



Measuring Broadband Australia



Report 15, December 2021

In 2017, the Australian Competition and Consumer Commission (ACCC) launched its project to measure internet performance. SamKnows was appointed to supply their Whiteboxes to internet users in Australia to measure the performance of NBN fixed-line internet. In 2021, the Measuring Broadband Australia program was renewed and is expanding to cover additional market segments, such as NBN fixed wireless services.

The goal of Measuring Broadband Australia is to increase transparency and encourage greater performance-based competition and better internet performance throughout the country.

SamKnows prepares these reports each quarter for publication by the ACCC. The metrics are also presented by the ACCC in a public dashboard at <https://www.accc.gov.au/consumers/internet-landline-services/broadband-performance-data>. A data release containing the underlying summary data for this report can be found through <https://data.gov.au/>.

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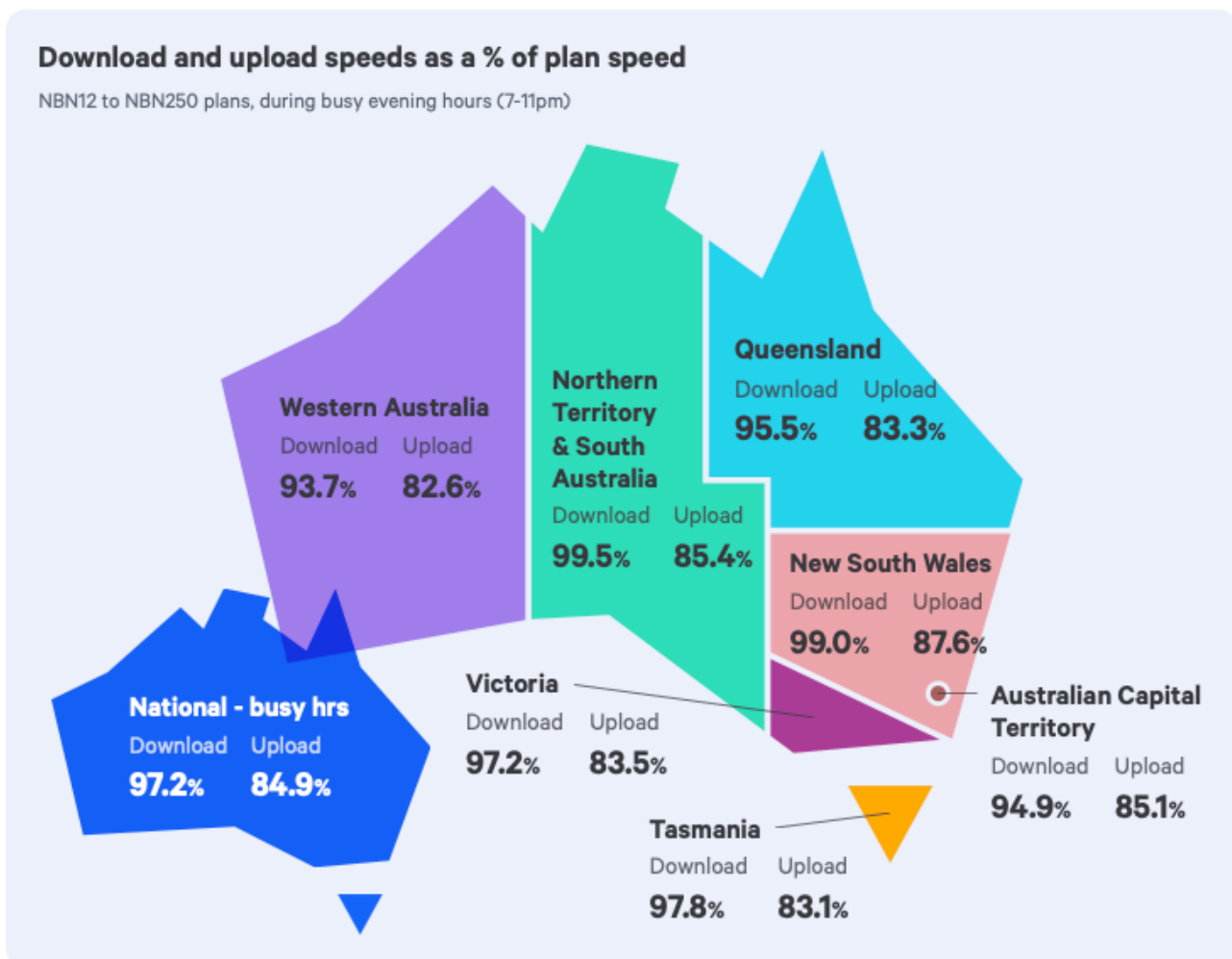
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Measuring Broadband Australia Report 15 Key Results

Geographical

Average performance during busy hours by State/Territory, September 2021.

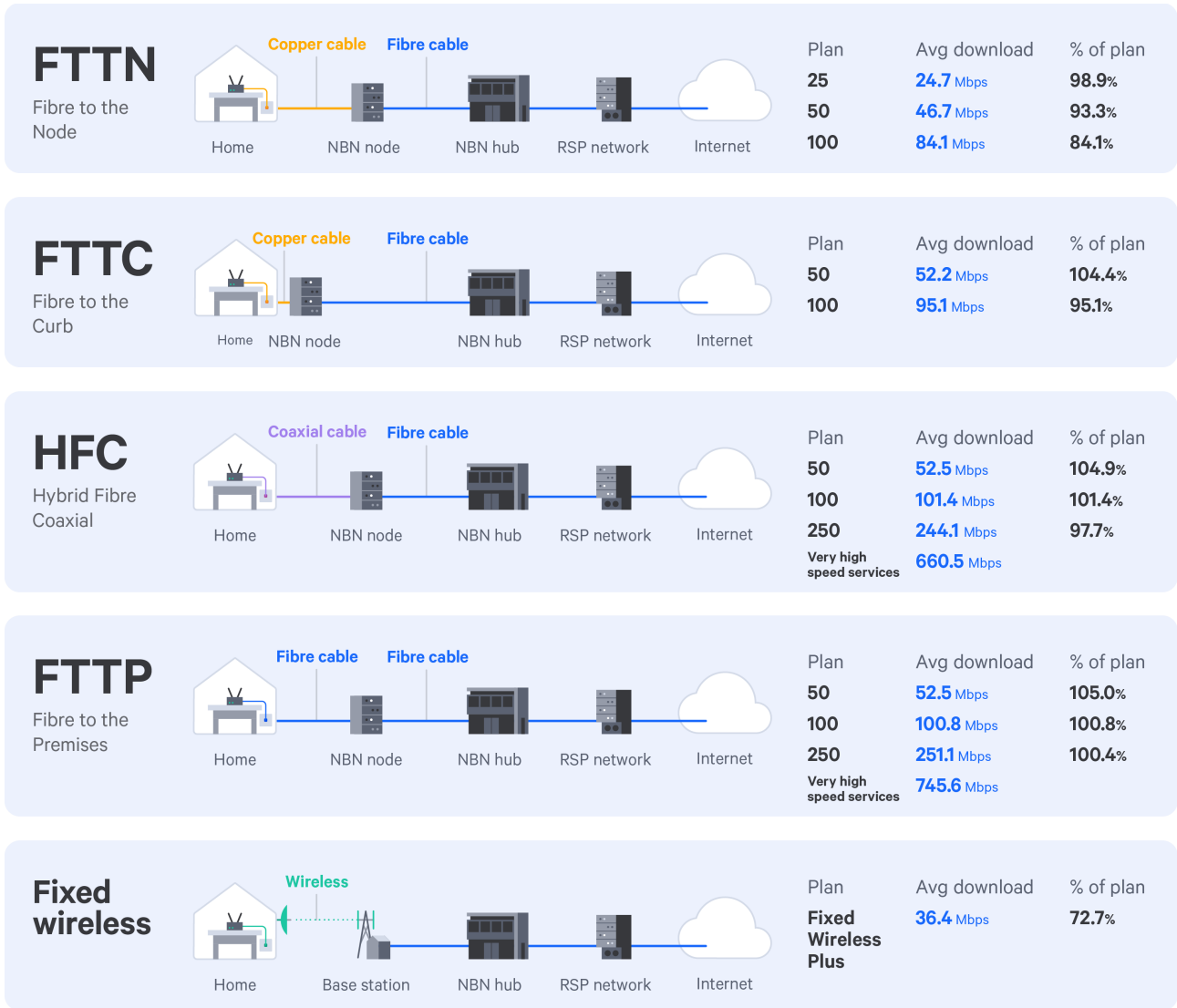
Including underperforming and impaired services.



NBN Access Technology

Download speeds during busy hours, September 2021.

Including underperforming and impaired services.



Quality of Experience

Streaming ultra-high definition (UHD) video during busy hours, September 2021.

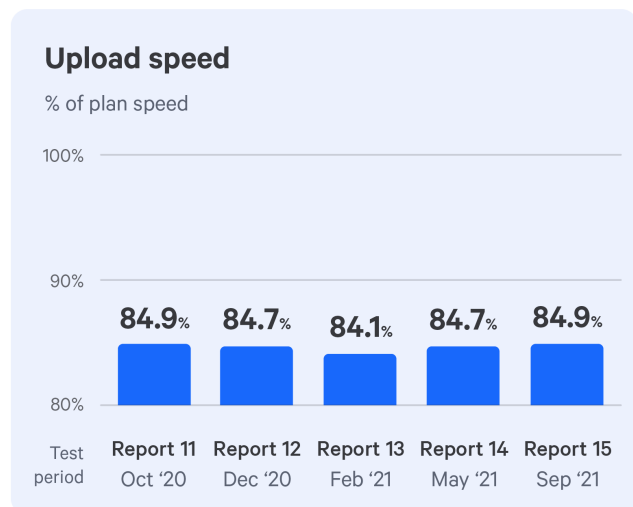
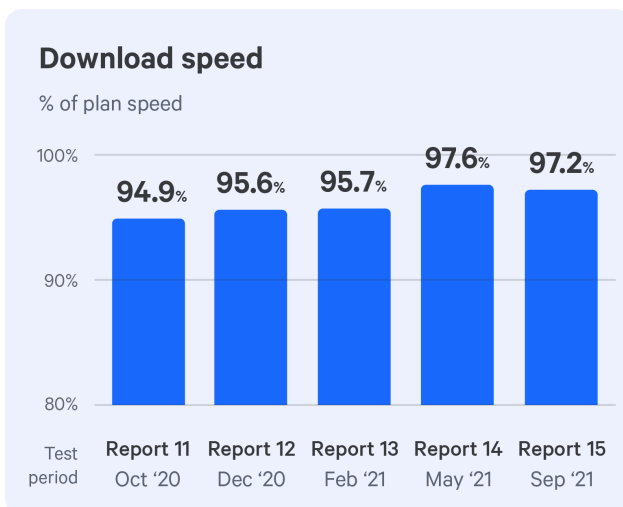
Including underperforming and impaired services.

NBN plan speed	% that can reliably stream UHD videos from Netflix								
25	97.8%	64.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1-2 Concurrent UHD video streams
50	99.1%	94.8%	79.1%	54.7%	0.0%	0.0%	0.0%	0.0%	3-4 Concurrent UHD video streams
100	99.5%	96.5%	93.5%	85.2%	79.8%	72.2%	55.2%	23.0%	6-7 Concurrent UHD video streams
250	98.0%	97.0%	92.9%	91.9%	88.9%	84.8%	75.8%	67.7%	7+ Concurrent UHD video streams
Fixed Wireless Plus	79.7%	40.7%	22.0%	11.9%	0.0%	0.0%	0.0%	0.0%	1-2 Concurrent UHD video streams

Long-term Trends

NBN12 to NBN250 plans, during busy hours.

Including underperforming and impaired services.



Overview

1 September 2021 to 30 September 2021

This is the fifteenth report issued as part of the Measuring Broadband Australia project. The main metrics of this report are based on measurements collected over the month of September 2021, a 30-day period.

Time series charts for download and upload performance

This report also presents the daily average download and upload performance of the major NBN fixed-line and NBN fixed wireless plans for the period August to October 2021. This is the first report to include daily average upload performance.

Despite many parts of Australia being under lockdown or experiencing some restrictions due to the COVID-19 pandemic, both NBN fixed-line and NBN fixed wireless download performance remained relatively stable between August and October 2021 compared with the previous quarter.

In the previous report, we analysed the average daily performance of the NBN fixed-line network over the course of the COVID-19 pandemic, from the start of February 2020 as a pre-COVID-19 baseline, to the end of July 2021. This analysis showed that average download speeds for NBN fixed-line services increased by around 10% to 15% since late 2020, compared with a February 2020 baseline. This increase is largely driven by NBN Co overprovisioning the download component of most NBN fixed-line plans by around 10 to 15% where possible, which occurred between June and August 2020. The analysis in this report shows that daily average download speeds for NBN fixed-line services between August and October 2021 were between +9% to +15% higher than the February 2020 baseline.

Covid-19 mitigation measures

During the August to October 2021 period, COVID-19 lockdowns continued to drive traffic growth over the NBN network. New South Wales (NSW) entered lockdowns from June, extending into October 2021. Victoria and the Australian Capital Territory (ACT) entered lockdowns from August which also extended into October 2021. Queensland experienced a week-long lockdown in July/August, the Northern Territory (NT) also experienced a shorter lockdown during August. Tasmania experienced a short lockdown during October 2020.

To help retail service providers (RSPs) accommodate increased network demand, in July 2021, NBN Co announced a COVID-19 relief package that rebated some excess wholesale charge costs for RSPs in July 2021.¹ Similar relief arrangements were provided in August and September 2021.² In October 2021, a new methodology was adopted that increased the potential amount of relief available for RSPs compared to the previous arrangements.

Volunteers using speed constrained in-home equipment

In the June 2021 and August 2021 Measuring Broadband Australia Reports (reports 13 and 14), we noted that some of the test results showed that a small number of our volunteers on NBN250 plans and above were always achieving below 100Mbps. We have assessed that most of these volunteers have a 100Mbps link within their home that is the bottleneck. A common cause of this is Customer Premises Equipment (CPE) or other network devices that have Ethernet ports with a physical limit of 100Mbps. Other potential sources of 100Mbps links are damaged Ethernet cables, intermediate devices that only support 100Mbps (such as old switches and hubs), and configuration of network equipment within the home. These consumers are unable to receive the full benefit of plans with download speeds above 100Mbps when there is a 100Mbps link in the path.

In reports 13 and 14, we excluded services on NBN250 plans or higher affected by a 100Mbps link. In contrast, this report includes all services and plans that may be affected by

¹ NBN Co, 'NBN Co releases top five tips to keep Australians safe and productive online', 30 July 2021, at: <https://www.nbnco.com.au/content/dam/nbn/documents/media-centre/media-statements/2021/nbn-co-releases-top-five-tips-to-help-australians-stay-safe-and-productive-online.pdf>

² NBN Co, 'Affordable broadband good news for Australian households', 22 September 2021, at: <https://www.nbnco.com.au/corporate-information/media-centre/media-statements/affordable-broadband-good-news-for-australian-households>.

an 100Mbps link. The ACCC has engaged with RSPs to encourage them to reach out to their consumers who may be using a constrained gateway device.

For further information on what to do if you are experiencing reduced speeds, see <https://www.accc.gov.au/consumers/internet-landline-services/home-broadband-for-consumers>.

Download performance between the States and Territories

As another feature for this report, we have included analysis on the performance across the States and Territories from August 2021 to October 2021. There are no clear indications of significant reductions in state-wide performance as a result of lockdown. Any relatively low levels of performance observed at a State/Territory level during lockdown were also observed outside of lockdown. The lowest performance between August and October 2021 for NSW, ACT, Tasmania and Victoria were observed during lockdown.

NBN fixed-line services³

Download speed test results

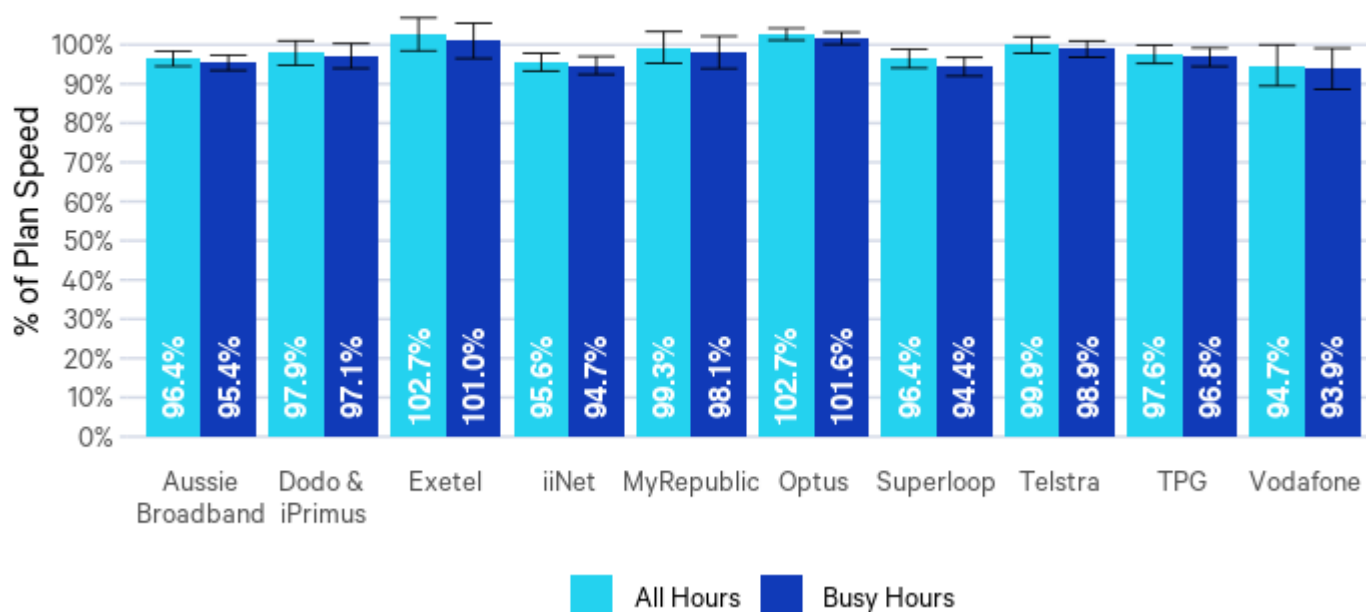
This report expresses results relating to download and upload speeds as a percentage of the service's plan speed.⁴ Plan speed is not always the same as the speed advertised for a plan by RSPs. Hence, where the report outlines speed measures below 100 percent of plan speed, this should not be interpreted as the RSP having failed to provide the speed that it advertised.

³ This section includes results from all major NBN fixed-line download plans, from NBN12 to NBN250. It excludes results from very high speed services as these are presented separately.

⁴ Plan speed refers to the maximum download or upload speed associated with the relevant retail plan. For example, a 12/1Mbps retail product has a maximum download speed of approximately 12Mbps and 1Mbps upload. A 100/20Mbps retail product has a maximum download speed of approximately 100Mbps and 20Mbps upload. 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.

Figure 1: Average download speed by RSP

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



During the September 2021 measurement period, users on NBN fixed-line services attained an average download performance of 98.3% of plan speed during all hours, decreasing to 97.2% during the busy hours (between 7pm and 11pm) which is when networks experience higher user activity.

These results are similar to the last (14th) Measuring Broadband Australia report. The corresponding figures in the last report were 98.4% of plan speed during all hours and 97.6% during busy hours.

As with previous reports, the 95% confidence intervals in Figure 1 above are a measure of 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, Telstra had an average download performance of 99.9% with a 95% confidence interval of $\pm 2.1\%$. This means that if we were to repeat our sampling 100 times, we expect that average performance would fall between 97.8% and 102.0% in at least 95 cases.

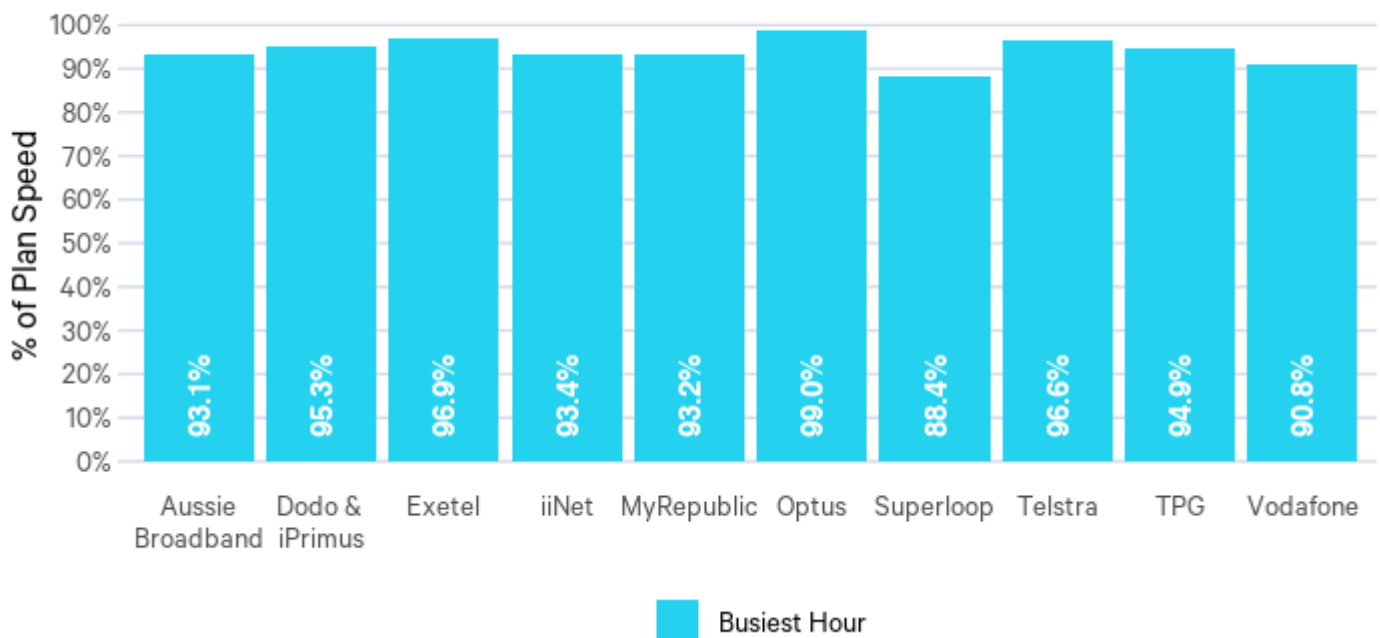
Figure 2 shows RSP results in the ‘busiest hour’, which is the fifth-lowest hourly average download speed across each busy hour by RSP in September 2021. The September 2021 measurement period had a total of 30 days with 4 busy hours each, totalling 120 busy hours

in the month. For each busy hour, we calculate the average download performance (download speed as a percentage of plan speed) for each RSP and use the fifth-lowest as the busiest hour.

The busiest hour gives an indication of the performance of each RSP when its network is under the highest levels of stress. The busiest hour download speed results in Figure 2 are lower than the busy hour download speeds shown in Figure 1. This indicates that there were periods of higher demand that affected consumers' performance on the NBN.

Figure 2: Busiest hour average download speed by RSP

NBN fixed-line plans. Including underperforming services.

