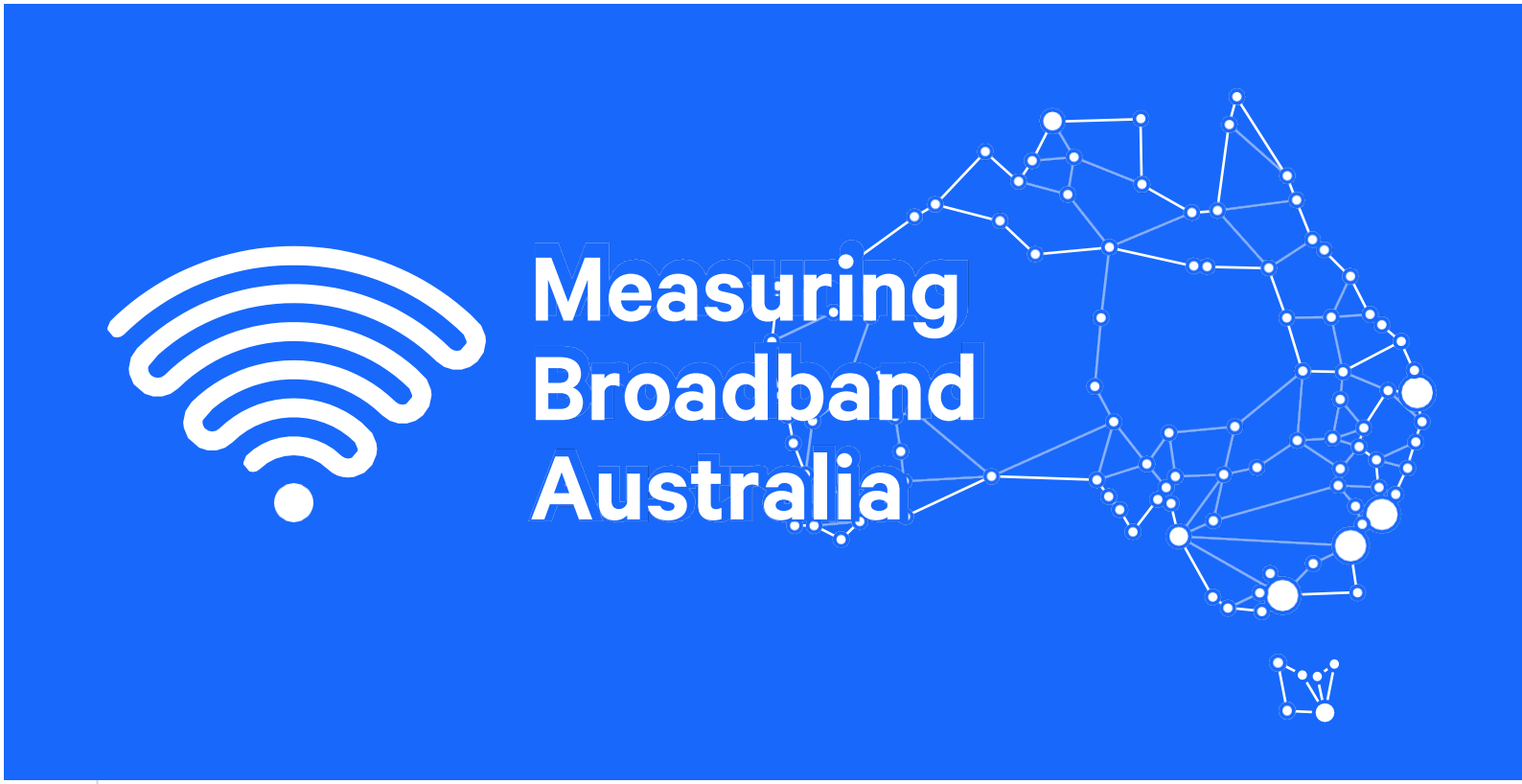


Report 14, August 2021

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 quality of experience for fixed-line internet.

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/.

Contents

Overview

1 May 2021 to 31 May 2021

This is the fourteenth report issued as part of the Measuring Broadband Australia project. This reporting period includes measurements collected over the month of May 2021, a 31 day period.

Review of NBN performance and COVID-19

As a feature in this report, we have analysed the average daily performance of the NBN fixed-line network over the course of the COVID-19 pandemic. We look back at NBN performance from the start of February 2020 as a pre-COVID-19 baseline, to the end of July 2021. The charts in this section also incorporate the performance of the three most popular NBN plans for the period from May 2021 to July 2021. The separate three-monthly time series charts (covering May to July 2021) are available on the ACCC's dashboard at https://www.accc.gov.au/consumers/internet-landline-services/broadband-performance-data.

The analysis shows declining daily average download speeds through the early phases of the COVID-19 lockdowns in March 2020. NBN Co waived retail service provider (RSP) charges for up to 40% additional CVC (connectivity virtual circuit) capacity from 23 March 2020. This helped to stabilise download speeds through record network-wide data demand (download throughput) peaks. Overprovisioning of many NBN services, which began in June 2020, remains in effect and has enabled an increase in average download speeds by around 10% to 15% compared with a February 2020 baseline.

Streaming performance of Fixed Wireless Plus plans

New to this report are the results of testing to Netflix performed over NBN Fixed Wireless Plus services. These tests measured the download speed to Netflix servers when streaming High Definition and Ultra High Definition video content. This is used to estimate the proportion of NBN Fixed Wireless Plus services which would be able

to reliably stream (without stopping and starting) a varying number of videos at High Definition and Ultra High Definition from Netflix simultaneously during busy hours.

Most Fixed Wireless Plus services achieved an average download speed that could support five High Definition video streams, or one Ultra High Definition video stream.

NBN fixed-line video streaming

Recent quarterly reports have included a section on video streaming results for NBN fixed-line services. In this report, the NBN fixed-line video streaming results are available in tables at the NBN tables section (page 51).

COVID-19: A year in review

Time Series of Average Daily Download Speeds from February 2020 to July 2021, NBN fixed-line plans

This section of the report analyses the average daily download speeds of the NBN fixed-line network over the course of the COVID-19 pandemic. We look back at NBN performance for the major NBN fixed-line plans from the start of February 2020 as a pre-COVID-19 baseline, to the end of July 2021. This section also compares the percentage change in average daily download speeds by NBN fixed-line plan against the pre-COVID February 2020 average baseline.

The following four charts present average daily download speeds for the following NBN fixed-line download speed 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 underperforming and impaired units.

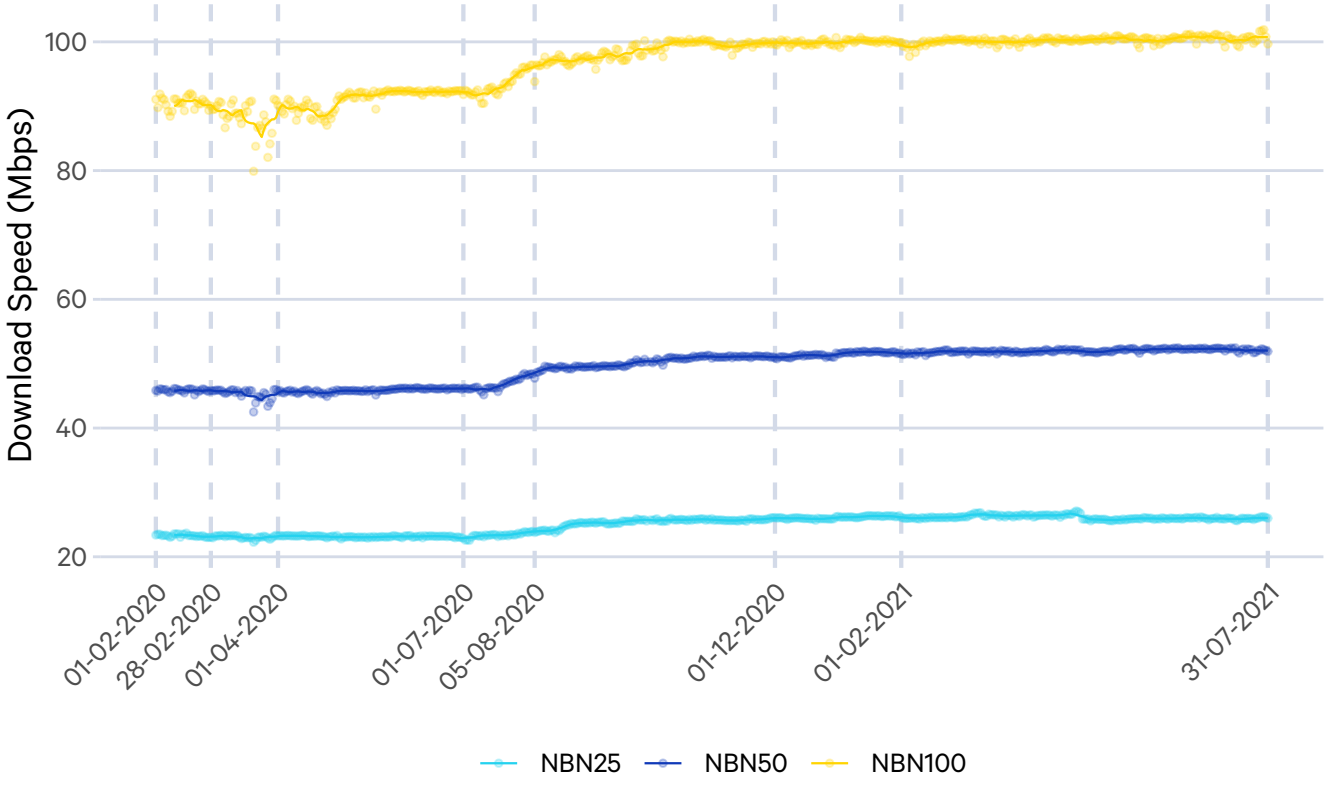
Figures 1 to 4 below incorporate the average daily performance for the three most popular NBN download plans for the period from February 2020 to July 2021. The separate three-monthly time series charts (covering May to July 2021) are available

on the ACCC's dashboard at https://www.accc.gov.au/consumers/internet-landline-services/broadband-performance-data.

Figures 1 and 2 below show the average daily download speeds during all hours, by NBN plan, since February 2020[1]. Figures 3 and 4 show the average daily download speeds during the busy hours by NBN plan over the same period. The vertical lines on figures 1 to 4 mark major events or actions taken to manage the increased load placed on the NBN over the period. These major events or actions are outlined in detail below.

Figure 1: Average daily download speeds during all hours by plan

February 2020 to July 2021. Daily averages with 10-day moving average
NBN fixed-line plans. Excluding underperforming and impaired services.



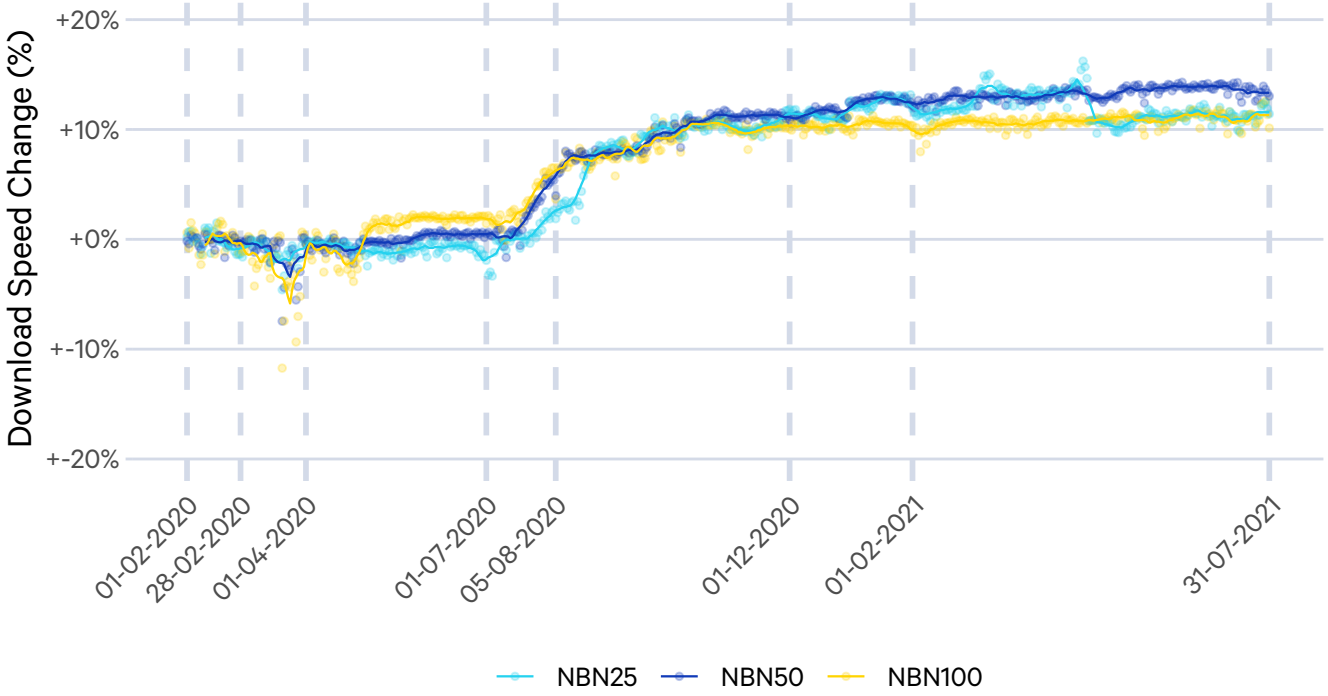
In February 2020, the average download speed of monitored services was lower than

[1] The solid lines on Figures 1 and 2 are a 10-day moving average. A 10-day moving average is the average of the current day's speed result and the speed results on the previous 9 days. We have used the 10-day rolling average to smooth out the influence of the speed variations experienced when COVID-19 lockdown measures first came into effect. The lighter dots on these figures are the average speed results per day.

the maximum plan speed of the respective plan. Starting from July 2020 average download speeds experienced a clear increase. In February 2021, 59.6% of NBN services we monitored recorded a higher average download speed than plan speed. The increase in download speed performance has continued over the past year to July 2021.

Figure 2: Change in average daily NBN fixed-line download speeds as compared to February 2020 baseline, during all hours by plan

February 2020 to July 2021, indexed to February 2020 baseline.
Daily averages with 10-day moving average.
NBN fixed-line plans. Excluding underperforming and impaired services.



In figures 1 to 4, February 2020, prior to the onset of the COVID-19 pandemic, is taken as the baseline period.

Figures 1 shows that in February 2020, the average daily download speed for each plan was lower than the maximum plan speed of the respective plan. Figure 1 shows a noticeable dip in download speeds in March 2020. In April 2020, download speed performance gradually recovers. This aligns with measures announced by NBN Co in March 2020 to manage the increased data load on the NBN fixed-line network.

Figures 1 and 2 show that starting from July 2020, average download speeds for the three speed plans experienced a clear increase. This aligns with NBN Co starting to implement over-provisioning of the download component of some speed tiers between June and August 2020.

In February 2021, 59.6% of NBN services we monitored recorded a higher average download speed than plan speed. Figures 1 and 2 show that the increase in download speed performance has continued over the past year to July 2021. Figure 2 also shows that during 2021 to date, download speeds were generally 10 to 15% higher than the February 2020 pre-COVID-19 baseline.

The major events or actions taken between February 2020 and July 2021 relating to NBN fixed-line network performance are:

- March 2020: retail NBN broadband performance dropped as most of Australia was in lockdown, leading to greater load on the network. NBN Co announced that it would waive RSP charges for additional CVC capacity of up to 40%, in response to increased COVID-19 related user demand[2].
    - On 28 February 2020: NBN busy hour peak download throughput was around 11 Terabits per second (Tbps); NBN Co has used this as its pre-COVID-19 baseline[3].
    - In mid-March 2020, the NBN peak download throughput increased by 13% during the busy evening hours compared to NBN Co's pre-COVID-19 baseline. By late-March 2020, peak download throughput increased by 25% during the busy evening hours compared with NBN Co's pre-COVID-19 baseline[4].

[2] NBN, 'nbn waives additional wholesale capacity charges of up to 40 percent for three months', 18 March 2020, at: https://www.nbnco.com.au/corporate-information/media-centre/media-statements/cvc-media-statement.
[3] NBN, 'Australian Data Demand: new weekly report reveals growth in nbn data demand', 2 April 2020, at: https://www.nbnco.com.au/corporate-information/media-centre/media-statements/australian-data-demand
[4] NBN, 'Australian Data Demand: new weekly report reveals growth in nbn data demand', 2 April 2020, at: https://www.nbnco.com.au/corporate-information/media-centre/media-statements/australian-data-demand.

- Starting in March 2020, over the top (OTT) video streaming providers implemented measures to reduce video streaming traffic and ease the strain on the NBN network[5].

- April 2020: performance of retail broadband services supplied by RSPs on the NBN recovered following NBN Co's offer to waive RSP charges for up to 40% CVC capacity. NBN peak download throughput reached 13.9 Tbps during the evening hours on 29 April 2020[6]. The peak download throughput coincided with the release of updates to a number of popular video games.

- June to August 2020: NBN Co began overprovisioning the download component of most NBN speed tiers by around 10 - 15 per cent where possible, leading to increased performance of retail NBN services.

- 5 August 2020: NBN peak download throughput was 16.2 Tbps during the evening hours (during Victoria's stage 4 lockdown)[7].

- December 2020: NBN Co started to taper its waiver of RSP charges for the additional CVC capacity.

- February 2021: NBN Co's waiver of RSP charges for additional CVC capacity was fully withdrawn.

- Sydney entered a protracted lockdown from late June 2021, with Victoria entering a number of shorter lockdowns from May 2021. Shorter lockdowns were also applied in other states through the winter months.

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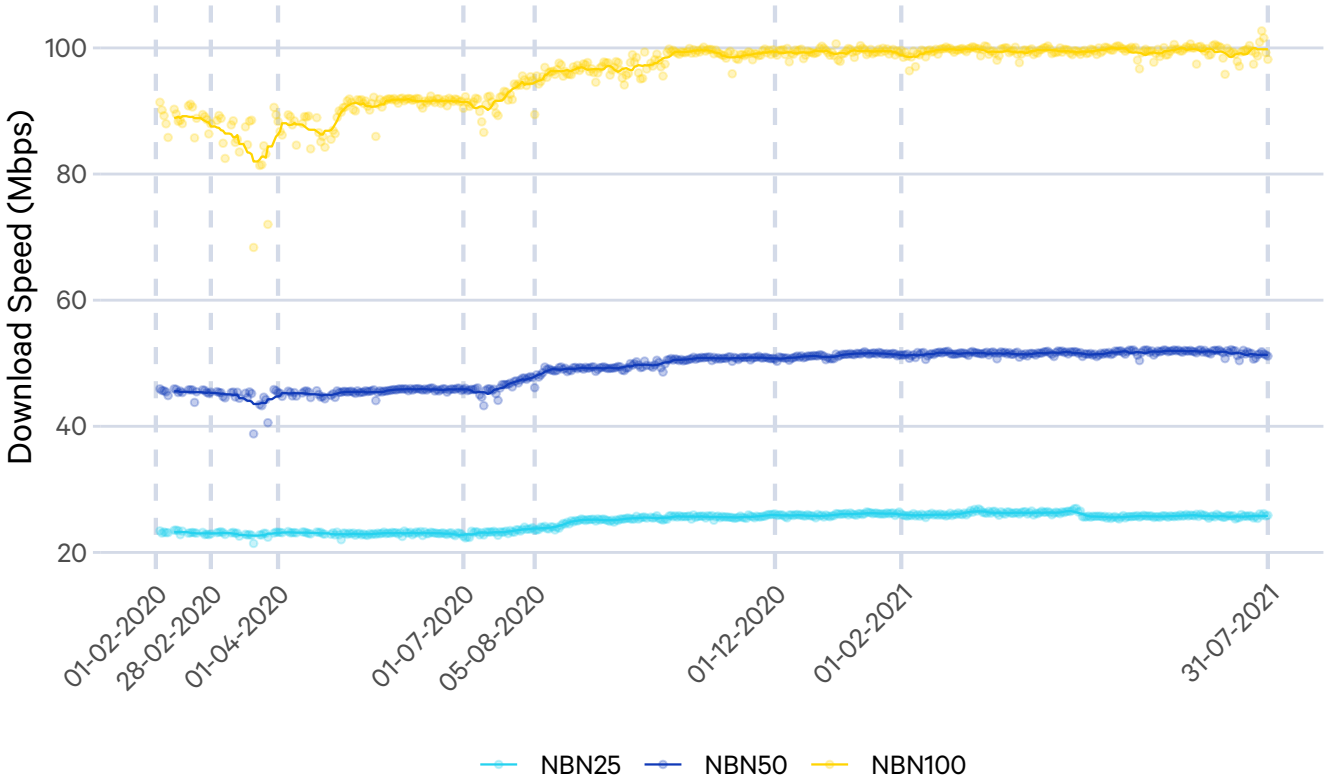
[5] OTT video streaming providers implemented these measures initially from March to June 2020, and then reinstated them from August and September 2020 following the Stage 4 lockdown commencing in Victoria. Major OTT video streaming services returned to full streaming bitrates in the last two weeks of September as COVID-19 restrictions eased in Australia, with most other OTT video streaming services returning to full bitrates during October 2020.
[6] NBN, 'Australian Broadband Data Demand: nbn records highest peak in data demand', 7 May 2020, at: https://www.nbnco.com.au/corporate-information/media-centre/media-statements/australian-broadband-data-demand.
[7] See NBN, 'Australian Broadband Data Demand: new peak in data demand', 14 August 2020, https://www.nbnco.com.au/corporate-information/media-centre/media-statements/data-demand-new-peak-in-data-demand.

