

Measuring Broadband Australia Program



Report 20, April 2023

The Measuring Broadband Australia program provides information on the real-world performance of broadband plans. The program aims to better understand how Australians are experiencing internet performance in their homes, provide Australian consumers with accurate and independent information about broadband performance to assist their purchasing decisions, and encourage greater performance-based competition and better internet performance.

These reports are prepared quarterly by SamKnows, an independent testing provider appointed by the Australian Competition and Consumer Commission (ACCC). The metrics are also presented in a public dashboard¹. Report 20 is based on data measurements taken from 1 to 31 December 2022.

The program relies on volunteers who host a testing device called a Whitebox on their broadband connection. The Whiteboxes, which are supplied by SamKnows, perform tests to measure internet performance using test servers maintained by SamKnows and hosted in Australia. More information about the program is available on the ACCC's website².

Underlying data for this report can be found at www.data.gov.au

¹ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

² <https://www.accc.gov.au/consumers/telecommunications-and-internet/broadband-speeds>

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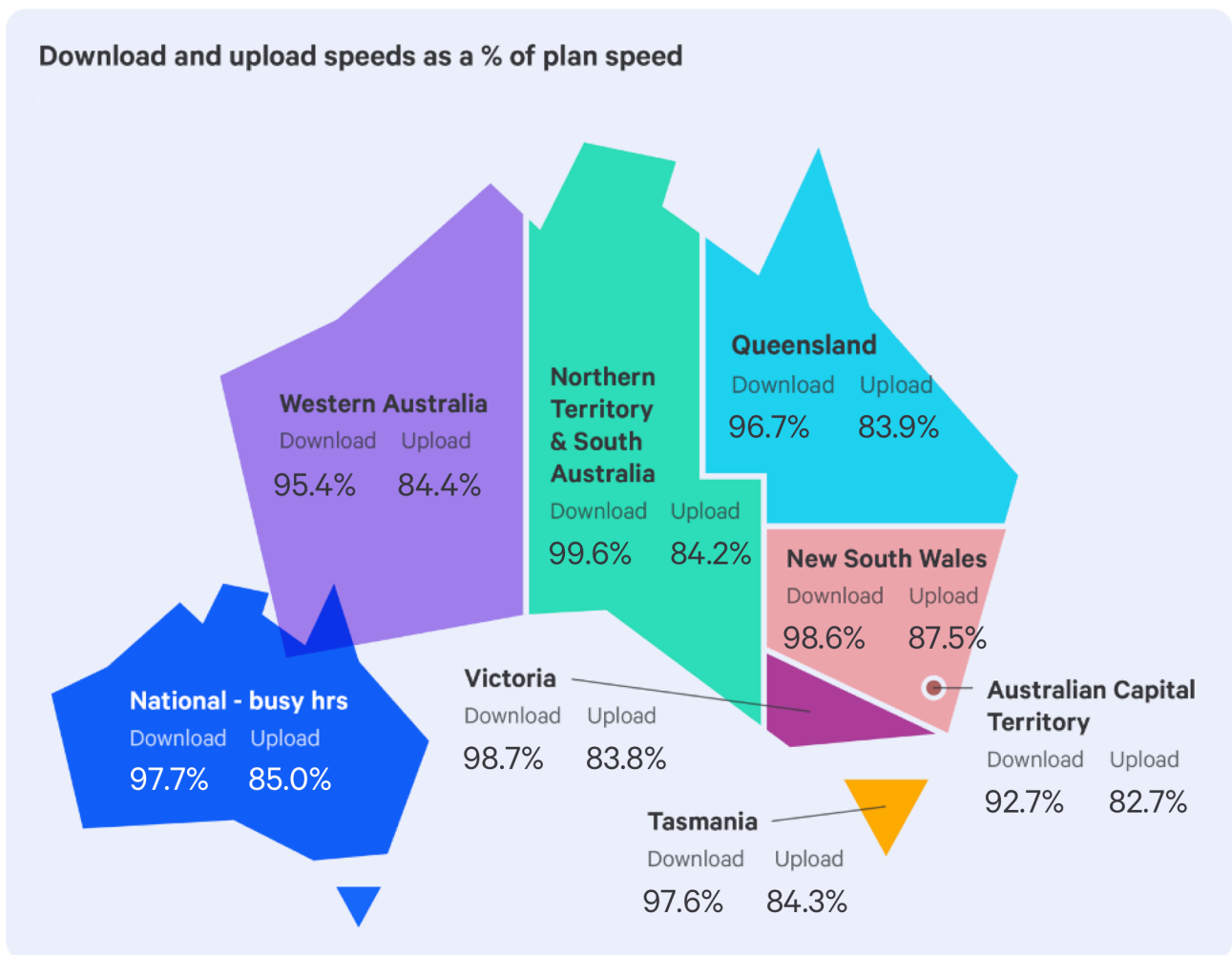
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Key results - December 2022

Performance during busy evening hours by state and territory

Average NBN fixed-line performance during busy hours (7-11 pm, Monday to Friday) by state/territory. Including underperforming and impaired services, excluding very high speed services.

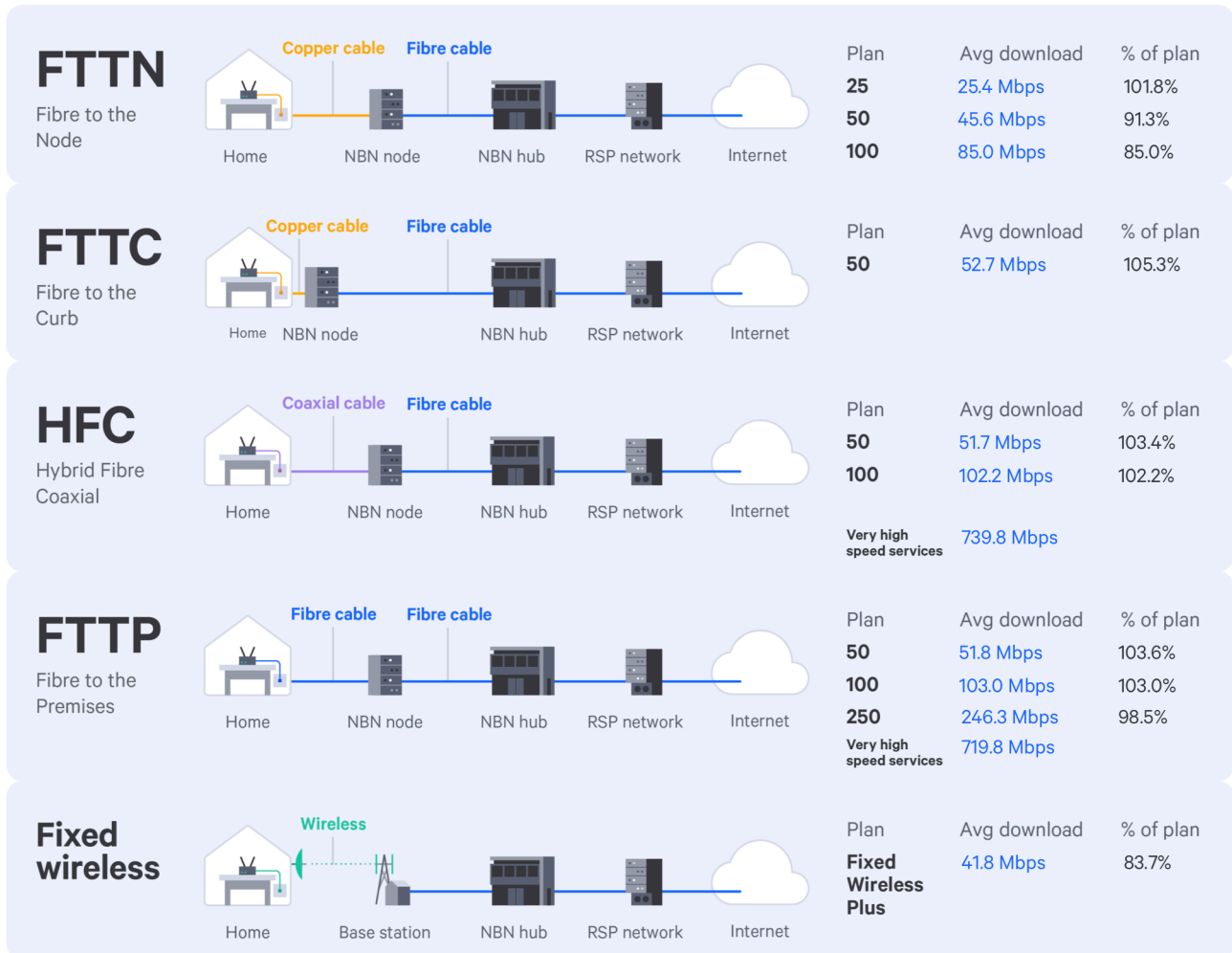
The speeds ranged from 92.7%-99.6% of plan speed for download and 82.7%-87.5% for upload.



NBN access technology

Download speeds during busy hours (7-11 pm, Monday to Friday), December 2022.
Including underperforming and impaired services.

Results are presented only for speed tiers and technologies having a sufficient panel size.



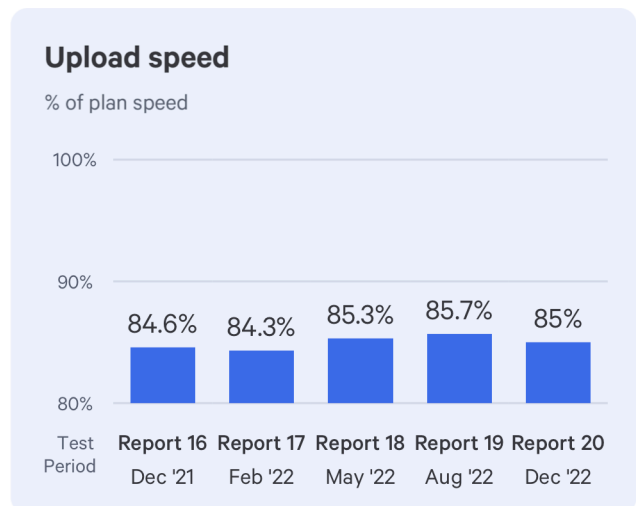
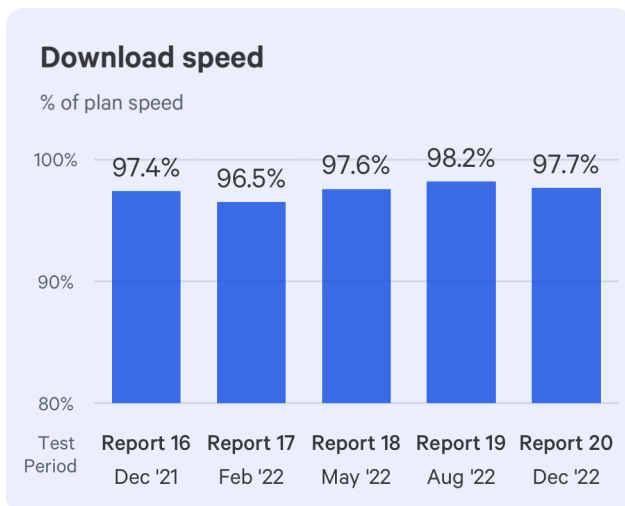
Quality of experience

Streaming high definition (HD) and ultra-high definition (UHD) video during busy hours (7-11 pm, Monday to Friday), December 2022. Including underperforming and impaired services.