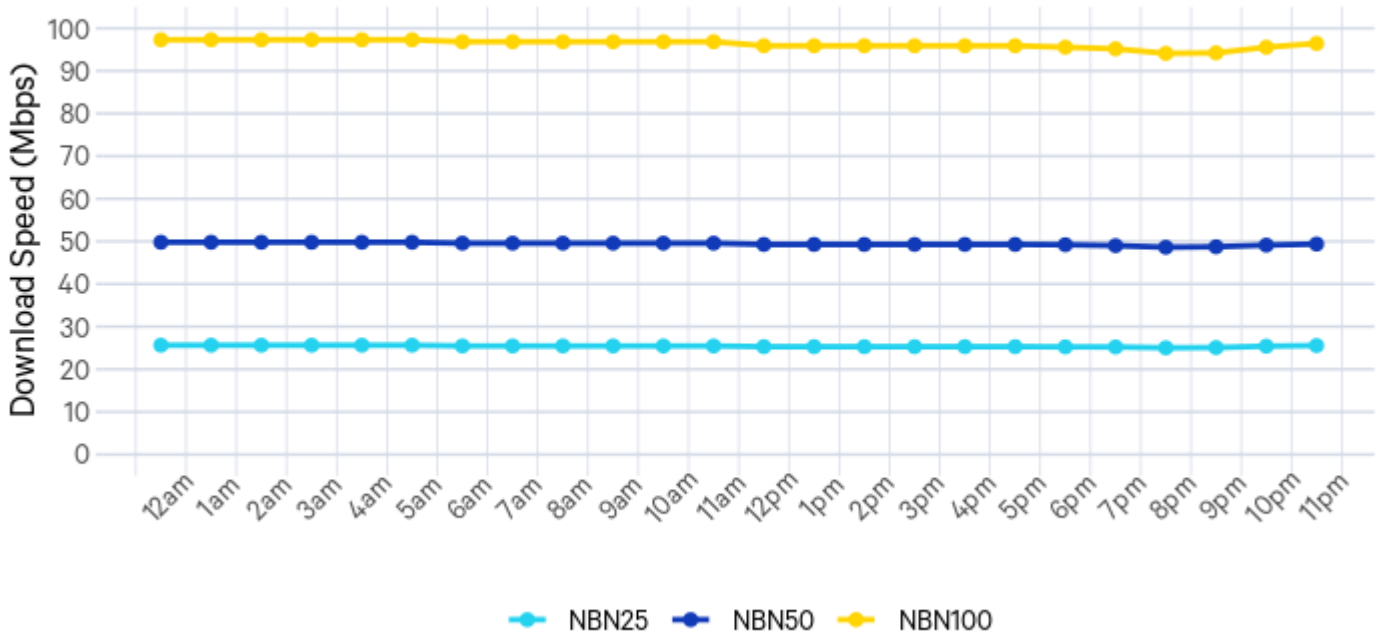


The range of speeds by RSP during the busiest hours varied from between 88.4% to 99.0% of plan speed. This is a wider range of results compared with the download metrics for all hours and busy hour metrics shown in Figure 1. Some RSPs were more affected by high demand peaks than other RSPs.

Figure 3 shows download speeds averaged across the month for each hour in the day.

Figure 3: Average hourly download speed by plan

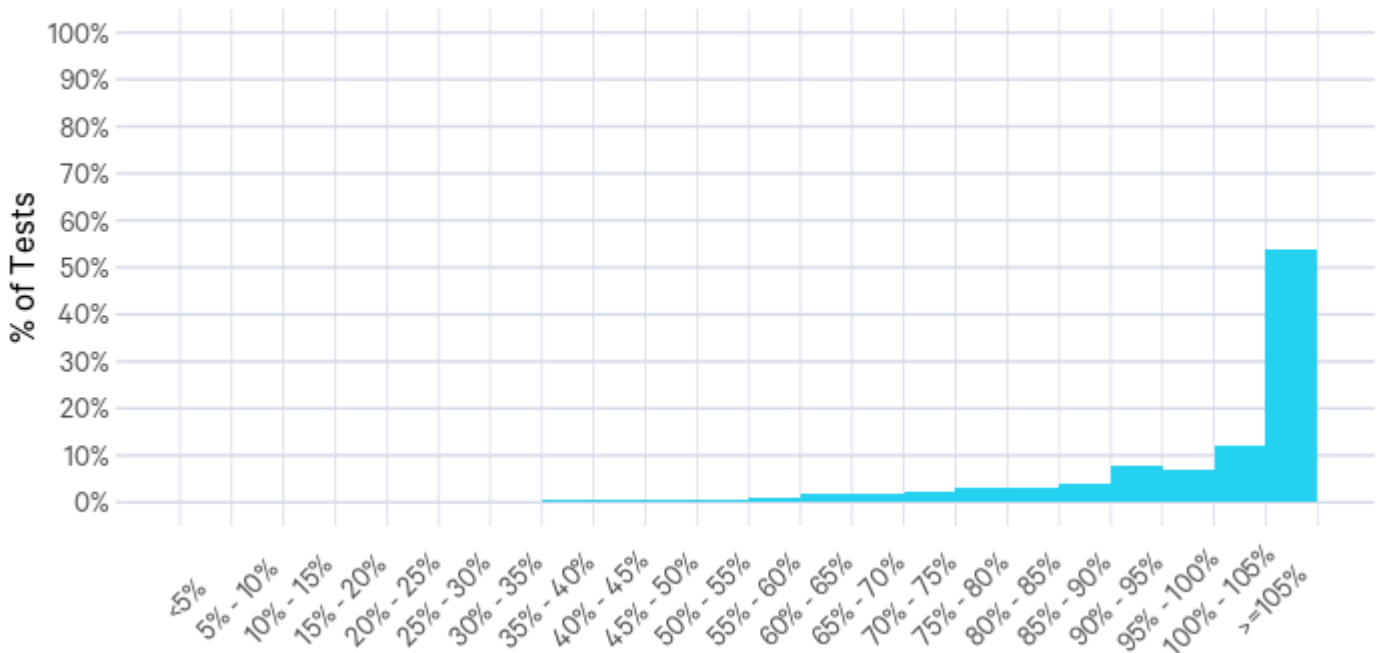
NBN fixed-line plans. Including underperforming services.



Average download speeds held steady throughout the day for users on most NBN plans. The 100Mbps NBN plans remain the most affected by increased user activity in the evening hours: speeds typically started to decrease during the evening, dipping to 3.2Mbps below the day's maximum by 8pm, and would recover to higher levels during the night. The average dip in NBN100 speeds is higher than that observed in the previous report (2.4Mbps).

Figure 4: Frequency of download speeds attained during tests

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



During this reporting period, 243,837 download speed tests were performed across 1,268 Whiteboxes connected to fixed-line NBN infrastructure.

Of these tests, 65.9% achieved at least 100% of plan speed; for reference, 64.4% of tests in the previous report were at plan speed or higher.

The proportion of tests achieving less than 50% of plan speed was found to be 2.2% in this reporting period; for reference, 2.1% of tests failed to meet the 50% mark in the previous reporting period.

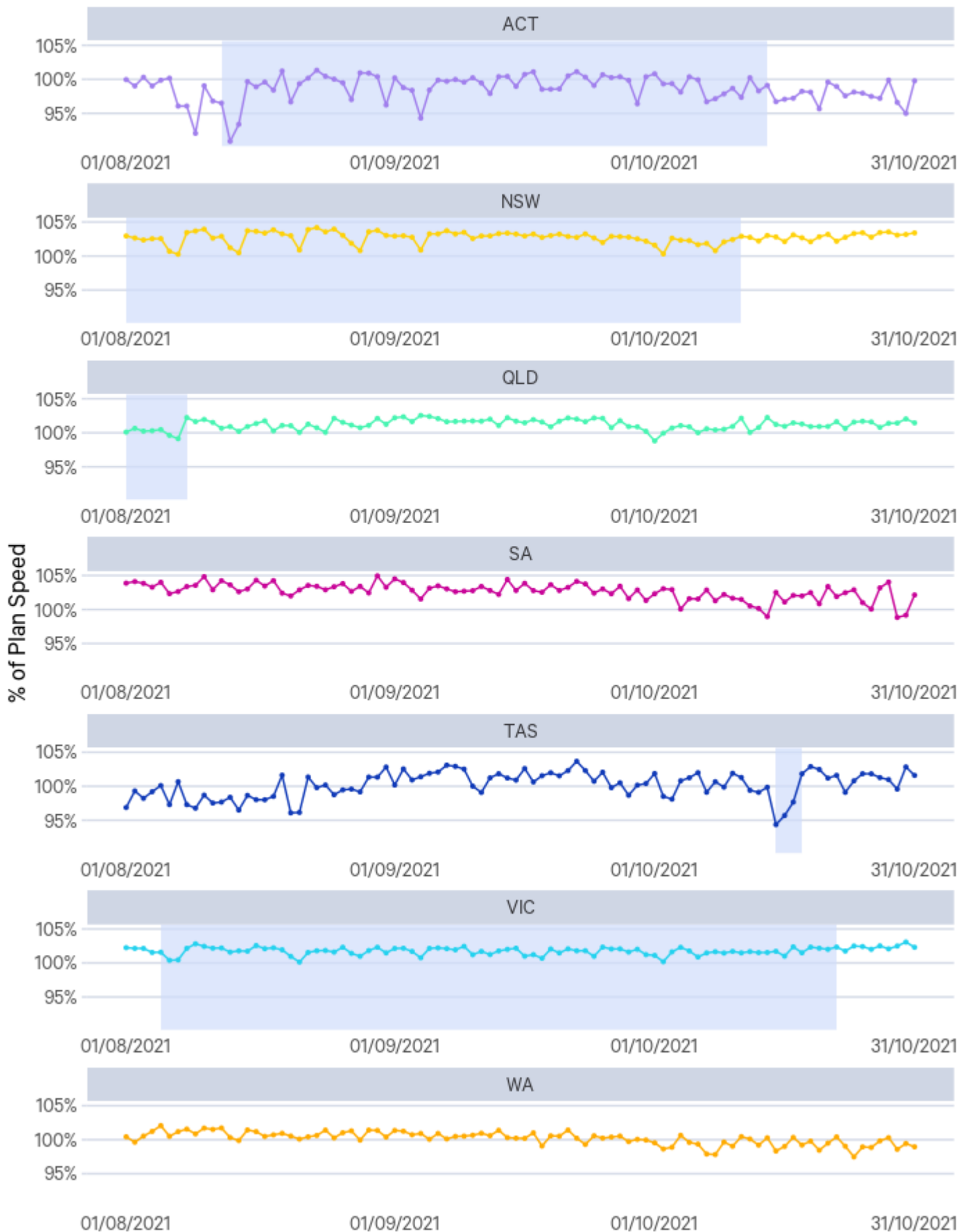
Download performance between the States and Territories

Figure 5 shows daily average busy hour download speeds by State/Territory.⁵ The data presented in this section covers the three-month period from 1st August 2021 to 31st October 2021. The shaded areas in this chart indicate periods in which the capital city of the relevant State or Territory was subject to COVID-19 lockdown measures.

⁵ We have not included data from the Northern Territory (NT) due to a low sample size in that region. In other parts of the report, NT is combined with SA. We have not taken this approach in this section since the NT went into lockdown during the reporting period whereas SA did not.

Figure 5: Daily average download speed by State/Territory

NBN fixed-line plans. Including underperforming services. Shaded areas indicate when capital cities were in lockdown. Data from the Northern Territory (NT) not included due to low sample size. August 2021 to October 2021.



The day-to-day changes in download speeds across all states range within 5% of plan speed except for a few days in the ACT and Tasmania. Days with drops in performance are also seen outside of the periods of strict lockdown in each State/Territory. Conversely, there are days during lockdowns where performance is at a similar level to times outside of lockdowns. At a State/Territory level, there is no clear indication of materially reduced download speed related to the onset of a lockdown.

Daily average download speeds by plan

NBN fixed-line plans from 1 August 2021 to 31 October 2021

This section of the report analyses the average daily download speeds of the NBN fixed-line network. This section also compares the percentage change in average daily download speeds by NBN fixed-line plan against a pre-COVID-19 February 2020 average baseline.

Figures 6-9 present average daily download speeds for the following NBN fixed-line plans:

- NBN100
- NBN50
- NBN25

The daily averages are calculated by aggregating raw test results by Whitebox, plan speed and day, with this then averaged across all Whiteboxes for each plan speed. Additionally, we have presented the percentage change in average daily download speeds for each fixed-line plan against a pre-COVID-19 February 2020 average baseline. For these time series charts, calculations have been conducted for all hours and busy hours (7pm - 11pm) from Monday to Sunday. Our calculations exclude underperforming⁶ and impaired⁷ services. All charts use a consistent set of Whiteboxes across the entire reporting period. If a Whitebox changed plan during the period, it is excluded.

Figures 6 and 7 show the average download speed each day for the NBN25, NBN50, and NBN100 plans. Performance is broadly stable for all plan speeds during all hours. There is

⁶ We classify a service as 'underperforming' if no more than 5 percent of speed tests that we conducted over the service achieved a speed that was above 75 percent of maximum plan speed. This test effectively identifies those 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.

⁷ Impaired services are those where NBN Co provides us with the information that the maximum plan speed cannot be attained due to physical limitations.

more variability in network performance during busy hours compared with all hours, particularly for NBN100 plans.

Figure 6: Average daily download speeds during all hours by plan

NBN fixed-line plans. Excluding underperforming and impaired services.

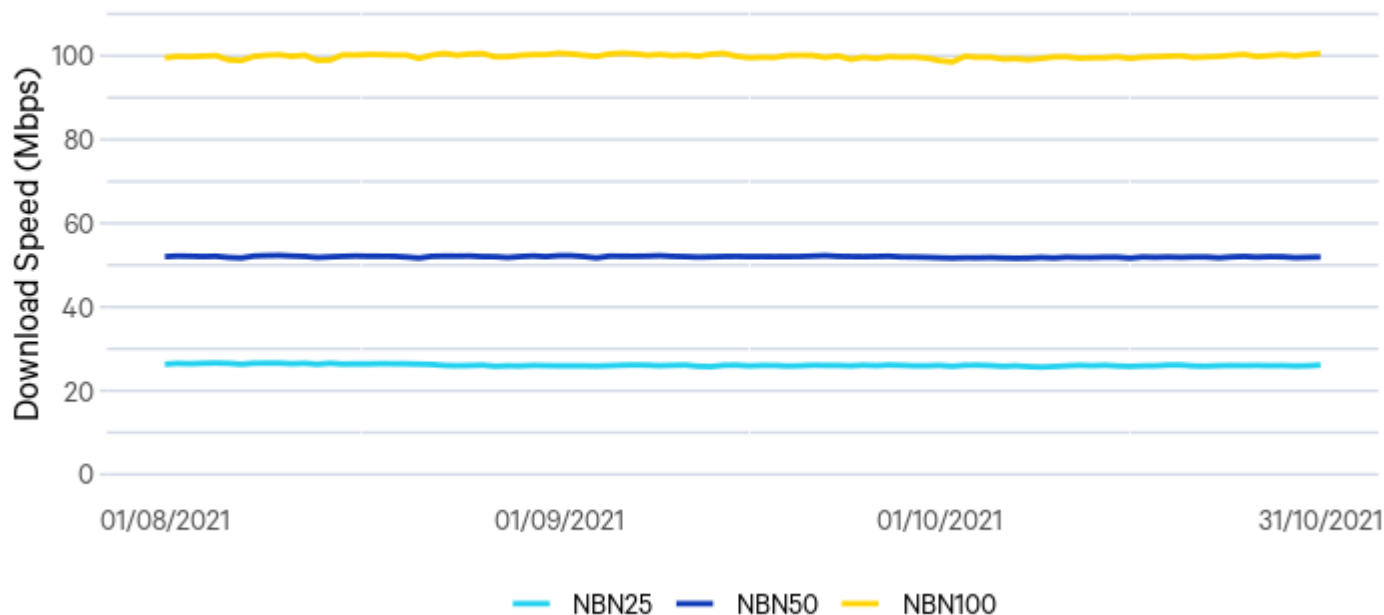
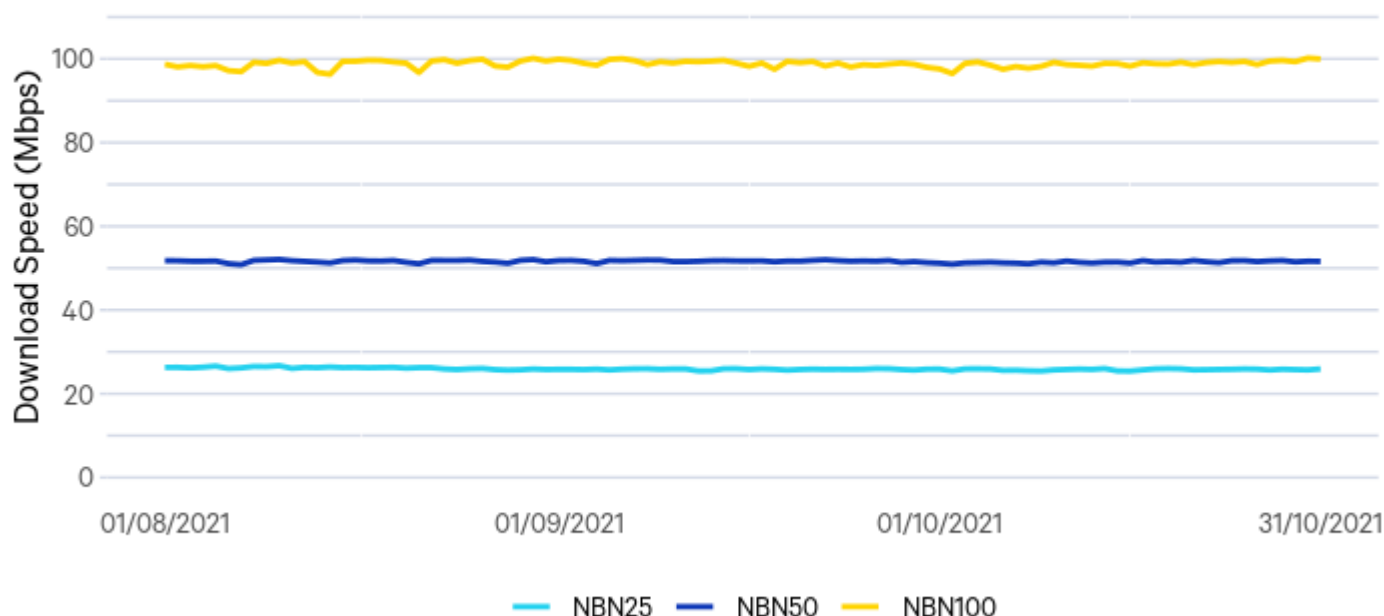


Figure 7: Average daily download speeds during busy hours by plan

NBN fixed-line plans. Excluding underperforming and impaired services.



Figures 8 and 9 track the percentage change in download speed recorded each day over the August to October 2021 period by plan speed, as compared against a pre-COVID-19 baseline of February 2020. Both figures exclude impaired and underperforming units.

During all hours, download speeds for the period were consistently above the February 2020 pre-COVID-19 baseline. This is due to the overprovisioning of the download component of most plans which was implemented between June and August 2020. Performance was broadly stable over the period, although the NBN25 plan finished the period slightly lower. Network download speed performance during busy hours follows a similar pattern to that of all hours but with higher variability across the period.

Figure 8: Change in average daily download speeds as compared to February 2020 baseline, during all hours by plan

NBN fixed-line plans. Excluding underperforming and impaired services.

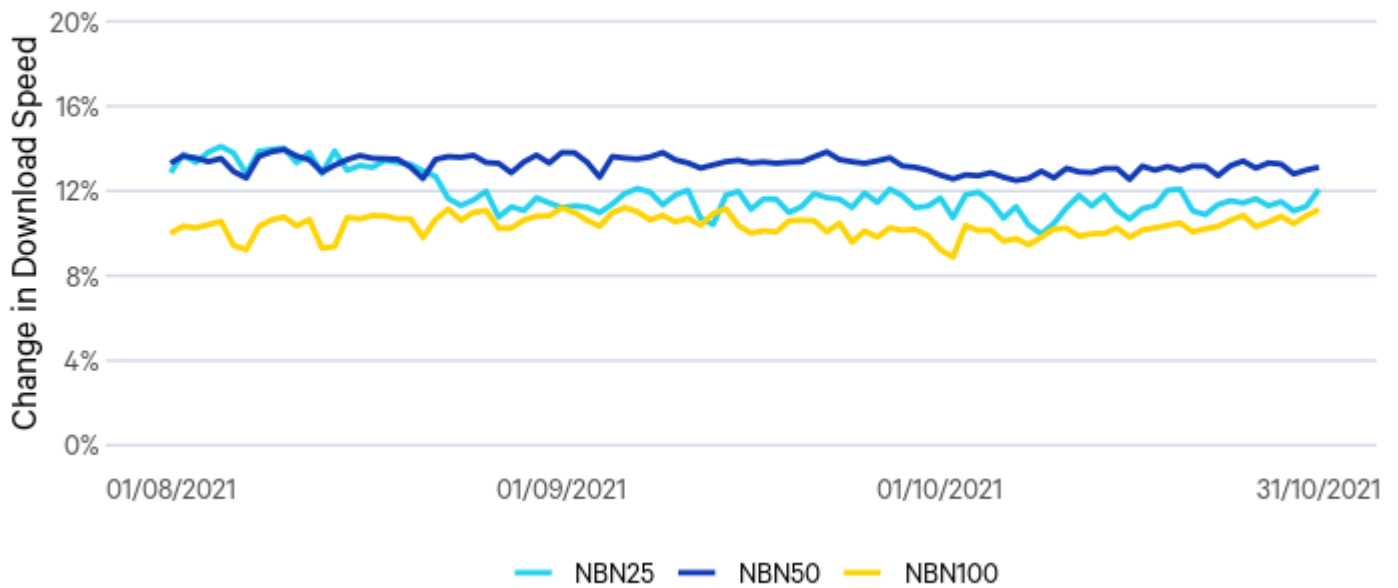
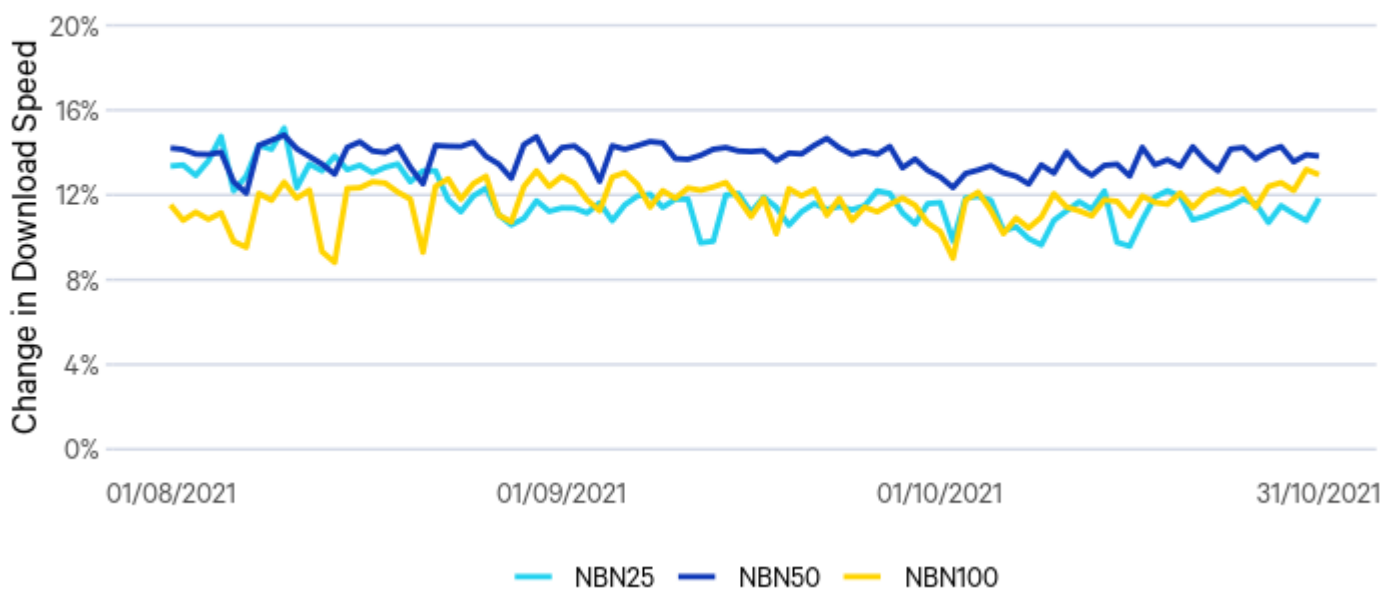


Figure 9: Change in average daily download speeds as compared to February 2020 baseline during busy hours by plan

NBN fixed-line plans. Excluding underperforming and impaired services.



