentage of premises receiving less than 2Mbps, superfast broadband availability, average broadband take up and average data use) to yield an overall performance rating out of five for each administrative authority in the UK. Each local authority is assessed and given a rating out of five for each metric, based on a predetermined scale (for example in relation to average sync speed, speeds of 15-22Mbps are given a score of 1, speeds of 10-15Mbps are given a score of 2, speeds of 8-9 Mbps are given a score of 3).

Ofcom's analysis is based on data received by Ofcom as part of its regulatory role, requested from the largest operators in each sector, or reusing data already submitted to Ofcom by industry where possible. In the fixed-line market, data was gathered from communications providers which together comprised over 80 per cent of that market. Speed data is based on analysis of over 13 million broadband connections and the composition of the sample reflects the mix of technologies (ADSL, ADSL2+, VDSL, FTTP, cable) and telephone line lengths in use across the UK

## USA

The National Telecommunications and Information Administration (NTIA) agency within the United States Department of Commerce undertakes a range of initiatives to increase access and use of broadband services in America. NTIA created the National Broadband Map<sup>2</sup> in 2011, in collaboration with 50 states, 5 territories and the district of Columbia as a tool to search, analyse and to map broadband availability across the USA. The map also provides an input to a competitive grants program for integrating broadband and information technology into state and local economies.

<sup>&</sup>lt;sup>1</sup> <u>http://maps.ofcom.org.uk/broadband</u>

<sup>&</sup>lt;sup>2</sup> http://www.broadbandmap.gov/rank

The map provides maps and text summaries of network availability, number of retail service providers, results of speed tests, average speeds, differences in services between urban and rural areas, and demographic information. It also has capability to show how an area ranks compared to other areas on a specified broadband performance metric.

States are funded to collect data on speeds and services from carriers, who voluntarily participate. The map is updated every 6 months on the basis of this data.

The broadband ranking feature allows users to select an area to be ranked which may include at a national level (i.e. compare all states, compare all counties) or ranked within a state (i.e. compare all counties or census places in a particular state). Users can also select the specific performance metric for comparison (speed, technology, number of providers and demographics). This then generates a list with best performing areas ranked first and worst performing areas ranked last.

## Canada

As part of the Broadband Canada Program (2009-2012), Industry Canada undertook an extensive survey in order to understand the extent to which Canadians remain underserved by existing broadband networks.

The National Broadband Maps<sup>3</sup> allows for searches by address and provides a summary of service providers operating in the surrounding area, as well as the types of services available (i.e. DSL, fixed line, fixed wireless, mobile wireless or satellite). The sites analysis is tailored to an area bounded by a hexagonal shape of approximately 3 km diameter.

The site lists 49,999 hexagons which are each based on a statistical description allowing comparison with other demographical information.

Although now archived, the Canadian site was launched simultaneously with an invitation for consumers to provide feedback, including through the use of an online speed test.

The findings of this initiative were used as a basis to assess grant applications for projects from private companies or consortia to build and operate broadband infrastructure.

### Germany

The German Government, through its regulatory authority (Federal Network Agency), collects information describing existing utility infrastructure including telecommunications, and has created an Infrastructure Atlas which is accessible to infrastructure developers with the aim of ensuring a coordinated approach to deploying utility infrastructure extensions or improvements.

In May 2012, changes to Germany's Telecommunications Act came into force, providing the Federal Network Agency with more options for acquiring data for its Infrastructure Atlas, which had previously been operated on a voluntary basis. The Federal Network Agency can now require telecommunications network operators and companies that have telecommunications terminal equipment to provide it with specific information, including site data, leading to a significant improvement in the quality and quantity of data.

<sup>&</sup>lt;sup>3</sup> <u>http://www.ic.gc.ca/app/sitt/bbmap/hm.html?lng=eng</u>

At a consumer level, the German Government has also produced a broadband-specific atlas<sup>4</sup>, which also provides the opportunity for individual consumers to provide feedback on the information contained in the atlas, which can then be verified with the assistance of relevant service providers.

#### **European Union**

The European Commission published its Broadband Coverage in Europe 2012<sup>5</sup> report to support the objectives of the European Union's Digital Agenda. The report supports the Agenda's objectives of providing all European Union citizens with basic broadband coverage by 2013, and with broadband speeds of at least 30 megabits per second by 2020. The report was commissioned by the Directorate General for Communications Networks, Content and Technology, DG Connect, with data from network operators and National Regulatory Agencies.

This project reports on the number and proportion of households in each European Union country (as well as Norway, Iceland, Croatia and Switzerland) that can access a range of broadband technologies. It further identifies areas where more action is needed to achieve the objectives of the Digital Agenda. The project therefore provides detailed data to inform policy and regulation activities associated with enabling high speed broadband access for the European Union.

<sup>&</sup>lt;sup>4</sup> http://www.zukunft-breitband.de/DE/Breitbandatlas/breitband-vor-ort.html

<sup>&</sup>lt;sup>5</sup> http://point-topic.com/free-analysis/mapping-broadband-coverage-europe-2012



# Appendix E – Factors that affect the availability and quality of ADSL services over copper

## Cable distance

As a result of the gradual impact of cable length, there is a distance beyond which an ADSL service is effectively not capable of being supplied.