- In July 2021, NBN Co announced support for increased network capacity requirements as a COVID-19 relief measure[8].

Figure 3: Average daily download speeds during busy hours by plan

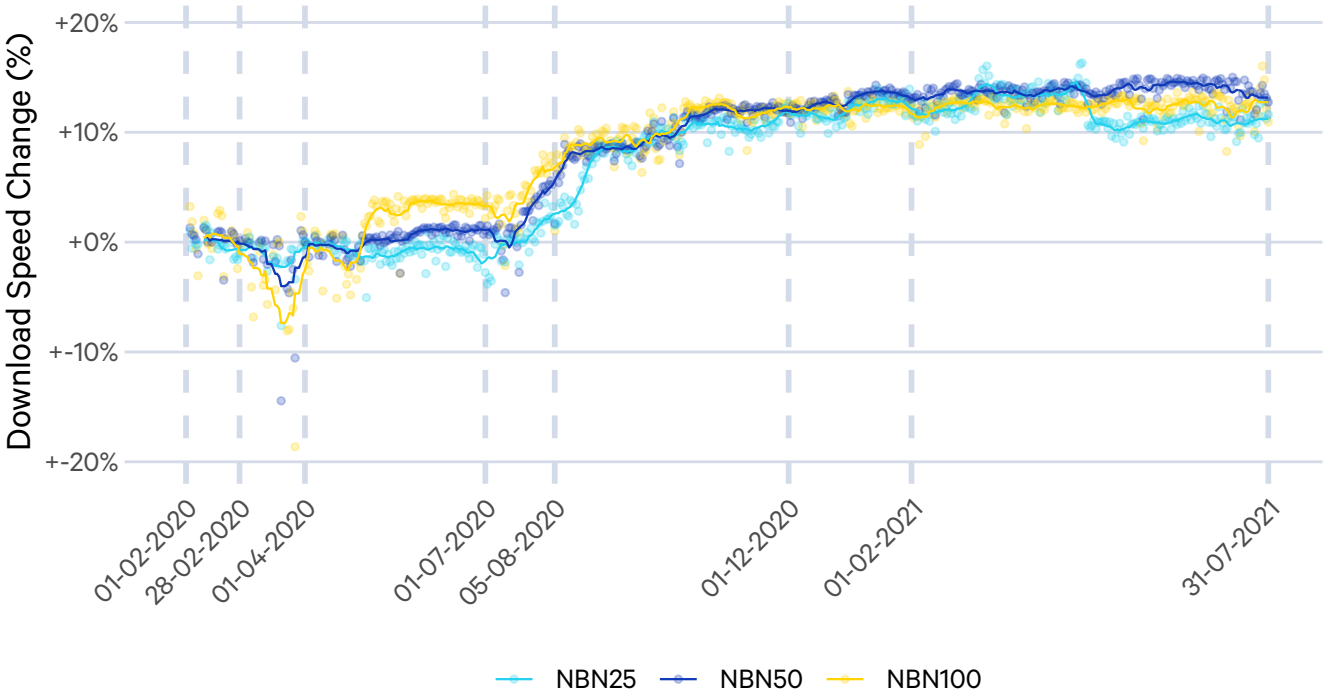
February 2020 to July 2021. Daily averages with 10-day moving average
NBN fixed-line plans. Excluding underperforming and impaired services.



[8] NBN, ' NBN Co moves to support increased data demand, extends additional capacity offer to internet retailers', 24 July 2020, https://www.nbnco.com.au/content/dam/nbnco2/2020/documents/media-centre/NBNCo-moves-to-support-increased-data-demand.pdf.

Figure 4: Change in average daily NBN fixed-line download speeds as compared to February 2020 baseline, during busy hours by plan

February 2020 to July 2021, indexed to February 2020 baseline.
Daily averages with 10-day moving average.
NBN fixed-line plans. Excluding underperforming and impaired services.



The data in the preceding charts has been published previously within Measuring Broadband Australia's Monthly Key Indicators reports available from https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/measuring-broadband-australia-program/monthly-key-indicators-report and, as of, February 2021, in the quarterly reports available from https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/measuring-broadband-australia-program/previous-performance-reports.

As detailed in the Monthly Key Indicator reports in which this data was first published:

- All results in these charts exclude data from underperforming or impaired services.
- Figures 1 and 2 are based on data taken from all hours of the day.

- Figures 3 and 4 are based on data taken from busy hours (7pm - 11pm) from Monday to Sunday.
- Results from May to July 2020 exclude data from the MBA testing infrastructure in NSW and WA: this testing infrastructure was affected by the unprecedented congestion levels experienced at the time.
- Results from August to 8 October 2020 exclude results from the Victoria (Melbourne) server. Results from a newly established test server in Victoria are included from 8 October 2020.
- The first few days of November 2020 exclude results from the New South Wales (Sydney) server. Results from a newly established test server in New South Wales are included from 3 November 2020.
- NBN100 results from August 2020 onwards combine data from services on the 100/40 Mbps and 100/20 Mbps speed tiers; prior NBN100 results are based just on the 100/40 Mbps speed tier.

NBN fixed-line services[9]

Download Speed Test Results

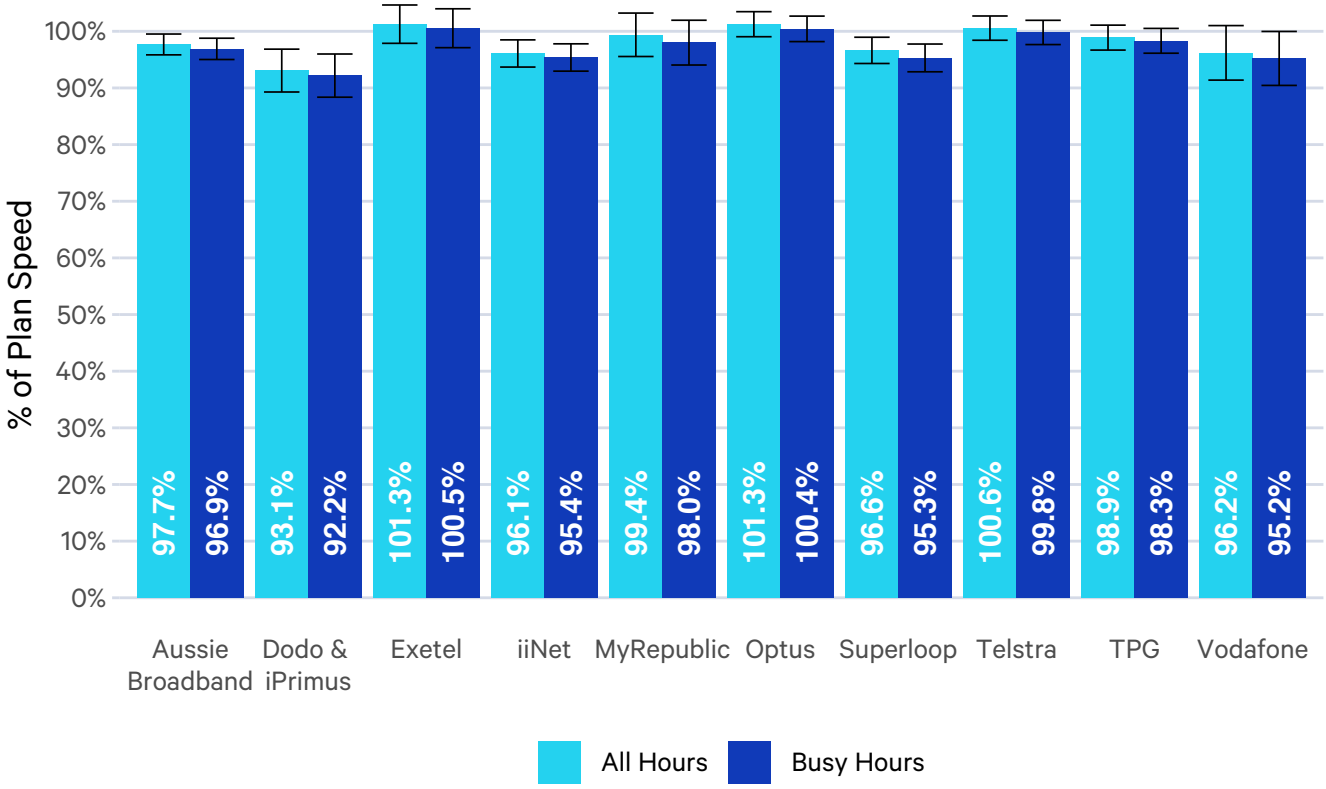
This report expresses results relating to download and upload speed as a percentage of the service's plan speed.[10] Plan speed is not always the same as the speed advertised for a plan by RSPs. Hence, where the report outlines speed measures below 100 percent of plan speed, this should not be interpreted as the RSP having failed to provide the speed that it advertised.

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

[10] 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 5: Average download speed by RSP

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



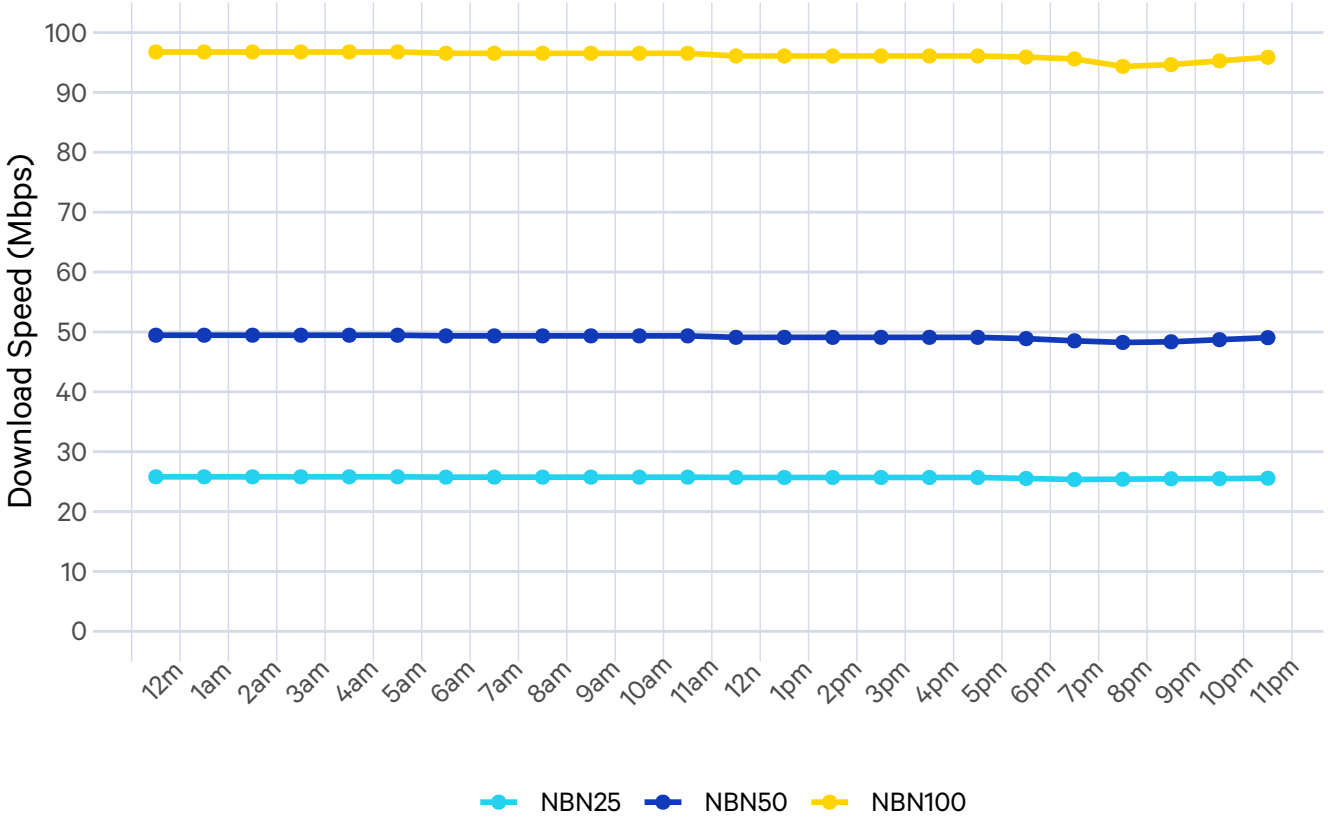
During this period, users on NBN connections attained an average download performance of 98.4% of plan speed during all hours, decreasing to 97.6% during the busy hours (between 7pm and 11pm) which is when networks experience higher user activity.

These results are a further overall increase compared with those in the last (13th) Measuring Broadband Australia report. The corresponding figures in the last report were 96.5% of plan speed during all hours and 95.7% during busy hours. A large part of this network level increase is a consequence of overprovisioning.

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 100.6% with a 95% confidence interval of ±2.1%. This means that if we were to repeat our sampling 100 times, we expect that average performance would fall between 98.4% and 102.7% in at least 95 cases.

Figure 6: Average hourly download speed by plan

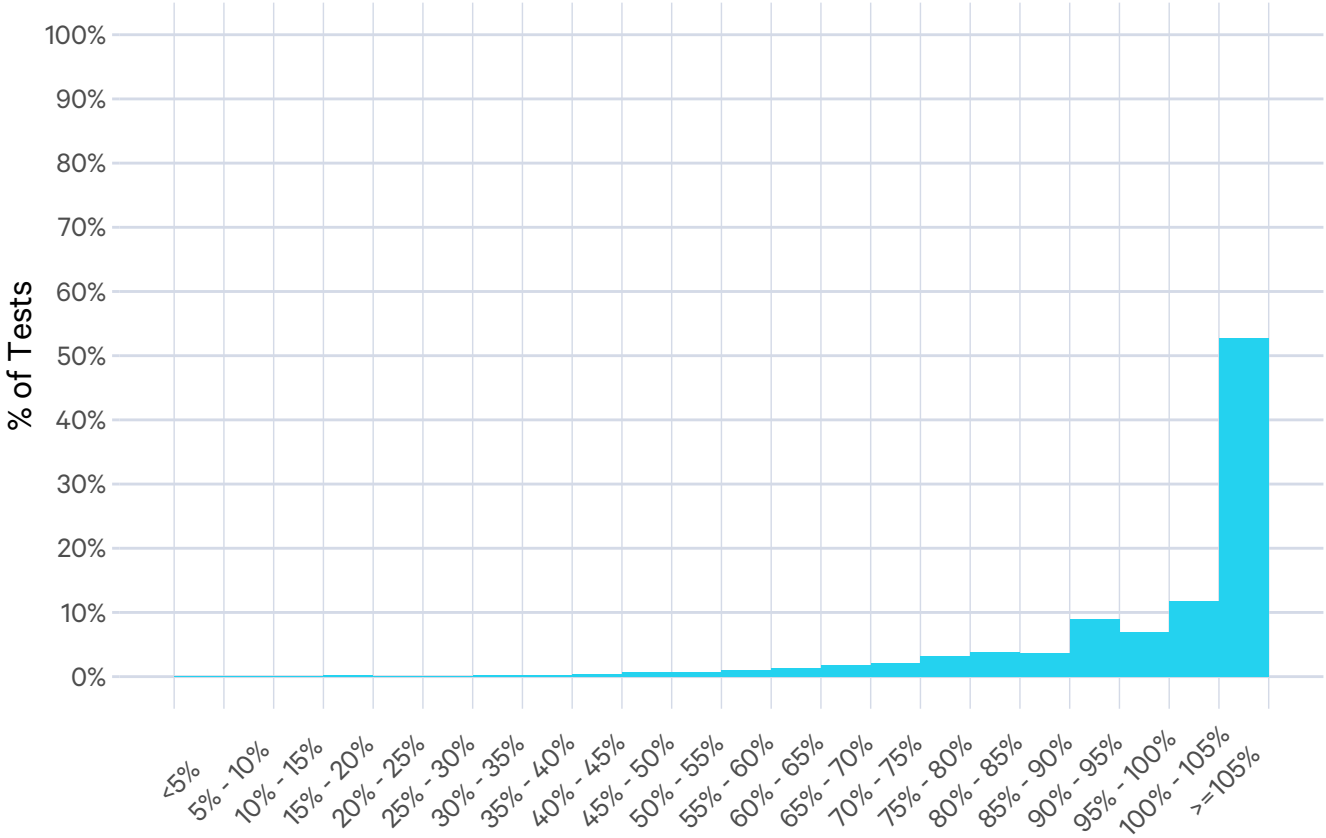
NBN fixed-line plans. Including underperforming services.



Average download speeds held steady throughout the day for users on most NBN speed tiers. The 100Mbps NBN tiers remain the most affected by increased user activity in the evening hours: speeds typically started to decrease during the evening, dipping to 2.4Mbps below the day's maximum by 8pm, and would recover to higher levels during the night. The average dip in NBN100 speeds is typical of what has been observed in previous reports.

Figure 7: Frequency of download speeds attained during tests

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



239,208 download speed tests were performed across 1,144 Whiteboxes connected to fixed-line NBN infrastructure during the period.