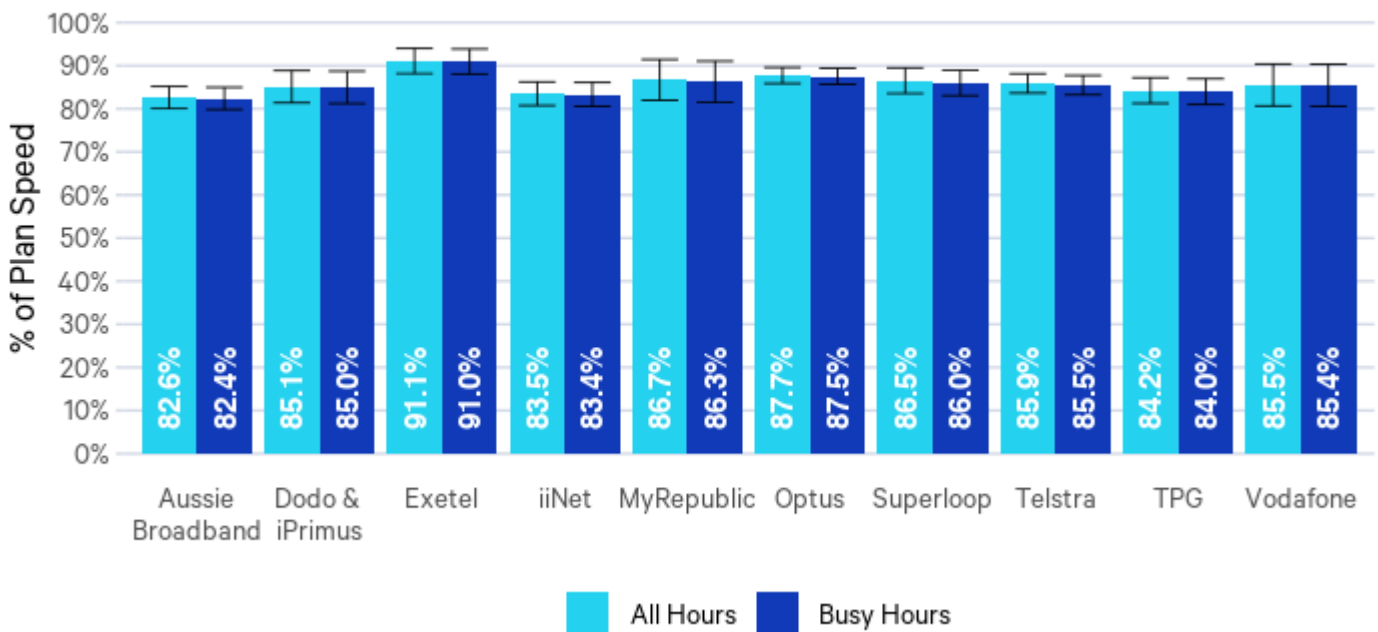
Compared against a pre-COVID-19 baseline, the main NBN fixed line plans' daily average download speeds between August 2021 and October 2021 are at stable levels of around +9% to +15%.

Upload speed test results

Figures 10 and 11 show upload speeds for the main NBN fixed-line RSPs and plans. 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. Unlike download speeds, the upload component of NBN speed tiers is not overprovisioned.

Figure 10: Average upload speed by RSP

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

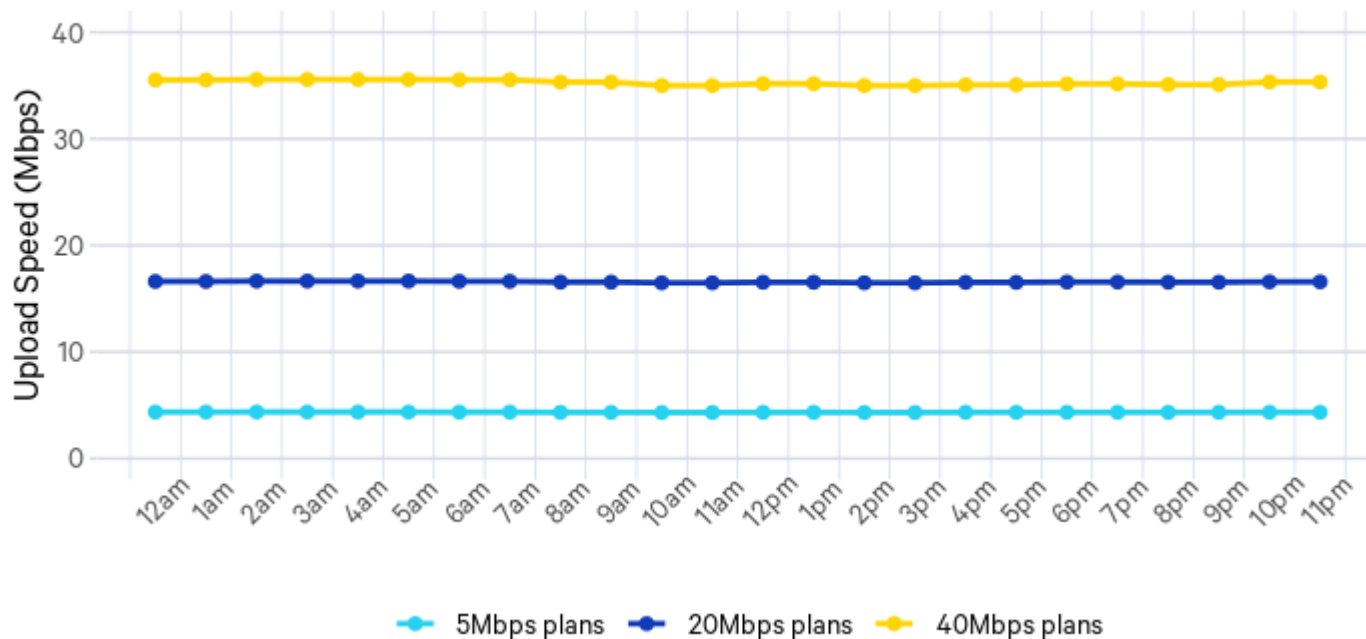


Upload performance remained similar when compared to the previous report, measuring May 2021: NBN services achieved an overall average upload performance of 85.1% during all hours, as against 84.9% in the previous report. As the upload is not overprovisioned, upload results are lower than download results relative to plan speed.

Average upload performance ranged between 82.6% and 91.1% during all hours across RSPs.

Figure 11: Average hourly upload speed by plan

NBN fixed-line plans. Including underperforming services.



Average hourly upload speeds were steady throughout the day, with negligible change during busy evening hours.

Daily average upload speeds by plan

NBN fixed-line plans from 1 August 2021 to 31 October 2021

This section of the report analyses the average daily upload speeds of the NBN fixed-line network. Figures 12 and 13 present average daily upload speeds for the following NBN fixed-line upload speed plans:

- 20Mbps
- 40Mbps

The daily averages are calculated by aggregating raw test results by Whitebox, plan speed and day, with this then averaged across all Whiteboxes for each plan speed. For these time series charts, calculations have been conducted for all hours and busy hours (7pm - 11pm) from Monday to Sunday. Our calculations exclude underperforming and impaired services. All charts use a consistent set of Whiteboxes across the entire reporting period. If a Whitebox changed plan during the period, it is excluded.

Figure 12: Average daily upload speeds during all hours by plan

NBN fixed-line plans. Excluding underperforming and impaired services.

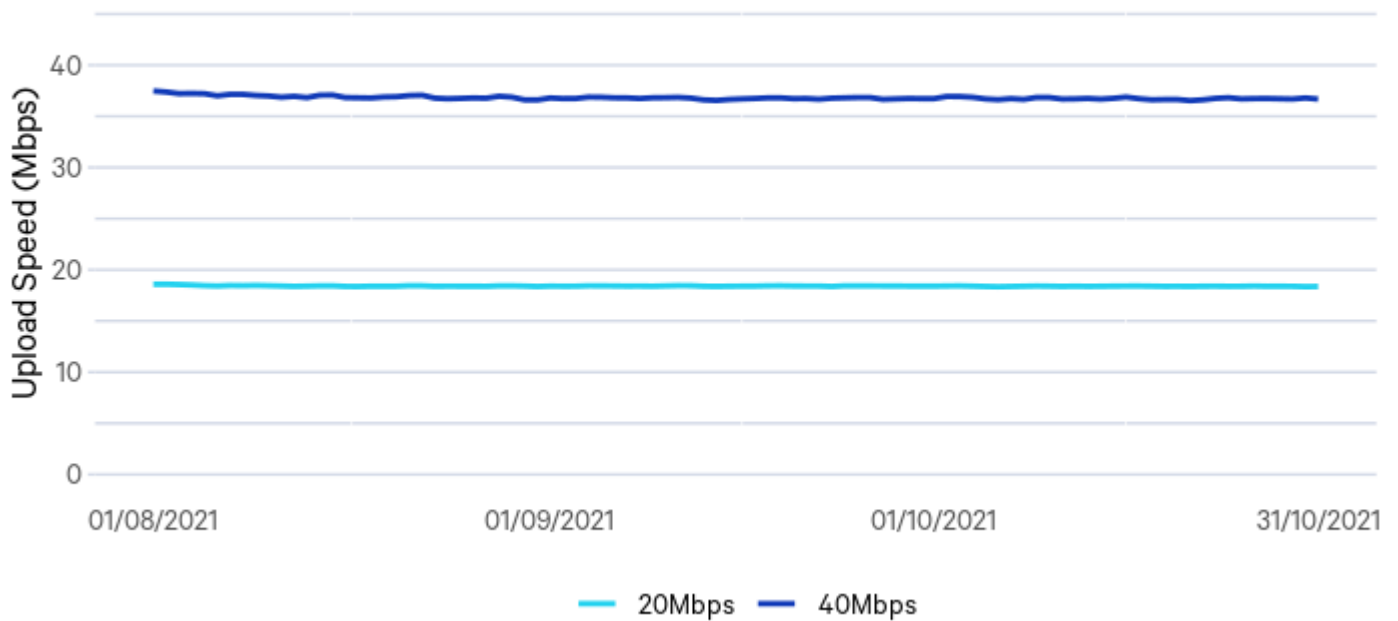
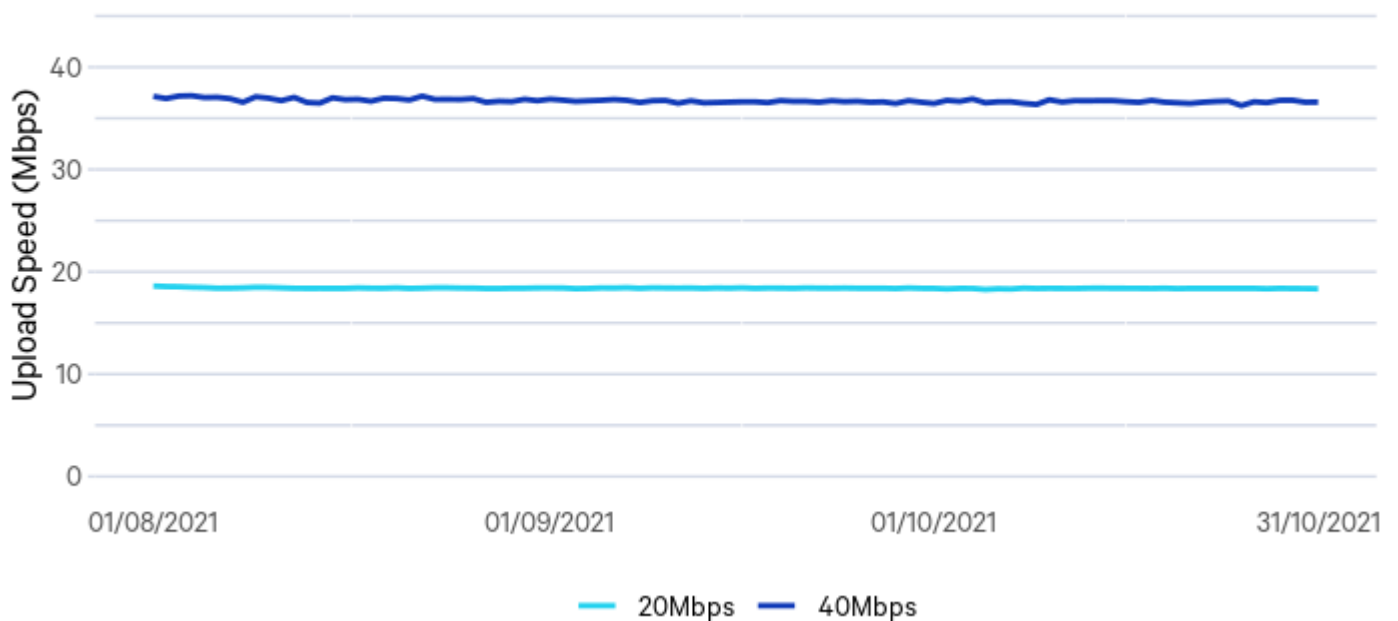


Figure 13: Average daily upload speeds during busy hours by plan

NBN fixed-line plans. Excluding underperforming and impaired services.



Figures 12 and 13 show that the daily average upload speed for plans with 20Mbps and 40Mbps upload speeds did not experience much variation between August and October 2021. There is also no noticeable difference in upload speeds during all hours and busy hours.

Impact of underperforming services on download speed

As in previous reports, we present separate measures of download performance exclusive of underperforming services. These are services that do not achieve speeds that approach plan speeds at any time of the day. They are essentially services that the RSP supplies to a consumer with a plan speed that cannot be attained due to specific physical limitations affecting the service.

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 underperforming services; a small number of underperforming services can have an appreciable effect on an RSP's overall performance metrics.

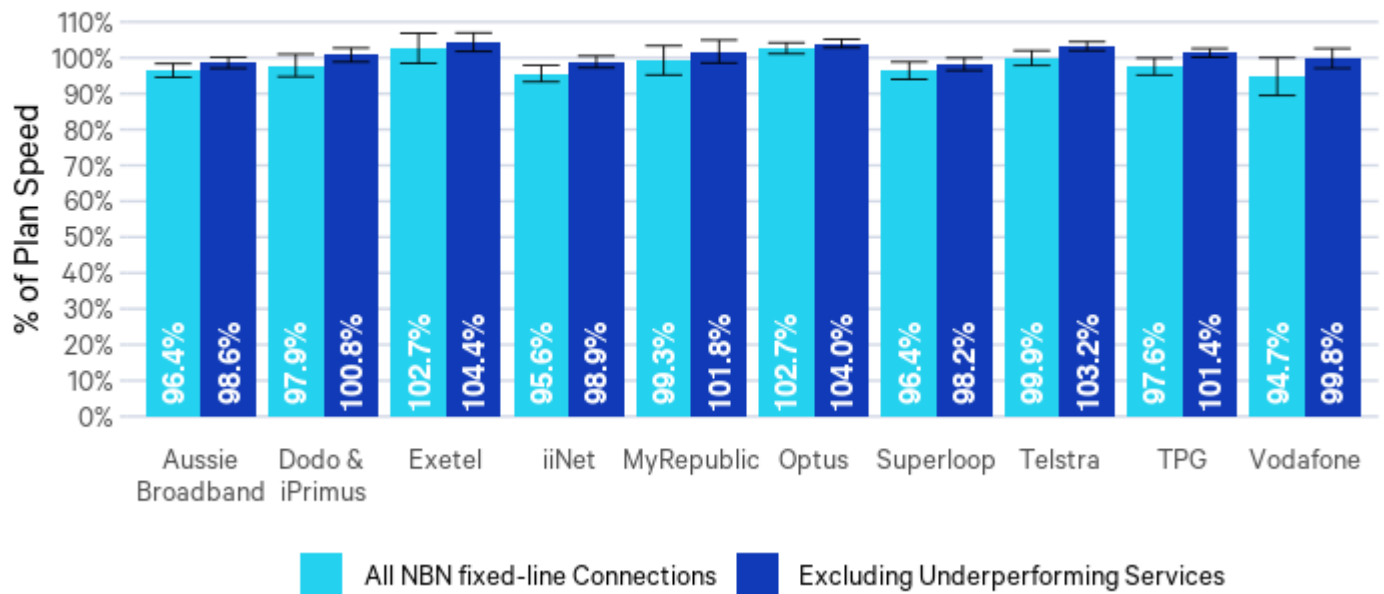
- Underperforming services represented 6.3% of the 1,268 NBN services that were tested for this report.
- Fibre to the node services make up 89% of underperforming NBN services in our sample.
- The NBN50 and NBN100 plans account for 89% of the underperforming NBN services in our sample.

Once underperforming services are excluded, the average download performance during all hours is 101.1% as against the 98.3% figure quoted earlier for all services. This means that if underperforming services had been remediated before the measurements were collected, then overall download performance would have been 2.8 percentage points higher than was actually observed during the period.

As in previous reports, all RSPs' performance were impacted to some extent by underperforming services during the period.

Figure 14: 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.

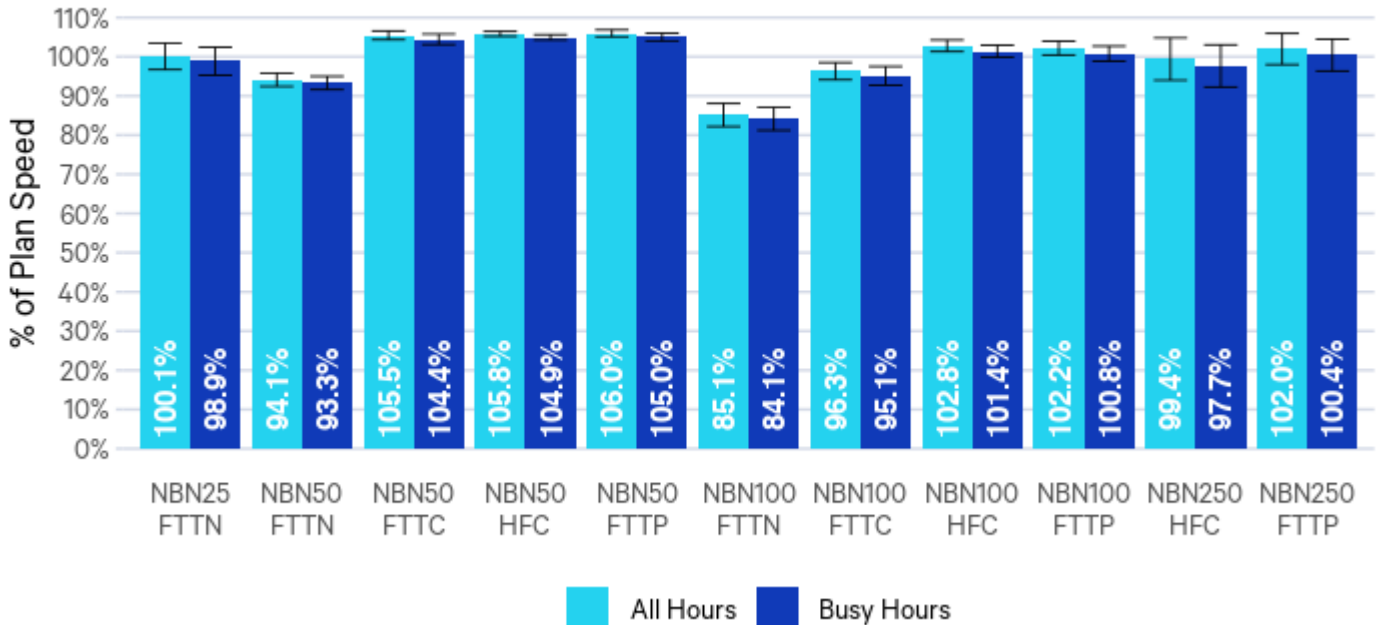


Download speed by NBN plan and access technology

Figure 15 shows average download speed for different access technologies for different NBN plans:

Figure 15: Average download speed by plan and technology

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



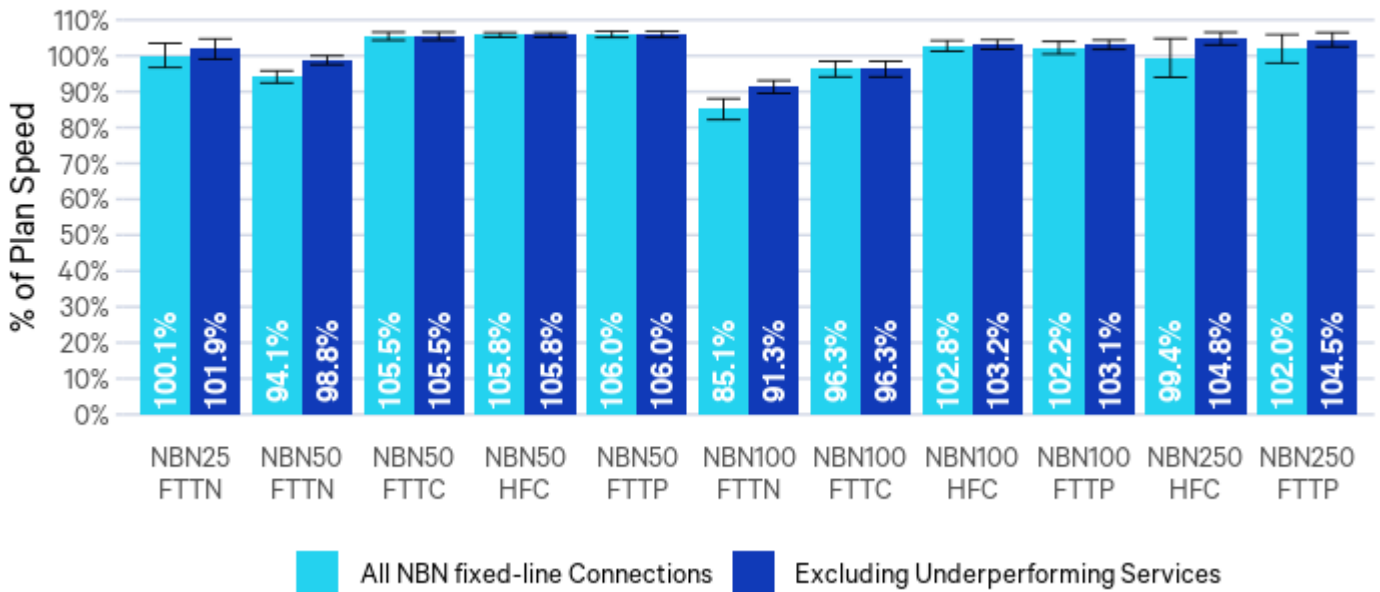
Within the NBN50 plan, fibre to the node services had an average download speed around 6Mbps lower than other technologies, a difference of 12% when comparing in percentage terms as shown in Figure 15. Within the NBN100 plans, fibre to the node services had an average download speed around 16Mbps lower than other technologies.

