Assessment 1: Broadband analytical study

MA5840 – Data Science and Strategic Decision Making for Business

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Section A – A Comparative Summary of Sampling Methods, Technologies and Performance Metrics

The United Kingdom's (UK) Office of Communications (Ofcom) has been measuring performance of their broadband network since 2008 and publishing the results in an annual report. By comparison, the Measuring Broadband Australia program has only been running since 2017-18, although reports are published on a quarterly basis by the Australian Competition and Consumer Commission (ACCC). An organisation called SamKnows has been used in both countries to collect the data.

The following analysis presents a comparative summary of the sampling methods, technologies included and performance metrics used in the two countries. It has been based on the ACCC's May 2020 report and OfCom's April 2017 report.

Both broadband performance monitoring programs relied on a panel-based arrangement in which residents using a fixed-line broadband service elected to receive a measuring device (a Whitebox) that connected to the router. Tests were run multiple times a day in order to capture performance data during peak and off-peak times (7 to 11pm in Australia and 8 to 10pm in the UK).

The total sample size used for the UK report was 4,824 compared to 1,270 for the Australian report. In both reports, results were generally only published if a pre-specified minimum sample size was met when the data was sliced by dimensions such as Retail Service Provider (RSP) or retail plan. For example, the minimum sample size required in Australia was 40 (ACCC, 2020c) and 50 in the UK (although anything less than 75 was to be treated with caution (Ofcom, 2017).

In both cases, the sample was selected in order to align with research requirements, which included being representative of the range of broadband RSPs available to consumers at the time (ACCC, 2019). However, the UK sample was also selected in such a way that it was also geographically representative of the broadband market, which included leasing 1,505 SamKnows panellists (Ofcom, 2017).

Finally, both reports were based on data collected over the course of an entire month. In Australia it was February 2020 and in the UK it was November 2016.

Prior to continuing on to compare the technologies and performance metrics, it should be noted that the style of the two reports are very different. In particular, the UK report contained a lot of detail about the technical and research methodology used, which was missing from the Australian report. For example, how results were weighted to ensure they were representative of the overall UK broadband population,

specific details about pre-screening of panellists and in what capacity they were used in the analysis and details about the quotas for each RSP plan.

As previously observed, both reports on broadband performance were only interested in fixed-line broadband services. The report on Australian broadband performance specifically stated that the results did not include the performance of fixed wireless or satellite services.

Both the UK and Australian reports measured the performance of the three main types of fixed-line broadband available to residents: ADSL or Asymmetric Digital Subscriber Line, HFC or Hybrid Fibre-Coaxial (also known as cable broadband) and optical fibre or fibre (ACCC, 2020c; Ofcom, 2016; Origin Energy, 2019). Each of these are described in more detail in the following paragraphs.

ADSL refers to standard broadband delivered over a copper telephone. Average speed depends on the distance of the home from the telephone exchange but in both countries typically ranges from 8 megabits per second (Mbps) for ADSL1 to about 24 Mbps for ADSL2+. Both types of ADSL technology are available in the UK and Australia, and were part of both reports, although in the UK any panellist with a plan less than or equal to 2 Mbps was excluded due to the low market share of that technology (Ofcom, 2017).

Cable broadband refers to broadband services delivered through hybrid fibre-coaxial cables and is not affected by distance. Cable broadband has a maximum speed of about 100 Mbps in Australia (Origin Energy, 2019), and up to 200 Mbps in the UK (Ofcom, 2016).

Fibre broadband refers to broadband services delivered via clusters of fibre optic cables. In Australia, there are four types of fibre broadband services available – fibre-to-the-curb (FTTC), fibre-to-the-node (FTTN), fibre-to-the-premises (FTTP) and fibre-to-the-building (FTTB) (NBN Co, n.d.). However, only the first three were included in the May 2020 report. UK residents only have access to fibre-to-the-cabinet[1] and FTTP services, but the Ofcom stated that there were insufficient panellists to enable inclusion of FTTP data in the April 2017 report. Speeds range up to 100 Mbps in Australia and up to 1,000 Mbps in the UK for FTTP broadband, although more typical speeds for FTTN broadband are between 38 Mbps and 76 Mbps.