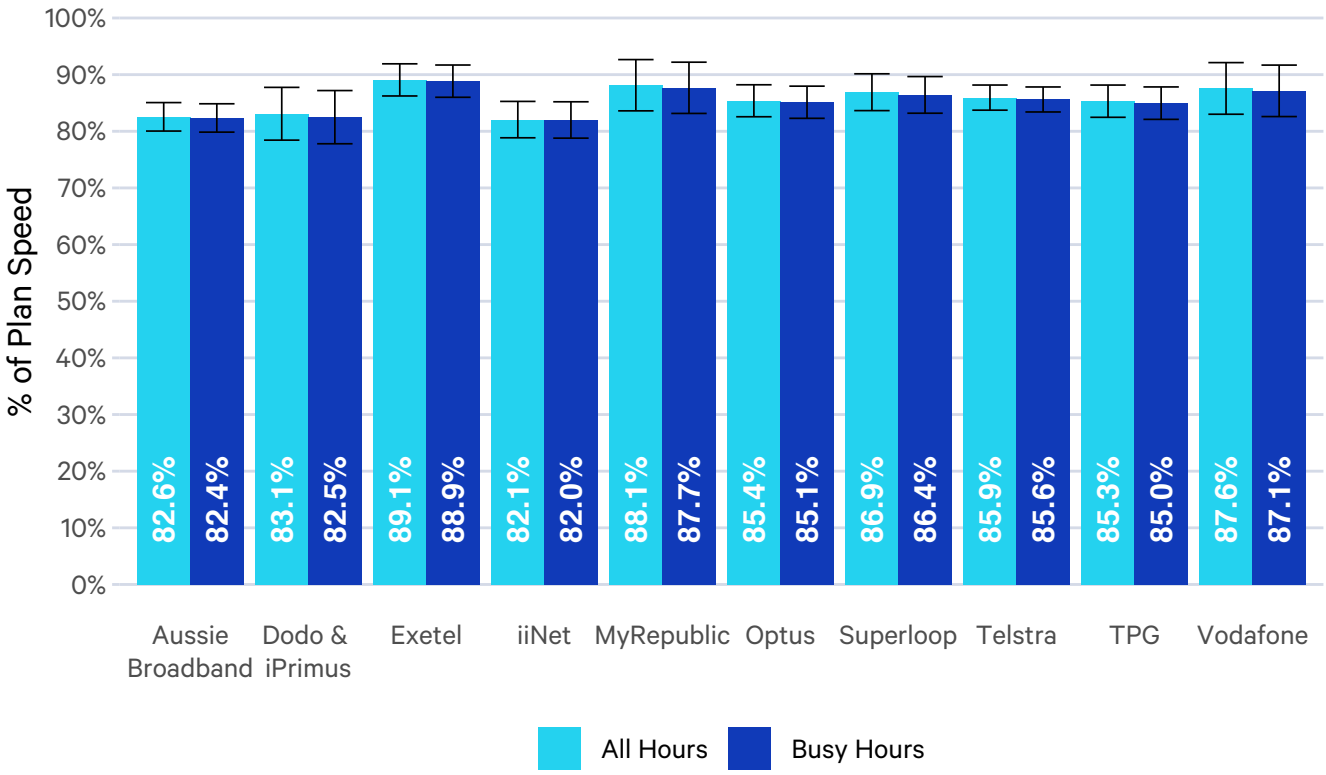
64.4% of tests in this reporting period achieved at least 100% of plan speed; for reference, 61.9% of tests in the previous report were at plan speed or higher.

2.1% of tests achieved less than 50% of plan speed; for reference, in the previous report 2.8% of tests also failed to meet the 50% mark.

Upload Speed Test Results

Figure 8: Average upload speed by RSP

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

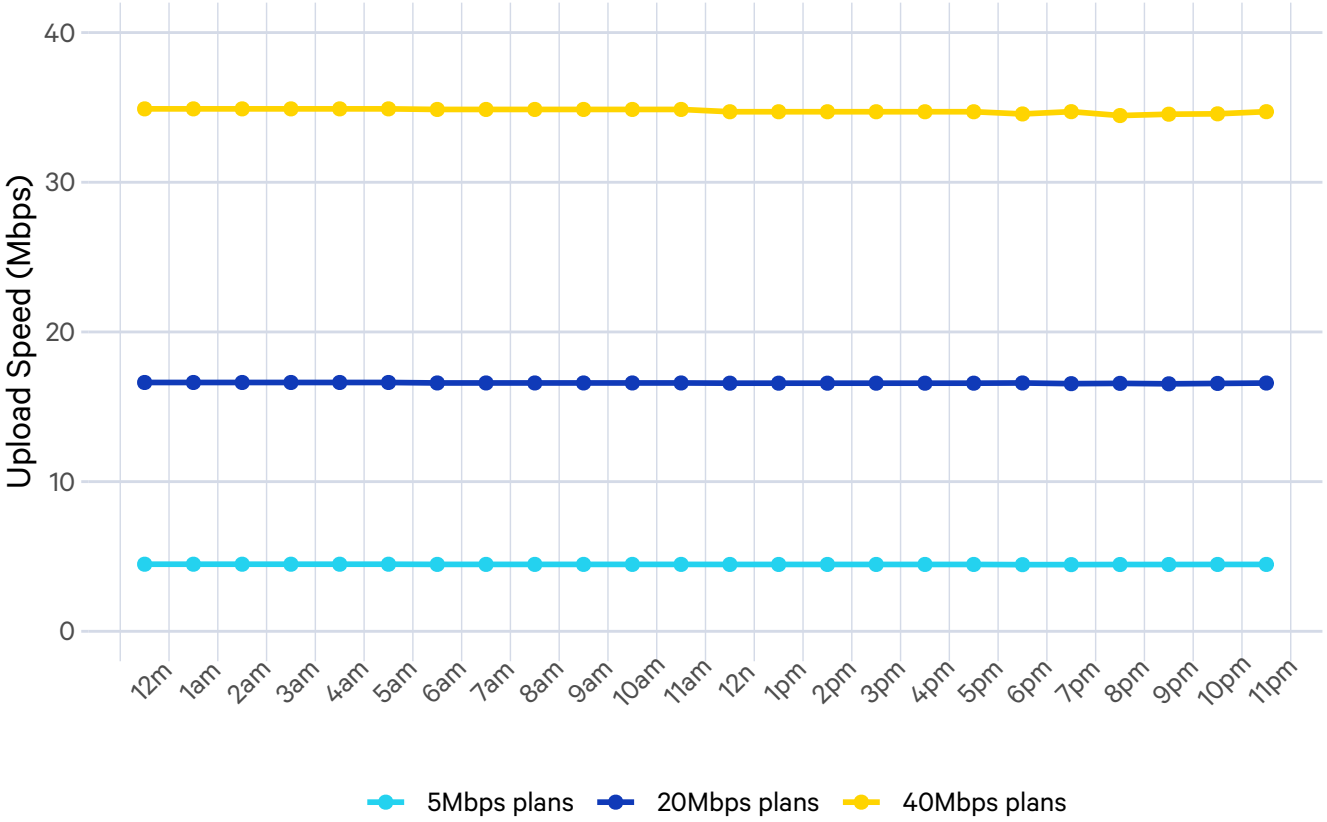


Upload performance was similar when compared to the previous report: NBN services achieved an overall average upload performance of 84.9% during all hours, as against 84.5% in the previous report. In contrast to download speeds, the upstream side of NBN services is not over-provisioned, and so upload results are lower than download results relative to plan speed.

Average upload performance ranged between 82.1% and 89.1% during all hours across RSPs.

Figure 9: 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.

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.

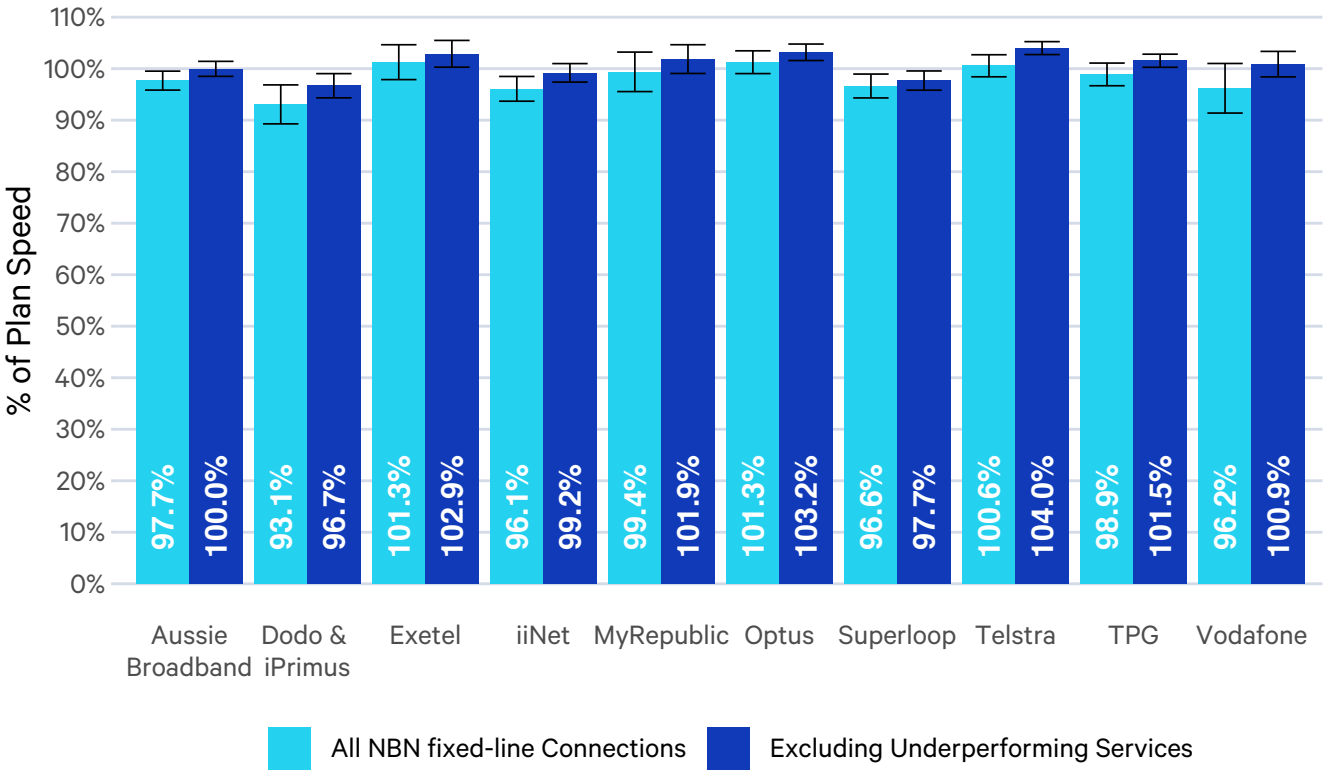
This information allows consumers to better understand the reported download and upload speed measures by removing the effect of services which, due to physical limitations, would be better assigned to another plan. At the same time, this comparison provides stronger incentives for service providers 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 6.2% of the 1,144 NBN services that were tested for this report. 96% of underperforming NBN services are fibre to the node connections. 94% of underperforming NBN services are on NBN50 and NBN100 plans. The average download performance once underperforming services are excluded is 101.1% as against the 98.4% 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 2.7 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 10: 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.

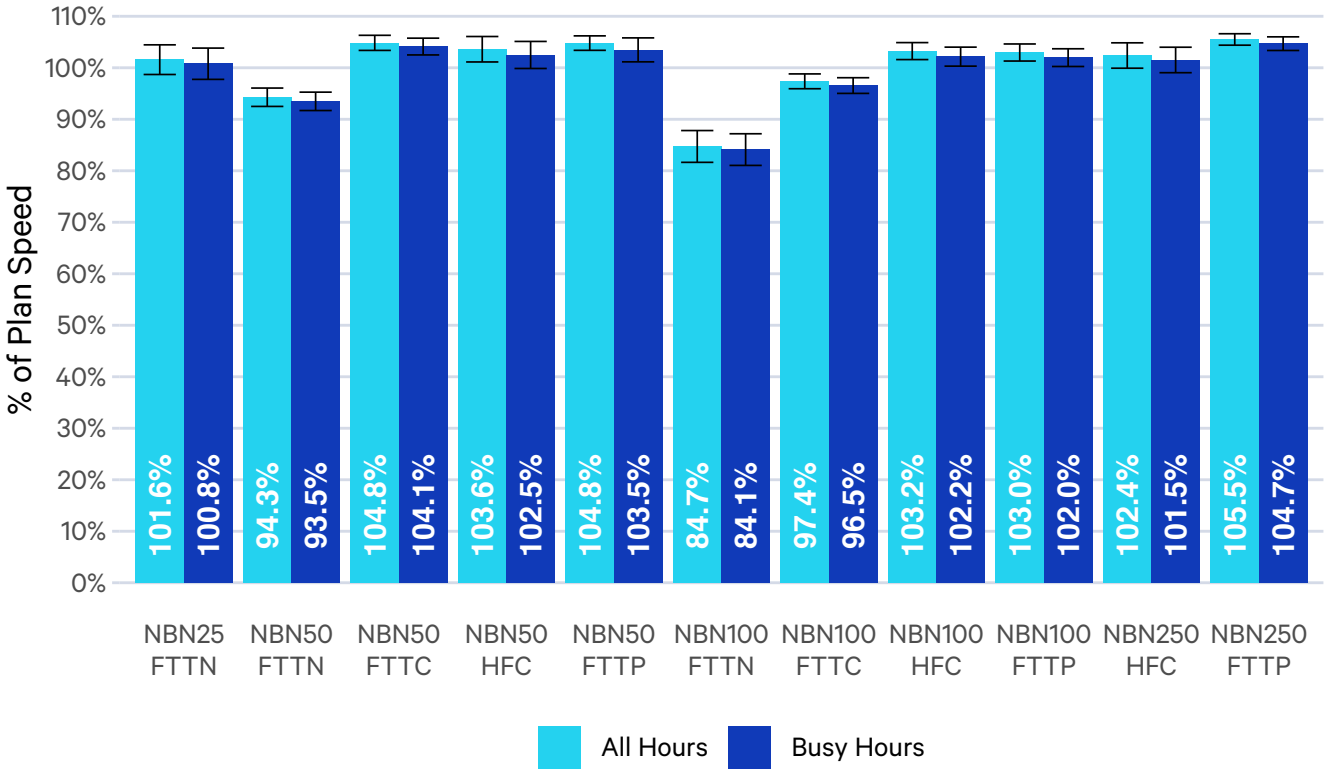


Download Speed by NBN Plan and Access Technology

The following chart shows average download speed for different access technologies for different NBN speed tiers. NBN250 is a new addition to this report:

Figure 11: Average download speed by plan and technology

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



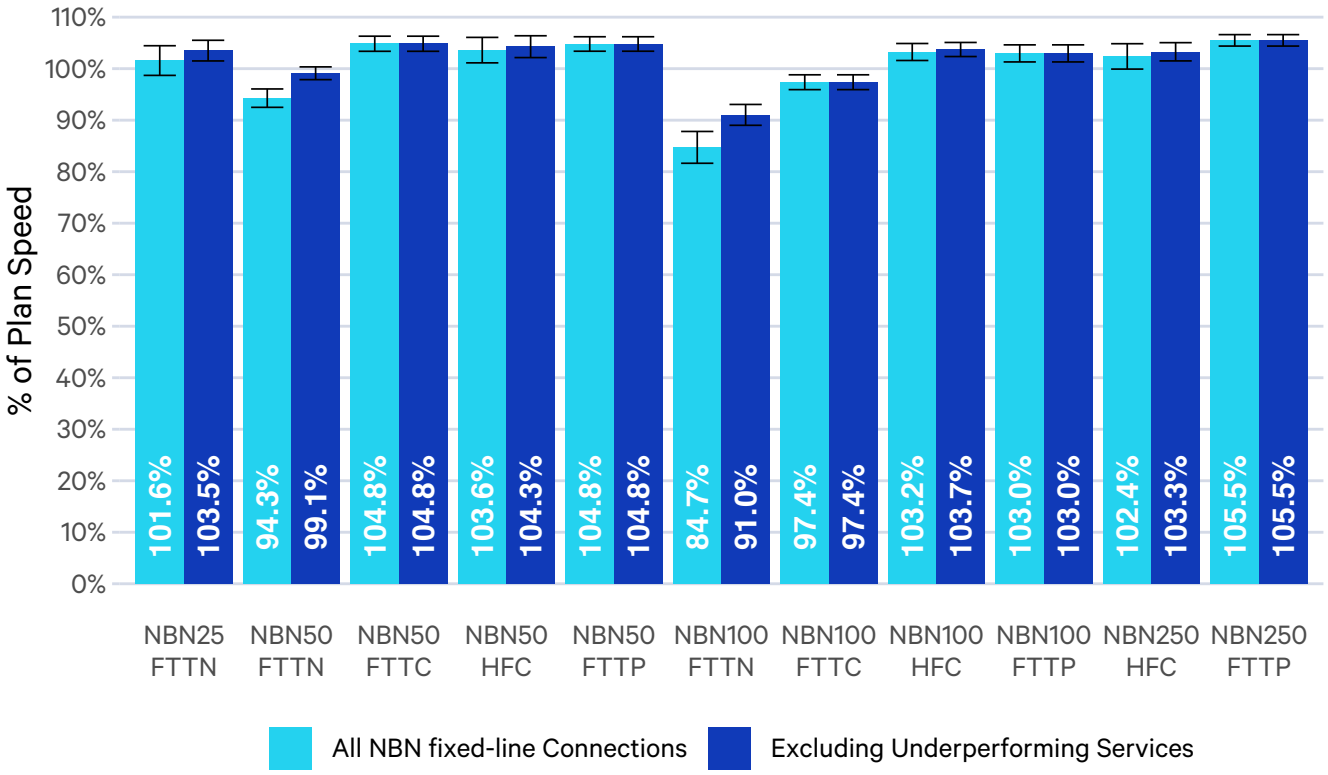
Within the NBN50 speed tier, fibre to the node services had an average download speed around 5Mbps lower than other technologies, a difference of 10% when comparing in percentage terms as shown in the chart above. Within the NBN100 speed tiers, fibre to the node services had an average download speed around 17Mbps 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.

The following chart shows the impact of underperforming services on average download speed across different plans and technologies.

Figure 12: 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.



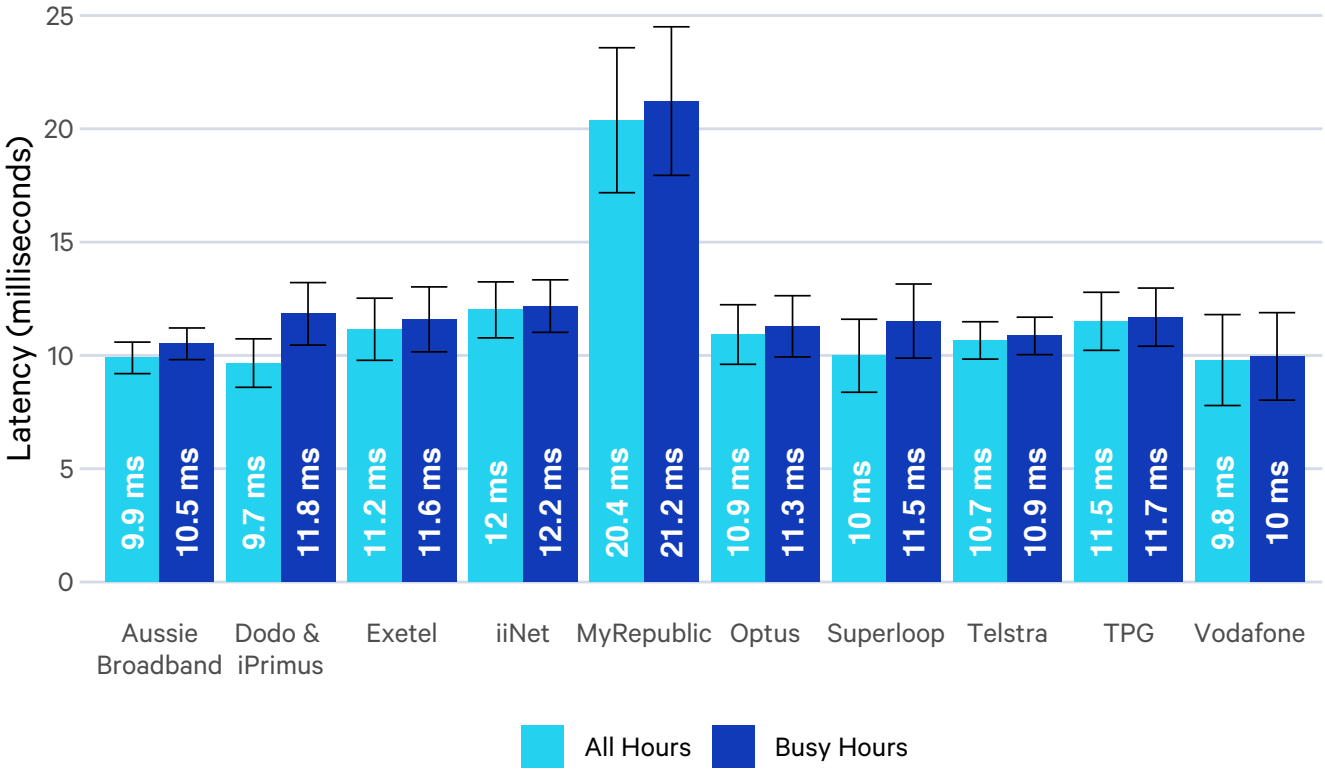
Fibre to the node services continue to account for the bulk of the impact from underperforming services across both the NBN50 and NBN100 speed tiers.