The pattern of results is similar to that seen in previous reports, with fibre to the node performing significantly below other access technologies for the 50 and 100 plans.

Figure 16 shows the impact of underperforming services on average download speed across different plans and technologies.

Figure 16: Average download speed by plan and technology - inclusive and exclusive of underperforming services

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



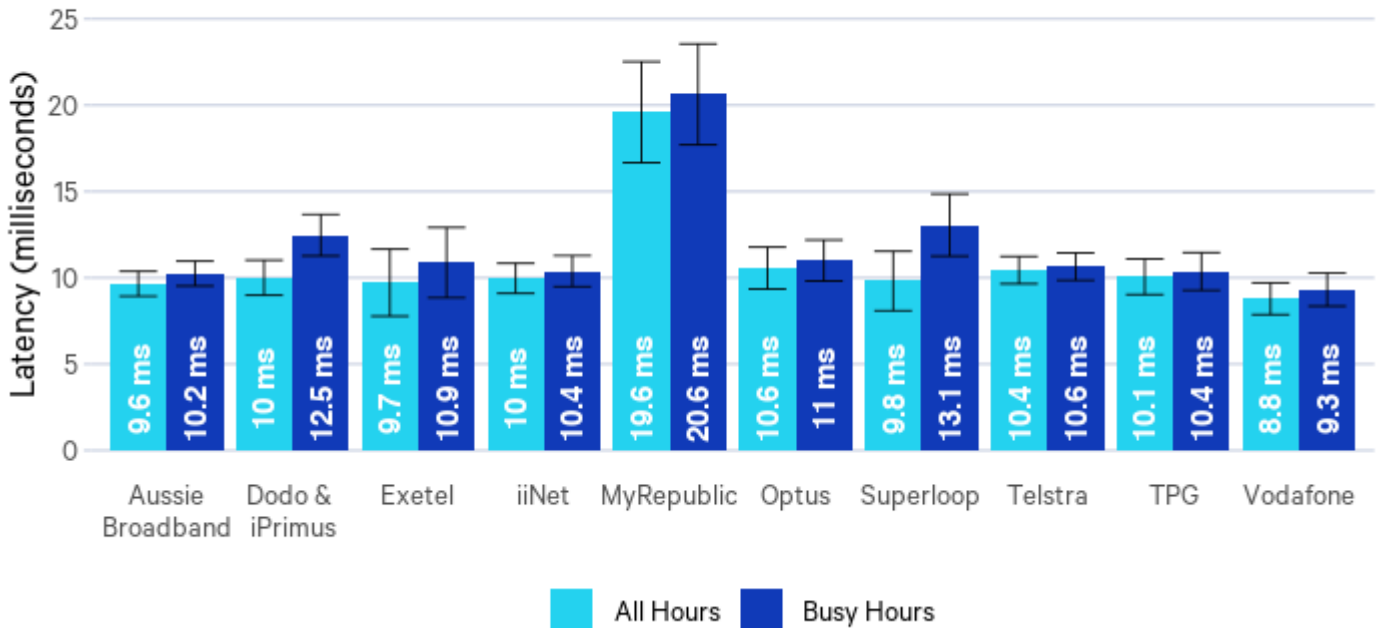
Fibre to the node services continue to account for the bulk of the impact from underperforming services across both the NBN50 and NBN100 plans.

Latency, webpage loading time, and packet loss by plan

Figure 17 shows average round trip latency, which is the average time required to send a packet of data to the test server and back. Lower latency will result in more responsive behaviour from real-time applications such as video conferencing and online gaming.

Figure 17: Average latency by RSP

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



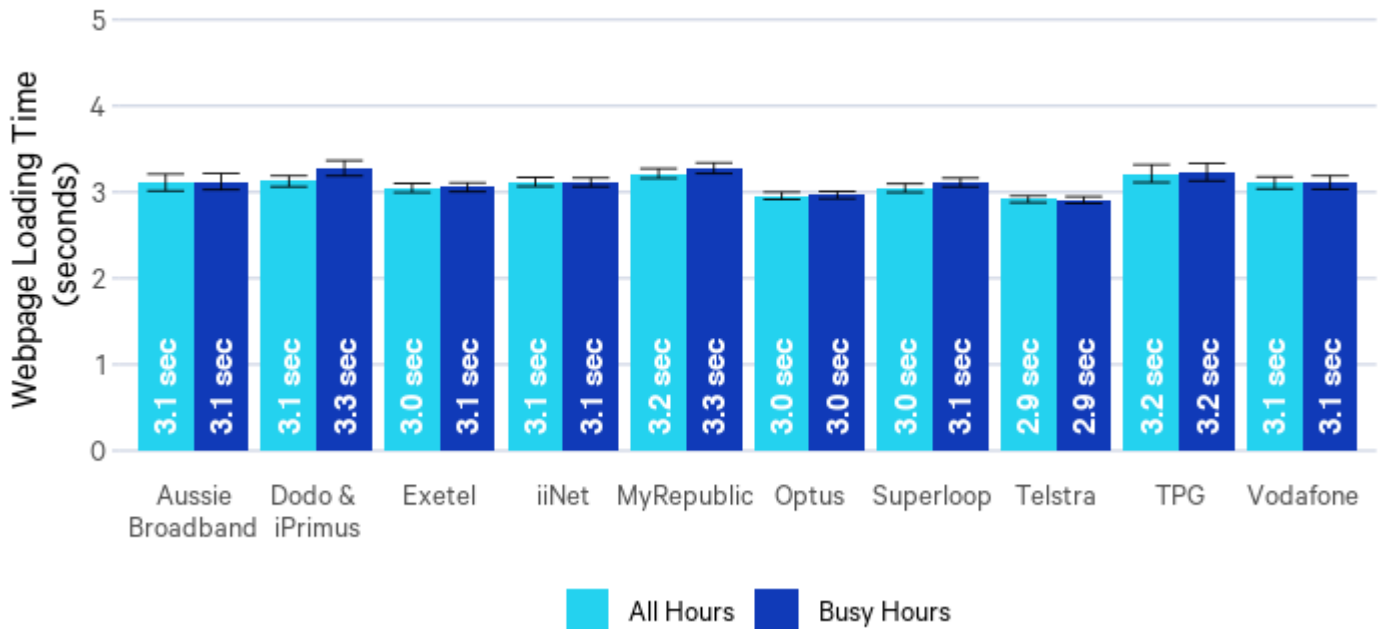
Latency results from this period are in line with the previous report: average latency was generally below 13ms during all hours across RSPs with the exception of MyRepublic.

MyRepublic services had higher average latency than those served by other RSPs, although MyRepublic's average latency did remain at a similar level during busy hours. It should be noted that these latency values are so low that their effect is unlikely to be noticed by a typical end user, even when using more latency-sensitive applications (such as videoconferencing services or online gaming).

Figure 18 shows the average time required to fully load eight popular webpages for Australian users across all NBN plans, per RSP.

Figure 18: Average webpage loading time by RSP

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

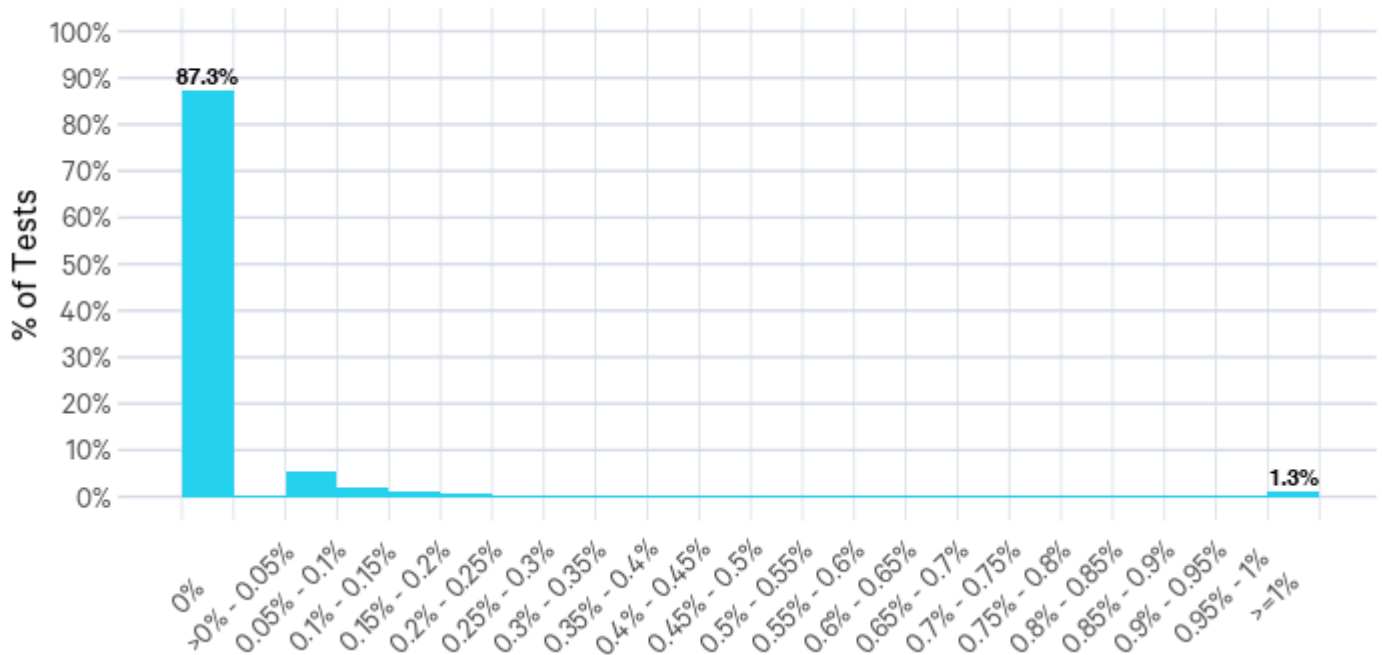


The average time needed to load a website decreased by approximately half a second for each RSP compared to the previous report. More information on the factors that impact web browsing experience can be found in the Web performance test report at <https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/measuring-broadband-australia-program/web-performance-test-report>.

Figure 19 shows the frequency at which different levels of packet loss occurred during tests. Packet loss measures the percentage of packets that were lost somewhere between the router and the test server, often due to network congestion. Packet loss is expressed as a percentage of all packets sent.

Figure 19: Frequency of packet loss rates observed during tests

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



A total of 793,271 packet loss tests were conducted over the measurement period. 87.5% of these tests had packet loss of either zero or less than 0.05%. For reference, in the previous report 88.0% of tests had packet loss below 0.05%.

At the other end of the scale, 1.3% of tests had packet loss greater than 1% as against 1.7% in the previous report. At levels above 1%, packet loss can cause issues which are detrimental to user experience, such as webpages failing to load and unstable video calls.

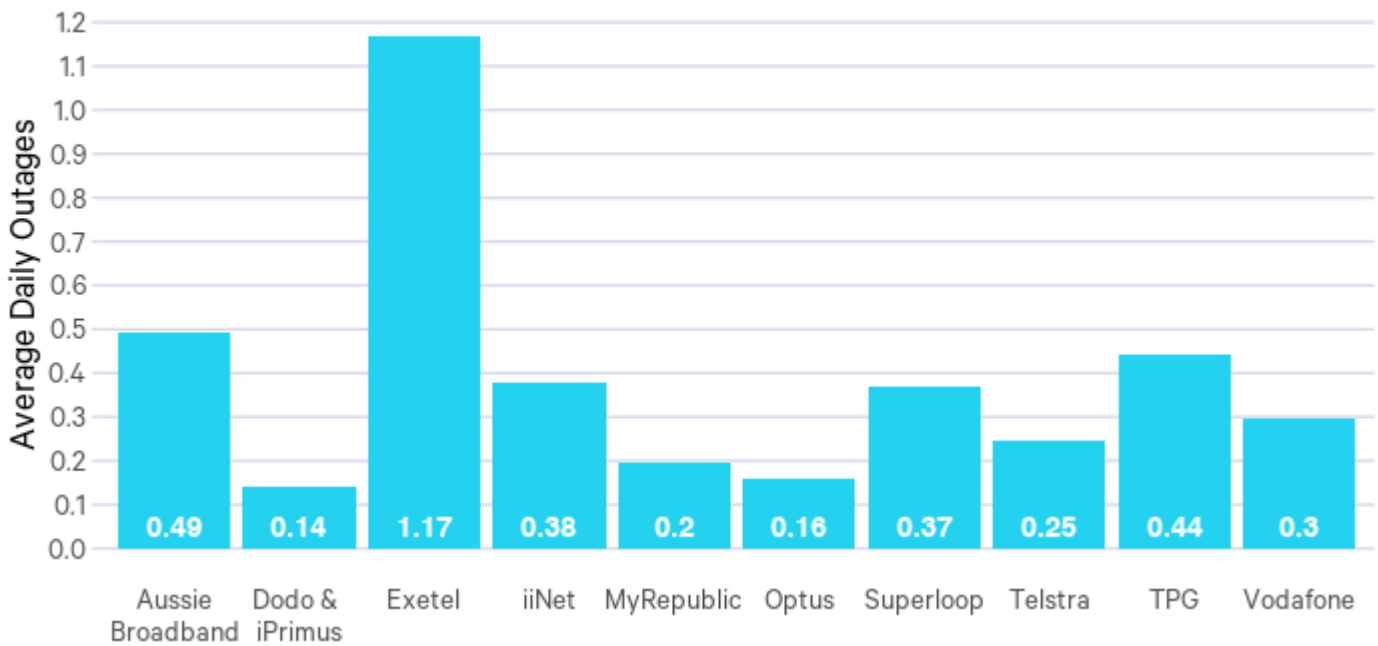
Outages

Figures 20 and 21 show, for each RSP:

- the average rate of daily outages for a service, indicating how often outages occurred
- the distribution of outage duration, indicating the severity of outages' impact on user experience.

Figure 20: Average daily outages lasting over 30 seconds by RSP

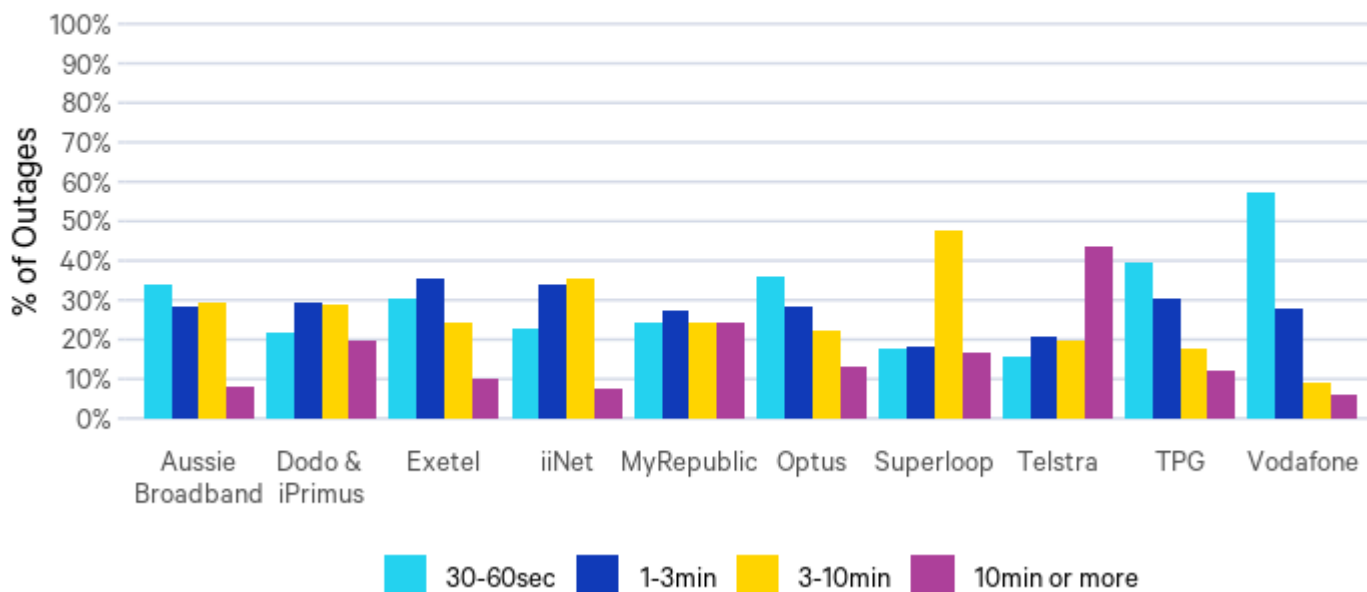
NBN fixed-line plans. All hours. Including underperforming services.



All RSPs' rates of outages were relatively low except for Exetel. Exetel's high result can mainly be attributed to a single period in the early afternoon of 7th September, when the Exetel services in our panel experienced a higher than usual rate of outages.

Figure 21: Distribution of outage duration by RSP - NBN plans including underperforming services - all hours

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



As the majority of outages last for no more than 3 minutes, outages are likely to have little material impact on end user experience.

Download speed during the busiest hour

In this report, the busiest hour speed is the fifth-lowest average hourly download speed across each busy hour within the month. A result in which the busiest hour speed is relatively close to the average busy hour speed indicates that a plan is relatively unaffected by higher demand especially at busy times. Results in which busiest hour speeds are further below the average busy hour speeds indicates that a plan is more affected by particularly high demand peaks.

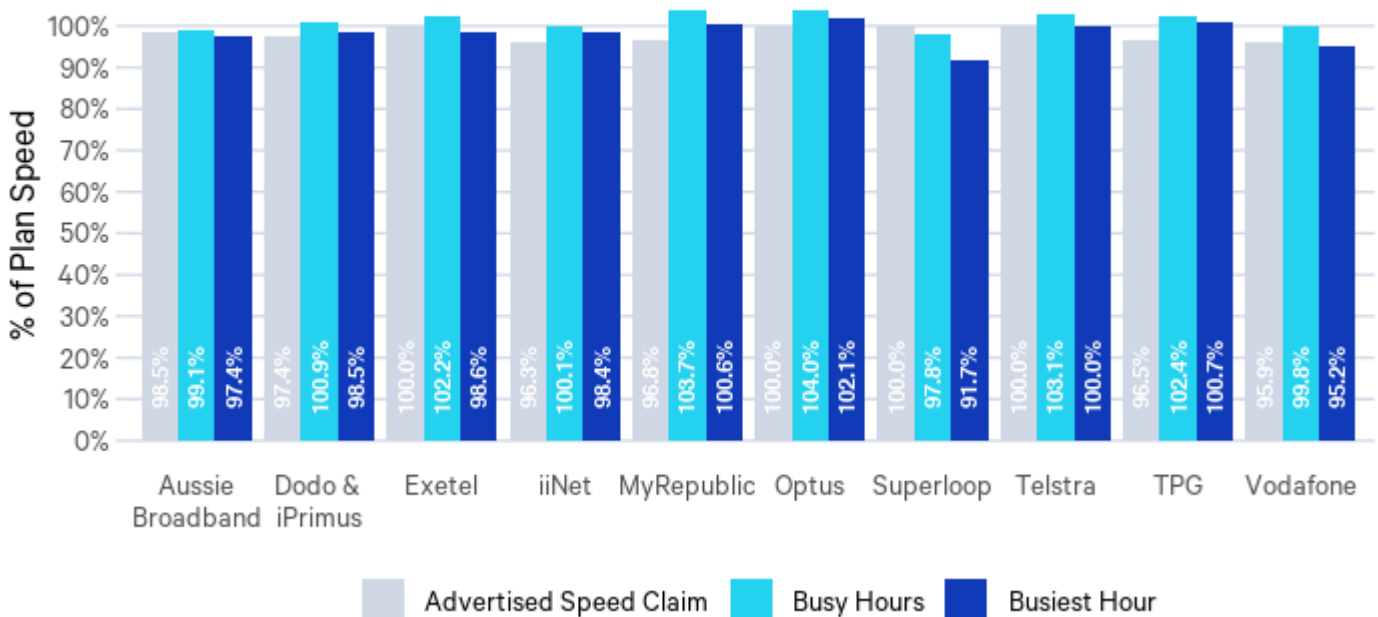
During the measurement period, RSPs advertised download speeds for their NBN50 and NBN100 products that were between 90% and 100% of the maximum achievable by the products, with Aussie Broadband advertising the lowest speed for NBN50 at 49Mbps and iiNet, TPG and Vodafone advertising the lowest speeds for NBN100 at 90Mbps. Exetel, Optus, Superloop and Telstra were advertising the highest speeds, offering the nominal 50Mbps for their NBN50 plan and 100Mbps for their NBN100 plan.

Figure 22 shows the typical evening hour speeds that were the predominant speed advertised by RSPs during the measurement period, as well as the busy hour and busiest hour download performance by RSP excluding underperforming and impaired services.

Figures 22 and 23 show performance by RSP for NBN50 and NBN100 plans across all NBN fixed-line technologies.

Figure 22: Advertised speeds and average download speeds by RSP

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

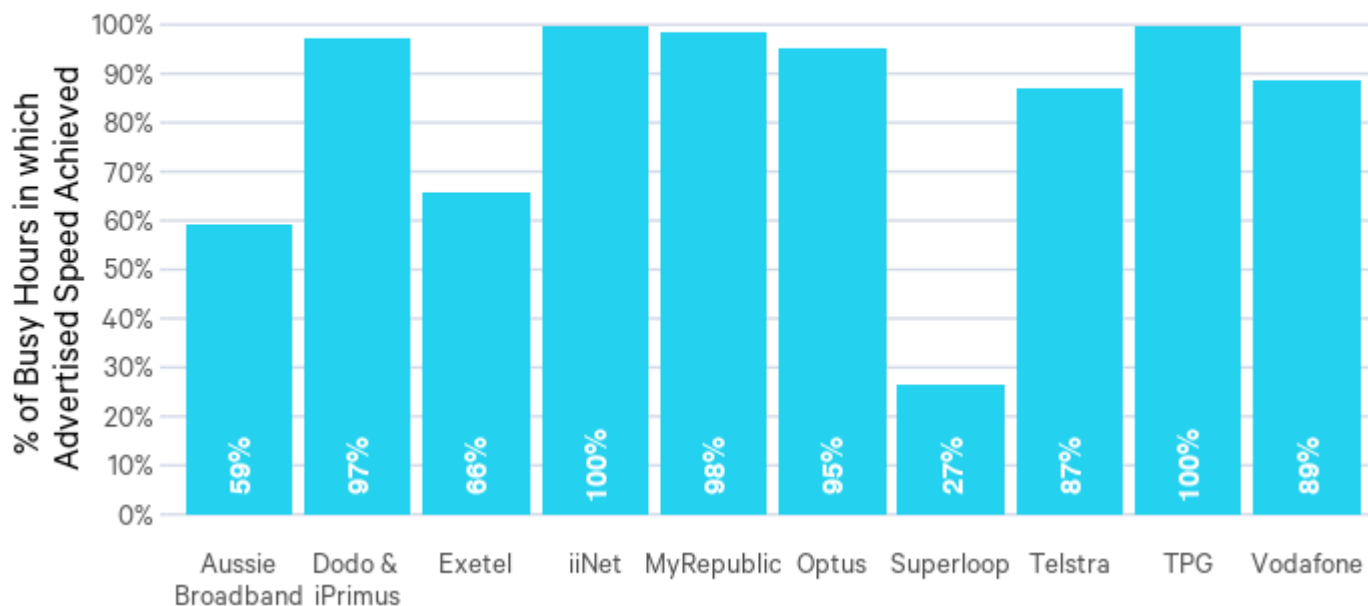


From these results we can see that if all underperforming services and impaired services had been remediated – or moved to a more appropriate plan - then the majority of RSPs would have average speeds that met or exceeded advertised speed claims during their busy hours.