NBN plan speed	% that can reliably stream HD & UHD videos from Netflix									
25	HD	HD	HD	HD	HD	HD	HD	HD	7+	Concurrent HD video streams
	100.0%	100.0%	98.8%	98.8%	98.8%	98.8%	97.5%	95.1%		
50	UHD	UHD	UHD	UHD	UHD	UHD	UHD	UHD	1-2	Concurrent UHD video streams
	98.8%	79.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
100	HD	HD	HD	HD	HD	HD	HD	HD	7+	Concurrent HD video streams
	100.0%	100.0%	100.0%	100.0%	99.3%	97.3%	96.4%	96.2%		
250	UHD	UHD	UHD	UHD	UHD	UHD	UHD	UHD	3-4	Concurrent UHD video streams
	97.8%	94.0%	83.6%	62.1%	0.0%	0.0%	0.0%	0.0%		
Fixed Wireless Plus	UHD	UHD	UHD	UHD	UHD	UHD	UHD	UHD	6-7	Concurrent UHD video streams
	99.8%	94.6%	91.7%	90.4%	87.3%	80.9%	69.9%	48.0%		
Fixed Wireless Plus	UHD	UHD	UHD	UHD	UHD	UHD	UHD	UHD	7+	Concurrent UHD video streams
	97.1%	97.1%	95.7%	94.3%	92.9%	92.9%	92.9%	91.4%		
Fixed Wireless Plus	UHD	UHD	UHD	UHD	UHD	UHD	UHD	UHD	1-2	Concurrent UHD video streams
	91.4%	60.0%	31.4%	10.0%	1.4%	1.4%	0.0%	0.0%		

Long-term trends

NBN fixed-line services, during busy hours, including underperforming and impaired services.



Overview

Testing period

This report is based on measurements collected from 1 to 31 December 2022.

Access networks

This report includes results for NBN fixed-line services (fixed-line plans up to 500 Mbps download), Other superfast access networks (fixed-line plans up to 500 Mbps download), NBN very high speed services and NBN fixed wireless services as regular items.

Online gaming included for the first time

This report includes online gaming test results for 16 popular online games. This is the first Measuring Broadband Australia report to present data on the online gaming experience. Game server latency results are heavily dependent on the location of the closest server. Results for games testing to servers in Australia were significantly lower (better) than for games testing to servers hosted in Asia and North America.

Volunteers using speed constrained in-home equipment

As with previous reports, this report includes all services and plans that may be affected by a 100 Mbps link within the volunteers' homes. A common cause of this is customer premises equipment³ (CPE) or other network devices that have Ethernet ports with a physical limit of 100 Mbps. Other potential causes are damaged Ethernet cables, intermediate devices that only support 100 Mbps (such as old switches and hubs) and configuration of network equipment within the home. Consumers affected by this issue are unable to receive the full benefit of plans with download speeds above 100 Mbps. The ACCC encourages retail service providers (RSPs) to reach out to their customers who may be using a constrained network device.

For further information on broadband speed issues, see the ACCC's website⁴.

Further metrics available on ACCC website

³ Network equipment provided by an RSP (generally including a home router/gateway).

⁴ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-speeds

Further metrics beyond those included in this report are available on the ACCC's broadband performance data dashboard⁵.

⁵ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

Important terms

Term	Definition	Significance
Advertised speed	The speed claim made by a retail service provider (RSP) for a given plan during a Measuring Broadband Australia reporting period. May be the same as or lower than the plan speed.	This report presents download speed results against RSPs' advertised speed claims for NBN50 and NBN100 plans. This metric shows consumers whether, and how often, units on our panel achieved the speed advertised by their RSP.
All hours	Data labelled "all hours" includes tests conducted at any time of the day.	
Busy hours	Data labelled "busy hours" includes only tests conducted between 19:00:00 and 22:59:59, Monday to Friday.	Networks experience higher user activity during busy hours. As a result, network performance can deteriorate compared to other times of the day.
Busiest hour	The fifth-lowest hourly average download speed across each busy hour by RSP during the monitoring period. For this calculation, busy hours include tests conducted between 19:00:00 and 22:59:59, Monday to Sunday.	The busiest hour indicates the performance of each RSP when its network is under the highest levels of demand. When the busiest hour speeds are significantly lower than the average busy hour speeds, then the service may be more affected by particularly high demand peaks.
Confidence intervals	Indicates how certain we are that the true average download speed lies between the upper and lower boundary indicated by the thin black lines. For example, if an RSP had an average download performance of 99.3% with a 95% confidence interval of $\pm 2.2\%$, this means that if we were to repeat our sampling 100 times, we would expect the average performance to fall between 97.1% and 101.5% in at least 95 cases.	Narrower confidence intervals indicate a more stable estimate than larger ones.
Download and upload speed	Download speed is the speed at which data can be transferred from the SamKnows test server to the consumer's computer, measured in megabits per second (Mbps). Upload speed is the speed at which information is transferred from the consumer's computer to the SamKnows test server, measured in Mbps.	The download and upload speeds associated with each retail plan are used by consumers to select a plan. Upload speed is especially relevant for applications where a user sends significant amounts of data to the internet, for example uploading files to cloud storage or running multiple simultaneous video conferencing sessions.
Download and upload performance	Measured download or upload speed expressed as a percentage of plan speed. e.g. for an NBN50 service, 100% download performance would be 50 Mbps.	This metric expresses how well a unit performs compared to the plan speed. Expressing results as a percentage of plan speed also allows results across different plan speeds to be aggregated. Prior to NBN Co overprovisioning the downlink, both the download and upload speeds were capped at 100% for the fixed-line plans. Since NBN Co began overprovisioning the downlink for fixed-line services, download results above 100% are common.

Term	Definition	Significance
Impaired services	Fibre to the node services where the maximum attainable download speed measured by NBN Co is below the plan download speed.	<p>Consumers on an impaired service are unable to achieve the full download speed of their plan (see "underperforming services"). These services require rectification of technical issues to improve performance. If this is not possible, it may be advisable for the consumer to move to a lower speed plan that is achievable.</p> <p>This report presents results both including and excluding impaired and underperforming services. This information allows consumers to better understand the reported download and upload speed measures by removing the effect of services which, due to physical limitations, would be better assigned to another plan. At the same time, this comparison provides stronger incentives for service providers to improve service quality for customers on impaired and underperforming services.</p>
Latency	The average time required to send a packet of data to the SamKnows test server and back to the consumer's computer, measured in milliseconds (ms).	The lower the latency, the better. Lower latency results in faster responses, providing a more reliable experience when using real-time applications such as video conferencing and online gaming. High latency may result in a lag or delay when using real-time applications.
NBN fixed-line	<p>Monitored connections on NBN Co's fixed-line footprint that utilise a physical line to connect the household to the NBN. There are a number of fixed-line technologies: fibre to the premises (FTTP), fibre to the curb (FTTC), fibre to the node (FTTN), fibre to the building (FTTB) and hybrid fibre-coaxial (HFC) access technologies.</p> <p>In this report, the NBN fixed-line section includes results for major NBN plans up to 500 Mbps download speed. It excludes results from very high speed services, which are presented separately. FTTN and FTTB access technologies are treated as identical.</p>	
NBN fixed wireless	Monitored connections on NBN Co's fixed wireless footprint. These services transmit data over radio signals to connect a household to the NBN using technology similar to mobile networks. Data travels from a transmission tower to an outdoor antenna fitted at the household.	Fixed wireless allows households to be connected to the internet without having to establish a physical, wired connection. This type of service is more prevalent in regional and remote areas, but consumers in outer metropolitan centres may also use this service.
NBN very high speed services	Services on the NBN Ultrafast plan, which has a download/upload speed range of 500-990/50 Mbps.	

Term	Definition	Significance
Other superfast access networks	Refers to households served by fixed-line networks other than NBN, for example, Uniti Group's LBNC0 and OptiComm fixed-line networks.	
Outages	This metric tracks how many times per day a broadband connection goes offline for at least 30 seconds. Outages between 12 am and 5 am are excluded, as this is when network maintenance typically occurs.	Outages can impact user experience, subject to their frequency and duration.
Overprovisioning	Refers to NBN Co providing higher data rates than the plan speed.	The purpose of overprovisioning is to accommodate protocol overhead. The protocol overhead contains address and other information required to enable data transfer to/from the end user and the internet. Overprovisioning compensates for the bandwidth taken up by protocol overhead, as it enables consumers to experience speeds closer to the maximum of their plan. Currently, NBN Co overprovisions certain plans on the downlink only. Hence download speeds may be closer to, or above plan speed, whereas upload speeds remain below plan speeds.
Packet loss	Packet loss counts packets that are sent over a network and don't make it to their destination, measured as a percentage of packets lost out of all packets sent.	At levels above 1%, packet loss can cause issues for certain types of applications. This may be detrimental to user experience.
Plan and plan speed	Plan refers to the retail broadband product. Each plan has an associated download and upload speed. For example, a 100/20 Mbps plan includes a 100 Mbps download plan speed and a 20 Mbps upload plan speed. The term "NBN100" refers to a download plan speed of 100 Mbps, but the upload plan speed may vary.	RSPs may advertise a maximum attainable speed and also state a different typical busy period speed that consumers are likely to experience, which may be the same or lower than the maximum attainable speed.
Underperforming services	Services that reach above 75% of plan speed in no more than 5% of download tests. These are services which rarely or never attain plan speed.	This metric effectively identifies services with maximum attainable speeds that fall closer to the maximum speed of a lower plan than to the maximum speed of the consumer's current plan. This is often, but not always, caused by a known physical impairment to FTTN services (see impaired services).
Video streaming (Netflix)	The number of Netflix videos at High Definition (HD) and Ultra High Definition (UHD) that can be streamed on a certain plan simultaneously.	

Term	Definition	Significance
Webpage loading time	The time it takes for a specific webpage to fully load. This is a combination test that includes download, latency and DNS in one test that accurately mimics real-world usage. This metric combines test results for eight popular Australian-based webpages.	

NBN fixed-line services

Download speed test results

This section includes results for major NBN plans up to 500 Mbps. It excludes results from very high speed services, as these are presented separately.

Figure 1A shows that users on NBN fixed-line services attained an average download performance of 99.1% of plan speed during all hours in December. This decreased to 97.7% during busy hours. These results are similar to the previous report, where the corresponding figures were 99.7% of plan speed during all hours and 98.2% during busy hours.

The December 2022 measurement period had a total of 31 days with 4 busy hours per day, totalling 124 busy hours in the month. The busiest hour download speed results in Figure 1B are lower than the busy hour download speeds shown in Figure 1A. This indicates that periods of higher demand affected network performance.

The range of speeds for the busiest hour (Figure 1B) varied from 89.5% to 100.2% of plan speed. This is a wider range of results compared with the download metrics for all hours and busy hours shown in Figure 1A. Some RSPs were more affected by high demand peaks than others. Most RSPs achieved busiest hour speeds above 90% of plan speed, which is in line with the previous report.

Average download speeds held steady throughout the day for users on most NBN plans. The 100 Mbps NBN plans remain the most affected by increased user activity in the evening hours.

Further detail on hourly average download and upload performance results for the main NBN fixed-line plans is available on the ACCC's website⁶.

⁶ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

Figure 1: Average download performance by RSP

NBN fixed-line plans. Including underperforming services. Error bars indicate 95% confidence intervals of the mean.