Latency, Webpage Loading Time, and Packet Loss by Plan

The following chart 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 13: Average latency by RSP

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



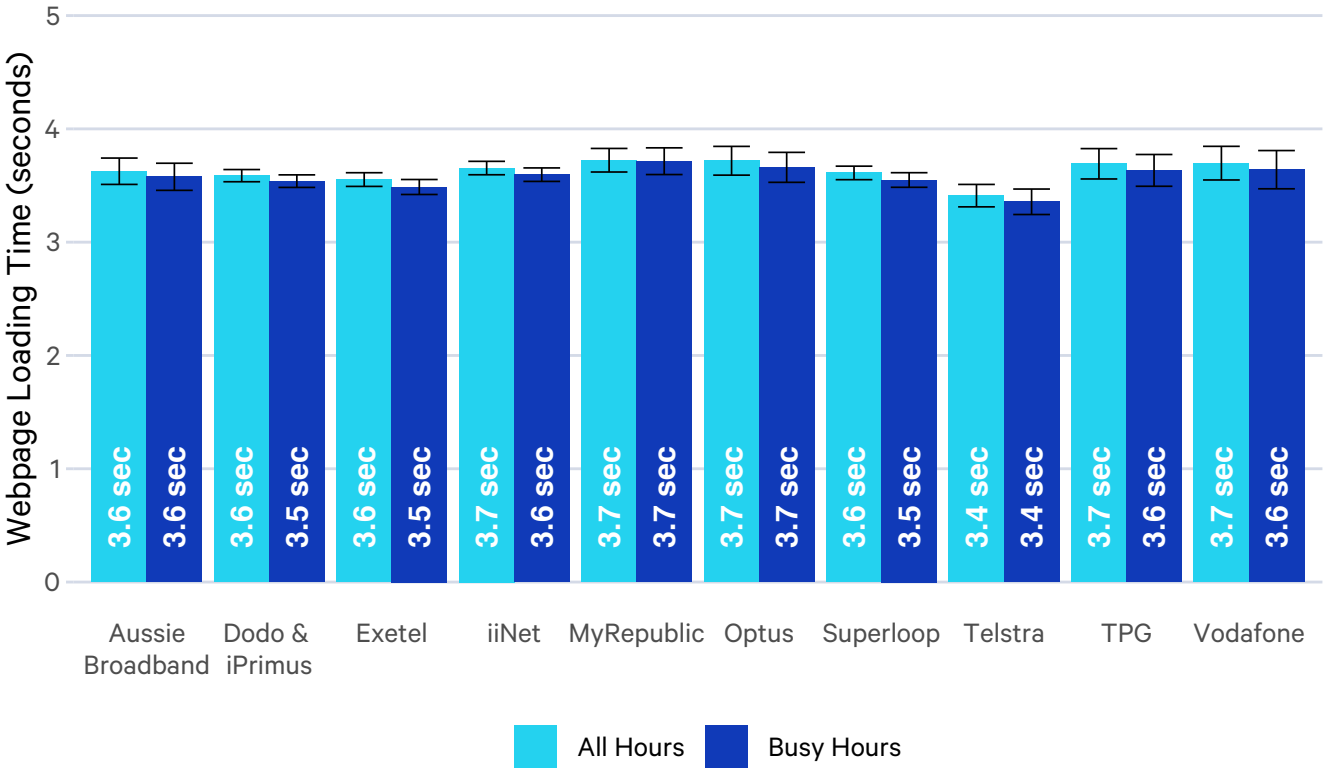
Latency results from this period are in line with the previous report: average latency was generally below 13ms during all hours across RSPs with the exception of MyRepublic.

MyRepublic services had higher average latency than connections served by other RSPs, although MyRepublic's average latency did remain at a similar level during busy hours. It should be noted that latency at even 30ms would have a detrimental effect on only the most latency-sensitive applications and would be unlikely to be noticed by an end user.

The following chart shows the average time required to fully load eight popular webpages for Australian users across all NBN speed tiers, per RSP.

Figure 14: Average webpage loading time by RSP

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

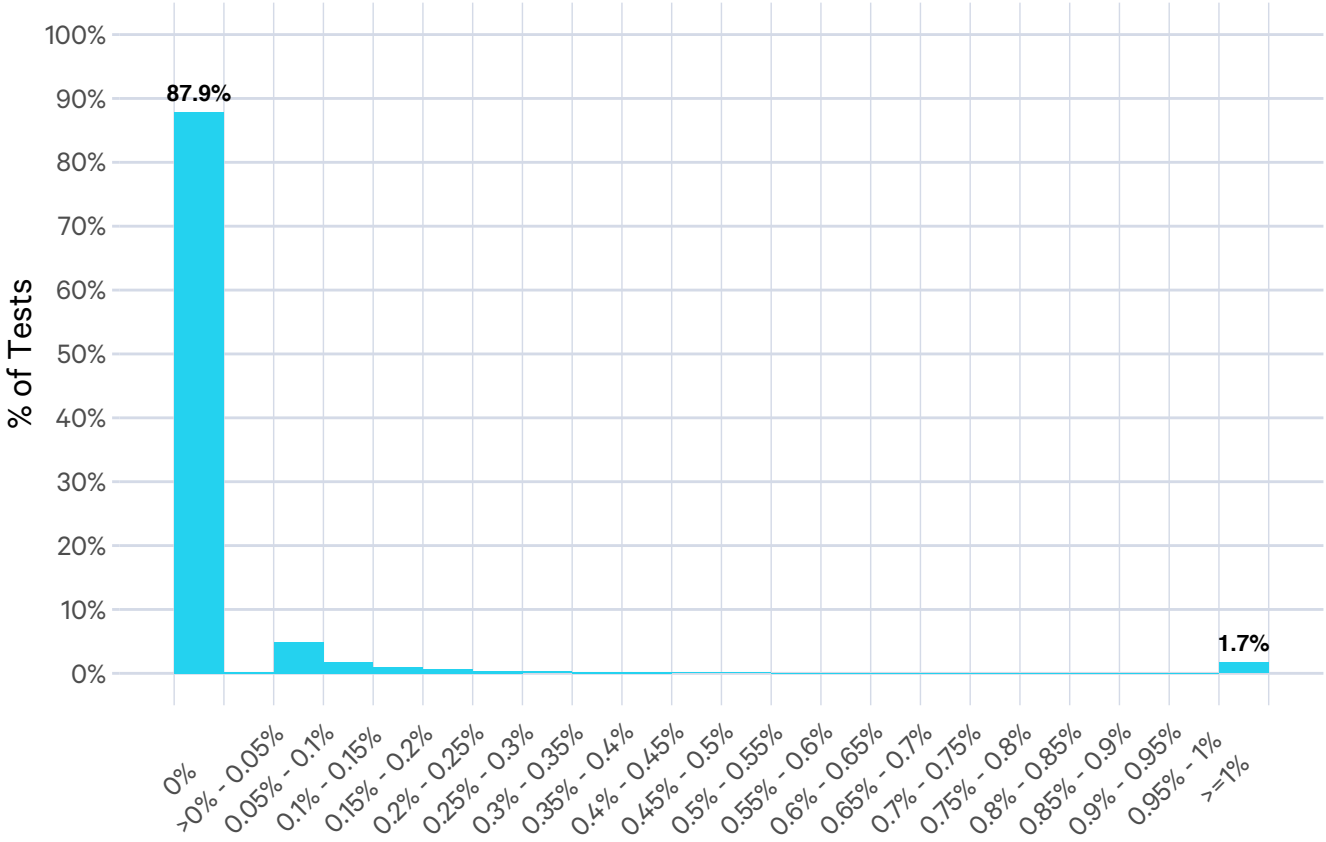


The average time needed to load a website was broadly in line with the average seen in previous reporting periods. More information on the factors that impact web browsing experience can be found in the Web performance test report at https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/measuring-broadband-australia-program/web-performance-test-report.

The following chart 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. Measured as a percentage of all packets sent.

Figure 15: Frequency of packet loss rates observed during tests

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



A total of nearly 759,632 packet loss tests were conducted over the measurement period. 88.0% of these tests had packet loss of either zero or less than 0.05%. For reference, in the previous report 88.3% of tests had packet loss below 0.05%.

At the other end of the scale, 1.7% of tests had packet loss greater than 1% as against 1.2% 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

The following charts 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 16: Average daily outages lasting over 30 seconds by RSP

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

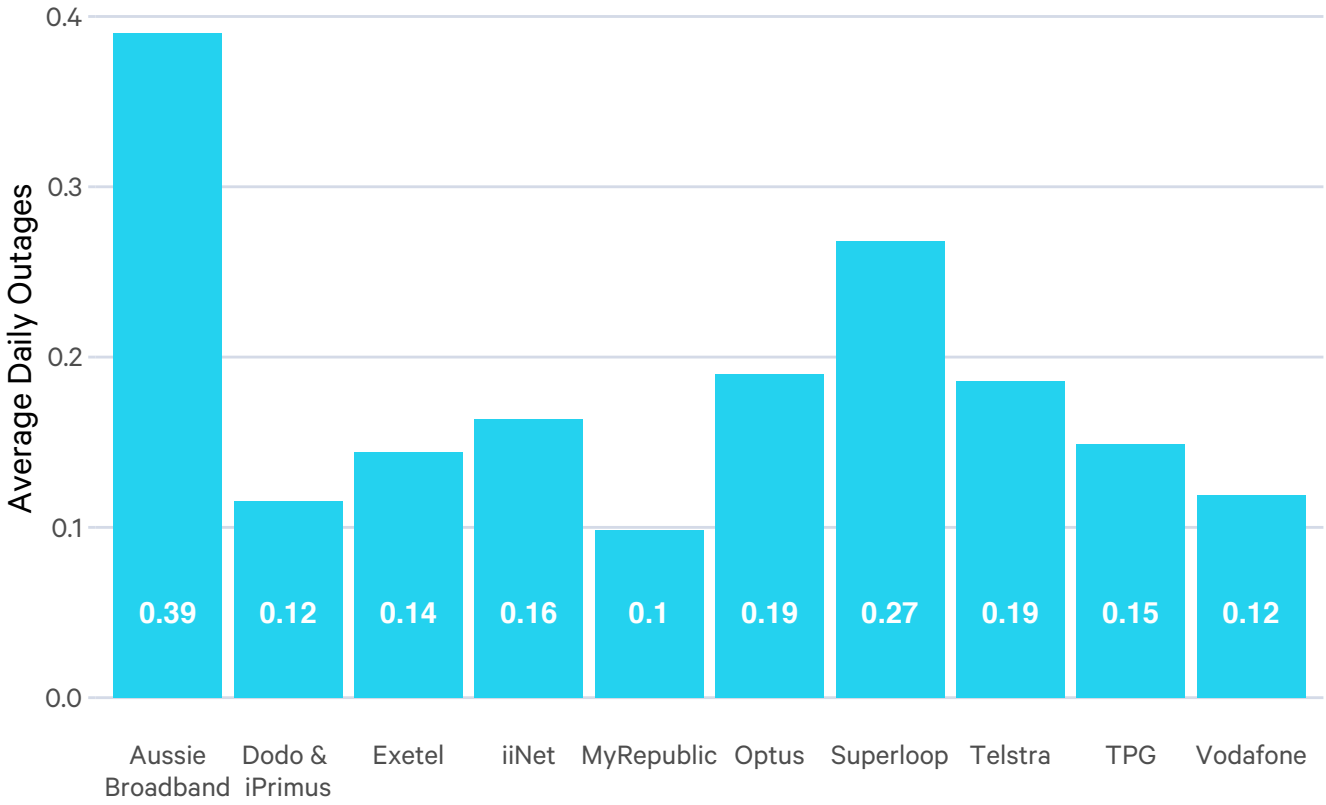
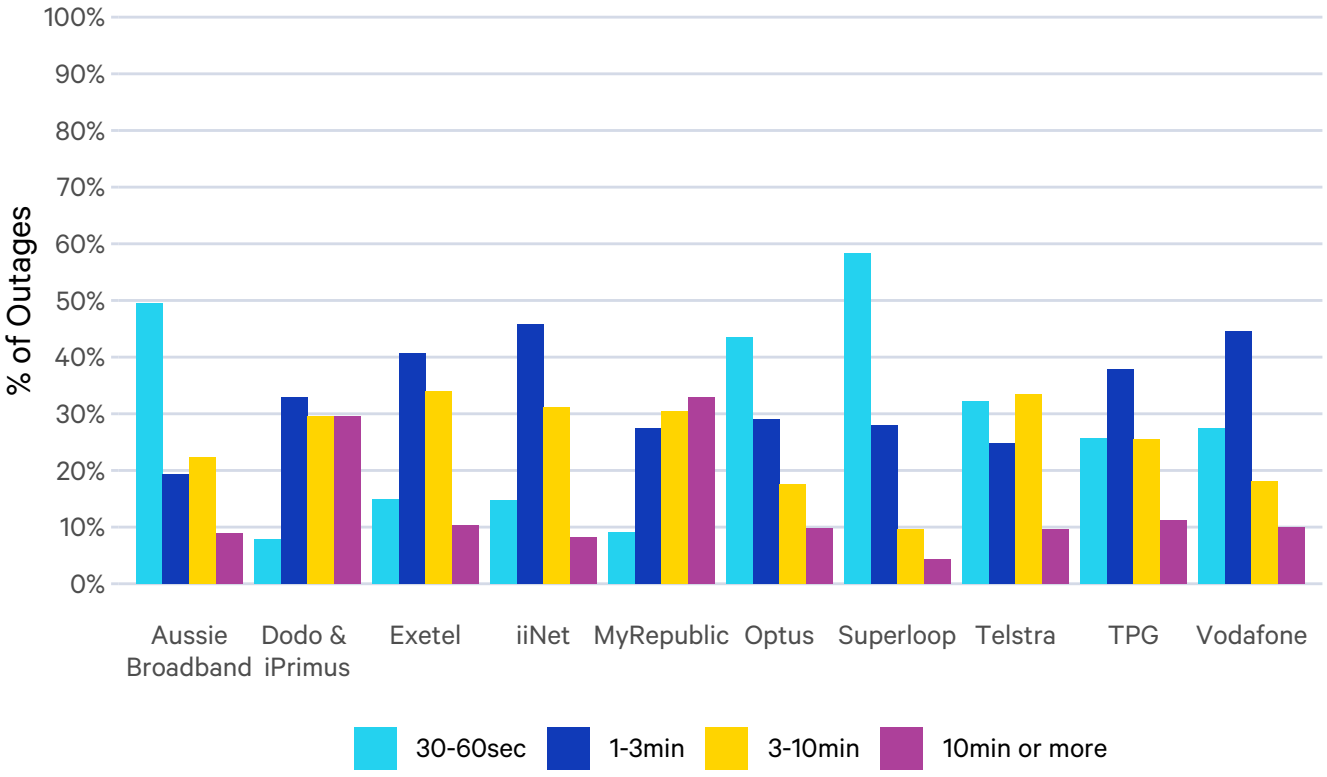


Figure 17: Distribution of outage duration by RSP - NBN plans including underperforming services - all hours

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



All RSPs' rates of outages were relatively low; no higher than the equivalent of one outage every three days. This, combined with the information that the majority of outages last for no more than 3 minutes, means that 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. The measurement period had a total of 31 days with 4 busy hours each, totalling 124 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. We take each RSP's fifth-lowest hourly download performance as an indicator of performance during the busiest hours when networks are under the highest levels of stress.

The chart below considers NBN50 and NBN100 plans and has three columns for each RSP:

- The first column is a weighted average of the predominant typical busy hour speeds advertised for these plans by each RSP during the measurement period, expressed as a percentage of the maximum speed achievable by the plan. The weights used are the numbers of Whiteboxes online on the NBN50 and NBN100 plans. See the NBN50 and NBN100 Advertised Speed Tables section (on page 69) for full detail.
- The second column shows download performance during busy hours, expressed as a percentage of plan speed.
- The third column shows download performance during the busiest hour (i.e. the fifth-lowest hourly average as explained above), expressed as a percentage of plan speed.

A result in which the busiest hour speed is relatively close to the average busy hour speed indicates that the 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 the plan is more affected by particularly high demand peaks.

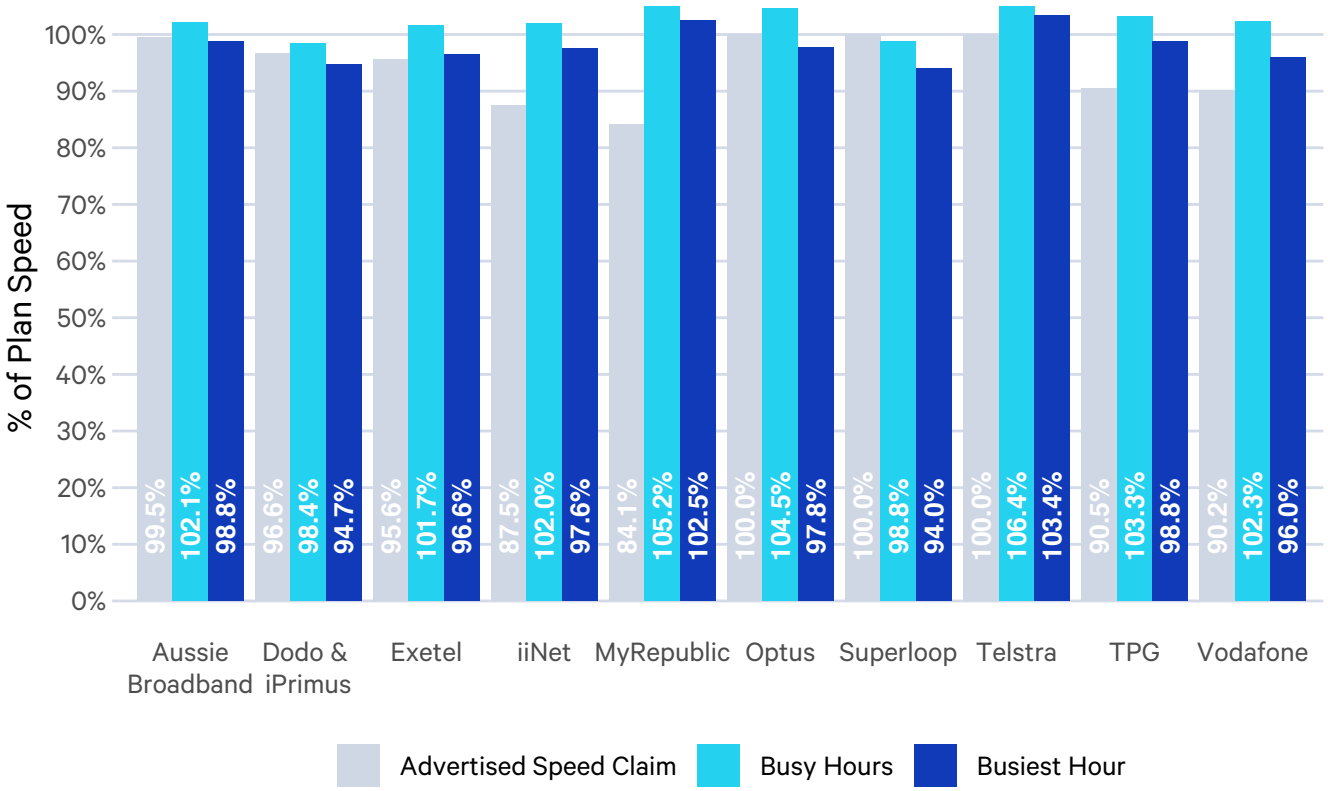
During the measurement period, RSPs advertised download speeds for their NBN50 and NBN100 products that were between 83% and 100% of the maximum achievable by the products, with MyRepublic advertising the lowest speeds, and Optus,

Superloop and Telstra the highest (each advertised a speed of 50Mbps for its NBN50 plan and 100Mbps for its NBN100 plan).

Any services which are underperforming (as defined above), or which have an acknowledged impairment which prevents the plan speed from being delivered, have been excluded.