SamKnows used eight main types of metrics to measure the performance of the Australian broadband network in the May 2020 report. These were:

- upload and download speed tests, which were sliced by time of day, RSP, plan or speed tier, state/territory and benchmarked against advertised RSP speeds
- video streaming tests to determine if NBN50 plans could support high definition YouTube or Netflix streams, sliced by RSP and time of day, and
- four technical quality measures

[1] Australian FTTN technology is approximately equivalent to UK fibre-to-the-cabinet technology so both types will be henceforth referred to as FTTN unless otherwise indicated.

- latency and webpage loading times by RSP and time of day
- packet loss frequency
- the frequency of daily outages lasting longer than 30 second by RSP

The report also included the impact of underperforming or impaired services on broadband performance against most of the above metrics, and sliced by dimensions such as technology/plan, RSP and time of day.

Given that SamKnows was used to collect broadband performance data for both markets, the metrics published in the UK April 2017 report were very similar, albeit somewhat more detailed. For example, there were significant sections of the UK report devoted to comparing broadband performance between different geographical locations or rural and urban areas.

Furthermore, the video streaming performance metrics were slightly different. In the UK report, the focus was solely on Netflix and looked at the proportion of streams that were delivered in standard definition, high definition and ultra-high definition (4K) by time of day and technology. The YouTube metric was excluded as not all YouTube streams were available in 4K, which meant it was not deemed as informative (Ofcom, 2017).

Finally, the UK report included several technical quality metrics missing from the Australian report. These included plan contention, domain service name (DNS) resolution times, DNS failure rates and jitter lengths.

Section B – A Strategic Question and Analytical Response

The author considered that the current Minister for Communications, Cyber Safety and the Arts would be interested in the relative performance of different broadband technologies used in Australia and the UK. As such, the analytical response provided below corresponds to the strategic question: Which technologies should be targeted to produce the biggest improvement in the performance of the Australian fixed-line broadband network over the next sixth months? The content of the response was based on the data underlying the ACCC's May 2020 and Ofcom's April 2017 reports.

The rollout of Australia's National Broadband Network (NBN) commenced in 2009 with the intention of improving the available of broadband services to consumers. However, by 2013 the ACCC had become aware that RSPs were possibly mis-representing the performance of their products, particularly as such information was not freely available for fixed-line broadband products (ACCC, 2013a).

As a result, the ACCC started considering a broadband performance monitoring program similar to one that has been operating in the UK since at least 2008. It is interesting to note that during initial stakeholder consultation, some entities questioned the need for such a program and the extent to which consumers would find the information useful (ACCC, 2013b).

Both monitoring programs focus on fixed-line broadband services, which collect data using monitoring units attached to participating households' routers. Whilst the scope of this report has been limited to the effect of broadband technology type performance, other factors assessed by the ACCC and Ofcom included location (UK only), RSP and plan.

In February 2020, overall and peak period download speeds were lowest for FTTN connections. On average, they were only able to achieve 82.0 per cent of the maximum plan speed, compared to over 90.0 per cent for other NBN technology types (see figure 1). The average upload speed performance of FTTN connections relative to the other types was similar.