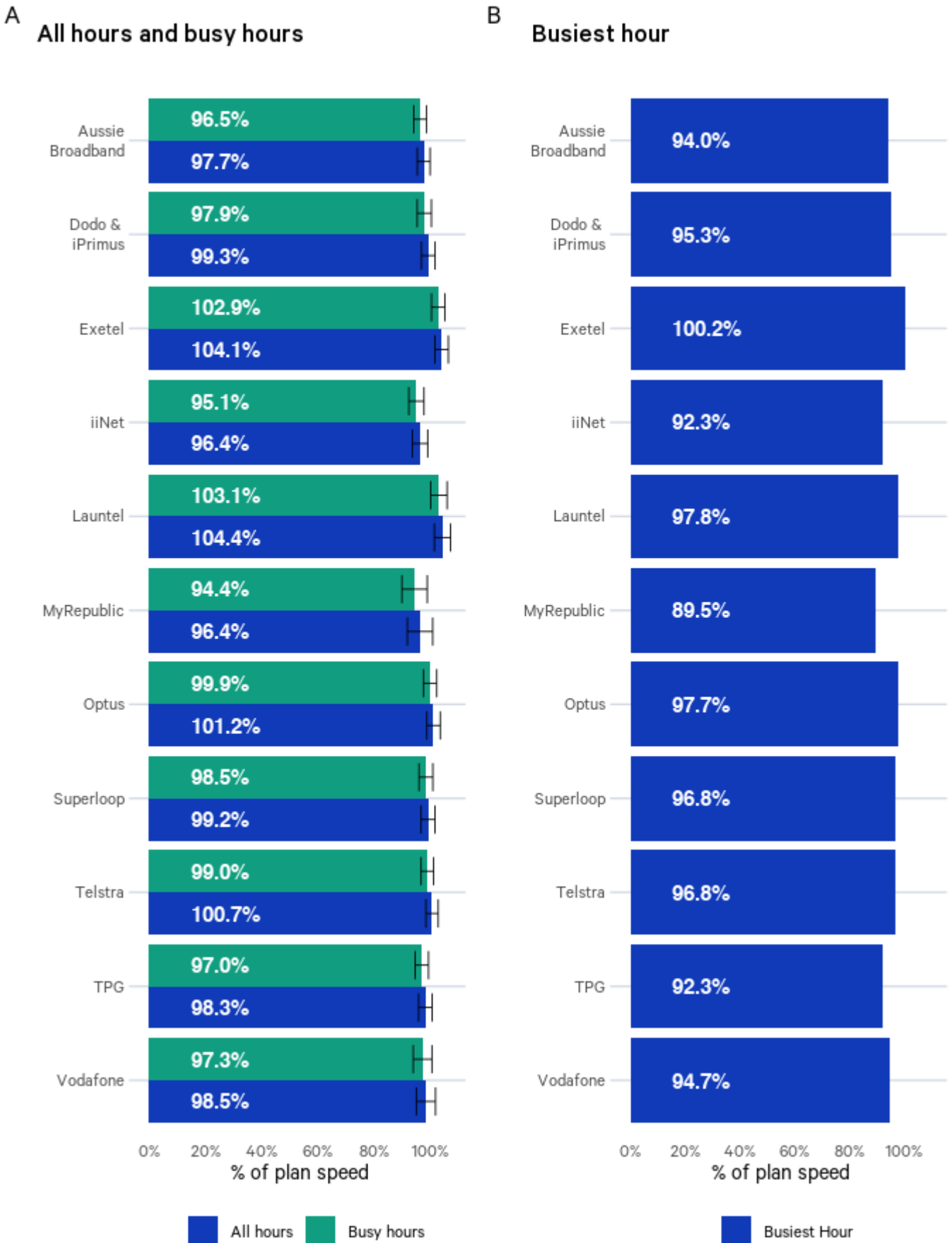
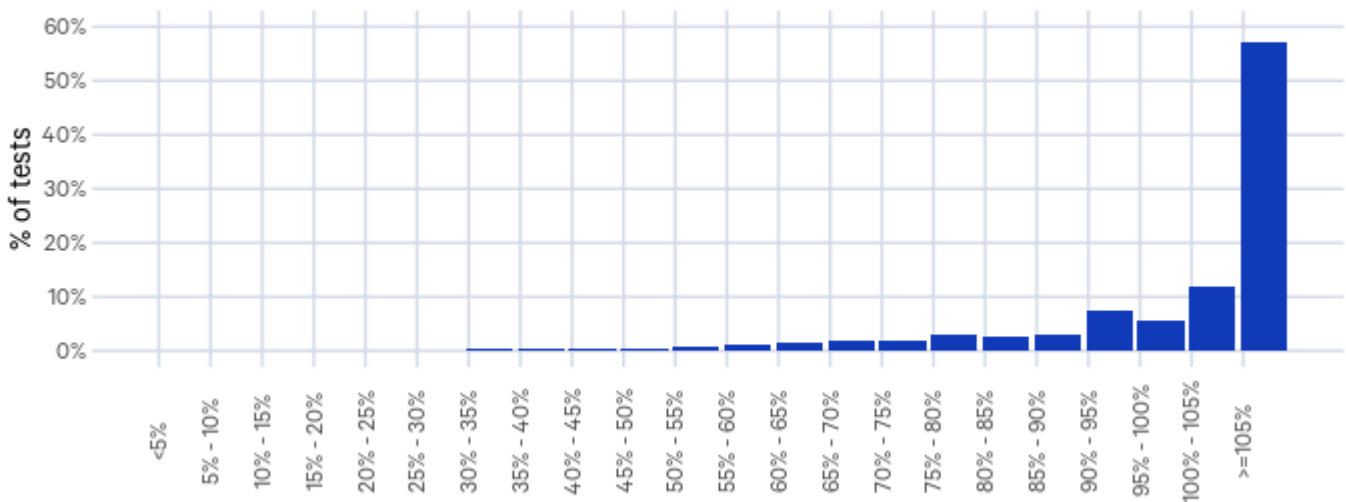


Figure 2 shows the distribution of 416,164 download speed tests performed across 1171 Whiteboxes connected to fixed-line NBN infrastructure during this period.

Of these tests, 68.9% achieved at least 100% of plan speed, and only 2.0% of tests achieved less than 50% of plan speed. In the previous report, 69.1% of tests were at plan speed or higher, and 1.6% of tests failed to meet the 50% mark.

Figure 2: Frequency of download speeds attained during tests

NBN fixed-line plans. All hours. Including underperforming services.



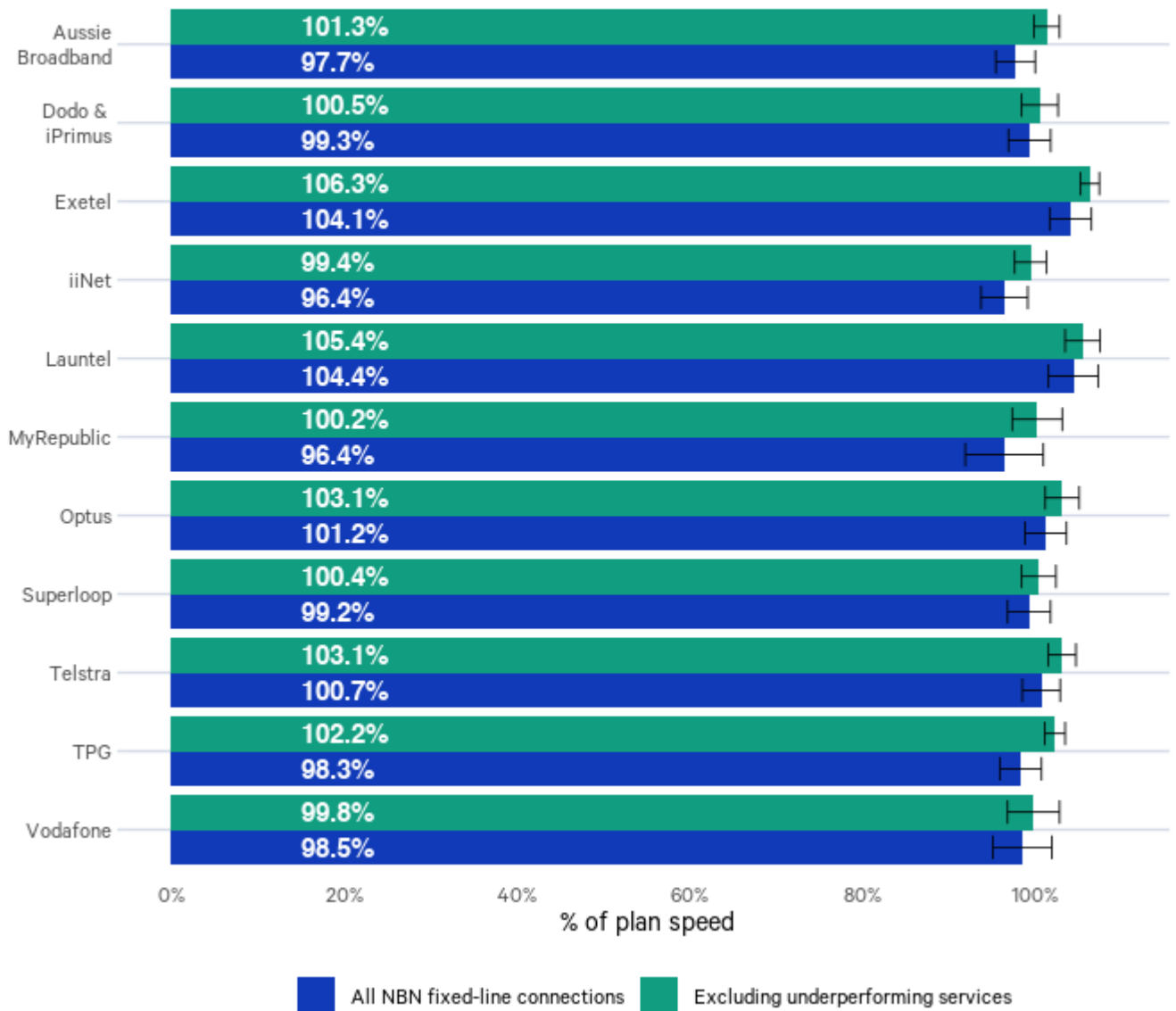
In Figure 3, we present separate download performance results including and excluding underperforming services. Underperforming services represented 6.1% of the 1171 NBN services tested for this report. In our sample, FTTN services made up 93% of underperforming NBN services, and NBN50 and NBN100 plans accounted for 93% of the underperforming NBN services.

Once underperforming services are excluded, the average download performance during all hours is 101.8% of plan speed compared with 99.1% for all services. Had underperforming services been remediated before the measurements were collected, the overall download performance would have been 2.7 percentage points higher during the period.

Underperforming services impacted the performance of all RSPs to some extent in December 2022.

Figure 3: Average download speed by RSP - inclusive and exclusive of underperforming services

NBN fixed-line plans. All hours. Error bars indicate 95% confidence intervals of the mean.