Although this cable distance can depend on the local condition of the copper and the degree to which it is isolated from electro-magnetic interference, the level of signal loss at 5 kilometres provides a practical limit to the areas beyond which a premises generally cannot access an ADSL service. It is recognised that rural areas are often serviced with heavier gauge cable that is capable of supporting ADSL services as far 8.6 kilometres for 0.9mm cable. However, as the analysis was conducted at a DA level, there is only a small proportion of DAs where density is larger than 5 kilometres and as such there is minimal effect on the results from adopting the 5 kilometre cut-off.

## Estimating telephone line length

Line length is a critical variable affecting ADSL performance across a DA. Data on geographic routing of telephone lines are not available, so an equivalent is required. As telephone lines are generally routed via streets from the telephone exchange to premises, an estimate of the cable length can be determined from the shortest street distance between these two points. However, telephone lines are frequently routed via a street cabinet which may contain the equipment necessary to deliver ADSL services, such that the street distance from the cabinet rather than the exchange to the premises is more critical. To automate the process of determining this distance (red dashed line) for each premises in a DA, the department modified its own purpose-built spatial tool (Streetcrawl), to account for the location of street cabinets which was provided for this analysis by Telstra.



Schematic diagram of the different architectures in the copper network, adapted from Access Network Dimensioning Rules Long run incremental costing model input, Telstra Corporation 2008.

It is noted that a factor of 10 per cent has also been added to this to account for the coils of excess cable that are typically stored in communication pits, to provide additional cable to facilitate local fault repairs. Data on the location of premises within each DA was sourced from the Geocoded National Address File (GNAF), while data on Telstra exchange service areas and Distribution Areas has come from the Pitney Bowes ExchangeInfo database, and used under license.

## **Technological impediments**

In addition to the progressive effect of cable distance, ADSL service delivery can also be inhibited due to the presence of a class of technology originally designed to maximise the extent voice services could be delivered without the need to deploy additional cabling from an existing exchange. Pair gain systems enable the delivery of more voice services than the number of individual cables available, and so provide a more cost effective way of expanding the network. However, in many cases these technology choices have not been compatible with ADSL service delivery and require additional remediation work to resolve.

There are a number of different systems used in Telstra's copper network, collectively referred to as pair gain systems, and often denoted as small, medium or large systems depending on the number of services that can be supported.

## Remote Integrated Multiplexers (RIMS)

RIMS are a type of large pair gain system capable of supporting a range of services with each RIM cabinet accommodating up to eight individual modules, each supporting 30 voice services. DSL services may also be provided where a 'minimux' has been deployed, which typically support the provision of 90 ADSL services.

Additionally, Telstra's 'Top-hat' project has resulted in the deployment of extension enclosures on the top of existing RIM cabinets to provide for the delivery of DSL services to approximately 220,000 premises.

## Remote Customer Multiplexer (RCM) & Digital Concentrator System (DCS-20)

RCM units provide 30 potential voice ports, with 4-5 being modules typically deployed into each RCM cabinet. DCS-20s also provide 30 ports per module and are typically installed in remote exchange buildings, where they may provide several hundred voice ports. Both of these structures within the copper network are not capable of support DSL services.

### Customer Multiplexer (CMUX)

A CMUX is a relatively new type of pair gain system. More complex than a RIM, it can handle various services such as voice, ISDN and ADSL services, and the various mix of services enabled depends on the local service requirements. For example, where existing voice services are provided via a RIM cabinet, a CMUX could be installed for the sole purpose of supporting the provision of ADSL services.

### Small/Medium Pair Gain Systems

Medium Pair Gain Systems, capable of supporting 10-30 voice services, but are not able to support the supply of ADSL services. The copper network also contains small pair gain systems (supporting between two and 10 voice services only), which must be removed before DSL services can be supplied over copper lines. In total, Telstra has advised there remain relatively few small and medium pair gain lines distributed throughout the copper network, constraining access to less than 1 per cent of the total services in operation.

## **Transposition**

Large pair gain systems were deployed to maximise the number of voice services that could be delivered over a limited number of cables originating at the local telephone exchange. Typically more cables were deployed than are needed to support the large pair gain system, and under a process known as 'transpositioning' this allowed the customer connection to be re-allocated to a copper cable that connects directly to the exchange and an ADSL service to be supplied.

This possibility has also been accommodated in the model based on an estimate provided by Telstra of the proportion of transposition requests that were successful when this process commenced a number of years ago. In effect, this increases the availability of ADSL services by approximately 30 per cent.

#### Port availability and capped exchange

ADSL services may be unavailable to some premises due to a shortage of available capacity (ports) at the local exchange. Although additional capacity could be deployed to provide for additional ADSL services in most cases, in a number of instances there is no free space within the exchange and the exchange is considered to be 'capped'.