Figure 18: Advertised speeds and average download speeds by RSP

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

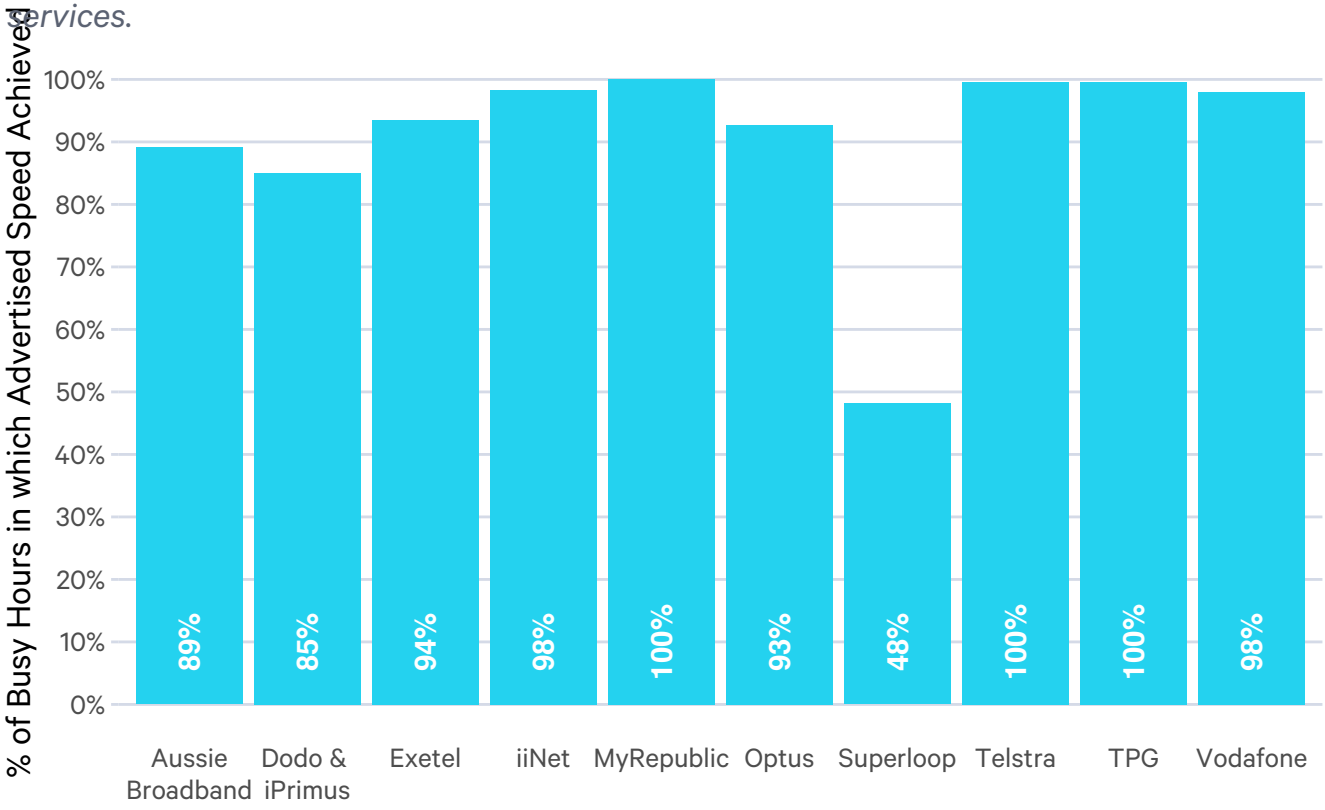


From these results we can see that if all underperforming services and impaired services had been remediated – or moved to a more appropriate plan - then all RSPs bar one would have average speeds that exceeded advertised speed claims during their busiest hour.

The chart below 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 19: 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 48% for any tested provider.

NBN very high speed services

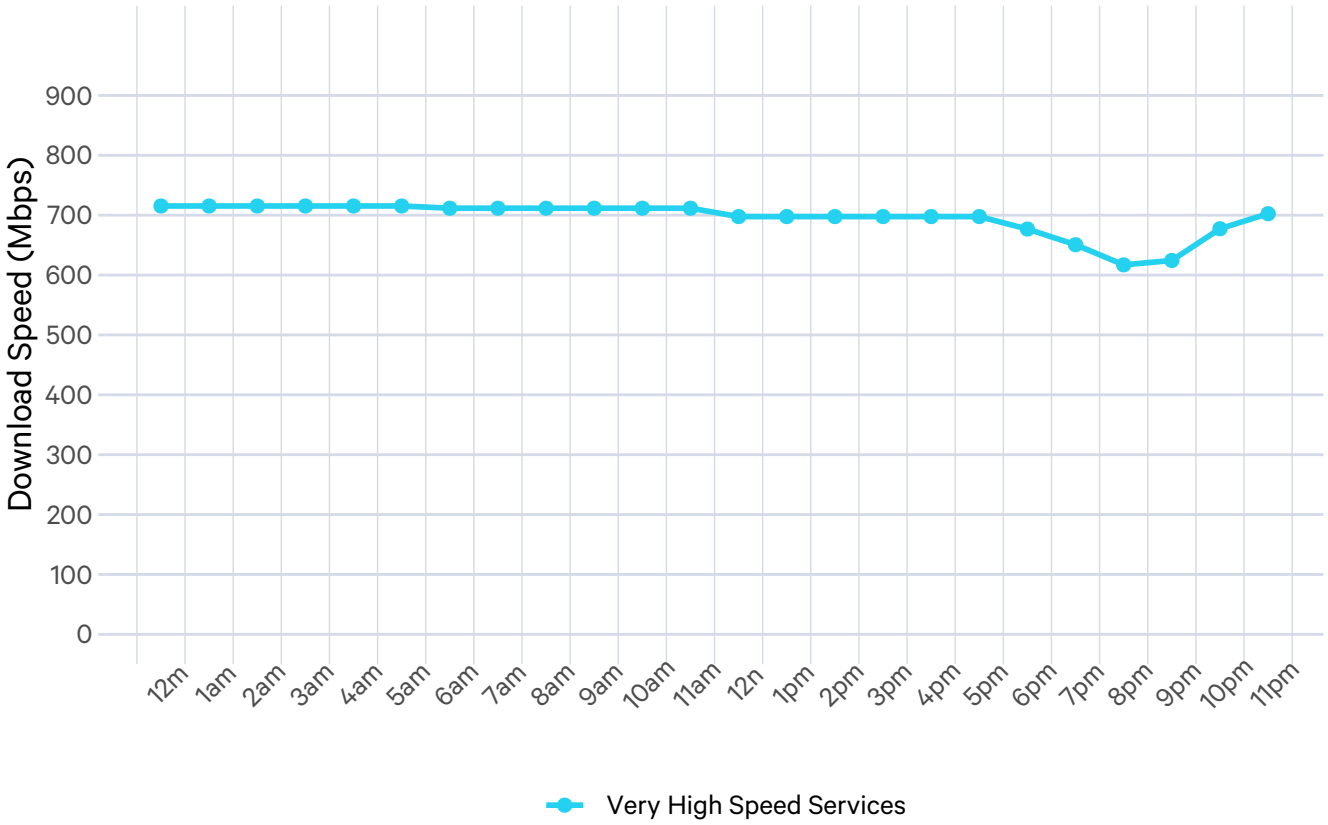
This section presents results for NBN fixed-line very high speed services for the same period, May 2021, as for other fixed-line results. Very high speed services refers to plans where the underlying wholesale product sold by NBN Co has a download/upload speed range of 500-990/50Mbps. This section is based on a total of 77 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.

NBN very high speed connections attained an average download speed of between 617Mbps and 715Mbps. Performance was less stable during the busy hours (between 7pm and 11pm) and wider evening peak period, which is when networks experience higher user activity.

Figure 20: Average hourly download speed for very high speed services

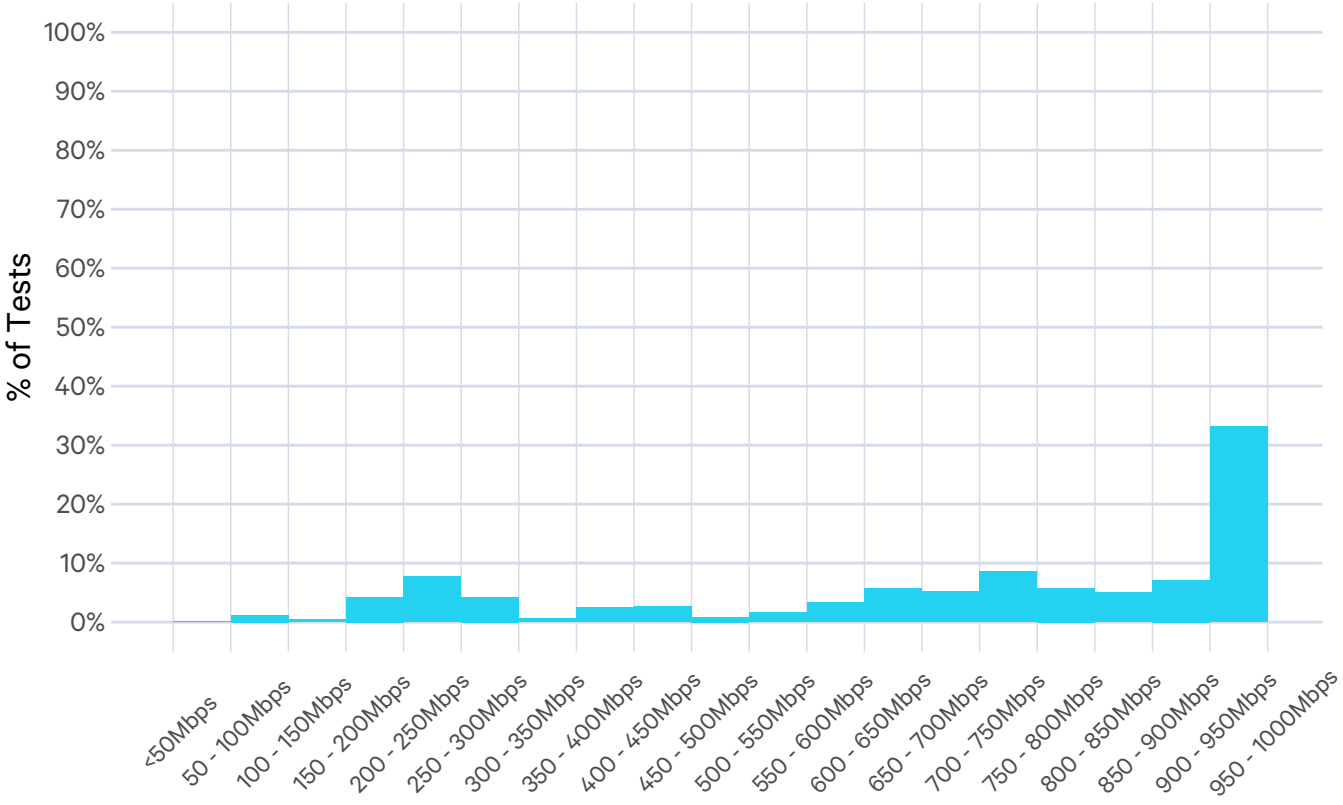
NBN very high speed services.



Average download speeds showed considerable variation throughout the day for very high speed services: speeds typically started to decrease during the evening, dipping to 98Mbps 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 21: Frequency of download speeds attained during tests of very high speed services

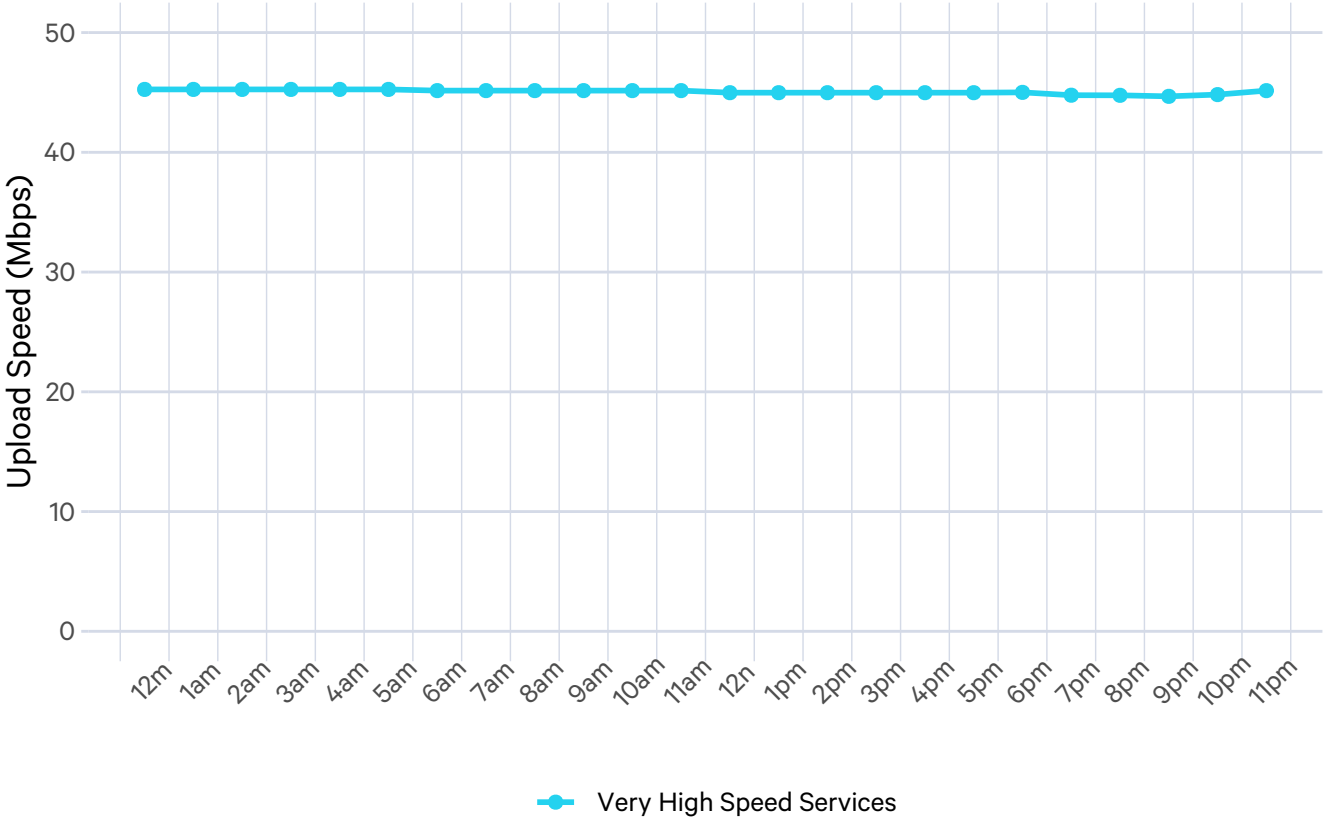
NBN very high speed services. All hours.



14,908 download speed tests were performed across 77 Whiteboxes connected to fixed-line NBN infrastructure during the period. 33.2% of tests conducted achieved a download speed of at least 900Mbps.

Figure 22: Average hourly upload speed for very high speed services

NBN very high speed services.



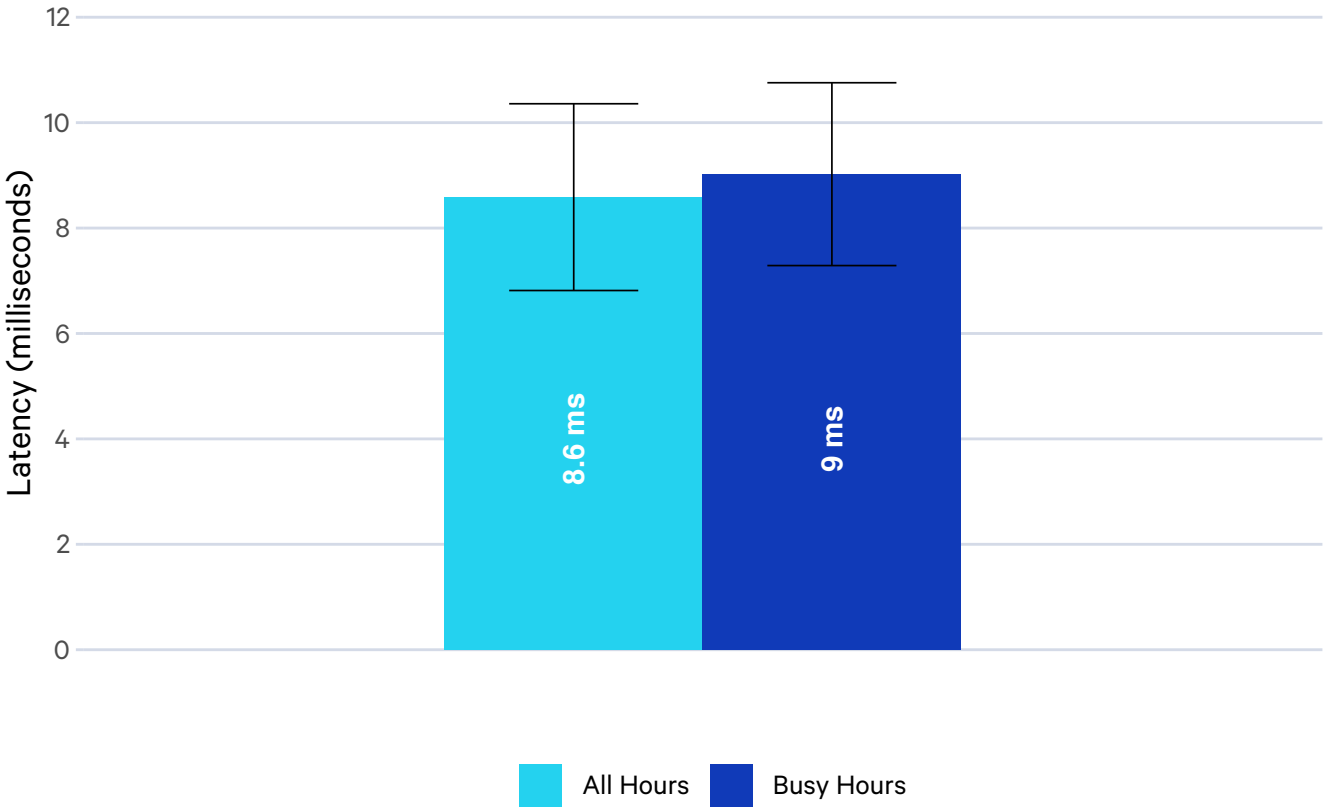
Upload speeds for very high speed services show little variation throughout the day.

Latency, Packet Loss and Outages

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

Figure 23: Average latency for very high speed services

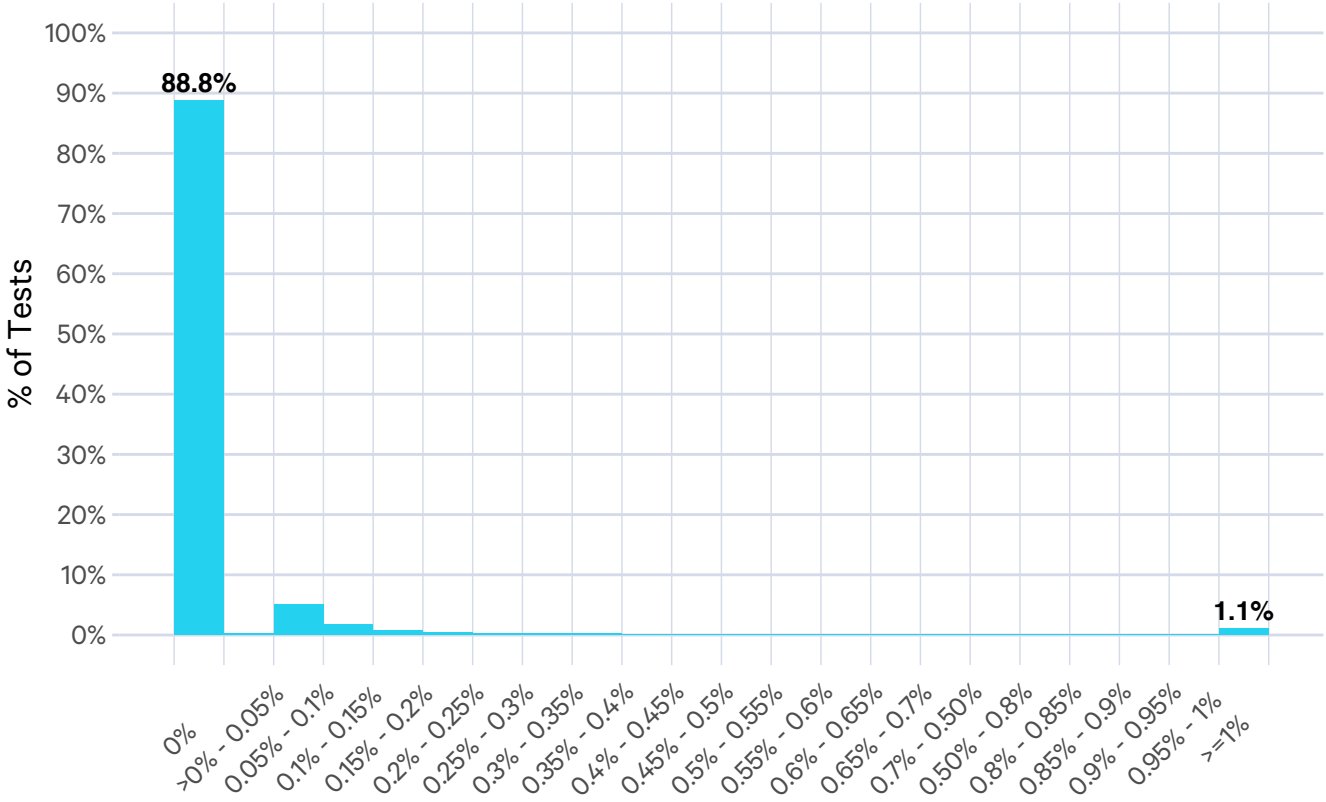
NBN very high speed services. Error bars indicate 95% confidence intervals of the mean.