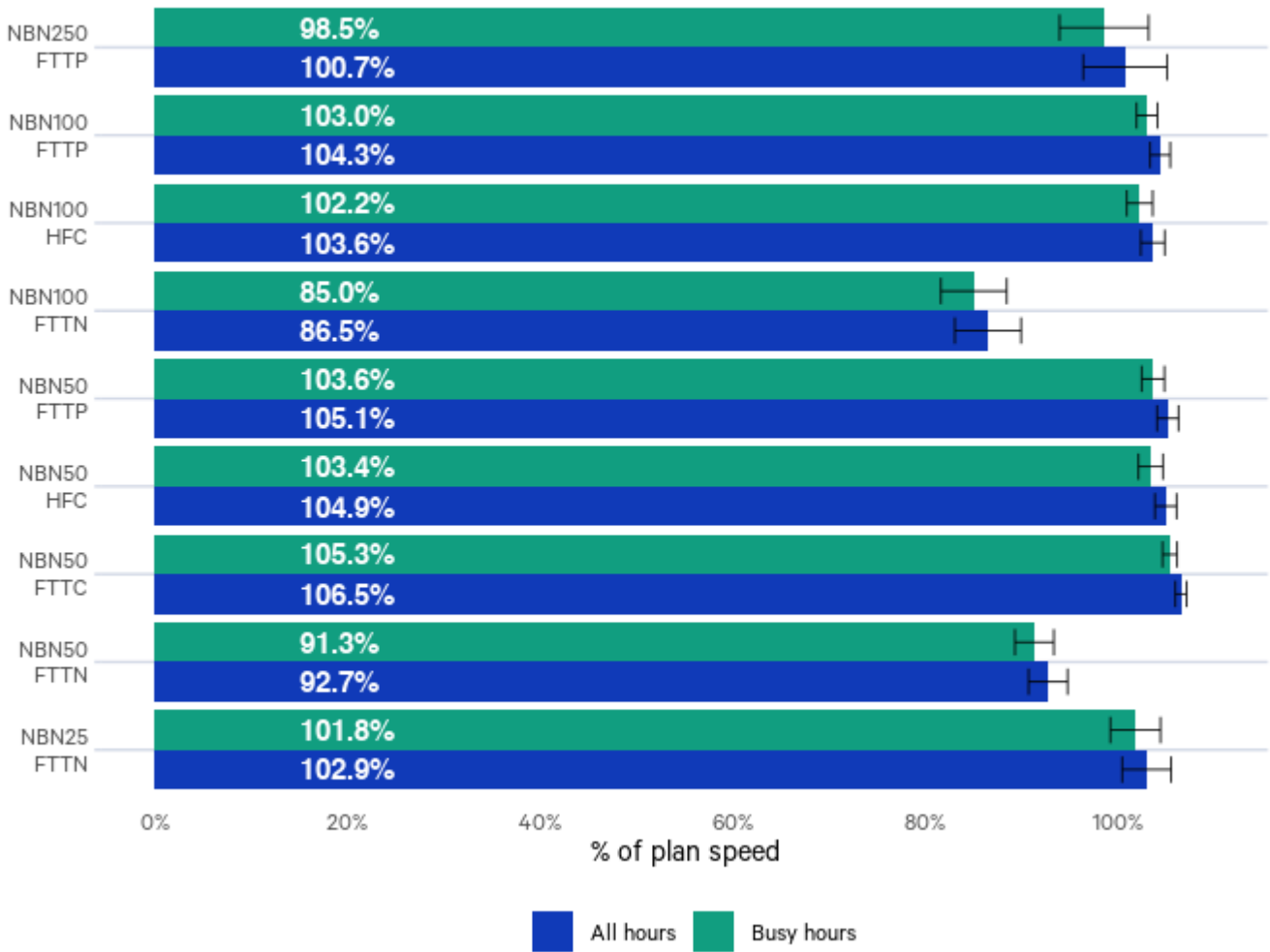
Within the NBN50 plan, FTTN services had an average download speed of around 6 Mbps lower than other technologies, a difference of 12%. Within the NBN100 plans, FTTN services had an average download speed around 17 Mbps lower than other technologies.

The results are similar to previous reports, with FTTN performing significantly below other access technologies for the NBN50 and NBN100 plans and accounting for the bulk of underperforming services across these plans. A comparison of NBN fixed-line download performance results including and excluding underperforming services by access technology is available on the ACCC’s website⁷.

⁷ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

Figure 4: Average download speed by plan and technology

NBN fixed-line plans. Including underperforming services. Error bars indicate 95% confidence intervals of the mean.



During the measurement period, RSPs advertised download speeds between 90% and 100% of the maximum plan speed for NBN50 and NBN100 products.

Figure 5A shows the typical evening hour speeds that were the predominant speeds advertised by RSPs during the measurement period, as well as the busy hour and busiest hour download performance by RSPs. The busy hour and busiest hour download performance is calculated against the nominal plan download speed (50 Mbps and 100 Mbps respectively), rather than the advertised speed claim.

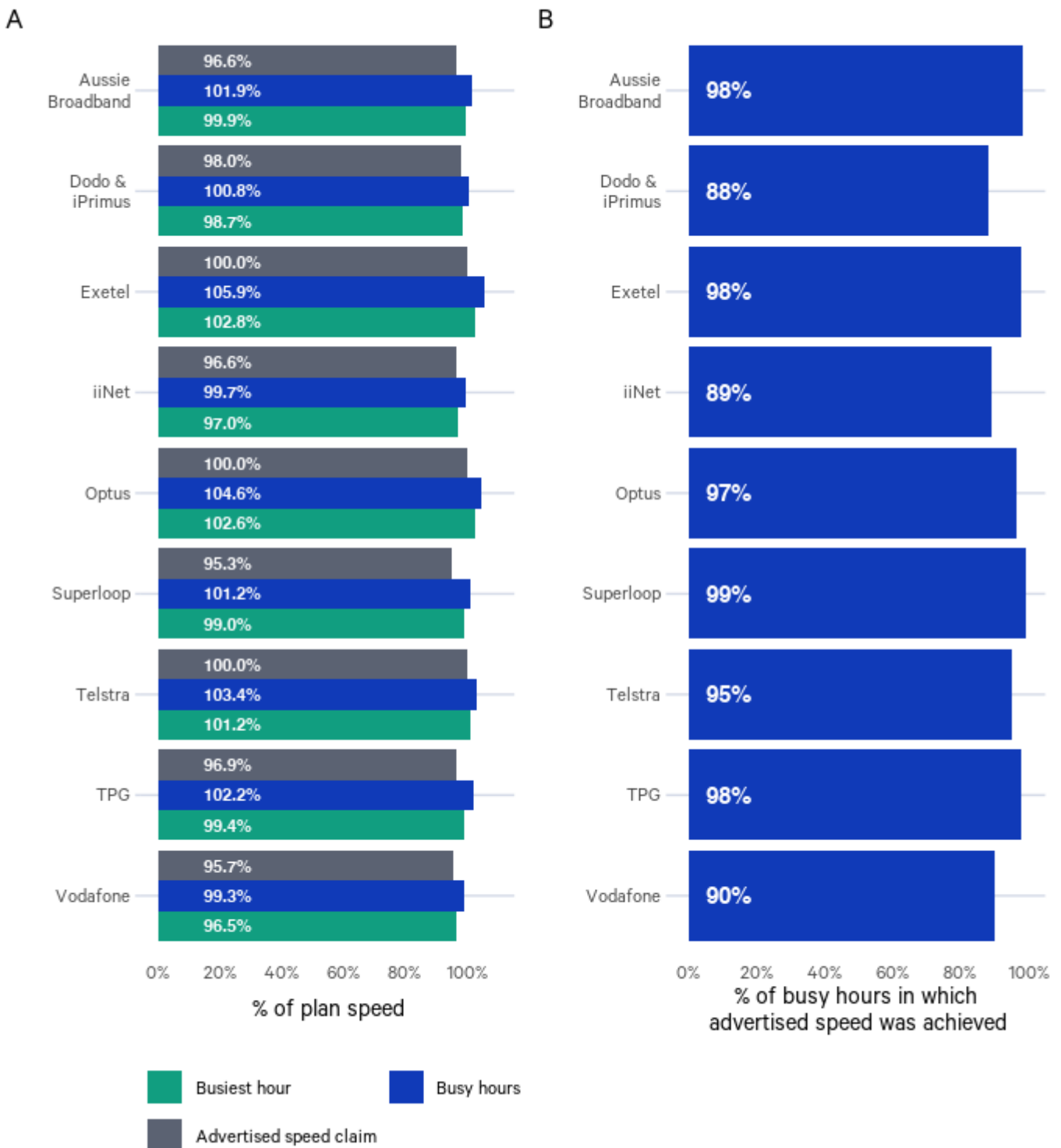
These results show that had all underperforming services and impaired services been remediated, or moved to a more appropriate plan, the average download speeds of most RSPs would have met or exceeded their advertised speed claims during their busy hours.

Figure 5B shows the percentage of busy hours during the period in which test speeds for NBN50 and NBN100 products met or exceeded the speeds advertised by RSPs. Had all

underperforming services and impaired services been remediated, or moved to a more appropriate plan, the proportion of busy hours when RSPs met their advertised speed claims would have been no lower than 88% for the providers presented.⁸

Figure 5: Advertised speeds and average download speeds by RSP

50 Mbps and 100 Mbps NBN fixed-line plans. Excluding underperforming and impaired services.



⁸ Figure 5B shows the proportion of busy hours where the advertised speed claim was achieved, rather than the proportion of busy hours where the nominal plan download speed was achieved. This means that an RSP advertising lower speed claims may achieve their advertised speed claim in a greater proportion of busy hours even when their busy hour download performance is lower. Conversely, another RSP advertising higher speed claims may only achieve their advertised speed claims in a lower proportion of busy hours even when their busy hour download performance is higher.

Upload speed test results

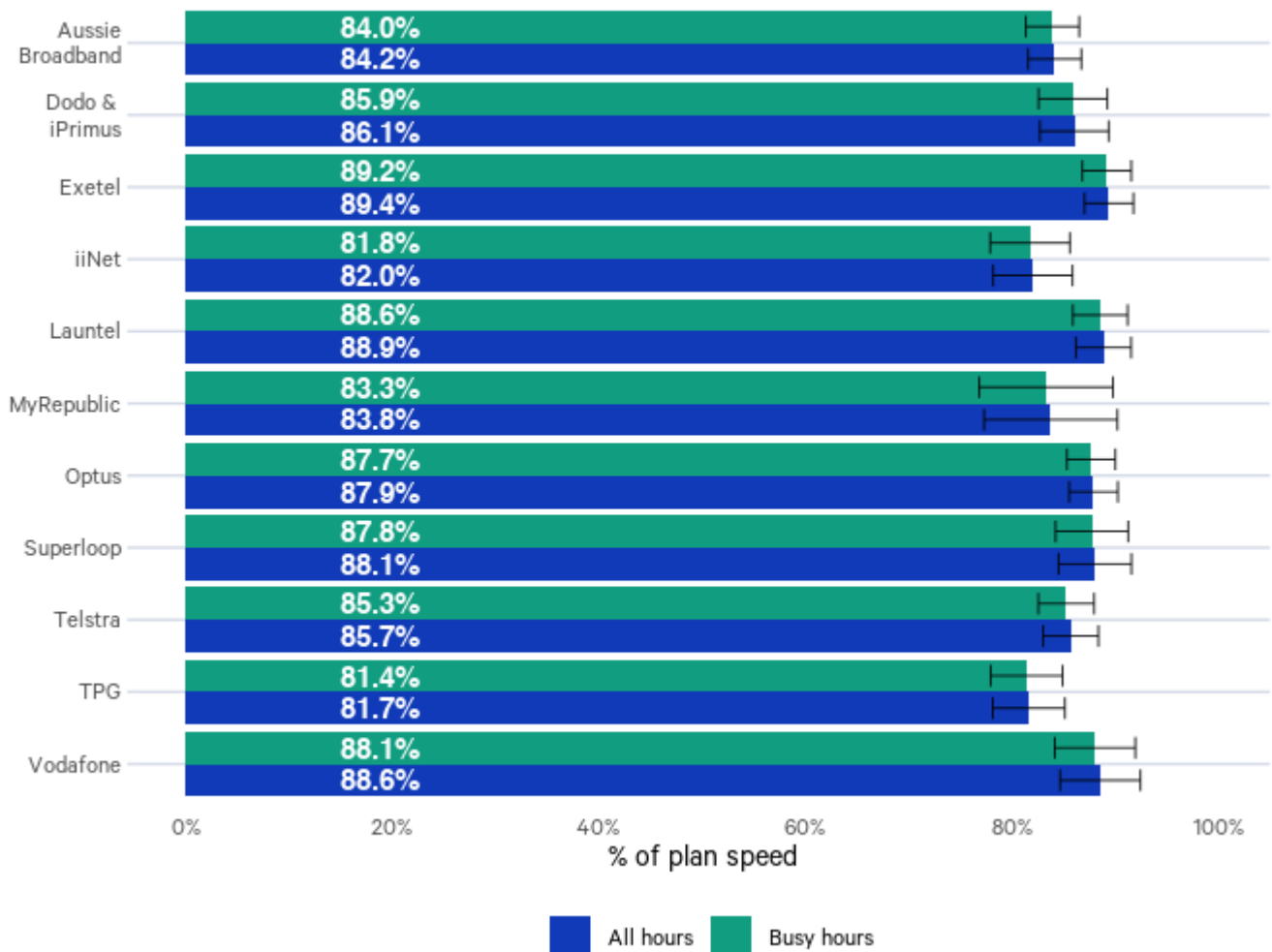
Figure 6 shows average upload performance for the main NBN fixed-line RSPs and plans. Unlike download speeds, the upload component of NBN speed tiers is not overprovisioned.