Not all premises served by capped exchanges or those with limited ports are unable to access ADSL services. Rather, due to these conditions, a proportion may be unable to access a service. It should be noted that port constraints are dynamic and change as customers make alterations to their service orders. For the purposes of this analysis, DAs in ESAs where there were fewer ports than would be required to support an increase in demand of 2 per cent<sup>6</sup> of the number of services in operation as at June 2013, were considered to have limited ports available.

<sup>&</sup>lt;sup>6</sup> Based on the Australian Bureau of Statistics Internet Activity Survey 2013, and the number of services in operation in each exchange service area as at 30 June 2013.



## Appendix F – Data inputs to the analytical model

Broadband Availability and Quality Data Inputs	Current as at	
Geocoded National Address File (G-NAF) – location of premises	September 2013	
ExchangeInfo data set – Exchange Service Area and Distribution Area boundaries, and large pair gain types (where present)	September 2013	
Spatial representation of FTTP networks		
iiNet FTTP	October 2013	
Telstra FTTP	October 2013	
NBN Brownfields and Greenfields	December 2013	
OPENetworks	October 2013	
Pivit	October 2013	
Opticomm FTTP	October 2013	
ClubLinks	October 2013	
Places Victoria	October 2013	
Sanctuary Cove	October 2013	
Spatial representation of HFC networks		
Optus HFC	October 2013	
Opticomm HFC	October 2013	
Telstra HFC	October 2013	
iiNet HFC	October 2013	
Spatial representation of FTTN network		
iiNet FTTN	October 2013	
Spatial representation of NBN Co's fixed wireless network		
NBN Co Fixed Wireless	December 2013	
Spatial representation of mobile broadband networks		
Telstra	September 2013	
Optus	October 2013	
Vodafone	October 2013	
Digital Subscriber Line Access Multiplexer (DSLAM) deployment in		
exchange and Customer Access Network (CAN) sites	1	
Record Reeping Rule reports for Telstra and linet (Infrastructure elements,	June 2013	
and Services in Operation (SIOS)) – includes spatial location of cabinets and		
ADGL immediates to evolve and CAN sites		
ADSL Impediments in exchange and CAN sites	Ostakar 2012	
Available ADSL Capacity – Exchanges: Teistra Wholesale website	October 2013	
Available ADSL Capacity – CAN: Teistra Wholesale website	Uctober 2013	
Access Broadband Minimux Report: Teistra Wholesale Website	July 2013	
ADSL Enabled ESAs: Teistra wholesale website	October 2013	
The number of current SIOs affected by unresolved small and medium pair	October 2013	
gains systems by Exchange Service Area from Telstra.		
Exchange capped list -	0.4.4.4.2012	
Fixed facilities access capped sites: Telstra wholesale website	Uctober 2013	
ADSL download sync speeds and the associated cable loss for SIOs from	May 2011	
Ditpov Rowes Street Pro street data (2012)	October 2012	
riting bowes streetrio street data (2013)	OCIUDEI 2013	

## Appendix G – Broadband glossary

ADSL/ADSL2+	Asymmetric Digital Subscriber Line technology provides internet access over copper cables. ADSL2+ can achieve download data rates of up to 24 Mbps while ADSL is up to 8 Mbps and generally have limited upload speeds of around 1 Mbps. Upload and download speeds decline as the length of the copper line increases.
Broadband	'Always on' internet connections.
Copper network	The Telstra copper telecommunications network which connects 99 per cent of Australian homes and businesses to the telecommunications network via a local exchange. Traditional telephone and ADSL services use the copper network.
Customer Access Network	The 'last mile' of a telecommunications network which connects homes and businesses to that network.
Distribution Area (DA)	A network component of a Telstra Exchange Service Area that typically comprises between 100-200 premises. DAs vary in geographical coverage, generally increasing in size as population or premises density decreases.
Data rate	Also known as bandwidth. It is the amount of data transferred over a connection per second, measured in bits per second (bps). It is often described as upload or download speed.
DSLAM	A Digital Subscriber Line Access Multiplexer is network equipment located in telephone exchanges that provides ADSL broadband services.
Exchange	A building which houses the equipment required to deliver telephone and broadband services to premises in a Telstra Exchange Service Area. There are approximately 5,000 Telstra exchanges across Australia.
Exchange Service Area (ESA)	Geographic area covered by a Telstra telephone exchange. Some ESAs contain more than one exchange.
Fibre	Fibre optic cable, a tube containing tiny strands of glass that transmit data in the form of light. Fibre enables data transmission at higher rates than copper.
Fibre to the Node (FTTN)	A network where fibre extends beyond the exchange to street cabinets (nodes) which are closer to end users. Copper lines then carry signals from the node to the premises.
Fibre to the Premises (FTTP)	A network where fibre is deployed from the exchange to individual premises. It is also called Fibre to the Home (FTTH).
Fixed Wireless	A high speed wireless network capable of supporting speeds of up to 25 Mbps downstream and 5 Mbps upstream, similar to good quality ADSL2+. The equipment used to access the network is 'fixed' to the customer's