Figure 23 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.

Figure 23: Proportion of busy hours where advertised speed was achieved - by RSP

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



If all underperforming services and impaired services had been remediated – or moved to a more appropriate plan - then the proportion of busy hours when RSPs met their advertised speed claims would have been no lower than for the majority of providers⁸.

⁸ Superloop had adjusted its advertised NBN100 speed claim down from 100Mbps to 96Mbps by 27th September 2021. The reported 27% is calculated using the predominant speed that Superloop advertised for its NBN100 plans throughout September 2021; when assessed against speed claims from 27th September, Superloop’s download speed exceeded advertised claims in 55.4% of September busy hours.

NBN very high speed services

This section presents results for NBN fixed-line very high speed services for the same period, September 2021, as for other fixed-line results. Very high speed services refers to plans where the underlying wholesale product sold by NBN Co has a download/upload speed range of 500-990/50Mbps (referred to by NBN Co as “Ultrafast”). This section is based on a total of 136 monitored very high speed services, across both fibre to the premises (FTTP) and hybrid fibre-coaxial (HFC) technologies.

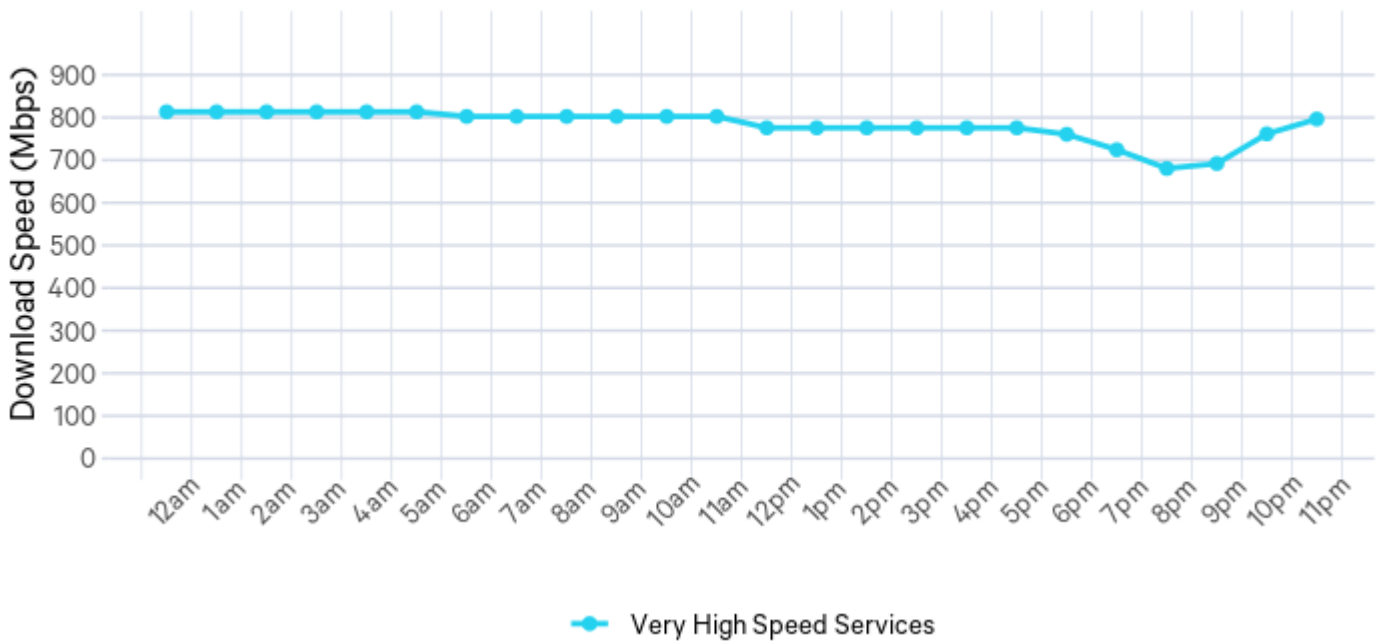
We note that currently, unlike other NBN plans, NBN Co does not overprovision on the download component of very high speed services. Coupled with the fact that the Whitebox connects via gigabit Ethernet to the home gateway, this means that the end-to-end link is limited to 1Gbps. After network/transport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

The hourly average download speeds attained by NBN very high speed services ranged across the day between 680Mbps and 813Mbps. Performance varied more during the busy hours (between 7pm and 11pm) and wider evening peak period, which is when networks experience higher user activity.

The measured download speeds show an improvement over the previous results.

Figure 24: Average hourly download speed for very high speed services

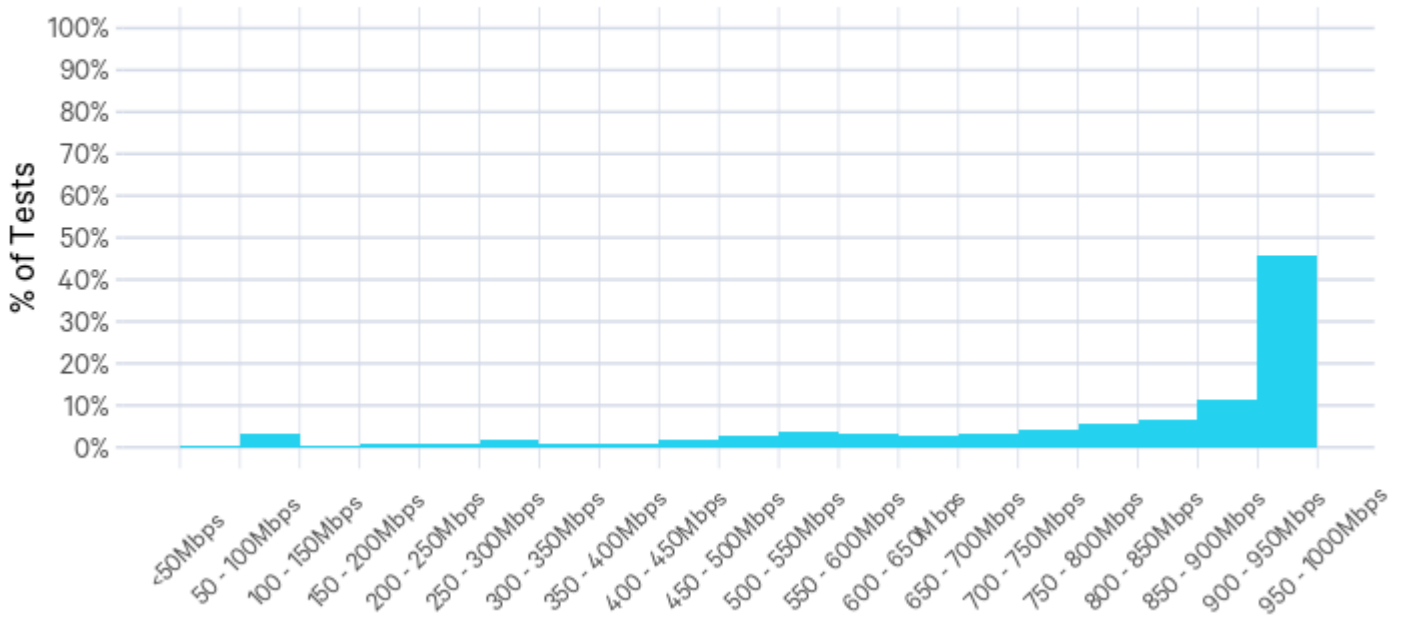
NBN very high speed services.



Average download speeds showed considerable variation throughout the day for very high speed services: speeds typically started to decrease during the evening, dipping to 133Mbps below the day’s maximum speed by 8pm, and would recover to higher levels later at night. This dip in speeds for very high speed services is greater than for the other major NBN plans considered earlier in this report, including NBN100 plans. This shows that NBN very high speed plans are more susceptible to congestion during busy periods than lower speed plans.

Figure 25: Frequency of download speeds attained during tests of very high speed services

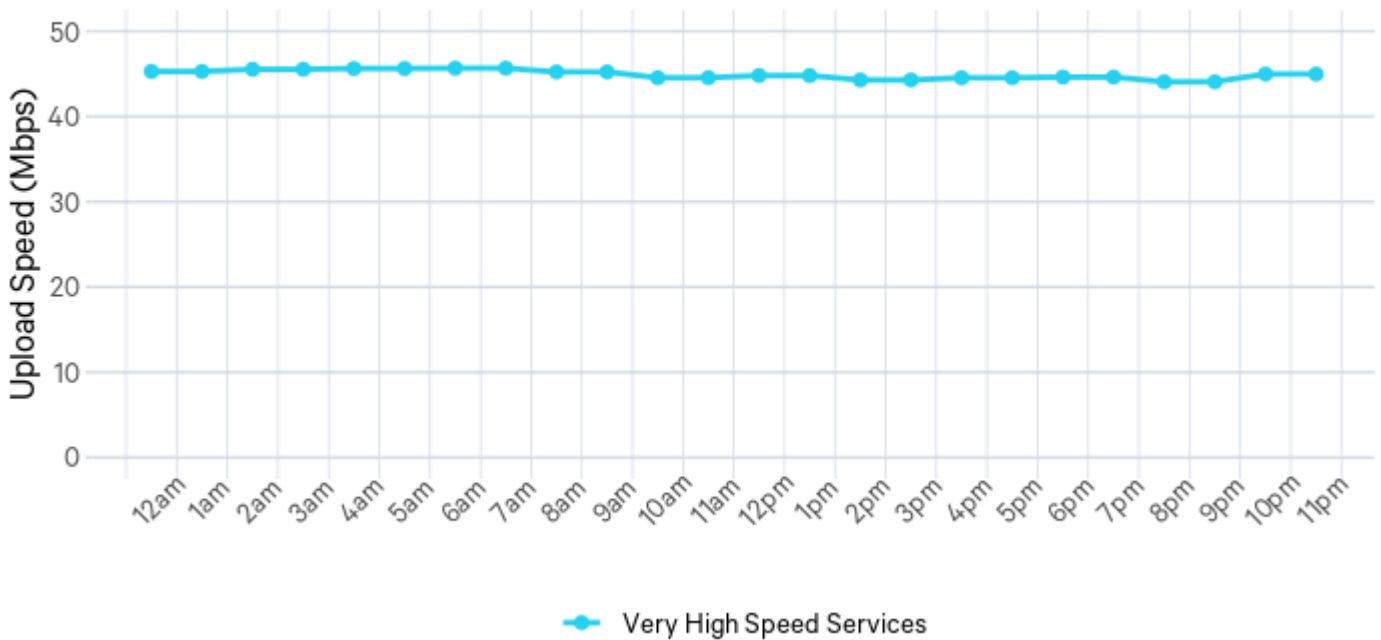
NBN very high speed services. All hours.



During this reporting period 24,076 download speed tests were performed across 136 Whiteboxes connected to fixed-line NBN infrastructure. Of these tests, 45.9% of tests conducted achieved a download speed of at least 900Mbps.

Figure 26: Average hourly upload speed for very high speed services

NBN very high speed services.



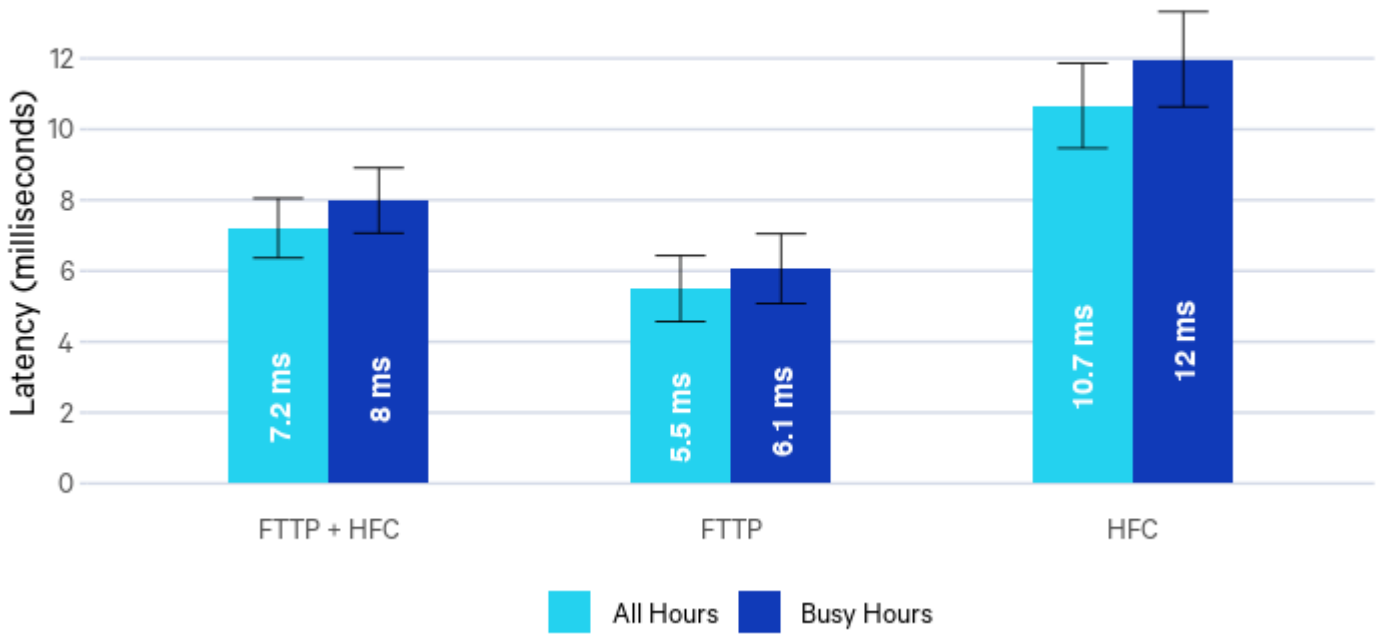
Upload speeds for very high speed services show little variation throughout the day.

Latency, packet loss and outages

The following section provides a brief overview of latency, packet loss and outages for very high speed services.

Figure 27: Average latency for very high speed services

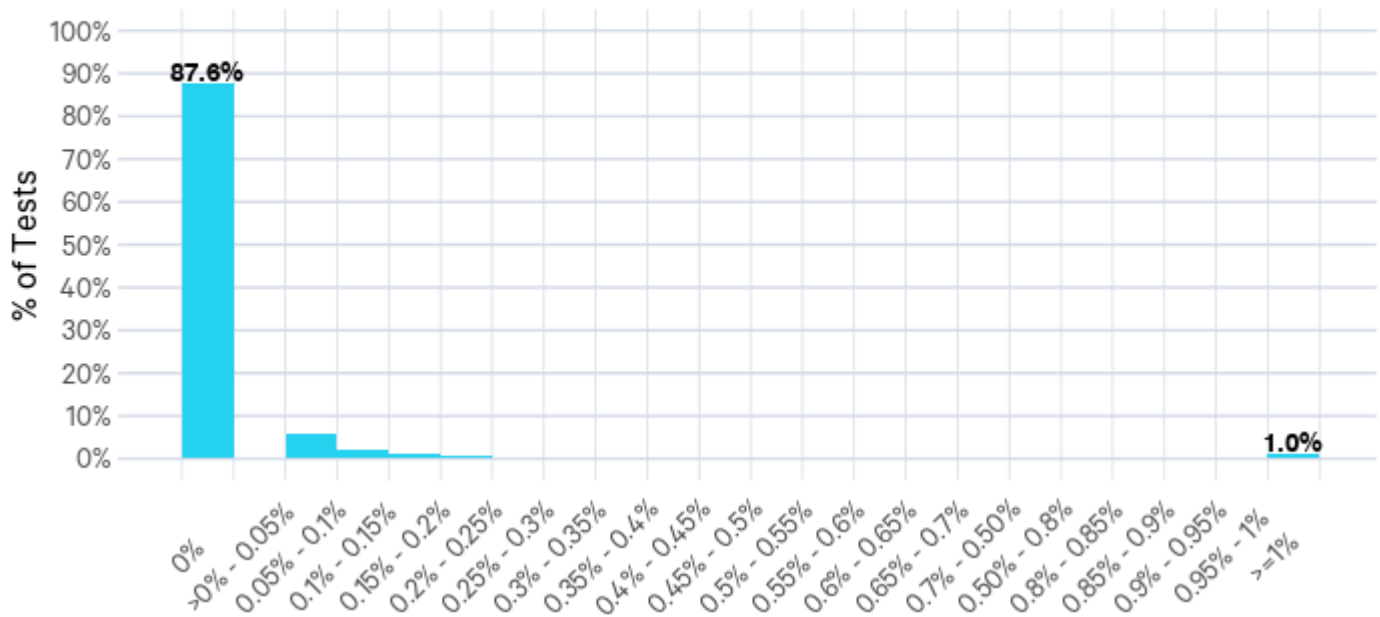
NBN very high speed services. Error bars indicate 95% confidence intervals of the mean.



Average latency for very high speed plans was recorded as 7.2 milliseconds during all hours, rising slightly to 8 milliseconds during busy hours. Although the average latency for very high speed services over HFC was around twice as high as the average latency through FTTP services, both latency values are so low that their effect is unlikely to be noticed by a typical end user.

Figure 28: Frequency of packet loss rates observed during tests of very high speed services

NBN very high speed services. All hours.



During this measurement period, 80,386 packet loss tests were conducted through very high speed NBN services. Of these tests, 87.8% had packet loss of either zero or less than 0.05%.

At the other end of the scale, 1.0% of tests had packet loss greater than 1%.

These results are broadly in line with those recorded for other fixed-line services.

Figures 29 and 30 show, for very high speed services, during all hours:

- the average rate of daily outages for a service, indicating how often outages occurred; and
- the distribution of outage duration, indicating the severity of outages' impact on user experience.

Figure 29: Average daily outages lasting over 30 seconds for very high speed services

NBN very high speed services. All hours.

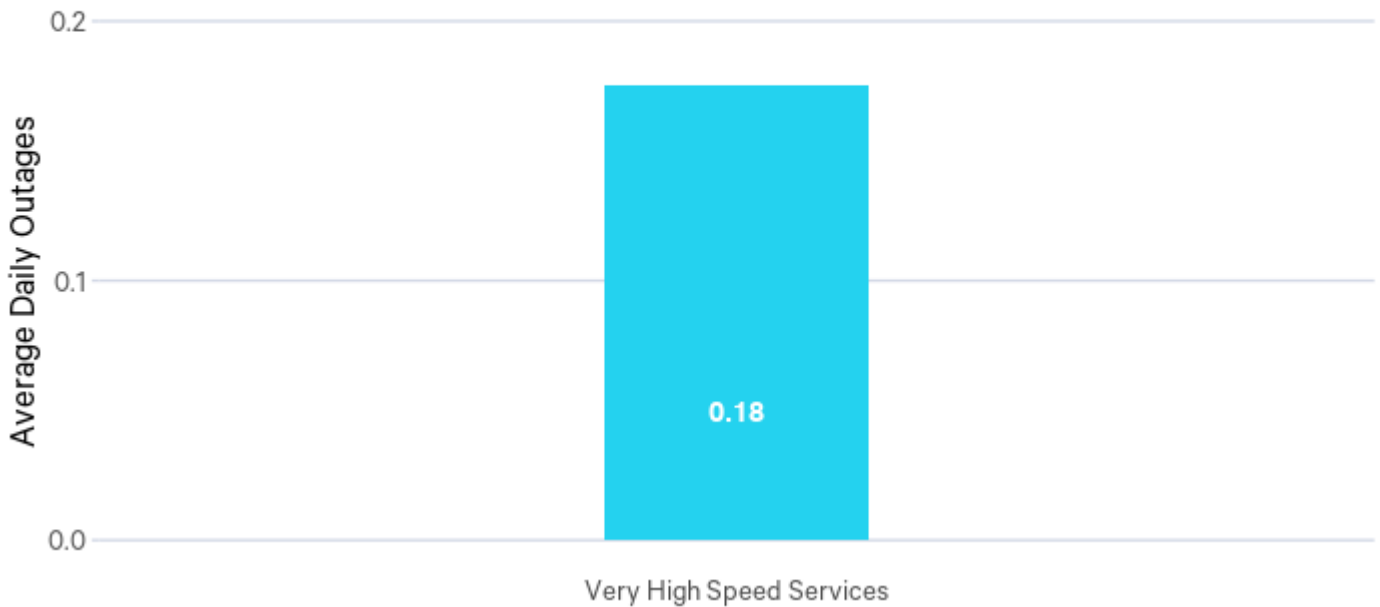
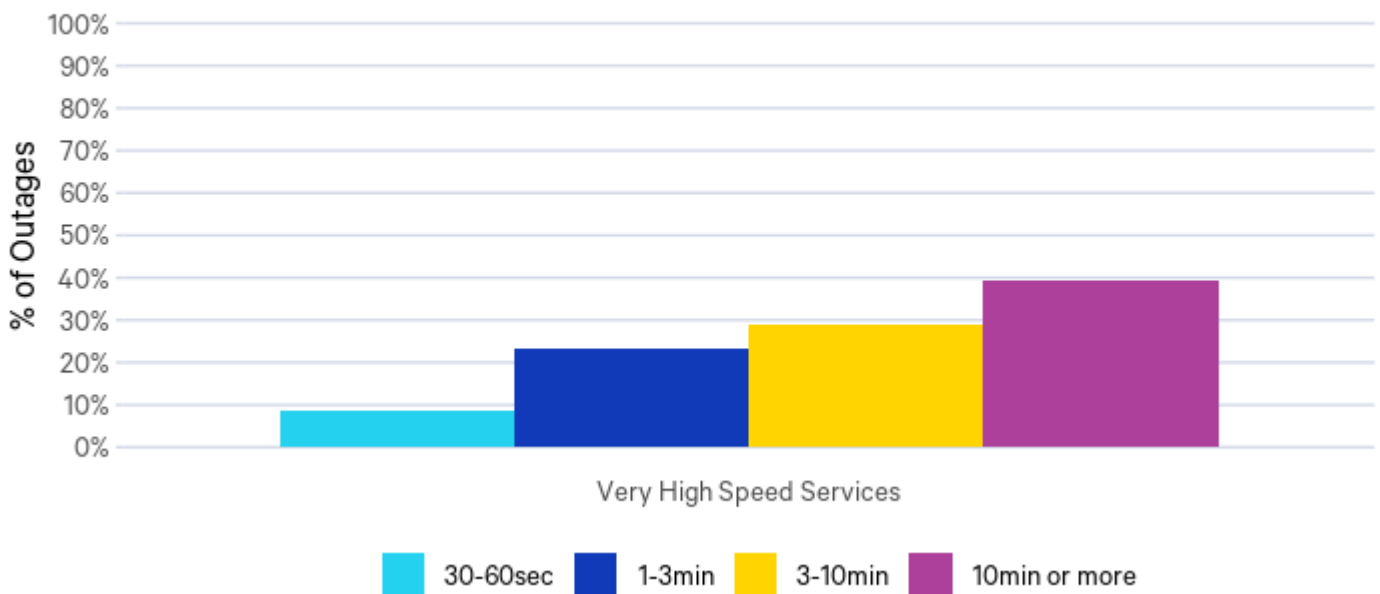


Figure 30: Distribution of outage duration by NBN very high speed services - all hours

NBN very high speed services. All hours.