Average upload performance ranged between 81.7% and 89.4% of plan speed during all hours across RSPs. The results are in line with the previous report.

NBN fixed-line services achieved an overall average upload performance of 85.3% of plan speed during all hours, compared to 86.0% in the previous report. During busy hours, NBN fixed-line services achieved an average upload performance of 85.0% of plan speed compared to 85.7% in the previous report. As the uplink is not overprovisioned, upload performance results are lower than download performance results.

Figure 6: Average upload speed by RSP

NBN fixed-line plans. Including underperforming services. Error bars indicate 95% confidence intervals of the mean.



Other metrics

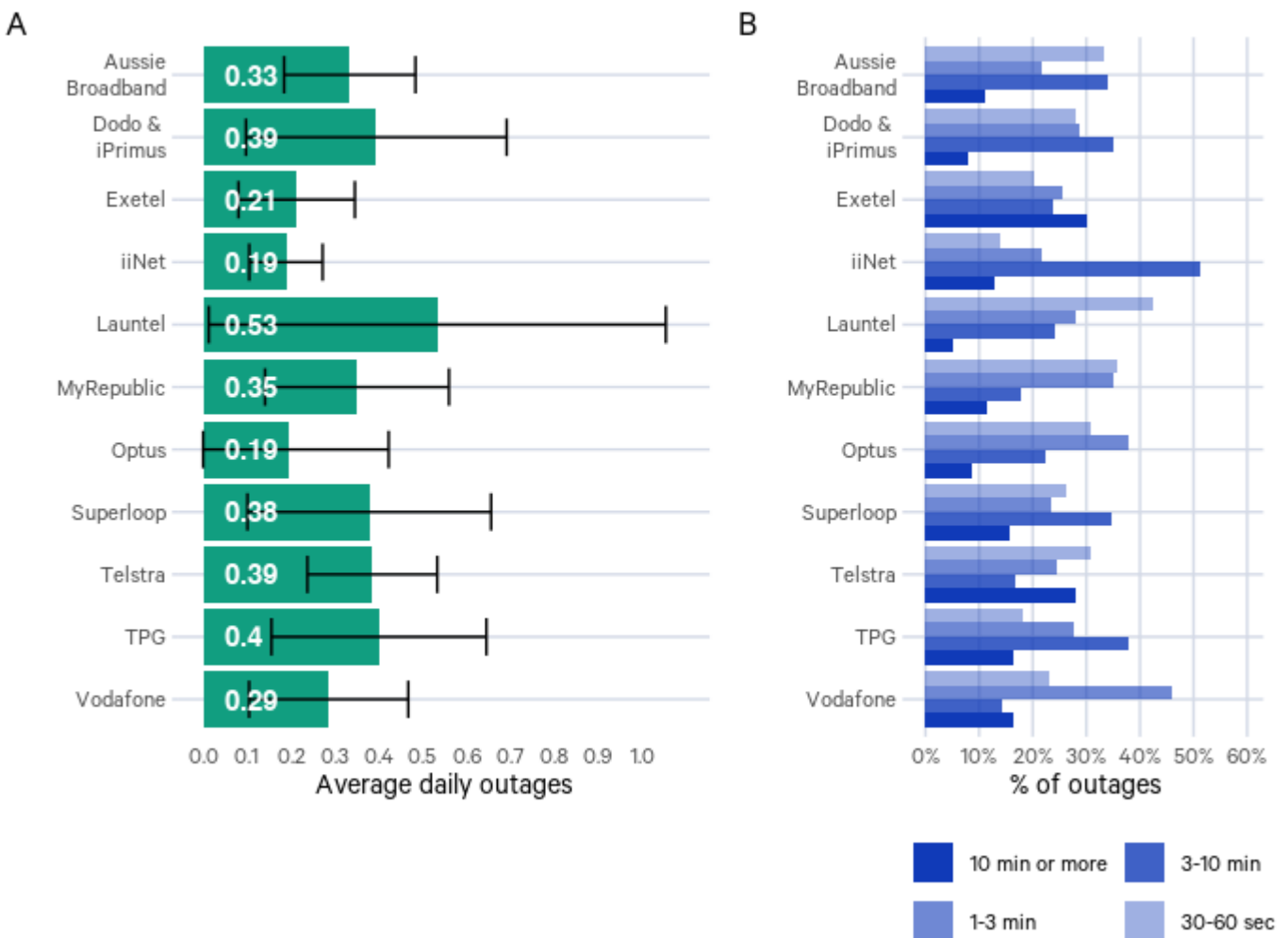
Latency, packet loss and webpage loading results were in line with results from previous reports. These results are available on the ACCC’s website⁹.

Figure 7 shows the average rate of outages per day and the distribution of outage duration for each RSP. These metrics indicate respectively how often outages occurred and the severity of outages’ impact on user experience.

All RSPs had relatively low outage rates. Across all RSPs, the average daily rate of outages on NBN plans was 0.35 outages per day with a confidence interval of ± 0.07 outages per day. As 58% of outages did not last longer than 3 minutes, outages were likely to have had little material impact on end user experience.

Figure 7: Outage characteristics

NBN fixed-line services. All hours. Error bars indicate 95% confidence intervals of the mean.



⁹ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

Other superfast access networks

This section presents data on 60 services on other superfast access networks on a variety of plans: 25/5 Mbps (5 units), 50/20 Mbps (15 units), 100/20 Mbps (11 units), 100/40 Mbps (15 units), 250/25 Mbps (10 units), 250/100 Mbps (3 units) and 400/50 Mbps (1 unit). The results presented are aggregated across the Uniti Group's LBNCo and OptiComm fixed-line networks. Download and upload speeds are expressed as a percentage of plan speed.

These results are indicative only and should not be used to draw inferences about the performance of other superfast access networks.

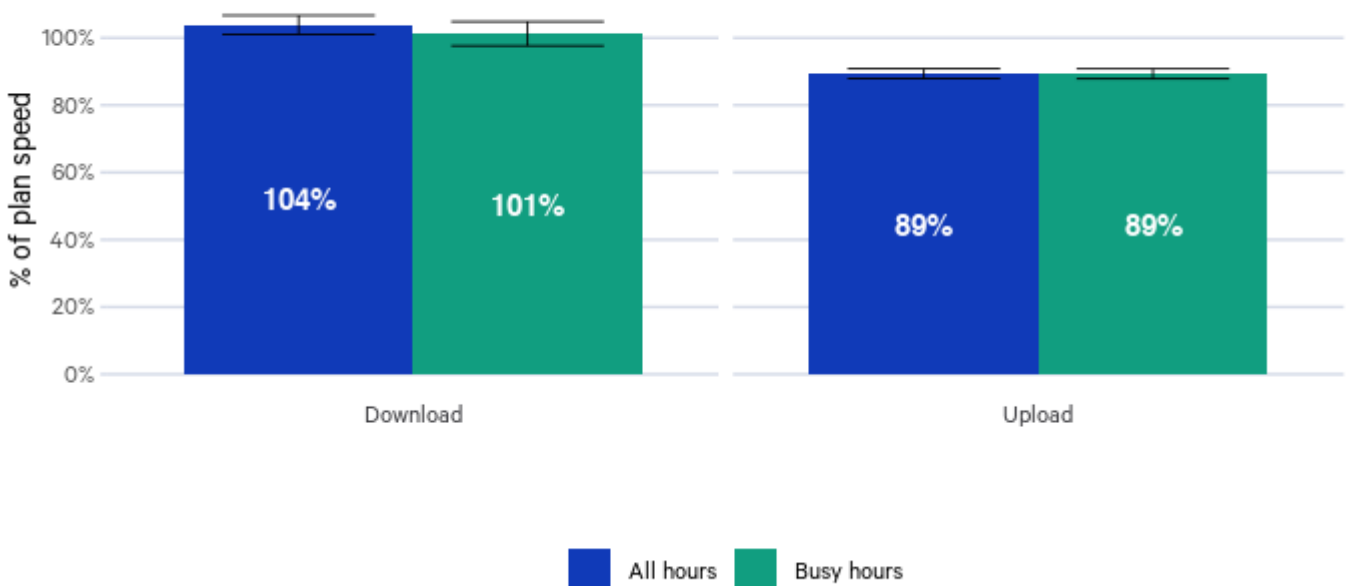
Speed test results

In December the sampled households on other superfast access networks attained an average download performance of 104% of plan speeds during all hours and 101% during the busy hours.

The sampled services on other superfast access networks attained an average upload performance of 89% of plan speeds during all hours and 89% during the busy hours.

Figure 8: Average download and upload speeds

Other superfast access networks. Error bars indicate 95% confidence intervals of the mean.



Other metrics

Latency, packet loss and webpage loading results were in line with results from previous reports. These results are available on the ACCC's website¹⁰.

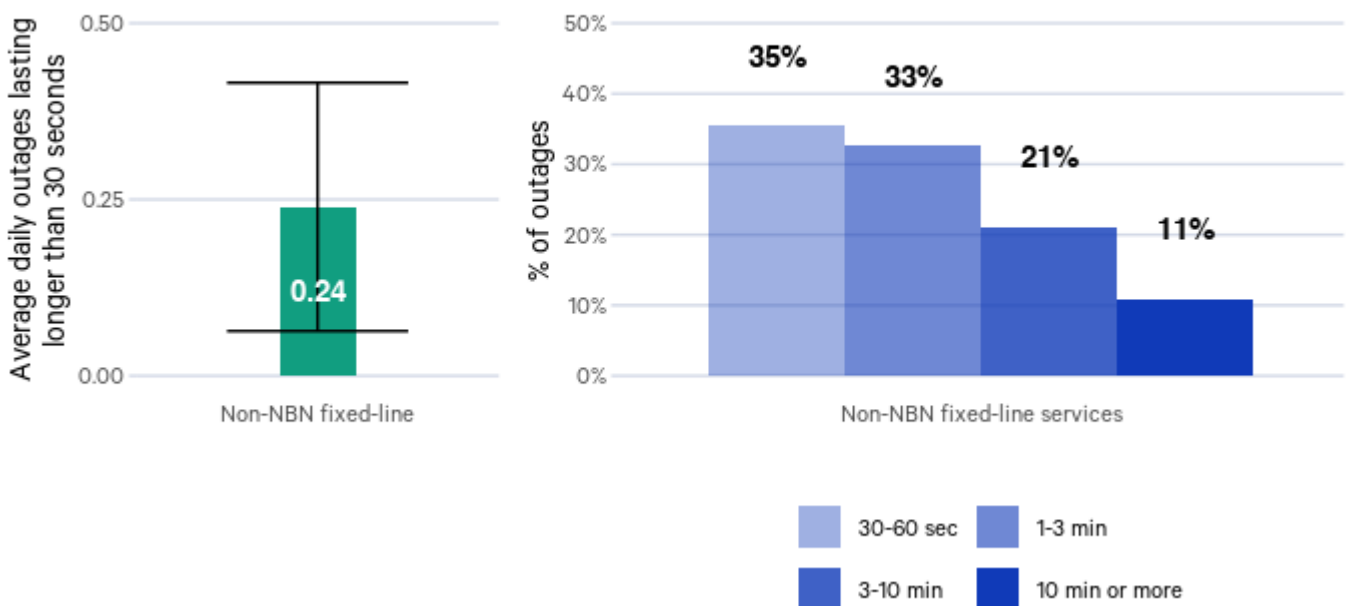
Figure 9 shows the average rate of daily outages and the distribution of outage duration for other superfast access networks during all hours.