Figure 1 Overall download and upload speeds by NBN technology

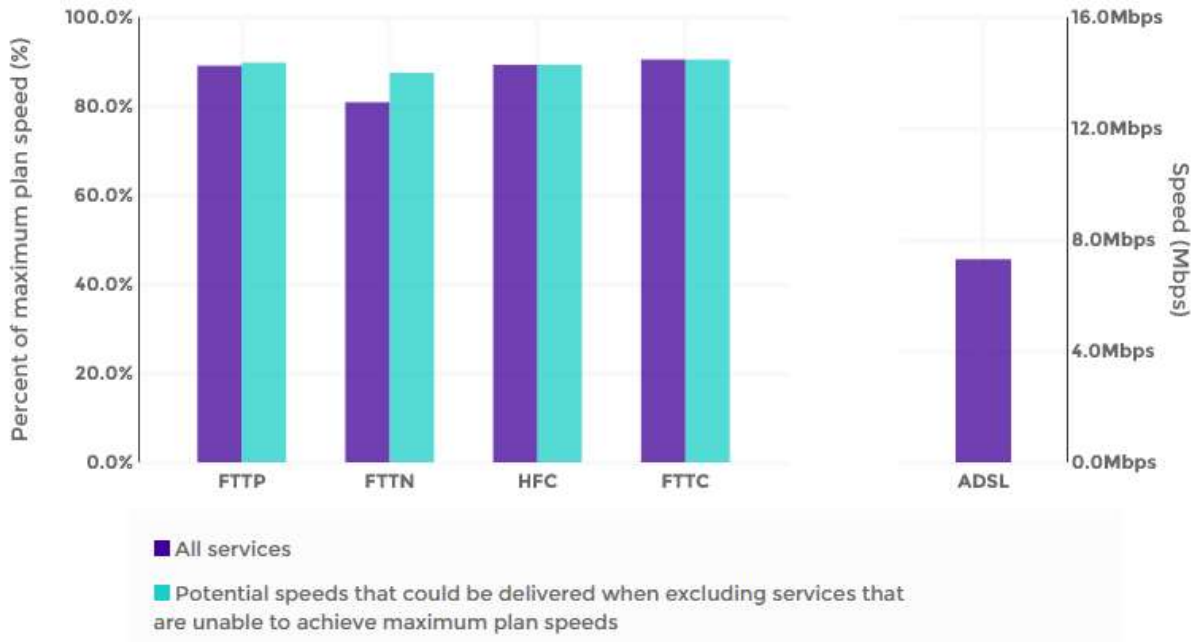
Technology	Download Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval	Sample Size
Fibre to the premises - FTTP	90.8%	7.4%	90.1% - 91.5%	393
Fibre to the curb - FTTC	91.4%	5.5%	90.2% - 92.7%	72
Fibre to the node - FTTN	82.0%	16.1%	80.7% - 83.3%	594
Hybrid fibre-coaxial - HFC	90.8%	5.4%	90.0% - 91.5%	203

Technology	Upload Average % of Maximum Plan Speed (all hours)	Standard Deviation	95% Confidence Interval	Sample Size
Fibre to the premises - FTTP	92.2%	8.4%	91.4% - 93.0%	392
Fibre to the curb - FTTC	92.7%	6.1%	91.3% - 94.1%	72
Fibre to the node - FTTN	77.9%	23.3%	76.0% - 79.8%	594
Hybrid fibre-coaxial - HFC	90.7%	6.3%	89.9% - 91.6%	203

Note. Source: (ACCC, 2020c, p. 15)

Furthermore, when the ACCC considered those services supplied to consumers that were unable to achieve maximum speed due to physical infrastructure limitations, they observed that 95.9 per cent of them were using FTTN technology. If all these underperforming services were excluded, then average download speed increased by 3.5 percentage points to 90.2 per cent (see figure 2).

Figure 2 Download speeds including and excluding underperforming services by technology

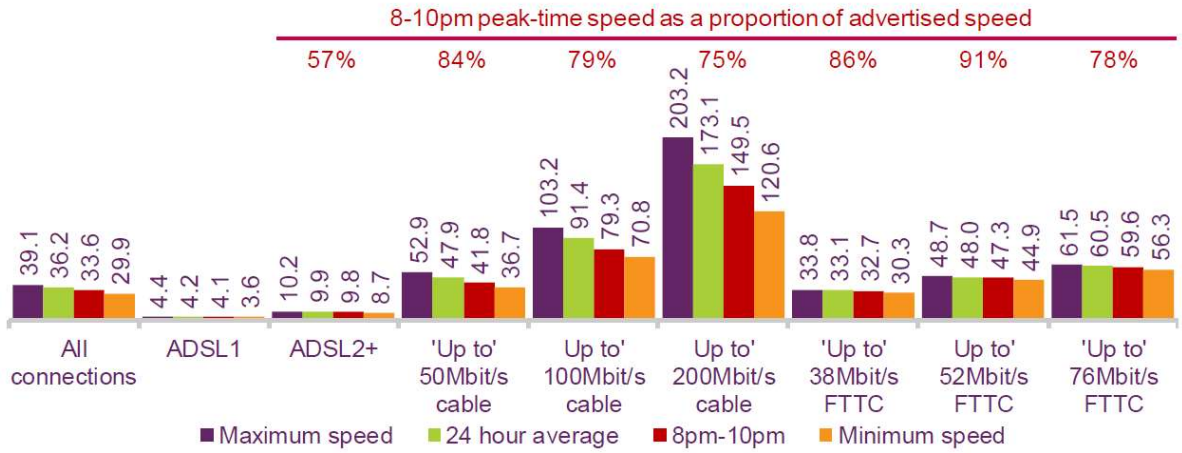


Note. Source: (ACCC, 2020a)