The rate of outages was low and compared favourably to other fixed-line plans.

We note that these results include services where we identified that the volunteer had a 100Mbps link within the home and were unable to receive the full benefit of their high speed plans. The ACCC has engaged with RSPs to encourage them to reach out to their consumers who may be using a constrained gateway device.

For further information on what to do if you are experiencing reduced speeds, see <https://www.accc.gov.au/consumers/internet-landline-services/home-broadband-for-consumers#factors-that-may-affect-your-broadband-quality>

This is the end of the report on NBN fixed-line services.

NBN fixed wireless services

Results for NBN fixed wireless services in this section cover the same period, September 2021, as for fixed-line results.

Fixed wireless performance is measured in much the same way as the fixed-line program, with SamKnows supplying its Whiteboxes to NBN fixed wireless internet users in Australia to measure the performance of their internet connection.

The goal is to increase transparency and encourage greater performance-based competition and better internet performance throughout outer metropolitan, regional, rural and remote areas of Australia.

The following sections present a brief summary of metrics for the NBN fixed wireless sample, for the 25/5Mbps and Fixed Wireless Plus plans.

Differences between NBN fixed-line and NBN fixed wireless services

NBN fixed-line services and NBN fixed wireless services utilise different technologies that are not directly comparable in terms of performance. An NBN fixed-line connection utilises a physical line running to the household to connect it to the NBN. There are a number of fixed-line technologies: fibre to the premises, fibre to the building, fibre to the curb, fibre to the node and hybrid fibre-coaxial cable.

An NBN fixed wireless connection transmits data over radio signals to connect a household to the NBN and uses similar technology to mobile networks. NBN typically uses this type of service in regional and remote areas, where the distance between households can be many kilometres, but outer metropolitan centres may also use NBN fixed wireless. Data travels from a transmission tower to an outdoor antenna fitted at each household. Each fixed wireless tower has one or more 'cells' containing the equipment that transmits signals to a dish or the outdoor antenna at a customer's home or other premise, allowing them to connect to the internet. NBN fixed wireless serves around 4% of NBN consumers, typically in rural and regional areas, but it may also be used in outer metropolitan centres.

The quality and maximum speed of a fixed wireless connection is often more variable than fixed-line technology.

The following environmental factors may affect fixed wireless:

- 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.

Another factor that may affect fixed wireless performance is network congestion. Each fixed wireless cell has a finite amount of capacity (e.g. a certain number of megabits per second, or Mbps), which 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 limits of the cell, this can cause the cell to become congested. The

impact of network congestion on the fixed wireless network is typically most noticeable during busy hours (between 7pm and 11pm).

For further information on using NBN fixed wireless, see

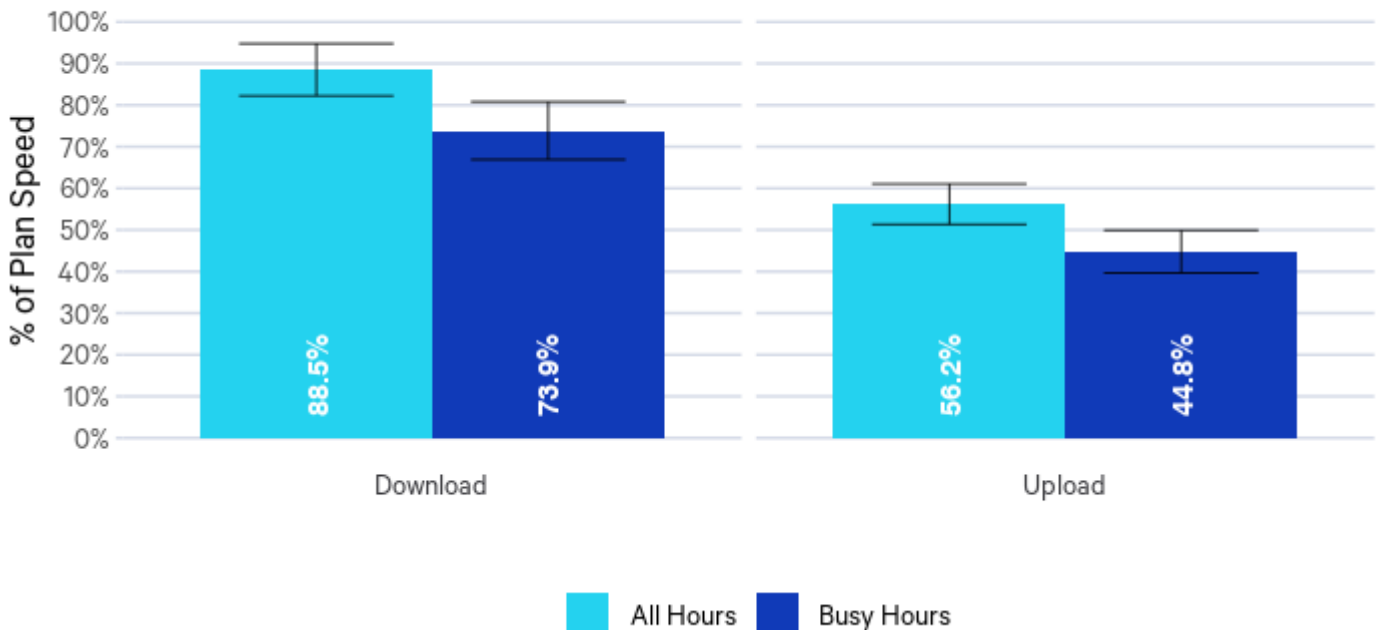
<https://www.accc.gov.au/consumers/internetlandline-services/broadband-speeds/using-nbn-fixed-wireless>.

Speed test results

In this section, we use download/upload speed benchmarks of 50/10Mbps for the Fixed Wireless Plus plan. We express the results of the Fixed Wireless Plus plan along with the 25/5Mbps fixed wireless plan as a percentage of the service's plan speed.

Figure 31: Average download and upload speeds for fixed wireless

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

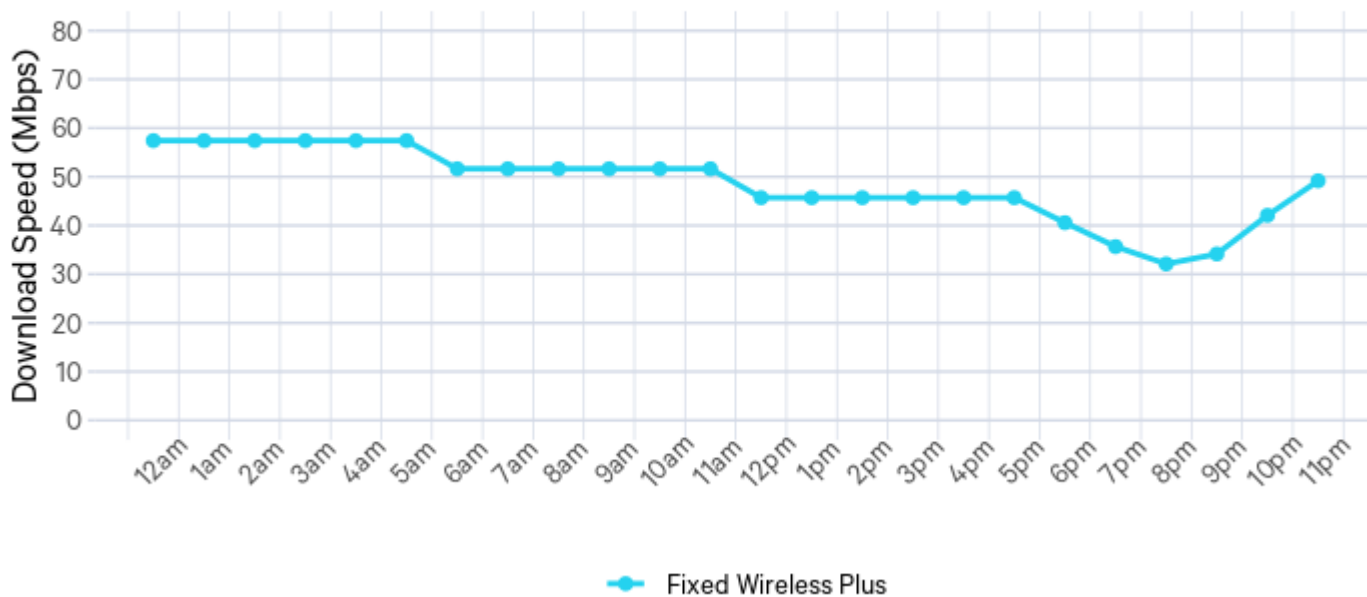


During this period, users on NBN fixed wireless services attained an average download performance of 88.5% of plan speeds during all hours, decreasing to 73.9% during the busy hours (between 7pm and 11pm), which is when networks experience higher user activity. In the previous report, concerning May 2021, average download performance was 83.7% of plan speeds during all hours and 71.6% during the busy hours. These results are based on a total of 73 NBN fixed wireless services across both the 25/5Mbps and Fixed Wireless Plus plans.

NBN fixed wireless services attained an average upload performance of 56.2% of plan speeds during all hours, decreasing to 44.8% during the busy hours (between 7pm and 11pm). In the previous report, concerning May 2021, average upload performance during all hours was 53.4% decreasing to 46.5% during busy hours.

Figure 32: Average hourly download speed for the Fixed Wireless Plus plan

NBN fixed wireless plans.



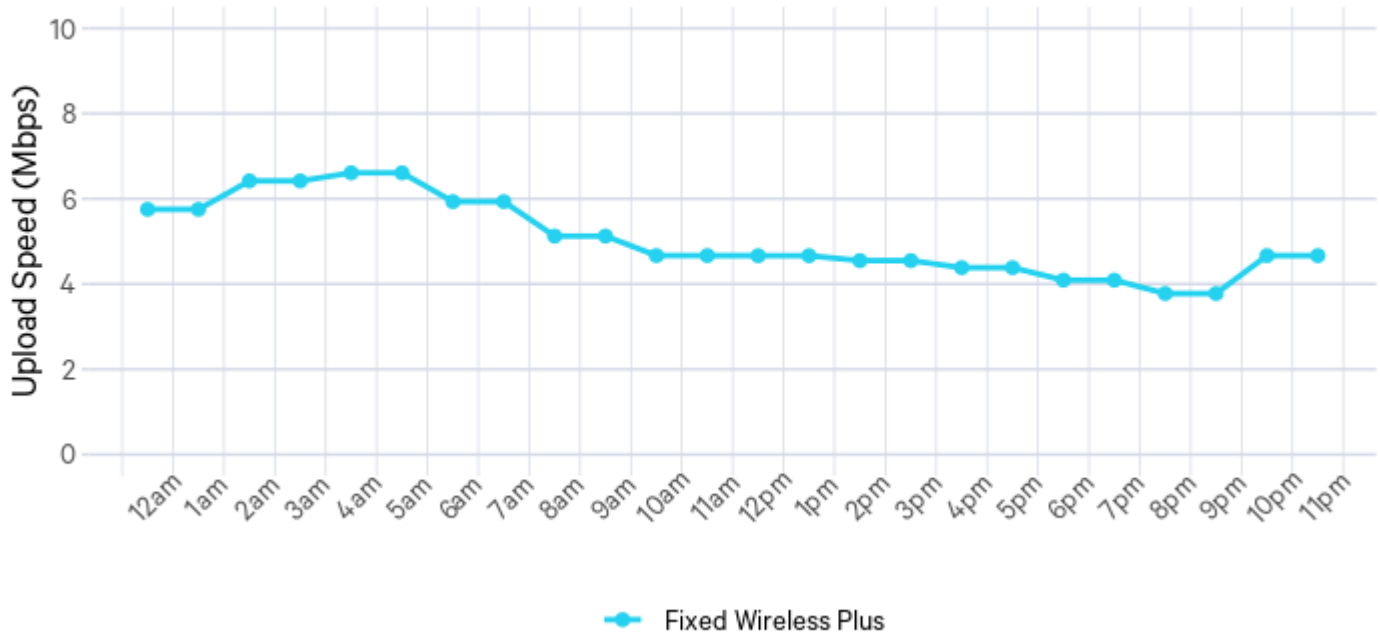
Average download speeds for the Fixed Wireless Plus plan showed considerable variation throughout the day: speeds typically started to decrease during the evening, dipping to 25Mbps below the day’s maximum speed by 8pm, and would recover to higher levels later at night. The average download speed for the Fixed Wireless Plus plan was 44.4Mbps during all hours, decreasing to an average of 36.4Mbps in the busy hours.

Upload speeds showed a similar pattern to download speeds and recorded lower values both during the busy hours and during the afternoon. The average upload speed for the Fixed Wireless Plus plan was 5.2Mbps during all hours, decreasing to an average of 4Mbps in the busy hours.

Both download and upload speeds showed considerable daily variation for fixed wireless products as can be expected with this technology. Network congestion can affect the fixed wireless network, particularly during the busy hours (between 7pm and 11pm).

Figure 33: Average hourly upload speed for the Fixed Wireless Plus plan

NBN fixed wireless plans.



Fixed Wireless Plus results are based on a total of 60 NBN fixed wireless services on the Fixed Wireless Plus plan.

Daily average download speeds by plan

The following two graphs track the average daily download speeds by plan for fixed wireless services for the period of August 2021 to October 2021. These NBN fixed wireless services comprise both 25/5Mbps and Fixed Wireless Plus plans.

The results presented here are indicative only, and firm inferences about the performance of fixed wireless products should not be made from these results.

Figure 34: Average daily download speeds during all hours by plan

NBN fixed wireless plans. August to October 2021.

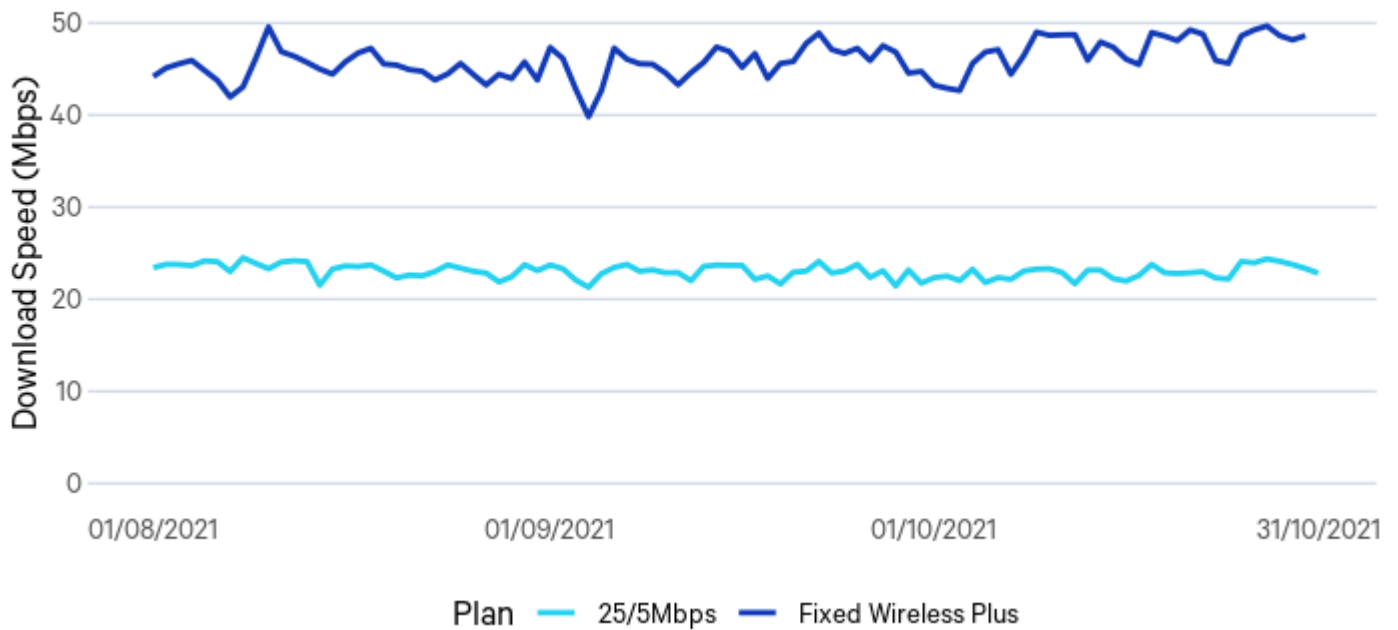
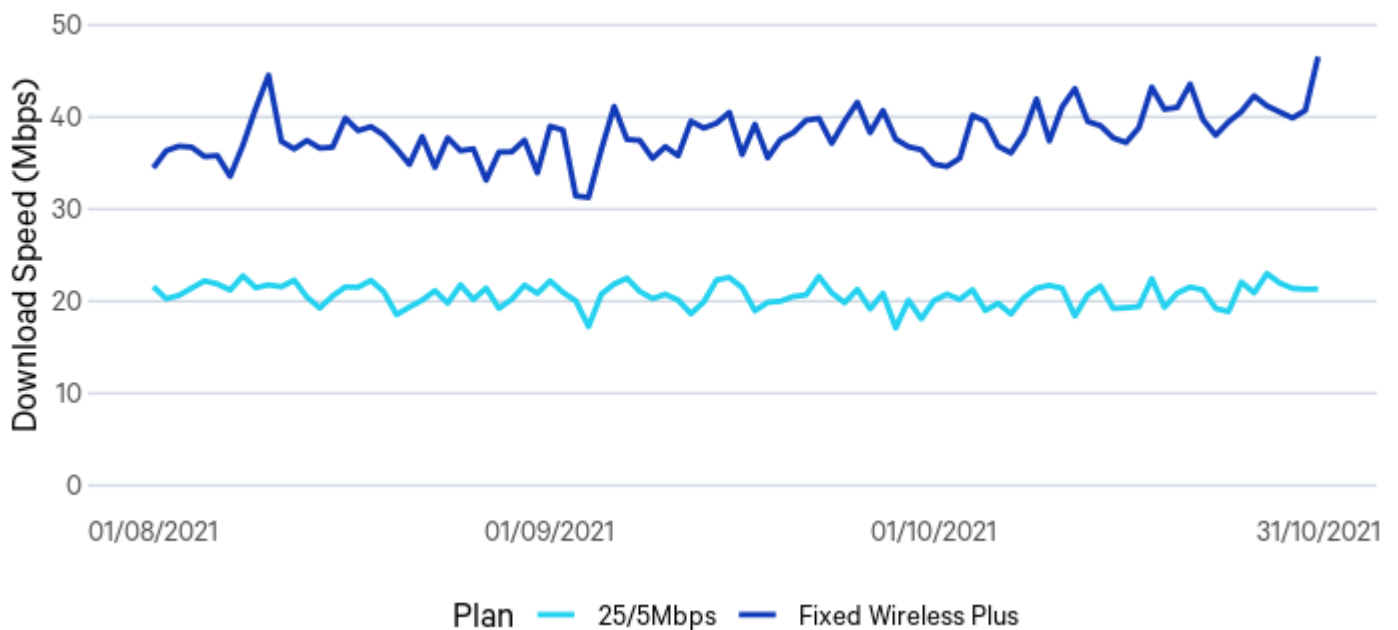


Figure 35: Average daily download speeds during busy hours by plan

NBN fixed wireless plans. August to October 2021.



Daily average upload speeds by plan

Figures 36 and 37 track the average daily upload speeds by plan for fixed wireless services for the period of August 2021 to October 2021. For these time series charts, calculations have been conducted for all hours and busy hours (7pm - 11pm) from Monday to Sunday. These NBN fixed wireless services comprise both 25/5Mbps and Fixed Wireless Plus plans.

The results presented here are indicative only, and firm inferences about the performance of fixed wireless products should not be made from these results.

Figure 36: Average daily upload speeds during all hours by plan

NBN fixed wireless plans. August to October 2021.