The rate of outages in December was in line with previous results, and 68% of outages did not last longer than 3 minutes.

The daily rate of outages varies strongly between households, from units experiencing no such event during the whole measurement month to units experiencing multiple outages per day on average.

Figure 9: Outage characteristics

Other superfast access networks. All hours.



¹⁰ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

NBN very high speed services

This section is based on a total of 133 monitored very high speed services, across both FTTP and HFC technologies. The results include data from services where we identified that the volunteer most likely had a 100 Mbps link within the home and was unable to receive the full benefit of their high speed plan.

Unlike other NBN plans, NBN Co does not currently overprovision the download component of very high speed services. Coupled with the fact that the Whitebox connects via gigabit Ethernet to the home gateway, this means that the end-to-end link is limited to 1 Gbps. After deducting network/transport protocol overheads, the fastest speed we expect to observe on these plans is around 940 Mbps.

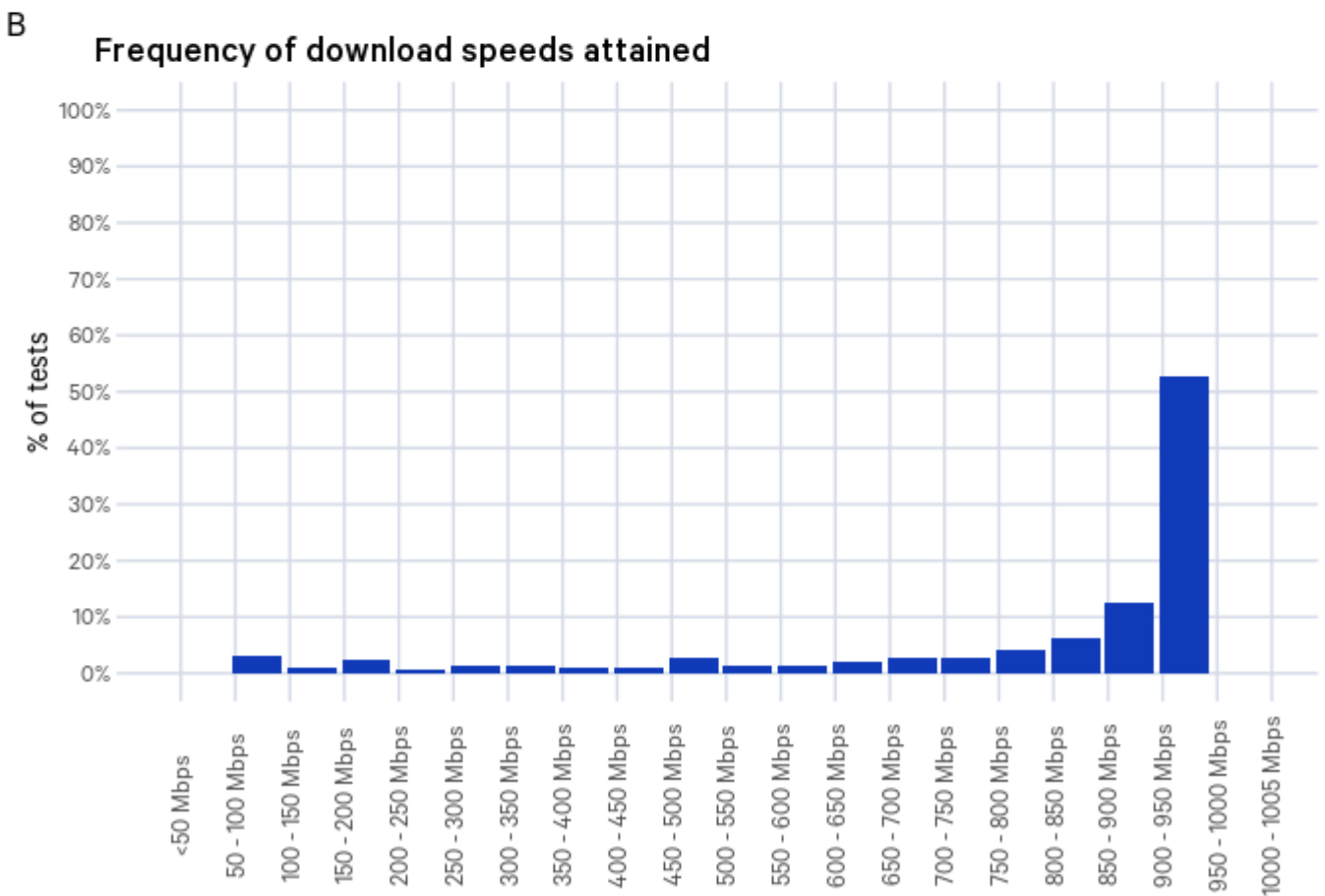
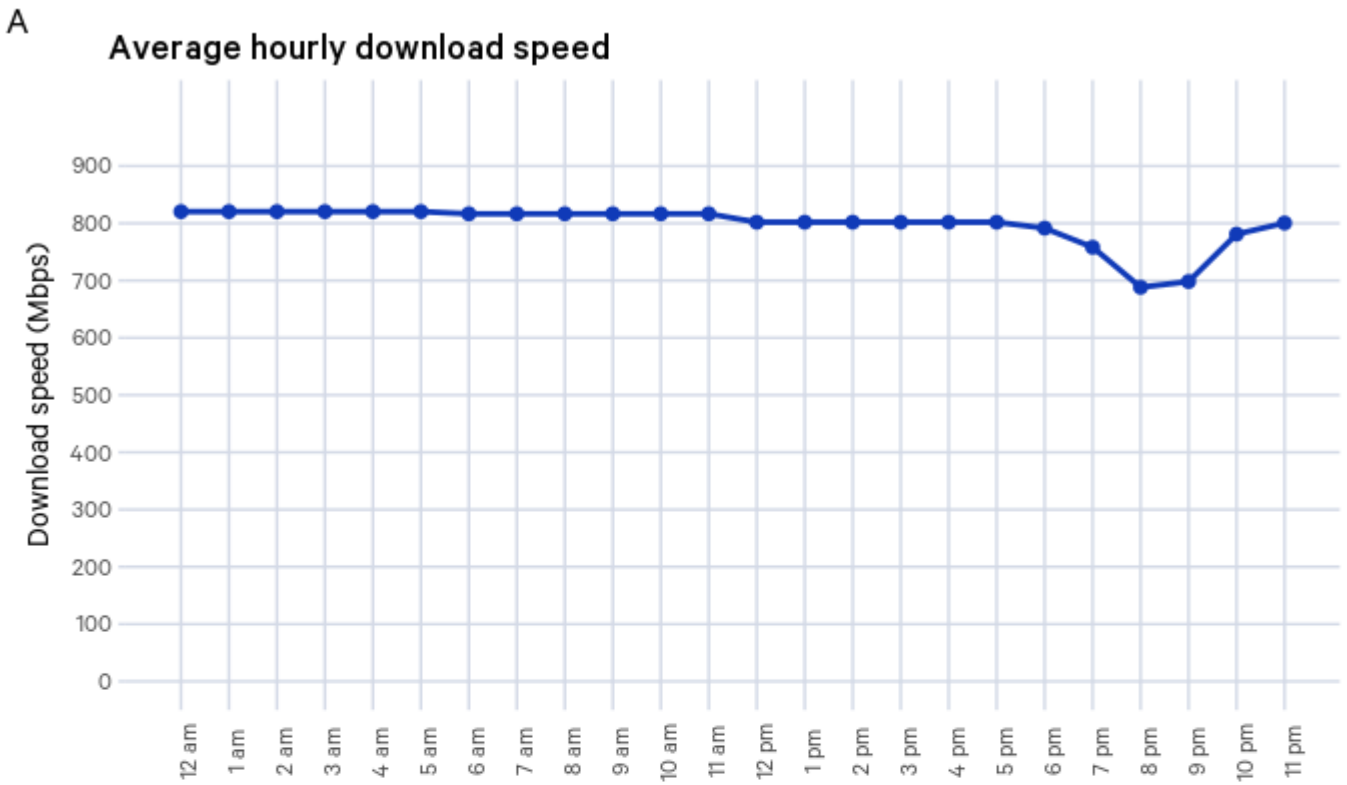
The hourly average download speeds attained by NBN very high speed services ranged across the day from 688 Mbps to 820 Mbps. Figure 10A shows that performance varied more during the busy hours and wider evening peak period. Speeds typically started to decrease during the evening, dipping to 132 Mbps below the day's maximum speed by 8 pm, and recovering later at night. This dip in speeds for very high speed services is greater than the dip observed on the other major NBN plans in previous reports, including NBN100 plans. This indicates that NBN very high speed plans are more affected by congestion during busy periods than lower speed plans.

The measured download speeds are in line with results from previous reports.

Figure 10B shows the distribution of 42,759 download speed tests performed across 133 Whiteboxes connected to very high speed services on fixed-line NBN infrastructure. Of these tests, 52.7% achieved a download speed of at least 900 Mbps.

Figure 10: Download speed test results for very high speed services

NBN very high speed services.



Other metrics

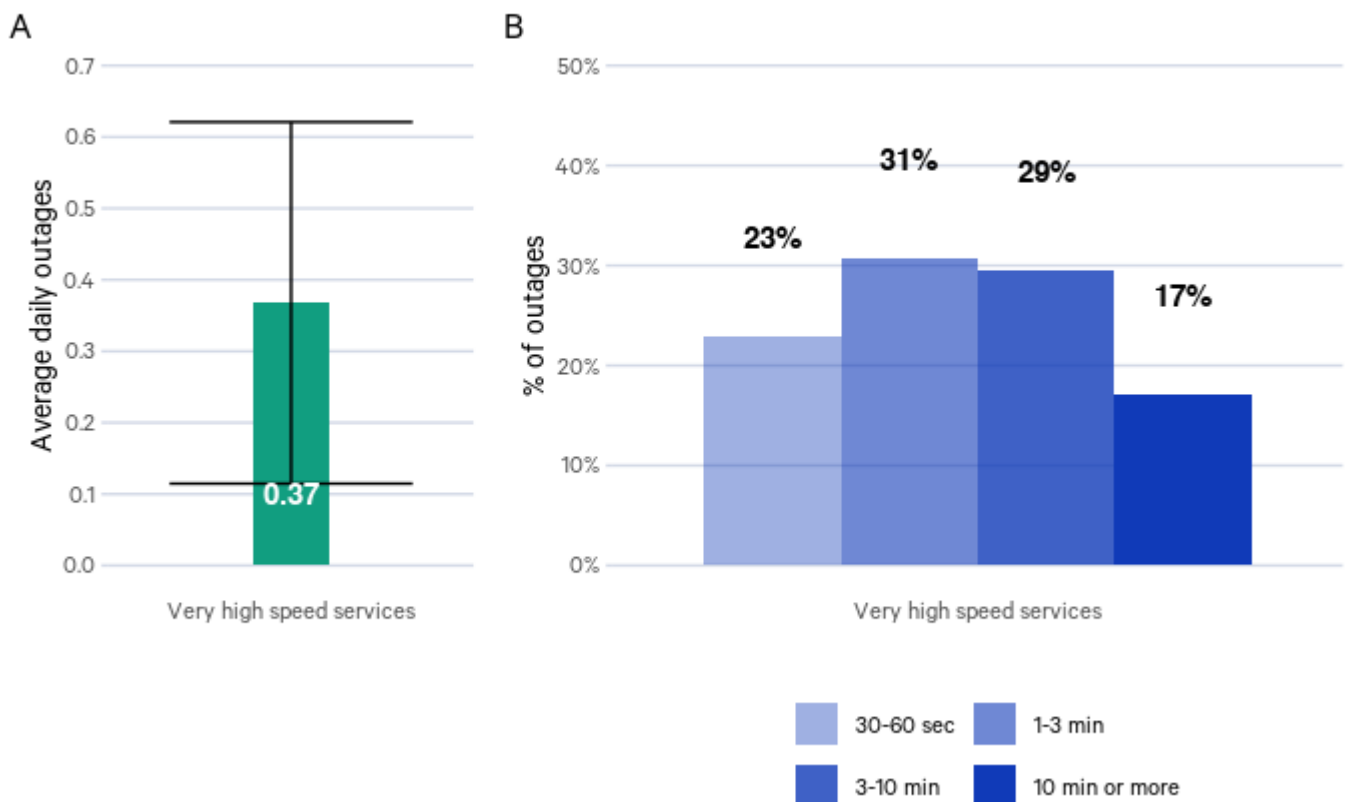
Latency, packet loss and webpage loading results were in line with results from previous reports. These results are available on the ACCC's website¹¹.