In comparison, whilst UK residents on cable connections had the best overall download speeds (as a percentage of maximum possible speed), they also

experienced the greatest loss in performance during periods of peak usage (12.0-percentage points). FTTN and ADSL connections both had negligible loss in performance on average during peak times (less than 1.5 percentage points; see figure 3). Ofcom (2017) attributed the large performance drop for cable broadband to network topology, which meant that this technology was more susceptible to contention[2] at peak times.

Figure 3 Overall and peak time download speeds by technology



Note. Source: (Ofcom, 2017, p. 12)

Data on the frequency and length of network outages by technology type also featured in both reports, and indicated that in Australia HFC and FTTN technologies were most problematic. HFC technology had the largest number of average daily outages lasting longer than 30 seconds, and most (61.8 per cent) were between one and 10 minutes long. In contrast, 36.8 per cent of FTTN outages were between three and 10 minutes long (see figure 4).

Figure 4 Proportion of outages by length and NBN technology

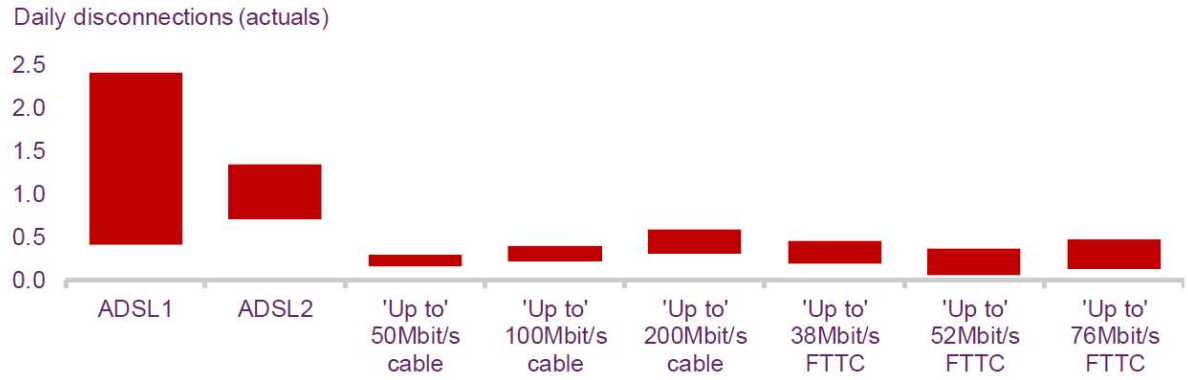
Technology	Percentage of Outages Lasting 30-60sec	Percentage of Outages Lasting 1-3min	Percentage of Outages Lasting 3-10min	Percentage of Outages Lasting 10min or more
Fibre to the premises - FTTP	56.1%	30.3%	5.8%	7.7%
Fibre to the curb - FTTC	56.7%	29.5%	8.3%	5.6%
Fibre to the node - FTTN	26.5%	26.8%	36.8%	10.0%
Hybrid fibre-coaxial - HFC	28.2%	30.2%	31.6%	9.9%

Note. Source: (ACCC, 2020c, p. 15)

[2] A slowdown in performance due to insufficient network bandwidth for multiple users.

The equivalent metric in the UK data was average daily disconnections. Ofcom concluded that although disconnections lasting longer than 30 seconds were rare across all types of technology, they averaged 0.3 for FTTN and cable services compared to 1.1 for ADSL (see figure 5). This was similar to the Australian results.

Figure 5 Average daily disconnections (30 seconds or lower) by technology



Note. Source: (Ofcom, 2017, p. 20)

Finally, whilst video streaming was a new metric in the Australian data (ACCC, 2020c) and only compared relative performance of NBN50 plans by RSP, Ofcom concluded that there was little discernible difference in the capability of cable and FTTN technologies in terms of being able to stream a single Netflix video in at least high-definition quality (Ofcom, 2017). ADSL services were able to stream high-definition video at least 67 per cent of the time, with ADSL1 unable to stream 4K-quality videos at any time (see figure 6).