Average latency for very high speed plans was recorded as 8.6 milliseconds during all hours, rising slightly to 9 milliseconds during busy hours.

Figure 24: Frequency of packet loss rates observed during tests of very high speed services

NBN very high speed services. All hours.



46,648 packet loss tests were conducted through very high speed NBN services over the measurement period. 89.1% of these tests had packet loss of either zero or less than 0.05%.

At the other end of the scale, 1.1% of tests had packet loss greater than 1%.

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

The following charts 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 25: Average daily outages lasting over 30 seconds for very high speed services

NBN very high speed services. All hours.

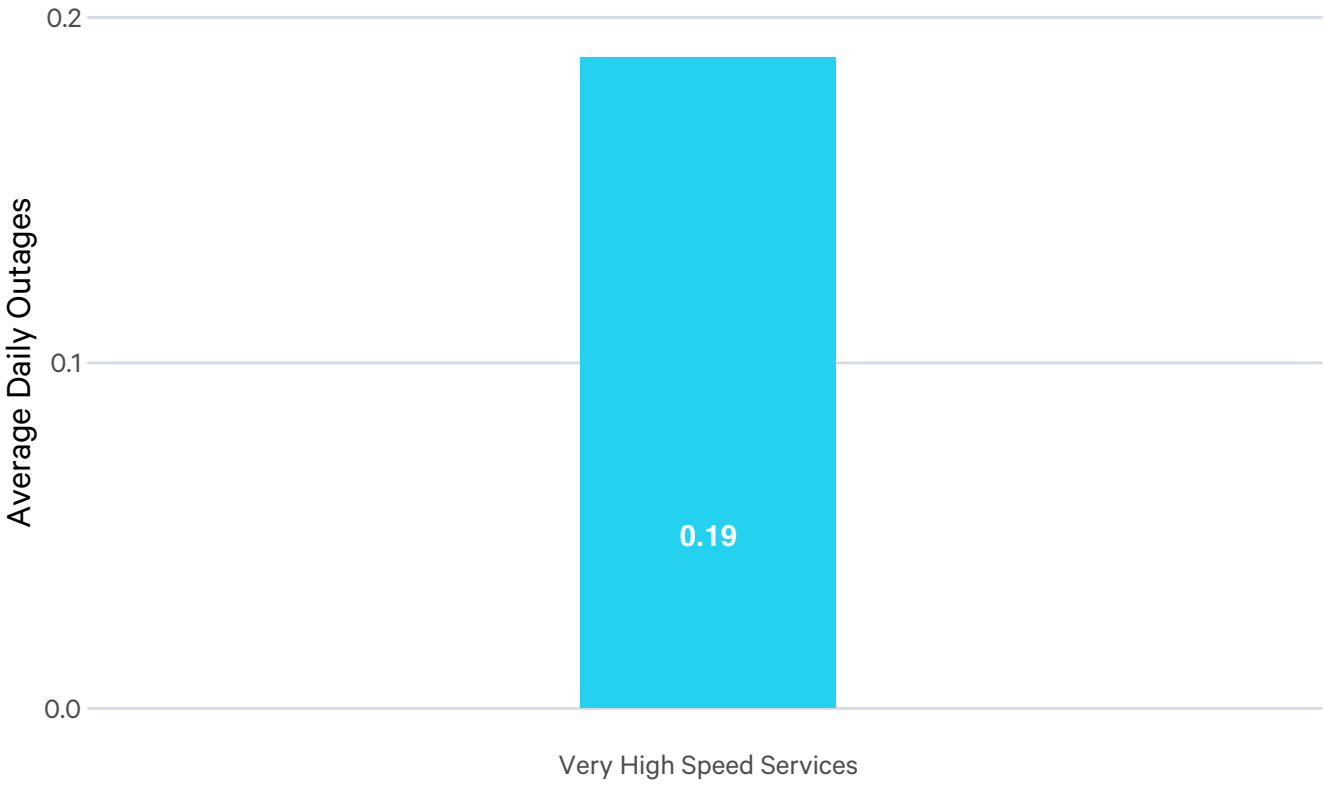
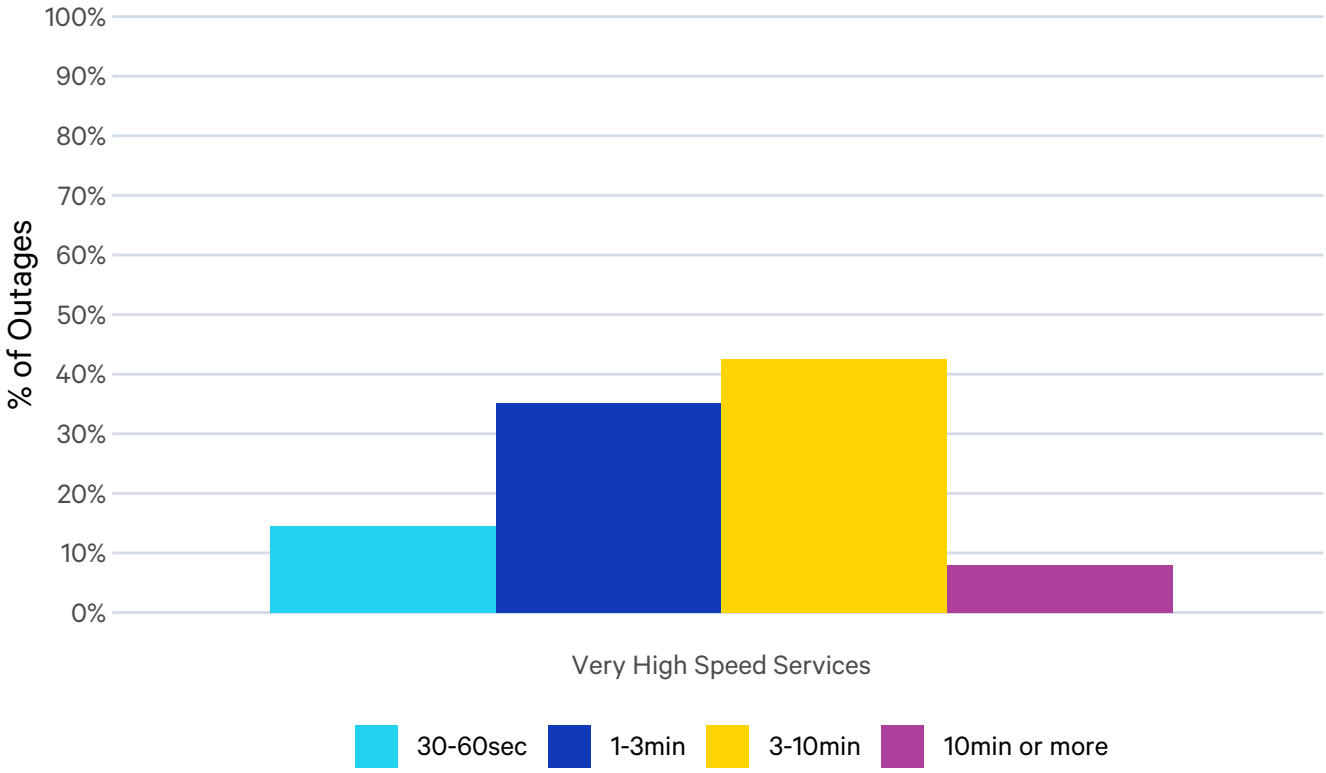


Figure 26: Distribution of outage duration by NBN very high speed services - all hours

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 exclude services where we identified that the volunteer was using speed constrained modem/home gateway equipment and so are 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. The NBN fixed-line services tables are found at the end of the report following the subsequent NBN fixed wireless section.

NBN fixed wireless services

Results for NBN fixed wireless services in this section cover the same period, May 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 quality of their internet experience.

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.

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 underlying summary data for this report can be found at https://data.gov.au/.

Differences between NBN fixed-line and NBN fixed wireless connections

NBN fixed-line connections and NBN fixed wireless connections 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 per cent of NBN consumers.

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).

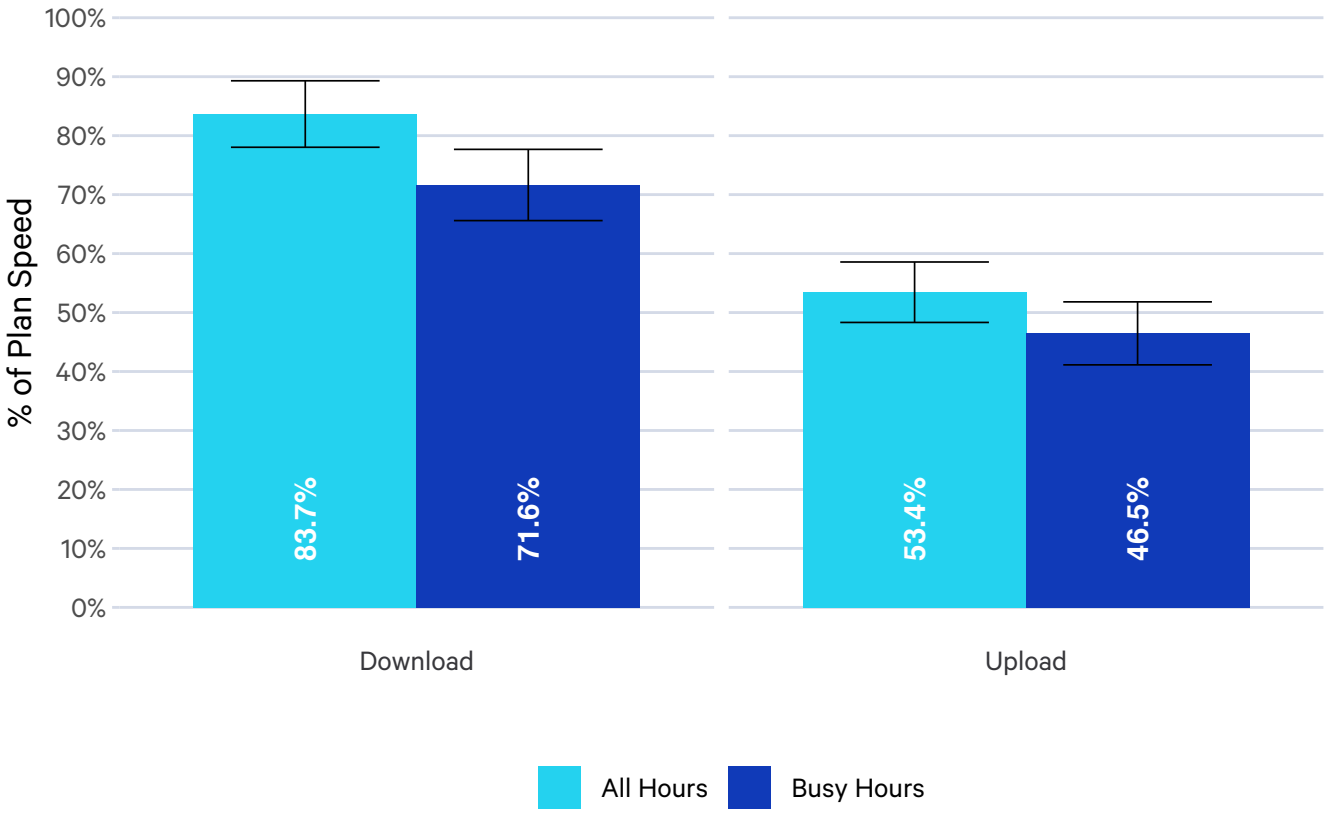
For further information on using NBN fixed wireless, see https://www.accc.gov.au/consumers/internetlandline-services/broadband-speeds/using-nbn-fixed-wireless.

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 27: Average download and upload speeds for fixed wireless

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



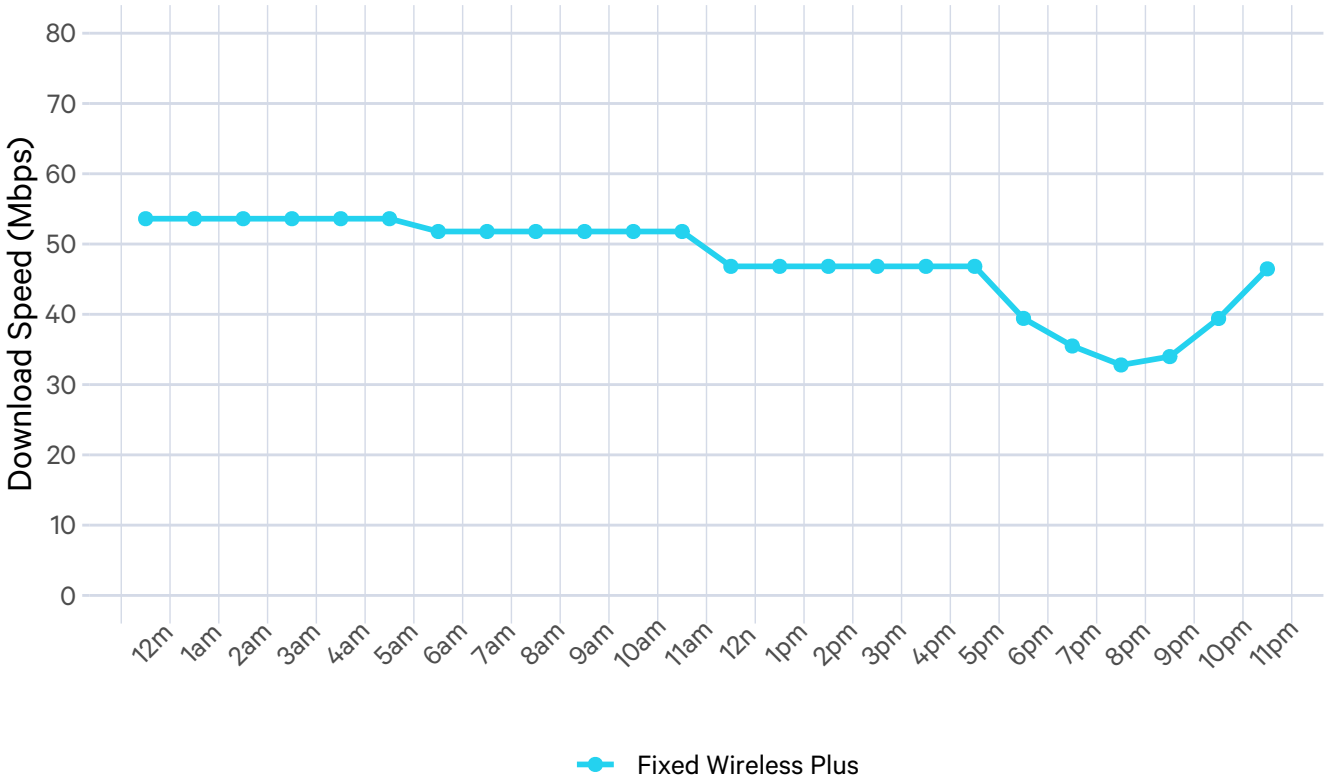
During this period, users on NBN fixed wireless connections attained an average download performance of 83.7% of plan speeds during all hours, decreasing to 71.6% during the busy hours (between 7pm and 11pm), which is when networks experience higher user activity. In the previous report, concerning February 2021, average download performance was 81.2% of plan speeds during all hours and 70.8% during the busy hours. These results are based on a total of 62 NBN fixed wireless services across both the 25/5Mbps and Fixed Wireless Plus plans.

NBN fixed wireless connections attained an average upload performance of 53.4% of plan speeds during all hours, decreasing to 46.5% during the busy hours (between

7pm and 11pm). In the previous report, concerning February 2021, average upload performance during all hours was 54.9% and during busy hours it was 48.4%.

Figure 28: Average hourly download speed for the Fixed Wireless Plus plan

NBN fixed wireless plans.



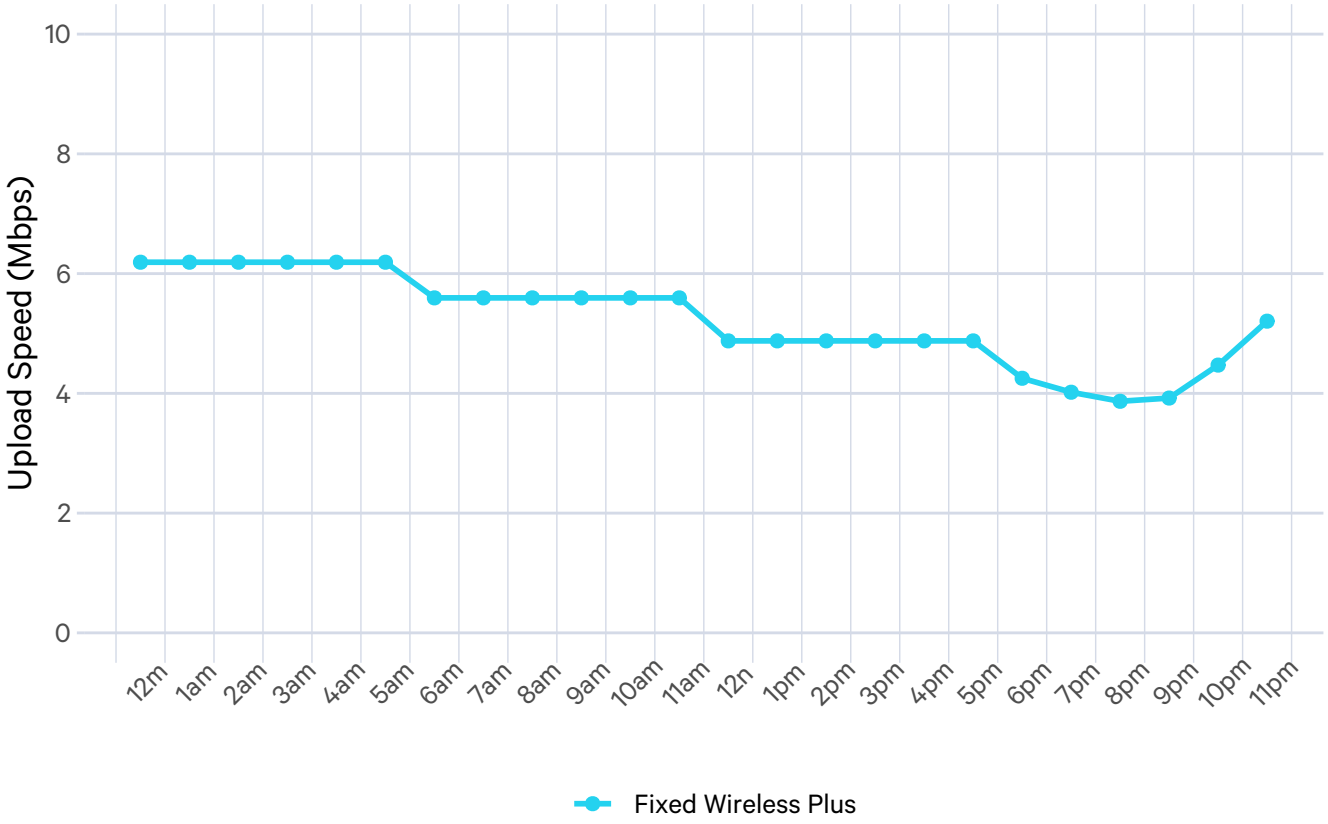
Average download speeds for the Fixed Wireless Plus speed tier showed considerable variation throughout the day: speeds typically started to decrease during the evening, dipping to 21Mbps below the day's maximum speed by 8pm, and would recover to higher levels later at night. While the significant decrease typically occurs during the busy hours (between 7pm and 11pm), there was also a notable decrease from midday, with speeds dipping to 10Mbps below the day's maximum speed and remaining at that level during the course of the afternoon. The average download speed for the Fixed Wireless Plus plan was 43.2Mbps during all hours, decreasing to an average of 36.2Mbps in the busy hours.