Figure 11 shows the average rate of daily outages and the distribution of outage duration for very high speed services during all hours.

The rate of outages was in line with previous results, and 54% of outages did not last longer than 3 minutes.

Figure 11: Outage characteristics

NBN very high speed services. All hours. Error bars indicate 95% confidence intervals of the mean.



¹¹ www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

NBN fixed wireless services

The following sections summarise key metrics from our NBN fixed wireless sample, for both the 25/5 Mbps (15 units) and Fixed Wireless Plus plans (70 units).

NBN fixed-line services and NBN fixed wireless services utilise different technologies that are not directly comparable in terms of performance.

The quality and maximum speed of a fixed wireless connection is often more variable than fixed-line technology. The following factors may affect fixed wireless performance:

- the distance of the consumer's premises to the fixed wireless tower
- whether there is a clear line of sight between the antenna on the roof of the premises and the fixed wireless tower, or if there is an obstruction (such as foliage)
- weather conditions such as extreme heat or heavy rain
- network congestion. Each fixed wireless cell has a finite amount of capacity (e.g. a certain number of megabits per second), that is shared between the households connected to that cell. Where more households in an area connect to a particular cell and/or those households increase their usage towards the limit of the cell, the cell can become congested. The impact of network congestion on the fixed wireless network is typically most noticeable during busy hours.

Speed test results

This section uses download/upload speed benchmarks of 50/10 Mbps for the Fixed Wireless Plus plan. The results of the Fixed Wireless Plus plan and the 25/5 Mbps fixed wireless plan are expressed as a percentage of plan speed.

The results in Figure 12A are based on a total of 85 NBN fixed wireless services across both the 25/5 Mbps and Fixed Wireless Plus plans.

During this period, users on NBN fixed wireless services attained an average download performance of 109.2% of plan speeds during all hours, decreasing to 84.7% during busy

hours. This is in line with the results in the previous report, where average download performance was 110.2% of plan speeds during all hours and 87.6% during busy hours.

NBN fixed wireless services attained an average upload performance of 73.0% of plan speed during all hours, decreasing to 58.7% during the busy hours. In the previous report, average upload performance during all hours was 73.2% of plan speed decreasing to 59.4% during busy hours.

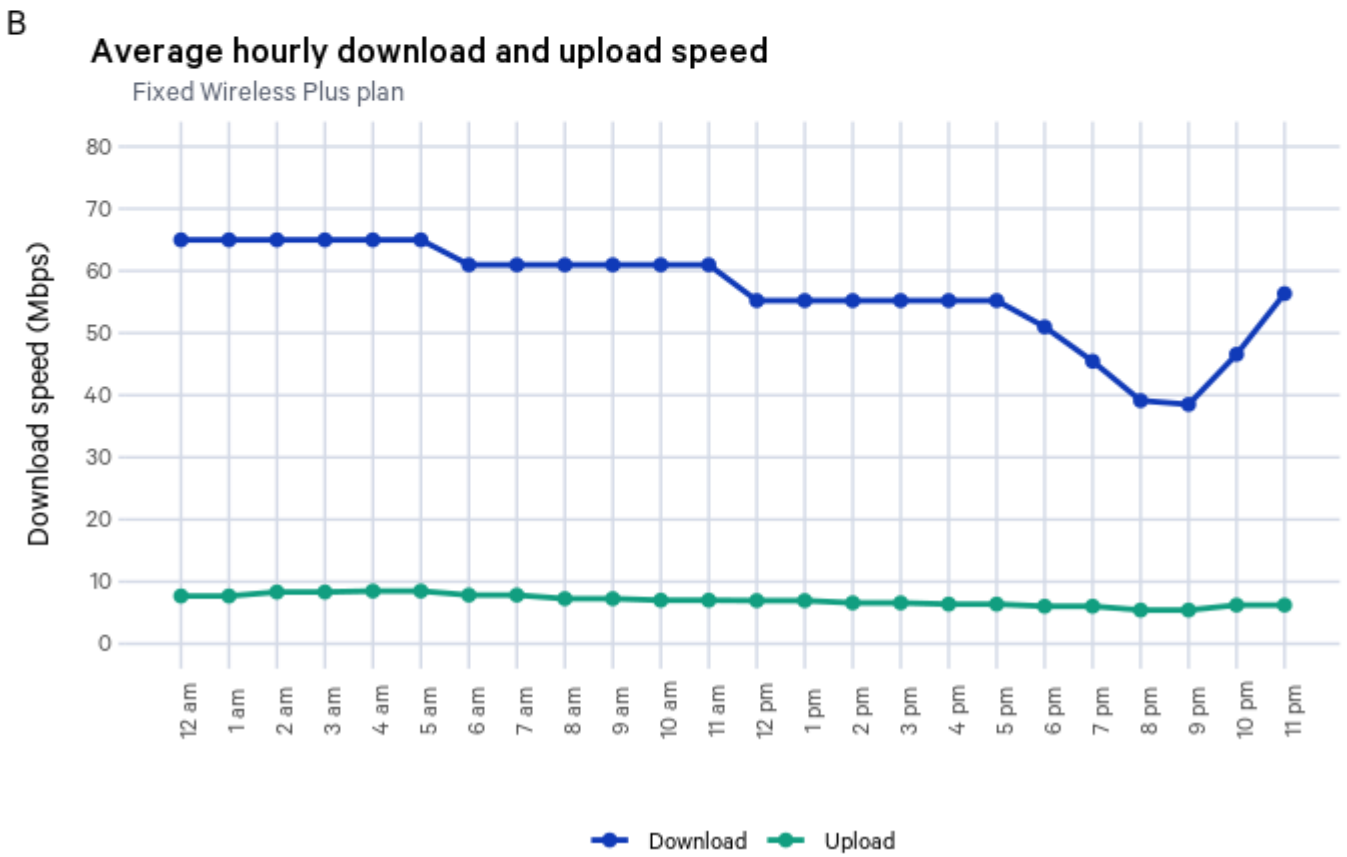
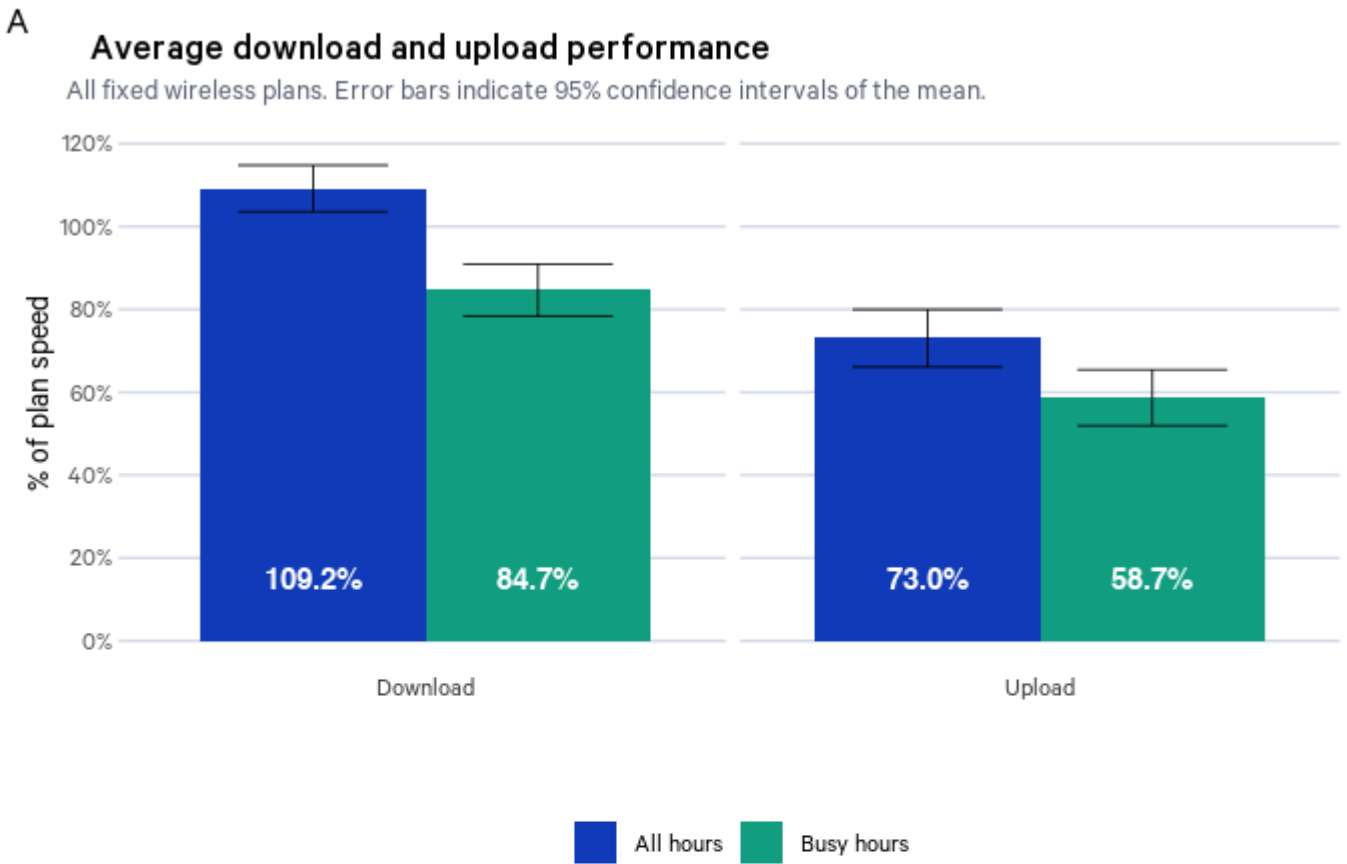
Figure 12B shows the variation in download and upload speeds during the day for Fixed Wireless Plus plans. These results are based on a total of 70 NBN fixed wireless services on the Fixed Wireless Plus plan.

Average download speeds for the Fixed Wireless Plus plan showed considerable variation throughout the day. Speeds typically started to decrease during the evening, dipping to 26 Mbps below the day's maximum speed by 9 pm, and recovering to higher levels later at night. The average download speed for the Fixed Wireless Plus plan was 55.8 Mbps during all hours, decreasing to an average of 41.8 Mbps during busy hours. In the previous report, the average download speeds were 56.5 Mbps and 43.7 Mbps respectively.

Upload speeds followed a similar pattern, recording lower values both during busy hours and during the afternoon. The average upload speed for the Fixed Wireless Plus plan was 7.1 Mbps during all hours, decreasing to an average of 5.5 Mbps during busy hours. In the previous report, the average upload speed was 7.1 Mbps during all hours, and 5.6 Mbps during busy hours.