Figure 6 Overall and peak time proportion of Netflix videos reliably delivered at the given video quality by technology

Note. Source: (Ofcom, 2017, p. 19)

Whilst thus far Australian and the UK have had a similar broadband technology mix available to residents, one of the consequences of the NBN rollout has been the gradual disconnection of ADSL services with a limited number of alternatives (if any)

available to Australian consumers. However, even in the UK, the proportion of residents on ADSL connections is relatively low (about 5 per cent in 2016) (Ofcom, 2017) and the data clearly indicated that ADSL in general performed worse on a number of different metrics than other fixed-line technologies.

Furthermore, the performance data clearly indicated that in Australia, future efforts should to improve the performance of the broadband network should focus on the FTTN technology as it exhibited the greatest average drop in download speeds during times of peak usage, had a greater proportion of outages lasting for longer periods of time, and had the greatest number of underperforming services. Finally, Ofcom recently observed consumers dissatisfied with their service often received better performance by switching broadband technologies or plan tiers rather than switching RSPs (Ofcom, 2020).

Section C – A Strategic Executive Summary for the Minister

The ACCC implemented a broadband monitoring program in 2017 to provide Australian residents with accurate, independent and comparable information about fixed-line broadband speeds and other performance metrics (ACCC, n.d.). The program was implemented in response to the continuing rollout of the NBN by NBN Co and the associated expected increased demand for high quality, high speed internet connections by consumers, and the presence of potentially misleading marketing claims about the performance of fixed-line and mobile products by RSPs (ACCC, 2013a).

During the initial research and design stage, the ACCC considered monitoring programs that had already been implemented by counterpart regulators in the UK, United States, Singapore and New Zealand (ACCC, 2013a). Given the similarities between the UK and Australian networks, it (the UK broadband network) was used to benchmark the current performance of the NBN. It also helped provide some insight as to where future investment by the Australian government might result in the best value-for-money and the largest benefit for the consumer.

As of March 2020, Telstra held the largest market share (48 per cent) of NBN services in operation (SIO) as a wholesale customer of NBN Co, followed by TPG (22.0 per cent) and Optus (15.3 per cent) (ACCC, 2020d).With respect to access technology types, in June 2019 52.0 per cent of all broadband SIOs were mobile broadband connections, 30.5 per cent were with the NBN and the remaining 17.5 per cent were retail non-NBN connections (of which around two thirds were DSL) (ACCC, 2020b).

The first section provided a comparative analysis of the sampling methods, included broadband technologies, and performance metrics from the November 2016 and February 2020 versions of the UK and Australian programs respectively. The main conclusion from this analysis was that program design was very similar, with some allowances made for differences in the two countries' broadband networks.

The second section considered the impact the type of broadband connection a consumer was using to connect their household to the internet had on broadband performance over three metrics common to both networks (download and upload speeds, and the frequency and length of network outages). The magnitude of the effect of underperforming or impaired services on the Australian network, and video streaming capability in the UK were also assessed. The main conclusion was that FTTN connections were the most problematic technology for Australian consumers, whereas in the UK it was cable or HFC technology.

As a result of the research, the following recommendations regarding Australia's broadband network and performance monitoring program have been made:

Future Investment Focus

1. The Australian government should work with the ACCC and NBN Co to remediate underperforming and impaired FTTN services to obtain a short-to-medium-term improvement in the performance of the broadband network.
2. In the long-term, the Australian government should work with NBN Co to convert all FTTN connections to FTTC or FTTP given that longer sections of copper wire often lead to reduced internet performance for consumers.
3. The Australian government should work with NBN Co to improve broadband technology infrastructure so Australian consumers are able to access products with similar headline speeds to those in the UK.

Performance Reporting

1. The ACCC should consider providing a more detailed breakdown of broadband performance by geographical region in Australia in order to assist consumers living in rural areas benchmark their internet performance.
2. The ACCC should consider expanding the program to include fixed wireless and satellite technologies, which are most common in rural and remote areas.
3. The ACCC should consider including data on consumer uptake of different technology types.
4. The ACCC should consider changing its video streaming metric to a comparison of the capability across the different types of technologies available similar to what has been done for the UK program.

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