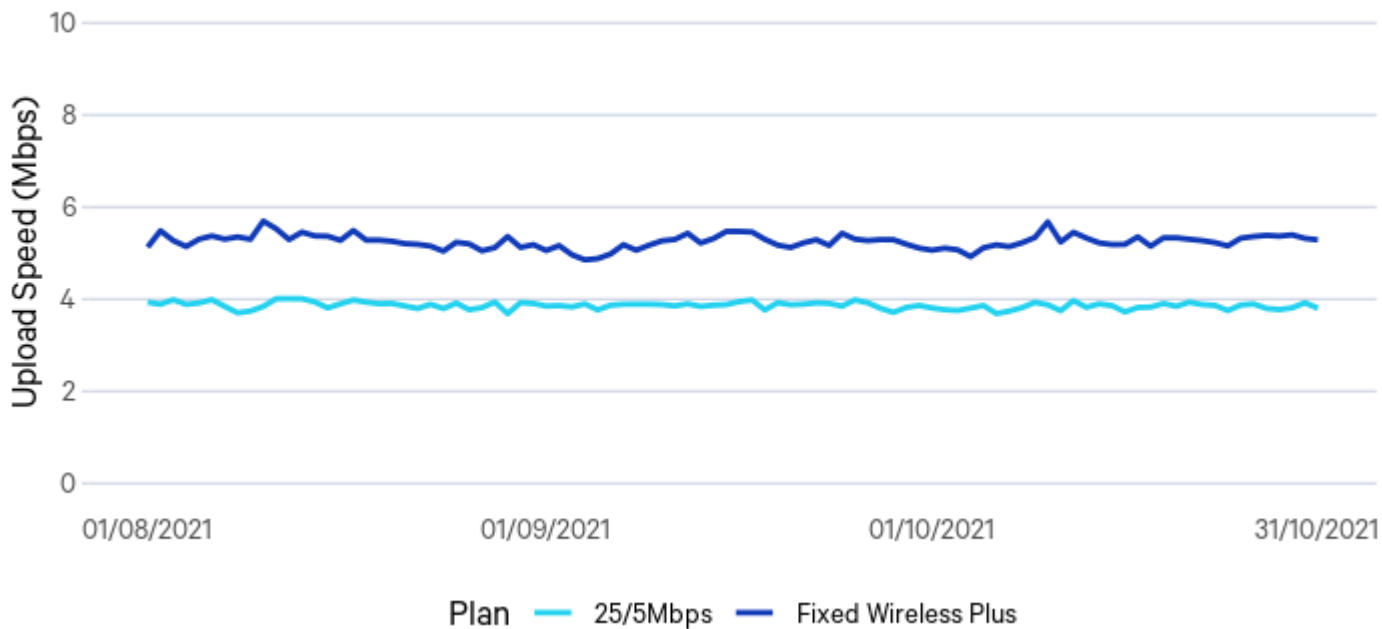
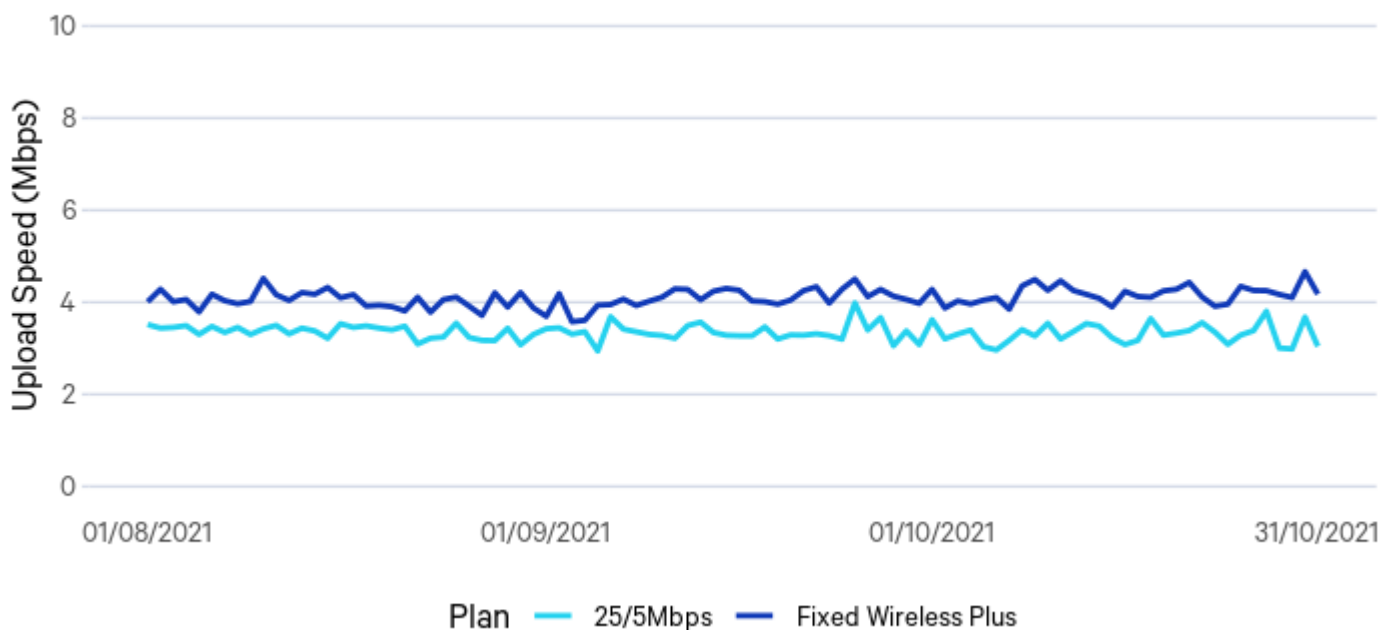


Figure 37: Average daily upload speeds during busy hours by plan

NBN fixed wireless plans. August to October 2021.



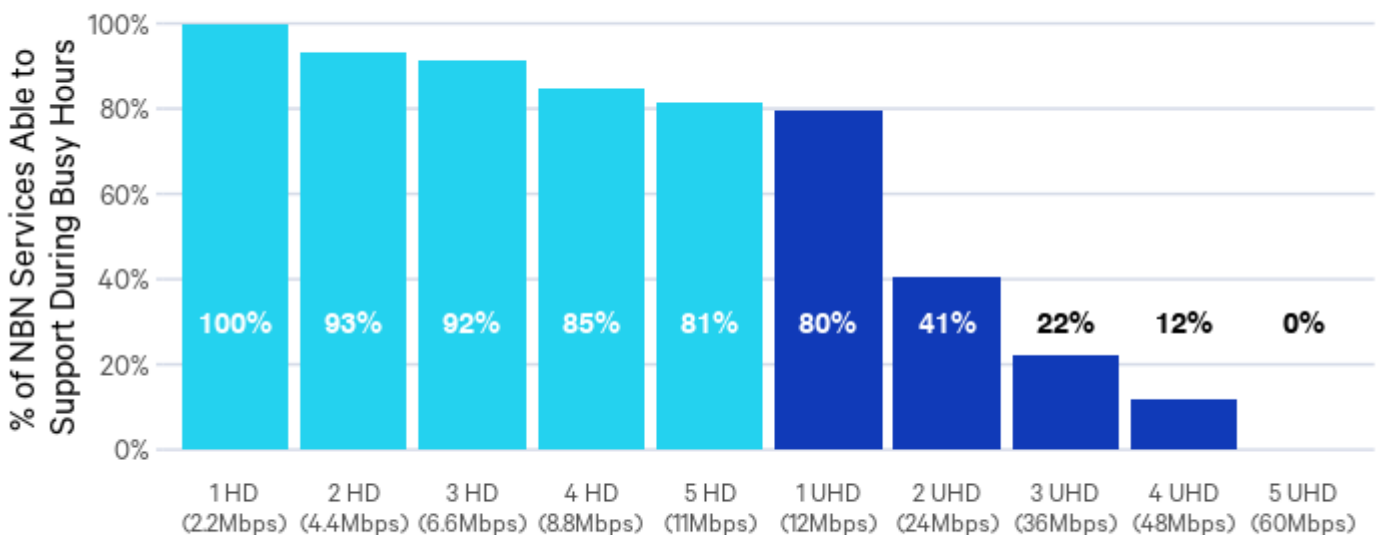
Video streaming

Figure 38 shows the proportion of services on the NBN Fixed Wireless Plus plan which would be able to reliably stream (with a low chance of stopping and starting) a varying number of videos at High Definition and Ultra High Definition from Netflix simultaneously.

We present results for Netflix as reports indicate that it has the largest volume of traffic over Australian networks and Netflix supports our testing of its services. We welcome interest from other streaming providers if they wish to participate in the program.

Figure 38: Netflix streaming for the Fixed Wireless Plus plan

Busy hours. Including underperforming and impaired services.



Number of Simultaneous Netflix Screens (HD = High Definition, UHD = Ultra High Definition)

Please note: the results are not cumulative and should be read separately for High Definition and Ultra High Definition streaming.

The results show that during the busy hours (7-11pm):

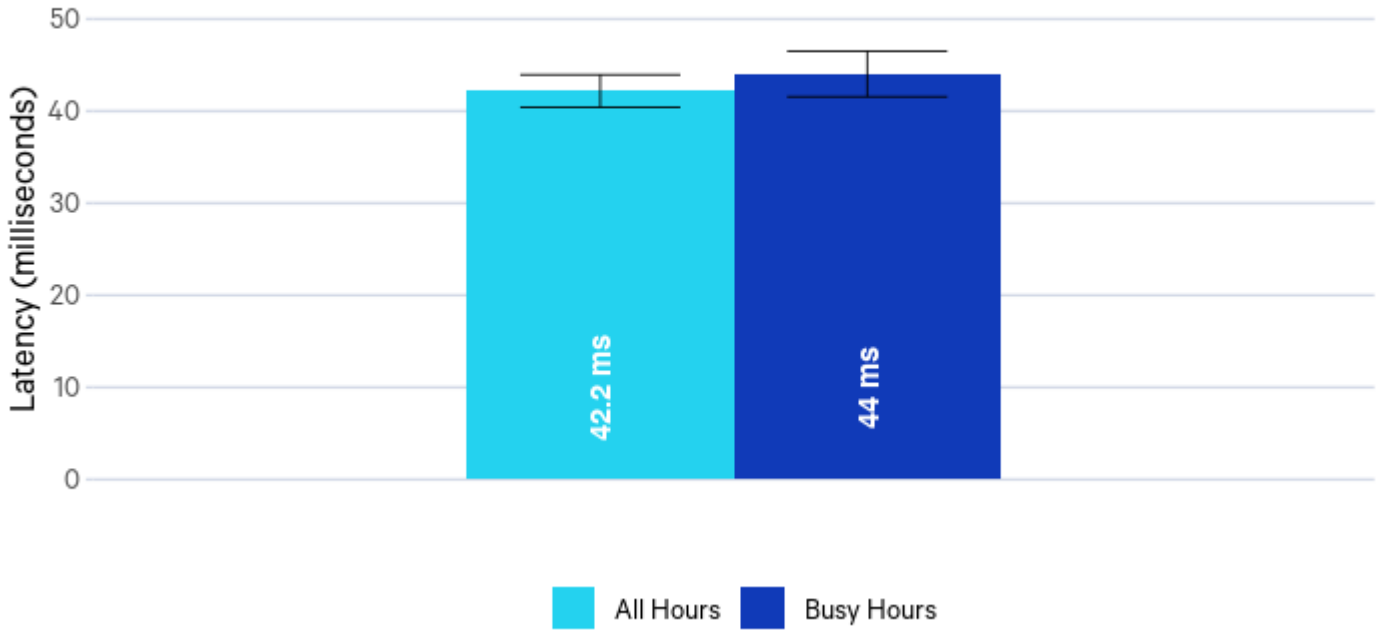
- Most Fixed Wireless Plus plans can support five High Definition, or one Ultra High Definition video stream.
- Less than half (41%) of Fixed Wireless Plus plans can support two Ultra High Definition streams.

Latency, packet loss and outages

The following section provides a brief overview of latency, packet loss and outages for fixed wireless plans.

Figure 39: Average latency for fixed wireless

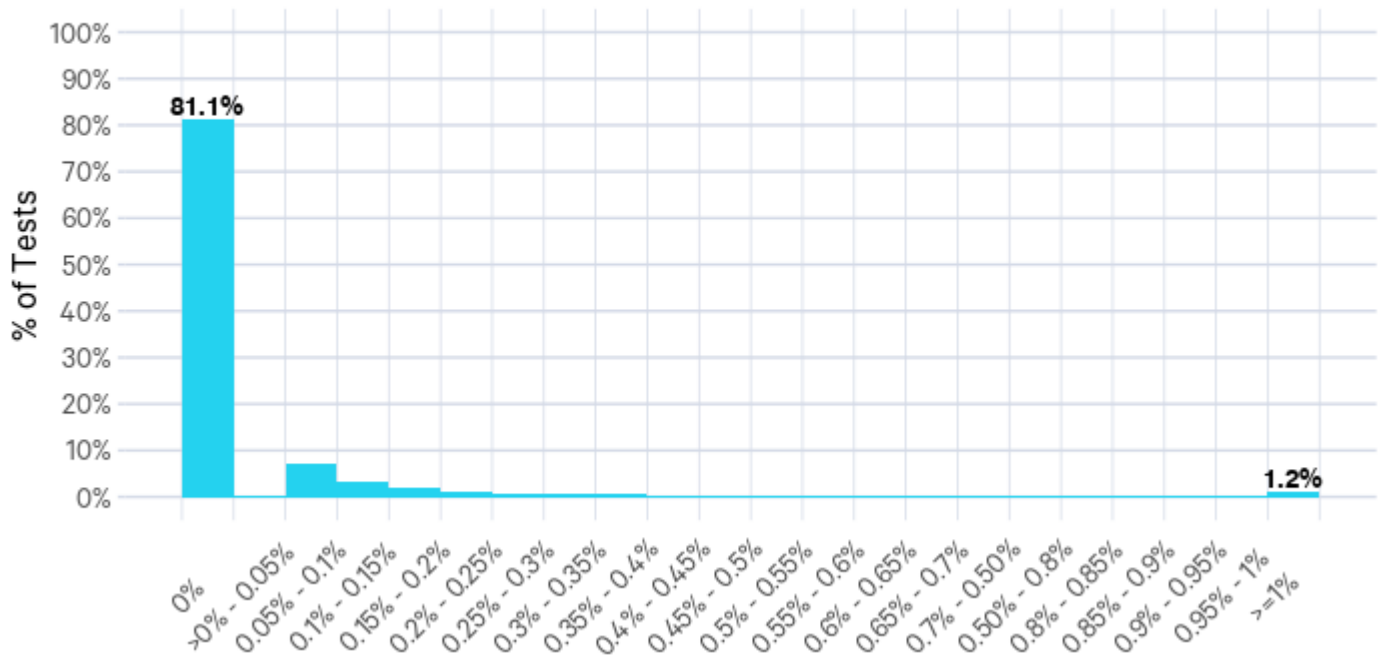
NBN fixed wireless plans. Error bars indicate 95% confidence intervals of the mean.



Average latency for fixed wireless plans was recorded as 42.2 milliseconds during all hours, rising slightly to 44 milliseconds during busy hours, broadly in line with the previous report.

Figure 40: Frequency of packet loss rates observed during tests

NBN fixed wireless plans. All hours.



During this measurement period, 44,137 packet loss tests were conducted through fixed wireless services. Of these tests, 81.5% had packet loss of either zero or less than 0.05%.

At the other end of the scale, 1.2% of tests had packet loss greater than 1%. This is a decrease since the previous report, where 3.2% of tests had packet loss greater than 1%.

These results are broadly in line with those recorded for fixed-line services.

Figures 41 and 42 show, for fixed wireless services, during all hours:

- the average rate of daily outages for a service, indicating how often outages occurred; and
- the distribution of outage duration, indicating the severity of outages' impact on user experience.

Figure 41: Average daily outages lasting over 30 seconds - fixed wireless

NBN fixed wireless. All hours.

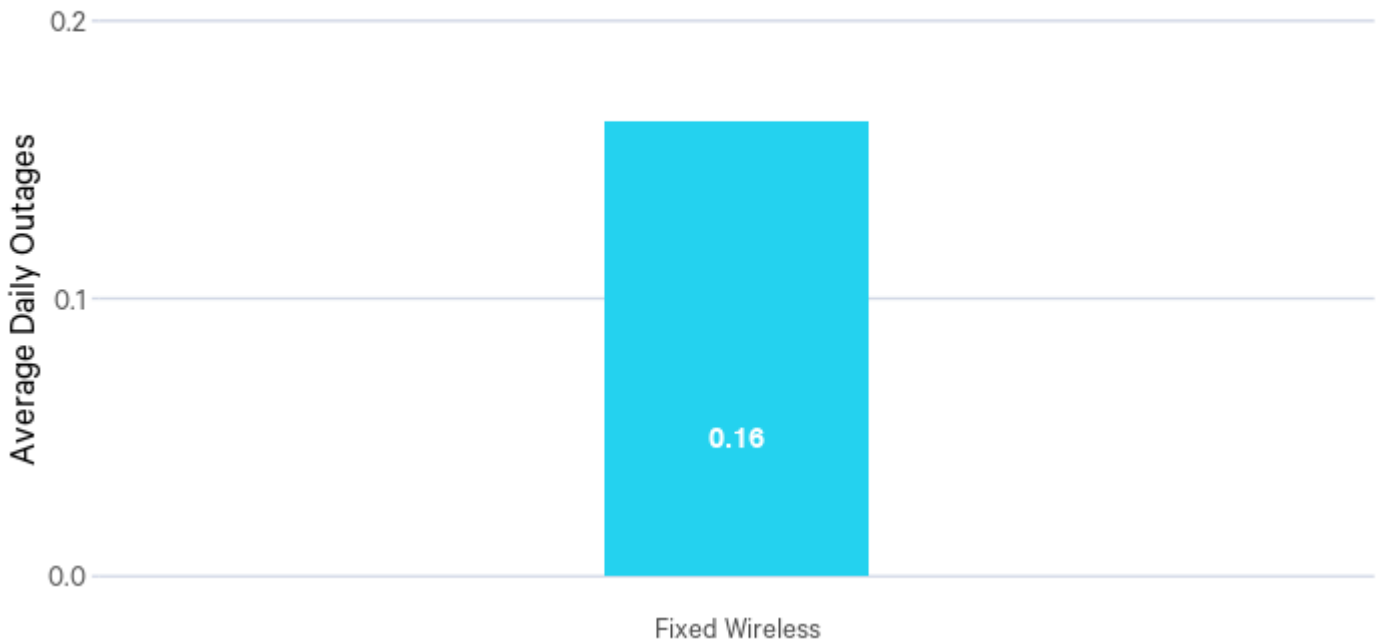
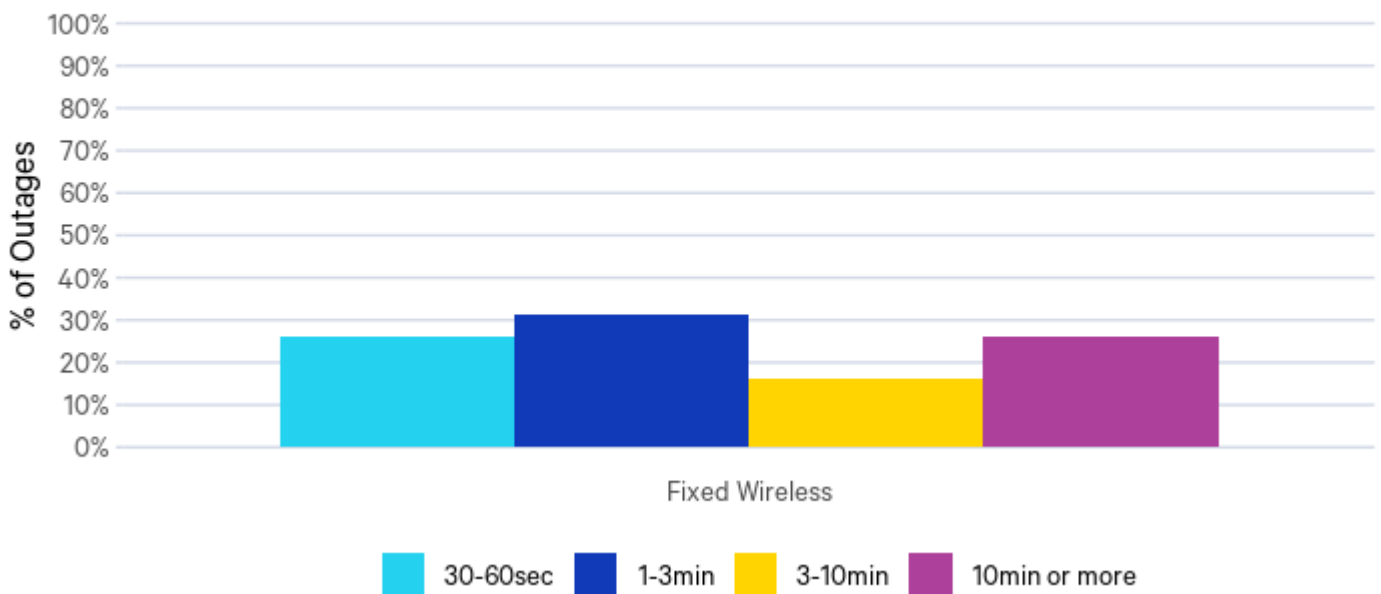


Figure 42: Distribution of outage duration by NBN fixed wireless plan - all hours

NBN fixed wireless plans. All hours.



NBN fixed-line services tables

NBN video streaming tables

The following tables show information on the proportion of NBN services on the main NBN fixed-line plans which would be able to reliably stream (with a low chance of stopping and starting) a varying number of videos from Netflix simultaneously during busy hours. Data from underperforming and impaired services is excluded.

A High Definition stream from Netflix takes up around 2.2Mbps data rate on average. For consumers with premium Ultra High Definition (4K) video stream, an Ultra High Definition stream from Netflix takes up 12Mbps data rate on average. The actual data rate will vary during video streaming: for example Netflix would use a higher data rate during a fast-paced action scene. The actual data rate will also depend on how many other users are using Netflix.

The Whitebox measures the total downstream data rate available from Netflix's servers. Therefore, by using multiples of 2.2Mbps (for High Definition) and 12Mbps (for Ultra High Definition) it allows us to infer whether a NBN fixed-line service would be able to support different numbers of simultaneous streams. This assumes no other use of the connection at the time, i.e. that Netflix is the only application running.

Download Plan	1 HD (2.2Mbps)	2 HD (4.4Mbps)	3 HD (6.6Mbps)	4 HD (8.8Mbps)	5 HD (11Mbps)	Panel Size
NBN12	100%	100%	100%	95%	86%	22
NBN25	100%	100%	100%	99%	98%	89
NBN50	100%	100%	100%	100%	99%	534
NBN100	100%	100%	100%	100%	99%	345
Download Plan	1 UHD (12Mbps)	2 UHD (24Mbps)	3 UHD (36Mbps)	4 UHD (48Mbps)	5 UHD (60Mbps)	Panel Size
NBN25	98%	67%	0%	0%	0%	89
NBN50	99%	97%	87%	65%	0%	534
NBN100	99%	97%	95%	88%	85%	345

RSP	Download Plan	1 UHD	2 UHD	3 UHD	4 UHD	Panel Size
Aussie Broadband	50	98%	90%	67%	40%	60
Dodo & iPrimus	50	100%	100%	100%	59%	37
Exetel	50	100%	100%	70%	45%	20
iiNet	50	100%	100%	96%	78%	72
MyRepublic	50	95%	80%	75%	50%	20
Optus	50	99%	97%	84%	73%	96
Telstra	50	100%	100%	98%	86%	97
TPG	50	100%	100%	95%	70%	61
Vodafone	50	100%	100%	100%	69%	26

RSP	Download Plan	1 UHD	2 UHD	3 UHD	4 UHD	Panel Size
Aussie Broadband	100	100%	92%	85%	65%	53
iiNet	100	100%	100%	100%	100%	42
Optus	100	98%	98%	98%	98%	59
Telstra	100	100%	100%	100%	100%	49
TPG	100	100%	100%	100%	97%	33
Superloop	100	100%	97%	97%	94%	33

NBN RSP tables

The following tables show statistical information on download speeds, upload speeds, and outages for each RSP across all NBN plans, and for individual NBN plans in instances where at least 40 Whiteboxes reported successfully during the test period.

- The overall speed is the average speed (download or upload) for the RSP, measured as a percentage of plan speed.
- Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.
- The 95% confidence interval is a range in which the 'true' average value is estimated to lie and is a function of the sample size (i.e. number of Whiteboxes online) and standard deviation.
 - If the standard deviation is larger then the confidence interval will be wider, reflecting greater variability in the underlying data. If the sample size is larger then the confidence interval will be narrower, reflecting more certainty in the underlying data.
 - For example: during testing, we measured an average download performance of 97.9% of plan speed for Dodo & iPrimus across all NBN plans with a 95% confidence interval of $\pm 3.1\%$. If we were to repeat our sampling 100 times, we expect that this average would fall between 94.7% and 101.0% in at least 95 cases.