Both download and upload speeds showed considerable daily variation for fixed wireless products, which is to be expected with fixed wireless products. Network congestion can affect the fixed wireless network, particularly during busy hours.

Figure 12: Speed test results for NBN fixed wireless



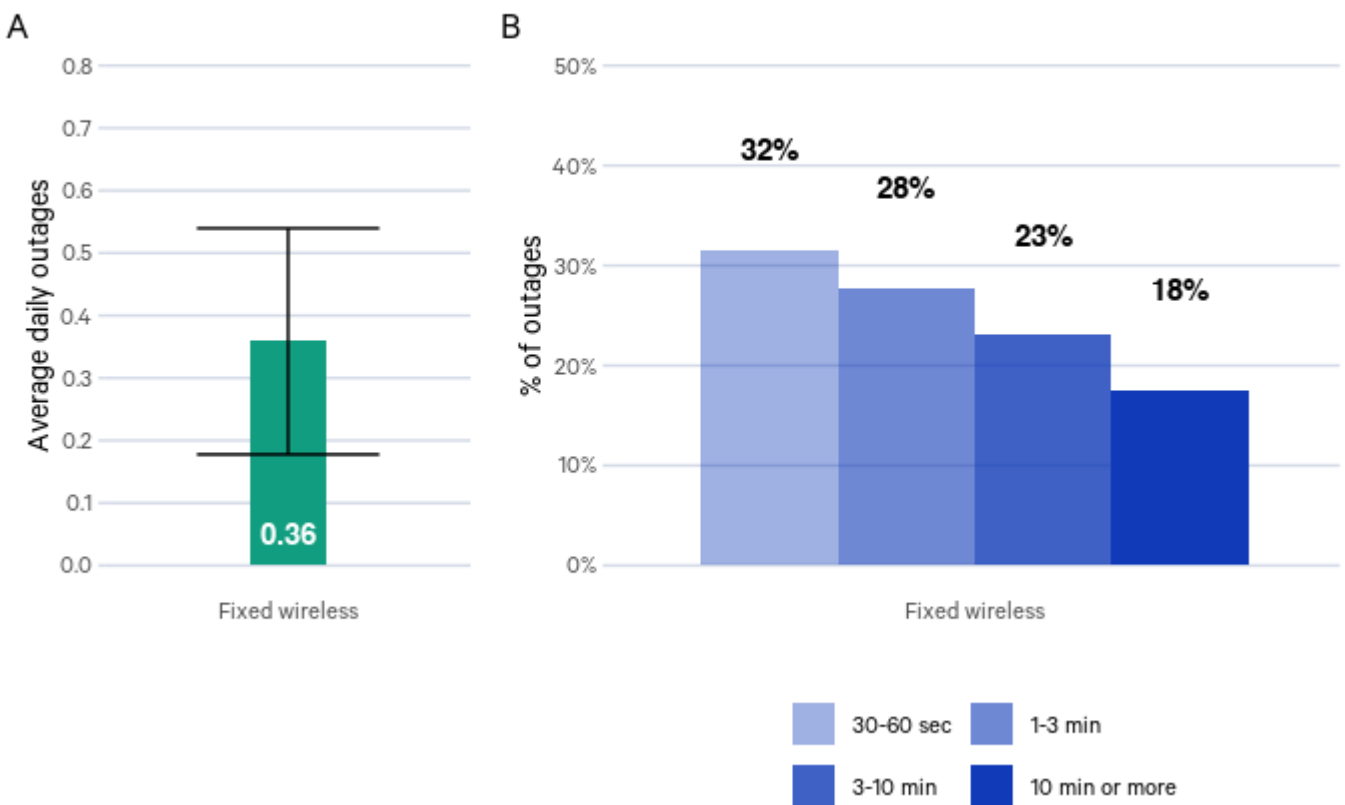
Other metrics

Latency, packet loss and webpage loading results were in line with results from the previous report. These results are available on the ACCC's website¹².

Figure 13 shows the average rate of daily outages and the distribution of outage duration for fixed wireless services during all hours. The rate of outages was in line with previous results and 59% of outages did not last longer than 3 minutes.

Figure 13: Outage characteristics

NBN fixed wireless. All hours. Error bars indicate 95% confidence intervals of the mean.



¹² www.accc.gov.au/consumers/telecommunications-and-internet/broadband-performance-data

Online gaming

This section presents test results for 16 popular video games: Among Us, Apex Legends, Diablo 3, Dota 2, FIFA¹³, Fortnite, Hearthstone, Heroes of the Storm, League of Legends, PUBG, PUBG Mobile, Rainbow Six Siege, Rocket League, Starcraft 2, Valorant and World of Warcraft.

The game tests measure the latency to the game servers. This metric indicates how responsive the game might feel to the player. The game tests discussed in this section do not measure how fast or slow downloading a game would be.

Fast-paced online games require low latency between users' machines and the central host server. Games will typically start to stutter and lag when it takes a long time to send data between a gaming device and an online gaming server. For games that rely on precision and/or fast reaction times, high latency can have a severe impact on gameplay. To prevent a single user's high latency ruining the game for the other participants, some game servers may refuse to admit players who have triple-figure latency. However, for games where precision and reaction times are less important, higher latencies might still be tolerable.

Game publishers are free to choose where they host their servers. This means that game publishers themselves have a major impact on the latency of their games through their choice of server locations. Depending on the game, the closest server may be thousands of kilometres away from the player. Over such long distances, the time it takes for a data packet to travel from a Whitebox to the game server and back again can become quite significant. Travelling 5000 km inside an optical fibre takes a data packet at least 25 ms. For reference, the distance between Sydney and Singapore is around 6300 km.

Game test results by plan speed

Similarly to idle latency results, latency to game servers is primarily influenced by the distance to the server and the access technology. Figure 14 shows that plan download speed did not have a direct impact on game test latency results for NBN fixed-line plans.

¹³ During the December 2022 measurement period, FIFA 21 was tested.

Therefore, a user experiencing high latency to game servers should not necessarily expect an improvement after switching to a higher speed tier.

Figure 14: Average latency to game servers by plan download speed (ms)

NBN fixed-line services. All hours. Lower (green) is better than higher (blue).

	25	50	100	250	1000
Among Us	164	167	160	163	154
Apex Legends	24	23	21	19	19
Diablo3	26	26	25	22	25
Dota2	36	26	22	20	20
FIFA	24	24	23	21	20
Fortnite	24	23	21	18	19
Hearthstone	187	194	191	176	171
Heroes of the Storm	186	193	189	176	171
League of Legends	24	23	22	20	21
PUBG	23	23	21	18	18
PUBG Mobile	102	105	104	101	98
Rainbow Six Siege	27	28	27	23	24
Rocket League	24	23	21	19	20
Starcraft2	24	23	22	19	22
Valorant	24	23	22	19	20
World of Warcraft	25	26	25	22	25
Idle latency	12	12	10	8	7

Game test results by access technology

Figure 15 shows the measured average latency to gaming servers split by access technology during all hours, for NBN services. For reference, average idle latency results (measuring latency to a SamKnows test server) is also shown for each access technology.

Access technology had a mild effect on gaming latency results. Similarly to the idle latency results, fixed wireless services experienced higher latencies on average than fibre connections across all games tested.

Another factor influencing latency to gaming servers is the distance to the server. During the measurement period, Hearthstone and Heroes of the Storm tested to servers hosted in North America, resulting in significantly higher average latencies (in the range of 200 ms) than games testing to servers hosted in Australia (Apex Legends, Diablo 3, Dota 2, FIFA, Fortnite, League of Legends, PUBG, Rainbow Six Siege, Rocket League, Starcraft 2, Valorant and World of Warcraft). PUBG Mobile tested to servers in Asia, resulting in higher latencies than games testing to servers in Australia, but not as high as games testing to servers in North America. Although Among Us hosts a server in Asia, a substantial proportion of tests (20–50% depending on location) were directed to their North American server, because this yielded lower latency than the Asia server at the time of testing.

Figure 15: Average latency to game servers by access technology (ms)

All hours. Lower (green) is better than higher (blue).

Among Us	169	161	165	153	151	160	198
Apex Legends	26	16	23	18	17	25	57
Diablo3	29	18	26	20	23	31	63
Dota2	31	17	25	21	18	24	78
FIFA	27	16	26	20	17	25	58
Fortnite	26	17	22	18	17	23	59
Hearthstone	194	185	194	182	165	185	222
Heroes of the Storm	194	184	193	180	165	184	221
League of Legends	26	16	24	18	18	28	59
PUBG	26	16	21	18	17	22	59
PUBG Mobile	107	102	108	98	96	103	141
Rainbow Six Siege	30	22	27	23	22	28	65
Rocket League	25	16	24	17	17	26	59
Starcraft2	27	16	21	18	20	25	60
Valorant	25	16	24	18	17	26	61
World of Warcraft	29	18	26	20	23	30	63
Idle latency	15	8	10	8	6	10	43
	NBN Fixed-line FTTN	NBN Fixed-line FTTC	NBN Fixed-line HFC	NBN Fixed-line FTTP	NBN Very high speed FTTP	NBN Very high speed HFC	NBN Fixed wireless

Game test results by states & territories

The previous figure (Figure 15) showed that distance is an important factor when measuring latency to gaming servers. Figure 16 shows the measured average latency to gaming servers during all hours, split by state/territory. For reference, the average idle latency is also shown for each state/territory. For this chart, data from South Australia and the Northern Territory are combined due to their small sample sizes.

The games testing to servers in Australia (Apex Legends, Diablo 3, Dota 2, FIFA, Fortnite, League of Legends, PUBG, Rainbow Six Siege, Rocket League, Starcraft 2, Valorant and World of Warcraft) usually host their servers in Sydney. In line with this, the December 2022 data shows that, on average, New South Wales and the Australian Capital Territory had the lowest average gaming latency results (ranging from approximately 10–20 ms), followed by Victoria, Queensland and Tasmania (approximately 20–30 ms) and South Australia/Northern Territory (approximately 30–40 ms). Western Australia had the highest results (over 50 ms).

Results for the games testing to servers overseas (Among Us, Hearthstone, Heroes of the Storm and PUBG Mobile) show a less pronounced variation between connections from different Australian cities, or follow a different trend than the results for the games testing to local servers.

The idle latency results do not follow the same trends as the gaming latency results. The average idle latency values for Queensland, Victoria and Western Australia are in the same range as New South Wales and the Australian Capital Territory. This is because the idle latency test measures the time a round trip takes between a Whitebox and one of the SamKnows test servers, which are located not only in Sydney, but also in Brisbane, Melbourne and Perth.

Figure 16: Average latency to game servers by state (ms)

NBN fixed-line services. All hours. Lower (green) is better than higher (blue).

	ACT	NSW	NT + SA	QLD	TAS	VIC	WA
Among Us	157	157	167	169	164	162	179
Apex Legends	12	12	32	25	27	21	53
Diablo3	20	15	36	27	28	24	59
Dota2	15	15	41	30	31	25	57
FIFA	12	15	34	27	27	22	53
Fortnite	13	11	33	26	28	21	53
Hearthstone	172	183	201	189	187	191	221
Heroes of the Storm	175	182	197	189	186	189	220
League of Legends	12	12	31	25	27	22	57
PUBG	13	11	33	25	27	20	53
PUBG Mobile	108	108	99	122	105	101	71
Rainbow Six Siege	14	13	40	26	37	31	59
Rocket League	12	11	31	25	27	21	56
Starcraft2	16	12	33	24	27	21	56
Valorant	13	12	32	26	27	21	53
World of Warcraft	18	15	36	27	28	24	58
Idle latency	12	10	22	11	16	10	11