Uploads speeds showed a similar pattern to download speeds and recorded lower values both during the busy hours and during the afternoon. Both download and upload speeds showed 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). The average upload speed for the Fixed Wireless Plus plan was 4.8Mbps during all hours, decreasing to an average of 4.1Mbps in the busy hours.

Figure 29: Average hourly upload speed for the Fixed Wireless Plus plan

NBN fixed wireless plans.



Fixed Wireless Plus results are based on a total of 49 NBN fixed wireless services on the Fixed Wireless Plus plan.

Time Series of Average Daily Download Speeds

The following two graphs track the average daily download speeds by plan for fixed wireless units for the period of May 2021 to July 2021. These fixed wireless units comprise both 25Mbps and Fixed Wireless Plus speed 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 30: Average Daily download speeds during all hours by plan

NBN fixed wireless plans.

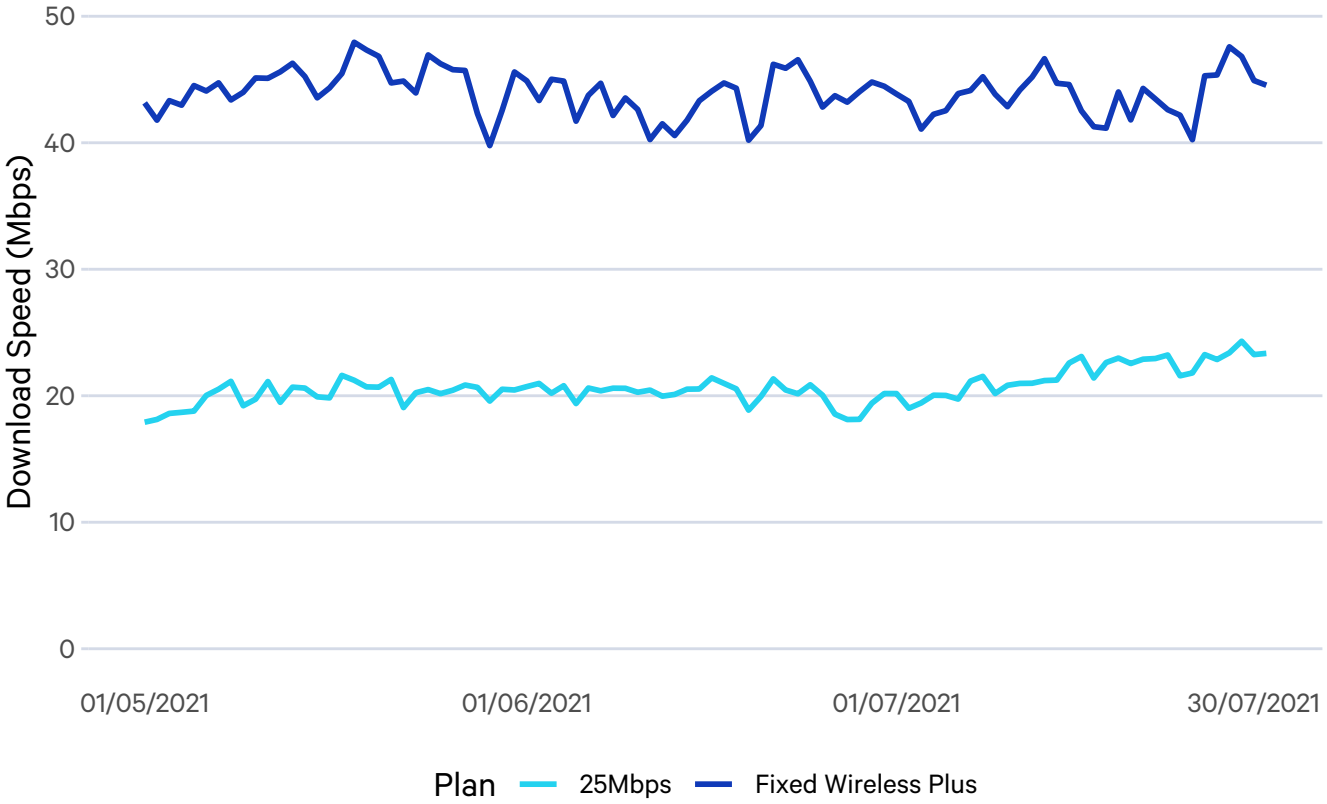
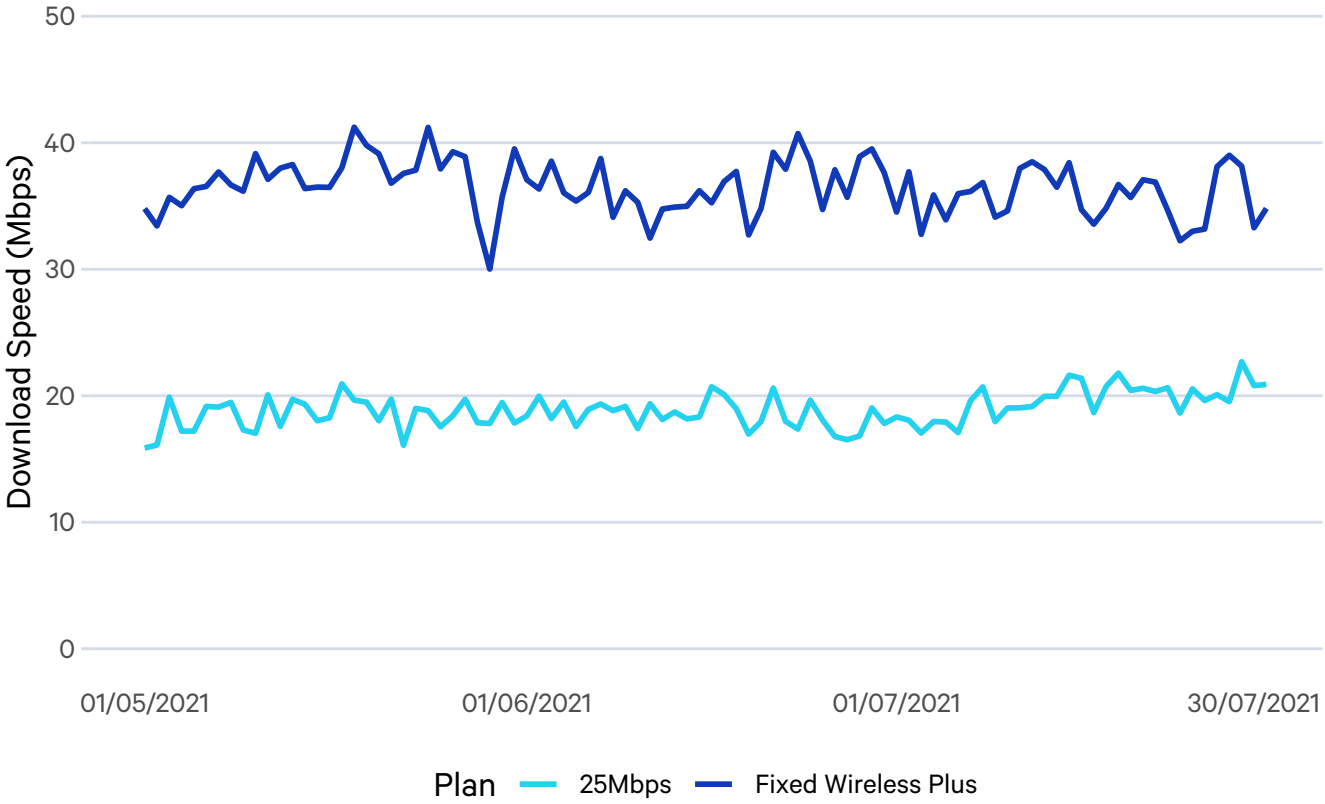


Figure 31: Average Daily download speeds during busy hours by plan

NBN fixed wireless plans.

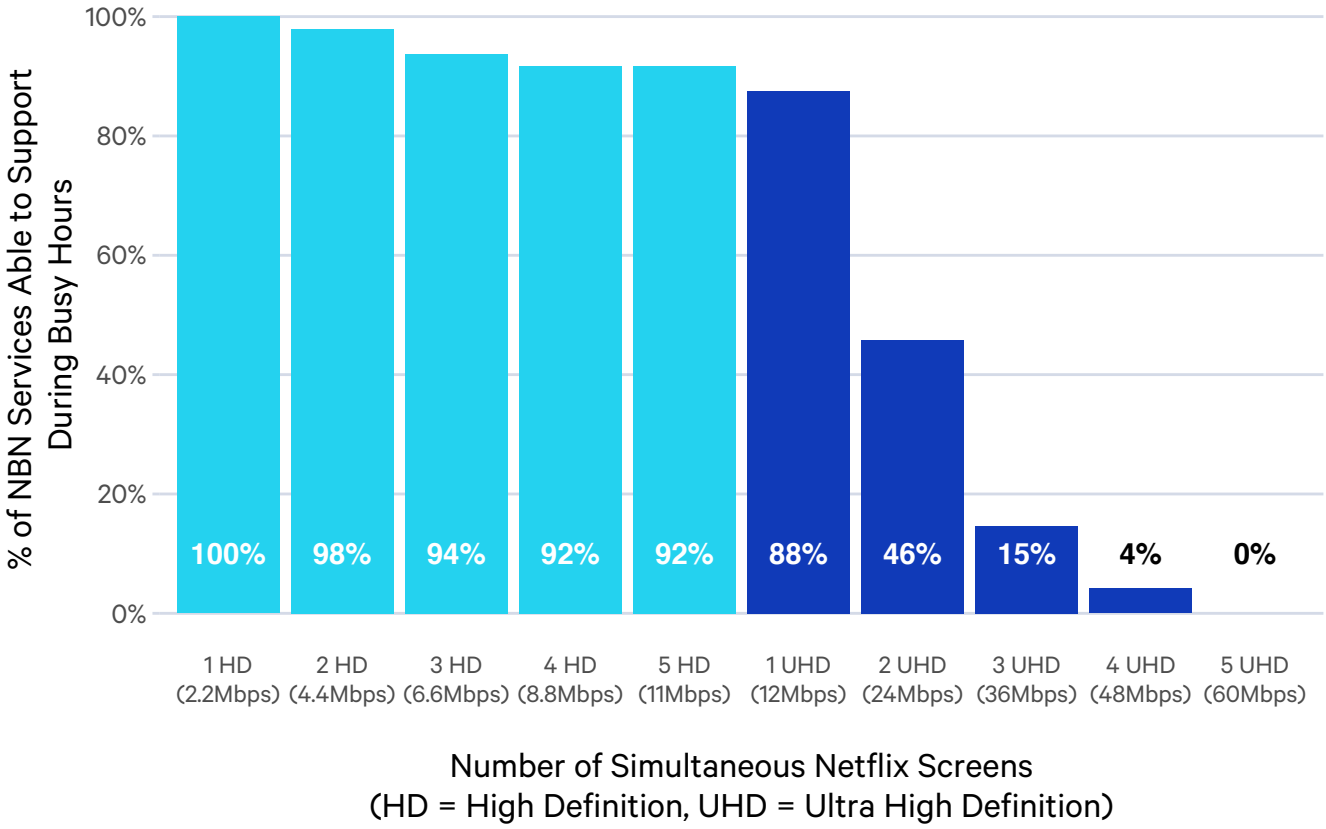


Video Streaming

The following chart shows the proportion of services on the NBN Fixed Wireless Plus plan which would be able to reliably stream (without 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 32: Netflix streaming for the Fixed Wireless Plus plan

Busy hours.



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.

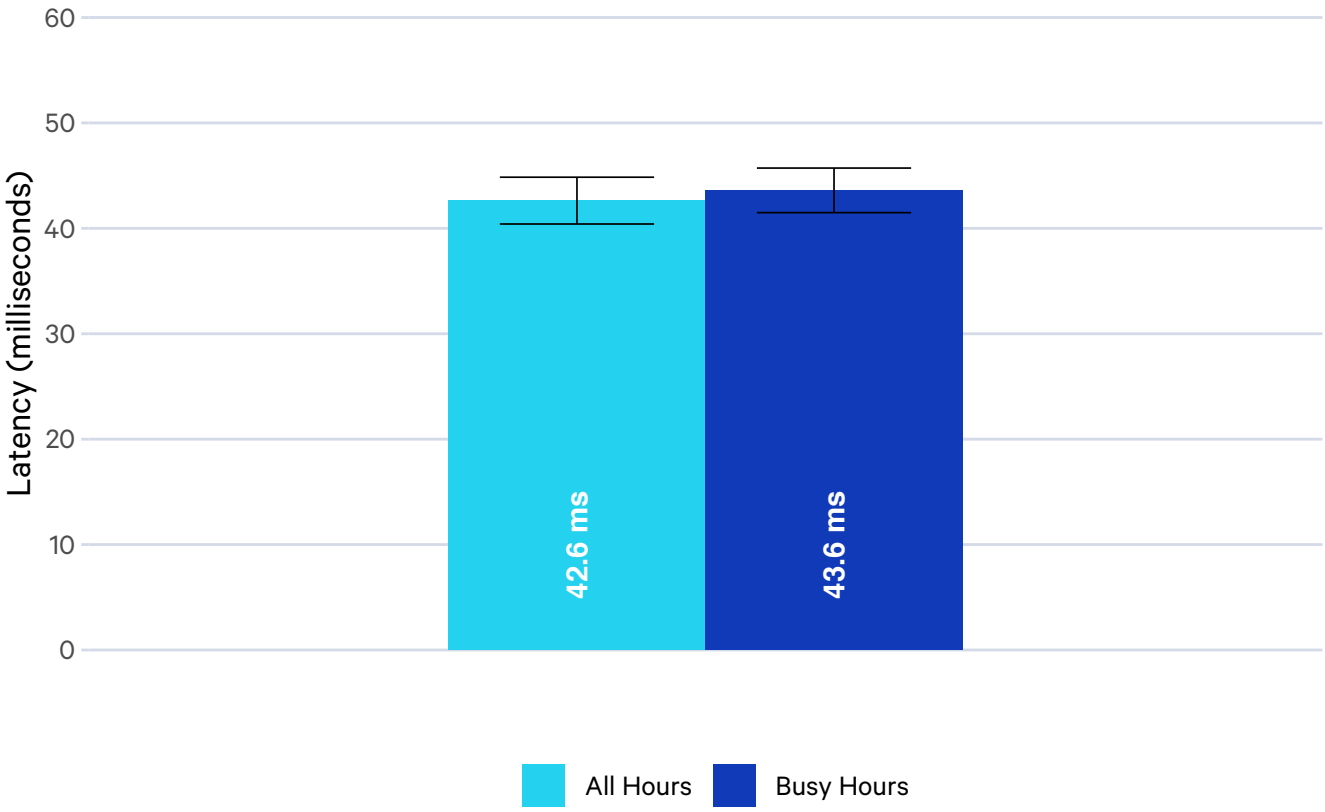
- Less than half (46%) of Fixed Wireless Plus plans can support two Ultra High Definition streams.

Latency, Packet Loss and Outages

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

Figure 33: Average latency for fixed wireless

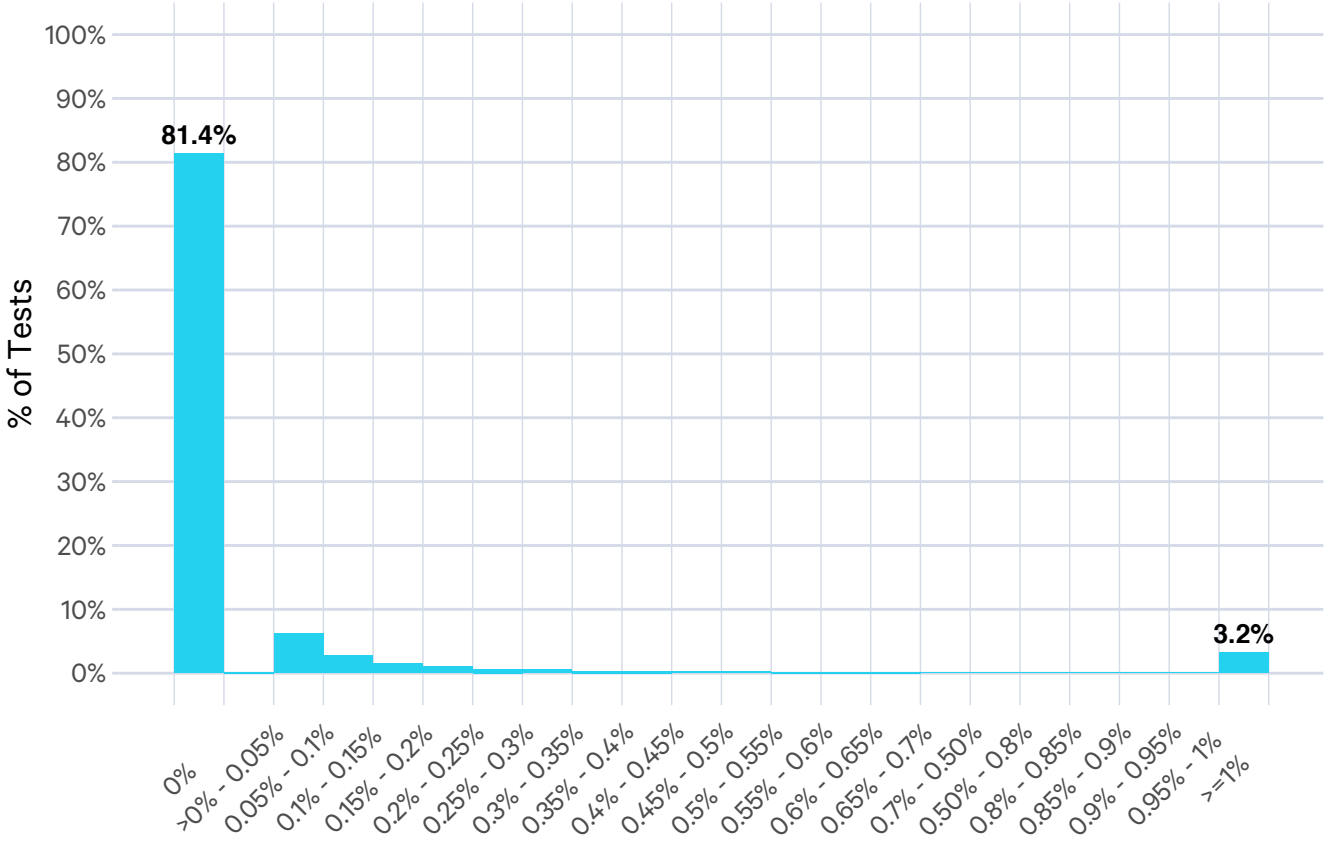
NBN fixed wireless plans. Error bars indicate 95% confidence intervals of the mean.



Average latency for fixed wireless plans was recorded as 42.6 milliseconds during all hours, rising slightly to 43.6 milliseconds during busy hours, broadly in line with the previous report.