Period	RSP	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	96.4%	13.6%	94.5% - 98.4%	193	35,152
All Hours	Dodo & iPrimus	97.9%	13.8%	94.7% - 101.0%	75	15,527
All Hours	Exetel	102.7%	13.0%	98.5% - 106.8%	37	7,321
All Hours	iiNet	95.6%	15.4%	93.3% - 97.9%	176	36,232
All Hours	MyRepublic	99.3%	14.3%	95.2% - 103.3%	48	8,362
All Hours	Optus	102.7%	11.0%	101.1% - 104.2%	196	37,767
All Hours	Telstra	99.9%	15.4%	97.8% - 102.0%	208	42,350
All Hours	TPG	97.6%	15.1%	95.2% - 99.9%	158	28,767
All Hours	Superloop	96.4%	10.2%	94.0% - 98.8%	69	12,004
All Hours	Vodafone	94.7%	19.5%	89.5% - 100.0%	53	9,675

Period	RSP	Download Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Aussie Broadband	95.4%	13.9%	93.4% - 97.4%	193	10,927
Busy Hours	Dodo & iPrimus	97.1%	13.9%	94.0% - 100.3%	75	4,752
Busy Hours	Exetel	101.0%	13.9%	96.5% - 105.5%	37	2,291
Busy Hours	iiNet	94.7%	15.5%	92.4% - 97.0%	176	11,117
Busy Hours	MyRepublic	98.1%	14.6%	93.9% - 102.2%	48	2,488
Busy Hours	Optus	101.6%	11.1%	100.1% - 103.2%	196	11,238
Busy Hours	Telstra	98.9%	15.4%	96.8% - 101.0%	208	13,086
Busy Hours	TPG	96.8%	15.1%	94.5% - 99.2%	158	8,559
Busy Hours	Superloop	94.4%	10.0%	92.0% - 96.7%	69	3,631
Busy Hours	Vodafone	93.9%	19.4%	88.7% - 99.1%	53	2,934

Period	RSP	Upload Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	82.6%	18.2%	80.0% - 85.2%	193	49,963
All Hours	Dodo & iPrimus	85.1%	16.5%	81.4% - 88.8%	75	21,647
All Hours	Exetel	91.1%	9.0%	88.2% - 94.0%	37	9,393
All Hours	iiNet	83.5%	18.6%	80.8% - 86.3%	176	50,543
All Hours	MyRepublic	86.7%	16.7%	82.0% - 91.4%	48	12,269
All Hours	Optus	87.7%	13.3%	85.9% - 89.6%	196	53,537
All Hours	Telstra	85.9%	16.5%	83.6% - 88.1%	208	58,838
All Hours	TPG	84.2%	19.1%	81.2% - 87.2%	158	41,486
All Hours	Superloop	86.5%	12.6%	83.6% - 89.5%	69	16,800
All Hours	Vodafone	85.5%	18.0%	80.7% - 90.4%	53	13,623

Period	RSP	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Aussie Broadband	82.4%	18.2%	79.8% - 85.0%	193	5,581
Busy Hours	Dodo & iPrimus	85.0%	16.6%	81.2% - 88.7%	75	2,399
Busy Hours	Exetel	91.0%	9.0%	88.1% - 93.9%	37	1,077
Busy Hours	iiNet	83.4%	18.6%	80.6% - 86.1%	176	5,725
Busy Hours	MyRepublic	86.3%	16.8%	81.5% - 91.1%	47	1,262
Busy Hours	Optus	87.5%	13.3%	85.6% - 89.4%	196	5,692
Busy Hours	Telstra	85.5%	16.6%	83.2% - 87.7%	208	6,584
Busy Hours	TPG	84.0%	19.1%	81.0% - 86.9%	157	4,335
Busy Hours	Superloop	86.0%	12.4%	83.1% - 88.9%	69	1,847
Busy Hours	Vodafone	85.4%	18.0%	80.6% - 90.3%	53	1,449

Period	RSP	Download Plan	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	50	95.5%	14.8%	92.2% - 98.7%	79	14,635
All Hours	Aussie Broadband	100	94.8%	11.5%	92.0% - 97.7%	63	11,117
All Hours	Dodo & iPrimus	50	98.3%	14.0%	94.1% - 102.6%	42	8,708
All Hours	iiNet	50	95.0%	17.2%	91.5% - 98.5%	94	20,354
All Hours	iiNet	100	92.9%	14.4%	89.0% - 96.8%	52	10,086
All Hours	Optus	50	103.7%	9.5%	101.9% - 105.5%	105	20,865
All Hours	Optus	100	99.6%	13.8%	96.3% - 102.9%	68	11,984
All Hours	Telstra	50	100.4%	14.0%	97.8% - 102.9%	115	24,299
All Hours	Telstra	100	97.0%	17.2%	92.5% - 101.4%	57	10,839
All Hours	TPG	50	98.0%	15.5%	94.5% - 101.6%	74	13,594
All Hours	TPG	100	92.8%	18.9%	87.1% - 98.4%	43	7,549

Period	RSP	Download Plan	Download Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Aussie Broadband	50	94.8%	14.8%	91.6% - 98.1%	79	4,606
Busy Hours	Aussie Broadband	100	93.3%	12.0%	90.4% - 96.3%	63	3,432
Busy Hours	Dodo & iPrimus	50	97.8%	14.1%	93.5% - 102.0%	42	2,703
Busy Hours	iiNet	50	94.3%	17.2%	90.8% - 97.8%	94	6,213
Busy Hours	iiNet	100	92.0%	14.7%	88.0% - 96.0%	52	3,070
Busy Hours	Optus	50	102.6%	9.6%	100.8% - 104.4%	105	6,252
Busy Hours	Optus	100	98.5%	13.9%	95.2% - 101.8%	68	3,426
Busy Hours	Telstra	50	99.3%	14.1%	96.7% - 101.9%	115	7,516
Busy Hours	Telstra	100	96.0%	17.0%	91.6% - 100.4%	57	3,297
Busy Hours	TPG	50	97.3%	15.4%	93.8% - 100.8%	74	4,068
Busy Hours	TPG	100	92.5%	19.0%	86.8% - 98.2%	43	2,206

Period	RSP	Upload Plan	Upload Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Aussie Broadband	20	79.9%	21.1%	75.9% - 84.0%	103	26,853
All Hours	Aussie Broadband	40	88.3%	8.8%	85.8% - 90.8%	47	11,650
All Hours	Dodo & iPrimus	20	84.8%	15.5%	80.7% - 88.9%	55	15,782
All Hours	iiNet	20	79.8%	21.4%	75.6% - 84.0%	99	29,656
All Hours	iiNet	40	88.5%	9.4%	85.8% - 91.2%	47	12,844
All Hours	Optus	20	86.5%	15.4%	83.7% - 89.3%	118	32,277
All Hours	Optus	40	89.2%	10.2%	86.6% - 91.9%	56	14,670
All Hours	Telstra	20	84.1%	18.7%	80.9% - 87.3%	129	37,196
All Hours	Telstra	40	86.3%	15.2%	81.7% - 90.8%	43	11,747
All Hours	TPG	20	81.7%	21.2%	77.2% - 86.2%	86	22,685

Period	RSP	Upload Plan	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Aussie Broadband	20	79.8%	21.1%	75.7% - 83.9%	103	2,989
Busy Hours	Aussie Broadband	40	87.9%	9.0%	85.3% - 90.5%	47	1,285
Busy Hours	Dodo & iPrimus	20	84.7%	15.4%	80.6% - 88.7%	55	1,769
Busy Hours	iiNet	20	79.7%	21.4%	75.5% - 83.9%	99	3,326
Busy Hours	iiNet	40	88.2%	9.6%	85.5% - 91.0%	47	1,480
Busy Hours	Optus	20	86.3%	15.4%	83.6% - 89.1%	118	3,435
Busy Hours	Optus	40	88.9%	10.2%	86.2% - 91.6%	56	1,478
Busy Hours	Telstra	20	83.8%	18.7%	80.6% - 87.0%	129	4,172
Busy Hours	Telstra	40	85.2%	15.1%	80.7% - 89.7%	43	1,278
Busy Hours	TPG	20	81.6%	21.3%	77.1% - 86.1%	86	2,383

RSP	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Aussie Broadband	0.49	2.33	0.16 - 0.82	193
Dodo & iPrimus	0.14	0.29	0.08 - 0.21	75
Exetel	1.17	4.64	-0.32 - 2.66	37
iiNet	0.38	2.08	0.07 - 0.69	176
MyRepublic	0.20	0.31	0.11 - 0.28	48
Optus	0.16	0.37	0.11 - 0.21	196
Telstra	0.25	0.51	0.18 - 0.32	207
TPG	0.44	1.78	0.16 - 0.72	158
Superloop	0.37	0.98	0.14 - 0.60	69
Vodafone	0.30	0.98	0.03 - 0.56	53

RSP	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
Aussie Broadband	34.2%	28.5%	29.2%	8.2%
Dodo & iPrimus	22.0%	29.3%	28.9%	19.9%
Exetel	30.1%	35.4%	24.4%	10.0%
iiNet	22.8%	34.0%	35.6%	7.7%
MyRepublic	24.3%	27.2%	24.3%	24.3%
Optus	36.0%	28.3%	22.5%	13.2%
Superloop	17.8%	18.0%	47.6%	16.6%
Telstra	15.7%	20.7%	19.9%	43.7%
TPG	39.5%	30.6%	17.8%	12.1%
Vodafone	57.3%	28.0%	8.9%	5.9%

NBN plan tables

The following tables show statistical information on download and upload speeds for each NBN plan, including all tested RSPs.

- The overall speed is the average speed (download or upload) for the particular NBN plan, measured as a percentage of plan speed.
- Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.
- The 95% confidence interval is a range in which the ‘true’ average value is estimated to lie.
 - For example: during testing, we measured an average download performance of 96.1% of plan speed for users subscribed to 100Mbps NBN fixed-line plans with a 95% confidence interval of $\pm 1.4\%$. If we were to repeat our sampling 100 times, we expect that this average would fall between 94.7% and 97.5% in at least 95 cases.

For the 12Mbps plan, the sample size is considered low and results are indicative only.

Period	Download Plan	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	12	102.4%	4.0%	100.8% - 104.1%	22	4,761
All Hours	25	101.6%	11.2%	99.3% - 103.8%	94	20,037
All Hours	50	98.7%	14.7%	97.6% - 99.9%	641	127,947
All Hours	100	96.1%	14.3%	94.7% - 97.5%	403	72,357
All Hours	250	100.8%	16.6%	97.5% - 104.1%	99	17,436

Period	Download Plan	Download Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	12	101.7%	4.7%	99.8% - 103.7%	22	1,455
Busy Hours	25	100.6%	11.8%	98.2% - 103.0%	94	6,239
Busy Hours	50	97.9%	14.7%	96.7% - 99.0%	641	39,130
Busy Hours	100	94.8%	14.4%	93.4% - 96.2%	403	21,764
Busy Hours	250	99.1%	16.8%	95.8% - 102.4%	99	5,388

Period	Upload Plan	Upload Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	1	95.8%	10.8%	91.3% - 100.3%	22	6,683
All Hours	5	86.9%	17.0%	82.8% - 91.0%	65	19,434
All Hours	20	83.0%	19.2%	81.6% - 84.4%	755	207,465
All Hours	40	88.4%	10.7%	87.2% - 89.6%	298	76,822

Period	Upload Plan	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	1	95.1%	10.3%	90.8% - 99.4%	22	751
Busy Hours	5	86.7%	17.0%	82.5% - 90.8%	65	2,150
Busy Hours	20	82.8%	19.2%	81.4% - 84.2%	754	22,805
Busy Hours	40	87.9%	10.7%	86.6% - 89.1%	297	8,248

NBN technology tables

The following tables show statistical information on download speeds, upload speeds, and outages on a per-technology basis.

- The overall speed is the average speed (download or upload) for the technology type, measured as a percentage of the plan speed for each subscriber.
- Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.
- The 95% confidence interval is a range in which the ‘true’ average value is estimated to lie.
 - For example: during testing, we measured an average download performance of 103.6% of plan speed for fibre to the premises NBN fixed-line services with a 95% confidence interval of $\pm 1.1\%$. If we were to repeat our sampling 100 times, we expect that this average would fall between 102.6% and 104.7% (rounded to 1 decimal place) in at least 95 cases.

Period	Technology	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Fibre to the premises - FTTP	103.6%	9.4%	102.6% - 104.7%	292	55,194
All Hours	Fibre to the curb - FTTC	100.8%	8.1%	99.3% - 102.2%	116	20,750
All Hours	Hybrid fibre-coaxial - HFC	103.4%	9.6%	102.2% - 104.5%	262	48,272
All Hours	Fibre to the node - FTTN	93.0%	17.1%	91.6% - 94.4%	598	119,621

Period	Technology	Download Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Fibre to the premises - FTTP	102.4%	9.9%	101.3% - 103.6%	292	16,824
Busy Hours	Fibre to the curb - FTTC	99.7%	8.7%	98.1% - 101.3%	116	6,362
Busy Hours	Hybrid fibre-coaxial - HFC	102.2%	9.8%	101.0% - 103.4%	262	14,699
Busy Hours	Fibre to the node - FTTN	92.1%	17.1%	90.7% - 93.5%	598	36,429

Period	Technology	Upload Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Fibre to the premises - FTTP	91.9%	6.5%	91.1% - 92.6%	292	77,541
All Hours	Fibre to the curb - FTTC	91.5%	5.2%	90.6% - 92.5%	116	29,373
All Hours	Hybrid fibre-coaxial - HFC	89.6%	10.6%	88.4% - 90.9%	262	67,677
All Hours	Fibre to the node - FTTN	78.6%	21.3%	76.9% - 80.3%	598	168,353

Period	Technology	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Fibre to the premises - FTTP	91.7%	6.5%	90.9% - 92.4%	291	8,590
Busy Hours	Fibre to the curb - FTTC	91.3%	5.2%	90.4% - 92.3%	116	3,214
Busy Hours	Hybrid fibre-coaxial - HFC	89.4%	10.7%	88.1% - 90.7%	262	7,453
Busy Hours	Fibre to the node - FTTN	78.4%	21.3%	76.6% - 80.1%	597	18,398

Technology	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Fibre to the premises - FTTP	0.31	2.16	0.062 - 0.56	292
Fibre to the curb - FTTC	0.55	1.84	0.219 - 0.89	116
Hybrid fibre-coaxial - HFC	0.19	0.38	0.144 - 0.24	261
Fibre to the node - FTTN	0.43	1.75	0.287 - 0.57	598

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 curb - FTTC	50.0%	27.0%	14.7%	8.3%
Fibre to the node - FTTN	28.9%	25.6%	29.4%	16.1%
Fibre to the premises - FTTP	32.5%	33.9%	21.6%	12.0%
Hybrid fibre-coaxial - HFC	21.8%	29.8%	28.6%	19.9%

NBN state tables

This table shows statistical information on download speeds on a per-state basis. In this report, we have been able to draw upon all of the test results from a range of locations.

- The overall speed is the average speed (download or upload) for the state, measured as a percentage of the plan speed for each panellist.
- Standard deviation is a measure of how widely or narrowly test speeds are distributed in the data set.
- The 95% confidence interval is a range in which the ‘true’ average value is estimated to lie.
 - For example: during testing, we measured an average download performance of 94.6% of plan speed for NBN fixed-line services in WA, with a 95% confidence interval of $\pm 3.4\%$. If we were to repeat our sampling 100 times, we expect that this average would fall between 91.1% and 98.0% (rounded to 1 decimal place) in at least 95 cases.

Period	State or Territory	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	NSW	100.0%	13.2%	98.7% - 101.3%	406	77,125
All Hours	ACT	95.7%	15.0%	92.0% - 99.5%	61	11,007
All Hours	VIC	98.4%	13.5%	97.0% - 99.8%	344	63,310
All Hours	QLD	96.5%	16.5%	94.3% - 98.7%	214	42,868
All Hours	WA	94.6%	18.3%	91.1% - 98.0%	110	22,416
All Hours	TAS	98.6%	13.9%	94.7% - 102.6%	48	9,774
All Hours	NT + SA	100.9%	10.0%	98.8% - 103.1%	85	17,337

NBN50 and NBN100 advertised speed tables

The figures in the following table are based on the typical evening hour speeds that were the predominant speed advertised by RSPs during the measurement period. The single weighted average speed claim is calculated based on the number of Whiteboxes online for each RSP for each plan (excluding underperforming and impaired services).

RSP	NBN50 Advertised % of Plan Speed	NBN100 Advertised % of Plan Speed	Number of NBN50 Whiteboxes (excluding underperforming and impaired services)	Number of NBN100 Whiteboxes (excluding underperforming and impaired services)	Weighted Advertised % of Plan Speed
Aussie Broadband	98.0%	99.0%	61	53	98.5%
Dodo & iPrimus	100.0%	92.0%	37	18	97.4%
Exetel	100.0%	100.0%	21	11	100.0%
iiNet	100.0%	90.0%	72	43	96.3%
MyRepublic	100.0%	93.0%	20	17	96.8%
Optus	100.0%	100.0%	96	59	100.0%
Superloop	100.0%	100.0%	17	33	100.0%
Telstra	100.0%	100.0%	98	49	100.0%
TPG	100.0%	90.0%	62	33	96.5%
Vodafone	100.0%	90.0%	26	18	95.9%

There were 120 busy hours across the 30 day period from 1st September 2021 to 30th September 2021. The following table shows the proportion of busy hours in which each RSP's average speed for each plan met the advertised claims above.

RSP	% of busy hours in which advertised download speed met or exceeded	% of busy hours in which advertised download speed met or exceeded (excluding underperforming and impaired services)
Aussie Broadband	0%	59%
Dodo & iPrimus	46%	97%
Exetel	66%	66%
iiNet	47%	100%
MyRepublic	49%	98%
Optus	57%	95%
Superloop	3%	27%
Telstra	24%	87%
TPG	29%	100%
Vodafone	61%	89%

NBN Whiteboxes connected to underperforming services

The following table shows the number of Whiteboxes on NBN services for each RSP, alongside the number of Whiteboxes connected to underperforming services.

RSP	NBN Whiteboxes	NBN Whiteboxes on underperforming services	% NBN Whiteboxes on underperforming services
Aussie Broadband	193	12	6%
Dodo & iPrimus	75	5	7%
Exetel	37	1	3%
iiNet	176	14	8%
MyRepublic	48	3	6%
Optus	196	6	3%
Other RSPs	55	3	5%
Superloop	69	4	6%
Telstra	208	14	7%
TPG	158	13	8%
Vodafone	53	5	9%
Total	1,268	80	6%

As highlighted earlier in the report, the majority of underperforming services are connected to fibre to the node infrastructure. The following table shows the number of Whiteboxes on fibre to the node services for each plan, alongside the number of underperforming services.

Technology	Plan	NBN Whiteboxes	NBN Whiteboxes on underperforming services	% NBN Whiteboxes on underperforming services
Fibre to the node - FTTN	12	12	0	0%
Fibre to the node - FTTN	25	61	3	5%
Fibre to the node - FTTN	50	388	46	12%
Fibre to the node - FTTN	100	128	22	17%
Fibre to the node - FTTN	Other NBN Plans	9	0	0%
Fibre to the node - FTTN	All NBN Plans	598	71	12%

NBN very high speed services tables

The figures in the following table are based on very high speed services, where the underlying wholesale product sold by NBN Co has a download/upload speed range of 500-990/50Mbps.

Period	Plan	Download Average Mbps (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Very High Speed	764.9Mbps	201.7Mbps	731Mbps - 798.8Mbps	136	24,076

Period	Plan	Download Average Mbps (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Very High Speed	717.4Mbps	208.2Mbps	682.5Mbps - 752.4Mbps	136	7,324

Period	Plan	Upload Average Mbps (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Very High Speed	45.1Mbps	3.7Mbps	44.5Mbps - 45.7Mbps	136	34,267

Period	Plan	Upload Average Mbps (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Very High Speed	44.4Mbps	4.8Mbps	43.6Mbps - 45.2Mbps	136	3,699

Plan	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Very High Speed	0.18	0.41	0.1 - 0.24	135

Plan	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
Very High Speed	8.6%	23.3%	29.1%	39.1%

NBN fixed wireless services tables

The figures in the following table are based on both the 25/5Mbps fixed wireless plan and the Fixed Wireless Plus plan.

Period	Technology	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Fixed Wireless	88.5%	27.3%	82.2% - 94.8%	73	13,566

Period	Technology	Download Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Fixed Wireless	73.9%	30.3%	66.9% - 80.8%	73	4,090









Period	Technology	Upload Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Fixed Wireless	56.2%	21.2%	51.4% - 61.1%	73	19,066

Period	Technology	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Fixed Wireless	44.8%	22.3%	39.7% - 49.9%	73	2,052

Technology	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Fixed Wireless	0.16	0.35	0.08 - 0.24	73

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
Fixed Wireless	25.9%	31.5%	16.3%	26.2%

Test Definitions

	Test	Definition
	Download	The speed at which data can be transferred from the SamKnows test server to your computer, measured in megabits per second (Mbps).
	Upload	The speed at which information is transferred from your computer to the SamKnows test server, measured in megabits per second (Mbps).
	Latency	How long it takes a data packet to go from your device to our test server and back to your device, measured in milliseconds (ms). The shorter the latency, the better.
	Jitter	The variation in the delay of received packets, measured in milliseconds (ms). Essentially it is a measure of the stability of latency.
	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.
	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.
	Outages	The outages metric tracks how many times per day your broadband connection goes offline for at least 30 seconds. Outages between 12am and 6am are excluded from this metric as this is when network maintenance typically occurs.
	Video Streaming	Measures the highest bitrate (in Mbps), and therefore quality level, you can reliably stream from real content servers.

Glossary

Term	Definition
SamKnows	The independent testing provider appointed to conduct testing for Measuring Broadband Australia. https://samknows.com/
Whitebox	A purpose-built hardware measurement agent manufactured by SamKnows, installed in volunteers' homes.
Testing Infrastructure	SamKnows-maintained test servers hosted within Australia.
Customer-Premises Equipment (CPE)	Network equipment provided by an RSP (generally including a home router/gateway).
NBN Service	A proxy for a single household which accesses the internet through the NBN.
Very High Speed Service	Services where the underlying wholesale product sold by NBN Co has a download/upload speed range of 500-990/50Mbps (referred to by NBN Co as 'Home Ultrafast').
Underperforming Service	Services which reach above 75% of plan speed in no more than 5% of download tests. These are services which rarely or never attain plan speed.
Impaired Service	FTTN / Fibre to the Node services where the maximum attainable line speed measured by NBN Co is below plan speed.
Plan / Plan	A retail product, for example 50/20Mbps or 100/40Mbps.
Plan Speed	The download and upload speeds associated the relevant retail plan. For example, plan speeds for NBN50 are 50Mbps down and 20Mbps up.
Advertised Speed	The speed claim made by an RSP for a given plan during a Measuring Broadband Australia reporting period. May be the same as or lower than plan speed.
Download Performance	Measured download speed expressed as a percentage of plan speed. e.g. for an NBN50 service, 100% download performance would be 50Mbps. Prior to overprovisioning this was capped at 100%. Since NBN has begun overprovisioning services, results above 100% are common.
All Hours	Refers to tests conducted at any time of the day.

Term	Definition
Busy Hours	Refers to tests conducted between 19:00:00 and 22:59:59, Monday to Friday.
Busiest Hour	Fifth lowest hourly average speed out of all busy hours in the month (including weekends cf. 'busy hours').
Fixed-Line	For reporting, fixed-line encompasses the FTTP (Fibre to the Premises), FTTB (Fibre to the Building), HFC (Hybrid Fibre-Coaxial), FTTC (Fibre to the Curb), and FTTN (Fibre to the Node) access technologies.
FTTN / Fibre to the Node	Measuring Broadband Australia treats the FTTN / Fibre to the Node and FTTB / Fibre to the Building access technologies as identical for reporting.