Figure 34: Frequency of packet loss rates observed during tests

NBN fixed wireless plans. All hours.



40,093 packet loss tests were conducted through fixed wireless services over the measurement period. 81.5% of these tests had packet loss of either zero or less than 0.05%.

At the other end of the scale, 3.2% of tests had packet loss greater than 1%. This is an increase since the previous report, where only 0.9% of tests had packet loss greater than 1%.

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

The following charts 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 35: Average daily outages lasting over 30 seconds - fixed wireless

NBN fixed wireless. All hours.

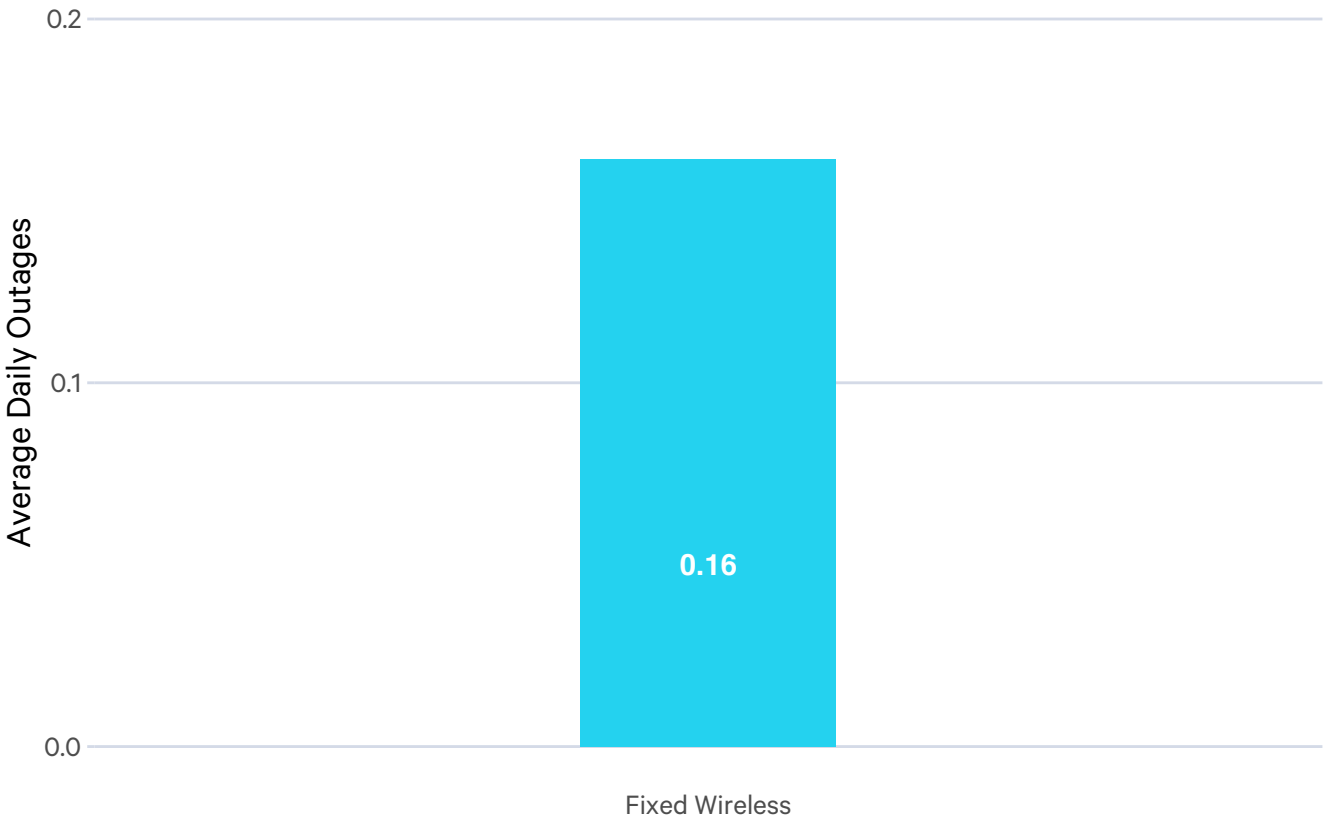
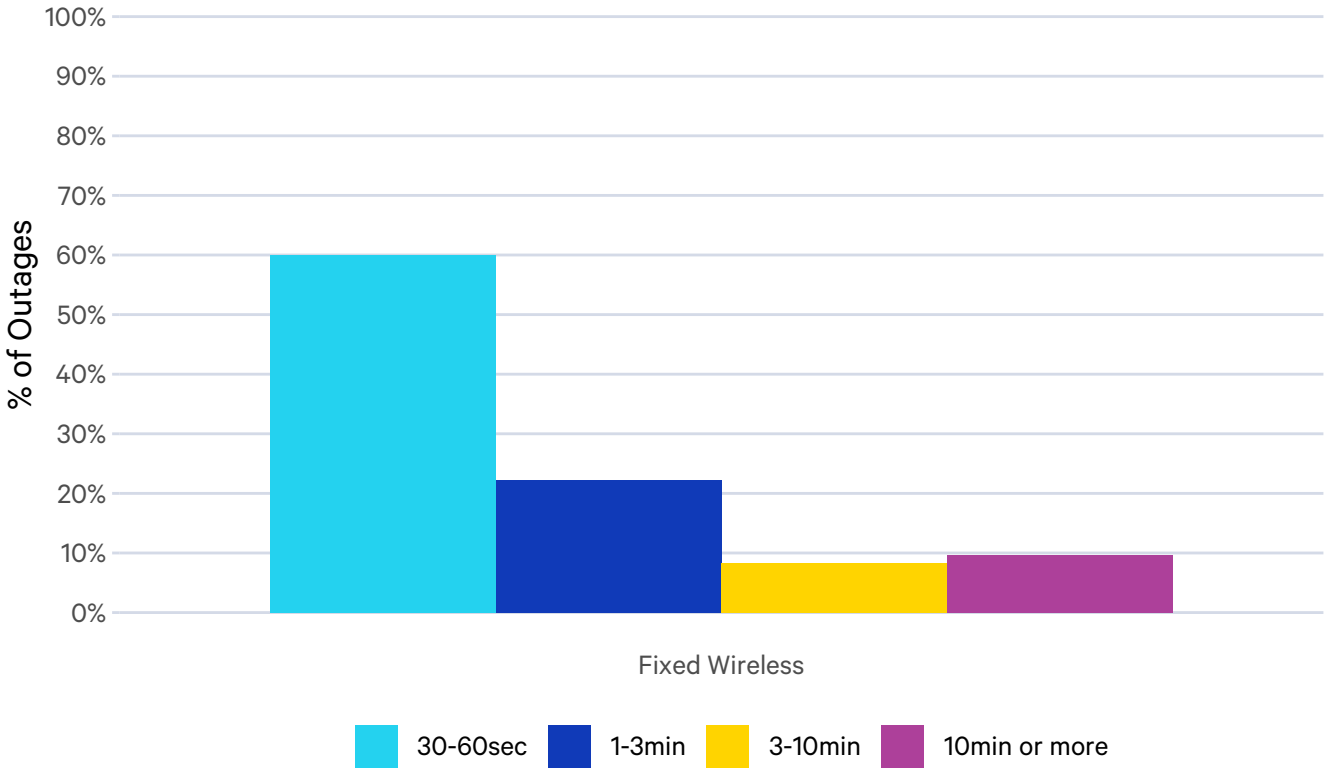


Figure 36: Distribution of outage duration by NBN fixed wireless plan - all hours

NBN fixed wireless plans. All hours.



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

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 (without stopping and starting) a varying number of videos from Netflix simultaneously.

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 Speed Tier	1 HD (2.2 Mbps)	2 HD (4.4 Mbps)	3 HD (6.6 Mbps)	4 HD (8.8 Mbps)	5 HD (11 Mbps)	1 UHD (12 Mbps)	2 UHD (24 Mbps)	3 UHD (36 Mbps)	4 UHD (48 Mbps)	5 UHD (60 Mbps)	Panel Size
NBN12	100%	100%	100%	100%	85%						20
NBN25	100%	100%	100%	100%	100%	99%	73%	0%	0%	0%	83
NBN50	100%	100%	100%	100%	99%	99%	97%	91%	67%	0%	467
NBN100	100%	100%	100%	100%	100%	100%	98%	95%	91%	85%	292

RSP	Download Speed Tier	1 UHD	2 UHD	3 UHD	4 UHD	Panel Size
Aussie Broadband	50	97%	83%	66%	31%	64
Dodo & iPrimus	50	100%	100%	100%	46%	26
Exetel	50	100%	100%	88%	51%	41
iiNet	50	100%	100%	95%	80%	55
MyRepublic	50	100%	100%	86%	57%	21
Optus	50	100%	100%	98%	89%	65
Telstra	50	100%	100%	100%	94%	83
TPG	50	100%	100%	98%	82%	44
Vodafone	50	100%	100%	97%	57%	30

RSP	Download Speed Tier	1 UHD	2 UHD	3 UHD	4 UHD	Panel Size
Aussie Broadband	100	100%	93%	87%	76%	54
iiNet	100	100%	100%	100%	97%	29
MyRepublic	100	100%	100%	92%	83%	24
Optus	100	100%	100%	100%	98%	45
Telstra	100	100%	100%	100%	100%	42
TPG	100	100%	100%	100%	100%	25

NBN RSP tables

The following tables show statistical information on download speeds, upload speeds, and outages for each RSP across all NBN speed tiers, and for individual NBN speed tiers 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 93.1% of plan speed for Dodo & iPrimus across all NBN speed tiers with a 95% confidence interval of ±3.9%. If we were to repeat our sampling 100 times, we expect that this average would fall between 89.2% and 97.0% 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	97.7%	13.3%	95.8% - 99.5%	202	40,313
All Hours	Dodo & iPrimus	93.1%	14.4%	89.3% - 96.8%	56	11,445

Period	RSP	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Exetel	101.3%	14.0%	97.9% - 104.6%	66	13,565
All Hours	iiNet	96.1%	15.0%	93.7% - 98.5%	150	33,995
All Hours	MyRepublic	99.4%	14.5%	95.6% - 103.2%	55	11,083
All Hours	Optus	101.3%	13.2%	99.0% - 103.5%	138	28,471
All Hours	Telstra	100.6%	15.1%	98.4% - 102.7%	190	42,537
All Hours	TPG	98.9%	13.2%	96.7% - 101.1%	137	27,069
All Hours	Superloop	96.6%	8.9%	94.3% - 99.0%	57	11,631
All Hours	Vodafone	96.2%	17.5%	91.4% - 101.0%	51	10,559

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	96.9%	13.6%	95.0% - 98.8%	201	11,588
Busy Hours	Dodo & iPrimus	92.2%	14.4%	88.4% - 96.0%	55	3,296
Busy Hours	Exetel	100.5%	14.2%	97.1% - 104.0%	66	3,816
Busy Hours	iiNet	95.4%	15.1%	93.0% - 97.8%	150	9,782
Busy Hours	MyRepublic	98.0%	15.0%	94.0% - 102.0%	55	3,100
Busy Hours	Optus	100.4%	13.5%	98.2% - 102.7%	138	7,999
Busy Hours	Telstra	99.8%	15.1%	97.7% - 101.9%	190	12,289

Period	RSP	Download Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	TPG	98.3%	13.1%	96.1% - 100.5%	137	7,665
Busy Hours	Superloop	95.3%	9.4%	92.9% - 97.8%	57	3,293
Busy Hours	Vodafone	95.2%	17.4%	90.4% - 100.0%	51	3,072

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% - 85.1%	202	40,009
All Hours	Dodo & iPrimus	83.1%	17.8%	78.4% - 87.8%	56	11,412
All Hours	Exetel	89.1%	11.6%	86.2% - 91.9%	64	13,228
All Hours	iiNet	82.1%	20.1%	78.9% - 85.3%	150	33,946
All Hours	MyRepublic	88.1%	17.1%	83.6% - 92.7%	55	11,046
All Hours	Optus	85.4%	16.9%	82.6% - 88.2%	138	28,382
All Hours	Telstra	85.9%	15.6%	83.7% - 88.2%	190	42,505
All Hours	TPG	85.3%	17.0%	82.5% - 88.2%	137	26,833
All Hours	Superloop	86.9%	12.5%	83.6% - 90.1%	57	11,635
All Hours	Vodafone	87.6%	16.6%	83.0% - 92.1%	51	10,545

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%	79.9% - 84.9%	202	11,495
Busy Hours	Dodo & iPrimus	82.5%	17.8%	77.8% - 87.2%	55	3,271
Busy Hours	Exetel	88.9%	11.6%	86.0% - 91.7%	64	3,757
Busy Hours	iiNet	82.0%	20.1%	78.8% - 85.2%	150	9,724
Busy Hours	MyRepublic	87.7%	17.1%	83.2% - 92.2%	55	3,085
Busy Hours	Optus	85.1%	17.0%	82.3% - 88.0%	137	7,981
Busy Hours	Telstra	85.6%	15.5%	83.4% - 87.8%	190	12,233
Busy Hours	TPG	85.0%	17.1%	82.1% - 87.8%	137	7,560
Busy Hours	Superloop	86.4%	12.5%	83.2% - 89.7%	57	3,299
Busy Hours	Vodafone	87.1%	16.6%	82.6% - 91.7%	51	3,095

Period	RSP	Download Speed Tier	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	95.1%	16.5%	91.6% - 98.7%	84	17,264
All Hours	Aussie Broadband	100	97.3%	10.7%	94.7% - 100.0%	64	12,555
All Hours	Exetel	50	102.0%	14.9%	97.6% - 106.3%	45	9,523
All Hours	iiNet	50	94.4%	16.9%	90.6% - 98.2%	78	17,690
All Hours	Optus	50	102.0%	12.0%	99.3% - 104.7%	74	15,862

Period	RSP	Download Speed Tier	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Optus	100	98.8%	15.6%	94.6% - 103.0%	53	9,961
All Hours	Telstra	50	100.1%	15.5%	97.1% - 103.1%	102	22,917
All Hours	Telstra	100	96.7%	17.7%	91.9% - 101.6%	52	10,954
All Hours	TPG	50	100.3%	11.0%	97.3% - 103.3%	52	10,046

Period	RSP	Download Speed Tier	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	94.5%	16.8%	90.9% - 98.1%	84	4,952
Busy Hours	Aussie Broadband	100	96.5%	10.7%	93.9% - 99.1%	64	3,627
Busy Hours	Exetel	50	101.4%	15.0%	97.0% - 105.8%	45	2,701
Busy Hours	iiNet	50	93.6%	17.0%	89.8% - 97.4%	78	5,005
Busy Hours	Optus	50	101.2%	12.3%	98.4% - 104.0%	74	4,479
Busy Hours	Optus	100	98.0%	15.8%	93.7% - 102.3%	53	2,755
Busy Hours	Telstra	50	99.2%	15.5%	96.2% - 102.3%	102	6,553
Busy Hours	Telstra	100	96.1%	17.6%	91.3% - 100.9%	52	3,163
Busy Hours	TPG	50	99.5%	11.1%	96.4% - 102.5%	52	2,795

Period	RSP	Upload Speed Tier	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	81.0%	19.9%	77.4% - 84.6%	117	23,972
All Hours	Aussie Broadband	40	87.6%	10.7%	84.3% - 90.8%	42	7,547
All Hours	Exetel	20	87.4%	13.6%	83.4% - 91.4%	44	9,378
All Hours	iiNet	20	77.8%	22.3%	72.9% - 82.6%	80	18,137
All Hours	Optus	20	83.6%	18.6%	79.5% - 87.7%	79	16,654
All Hours	Optus	40	87.4%	15.5%	83.0% - 91.7%	48	9,064
All Hours	Telstra	20	84.7%	17.5%	81.4% - 88.0%	111	25,006
All Hours	Telstra	40	85.2%	15.8%	80.4% - 89.9%	43	8,827
All Hours	TPG	20	81.0%	21.1%	75.5% - 86.4%	58	10,956

Period	RSP	Upload Speed Tier	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	80.9%	19.9%	77.3% - 84.5%	117	6,852
Busy Hours	Aussie Broadband	40	87.0%	10.7%	83.8% - 90.2%	42	2,194
Busy Hours	Exetel	20	87.1%	13.6%	83.1% - 91.1%	44	2,676
Busy Hours	iiNet	20	77.7%	22.3%	72.8% - 82.6%	80	5,114
Busy Hours	Optus	20	83.4%	18.6%	79.3% - 87.6%	78	4,700
Busy Hours	Optus	40	86.9%	15.7%	82.5% - 91.3%	48	2,502

Period	RSP	Upload Speed Tier	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Telstra	20	84.5%	17.4%	81.3% - 87.7%	111	7,125
Busy Hours	Telstra	40	84.4%	15.7%	79.7% - 89.1%	43	2,552
Busy Hours	TPG	20	80.7%	21.0%	75.3% - 86.1%	58	3,037

RSP	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Aussie Broadband	0.390	0.80	0.28 - 0.50	202
Dodo & iPrimus	0.115	0.22	0.06 - 0.17	56
Exetel	0.144	0.46	0.03 - 0.25	66
iiNet	0.163	0.54	0.08 - 0.25	150
MyRepublic	0.098	0.16	0.06 - 0.14	55
Optus	0.190	0.60	0.09 - 0.29	138
Telstra	0.186	0.52	0.11 - 0.26	190
TPG	0.149	0.30	0.10 - 0.20	137
Superloop	0.268	0.55	0.13 - 0.41	57
Vodafone	0.119	0.21	0.06 - 0.18	51

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	49.4%	19.3%	22.3%	8.9%
Dodo & iPrimus	7.9%	32.9%	29.6%	29.6%

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
Exetel	14.9%	40.7%	34.0%	10.4%
iiNet	14.8%	45.8%	31.2%	8.2%
MyRepublic	9.1%	27.4%	30.5%	32.9%
Optus	43.5%	29.1%	17.5%	9.8%
Superloop	58.3%	27.9%	9.6%	4.2%
Telstra	32.2%	24.8%	33.5%	9.6%
TPG	25.6%	37.8%	25.4%	11.1%
Vodafone	27.5%	44.5%	18.1%	9.9%

NBN speed tier tables

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

- The overall speed is the average speed (download or upload) for the particular NBN speed tier, 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 96.0% of plan speed for users subscribed to 100Mbps NBN fixed-line plans with a 95% confidence interval of ±1.6%. If we were to repeat our sampling 100 times, we expect that this average would fall between 94.4% and 97.6% in at least 95 cases.

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

Period	Download Speed Tier	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%	4.6%	100.5% - 104.4%	21	4,504
All Hours	25	102.6%	9.5%	100.6% - 104.5%	90	19,620
All Hours	50	98.1%	15.3%	96.8% - 99.4%	572	121,235
All Hours	100	95.9%	14.6%	94.4% - 97.5%	344	69,208
All Hours	250	104.3%	6.4%	103.0% - 105.5%	106	22,646

Period	Download Speed Tier	Download Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	12	101.2%	5.1%	98.9% - 103.5%	20	1,314
Busy Hours	25	101.9%	9.9%	99.9% - 104.0%	89	5,788
Busy Hours	50	97.2%	15.7%	95.9% - 98.5%	572	34,495
Busy Hours	100	95.1%	14.6%	93.5% - 96.6%	344	19,703
Busy Hours	250	103.4%	6.8%	102.1% - 104.7%	106	6,516

Period	Upload Speed Tier	Upload Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	1	96.0%	11.0%	91.3% - 100.7%	21	4,523
All Hours	5	89.5%	11.1%	86.7% - 92.2%	62	14,382
All Hours	20	83.0%	18.9%	81.6% - 84.5%	650	137,149
All Hours	40	86.8%	14.1%	85.2% - 88.5%	275	54,048

Period	Upload Speed Tier	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	1	95.4%	11.9%	90.2% - 100.7%	20	1,317
Busy Hours	5	89.3%	11.1%	86.6% - 92.1%	62	4,209
Busy Hours	20	82.8%	18.9%	81.4% - 84.3%	649	39,020

Period	Upload Speed Tier	Upload Average % of Plan Speed (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	40	86.3%	14.1%	84.7% - 88.0%	275	15,343

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 104.3% of plan speed for fibre to the premises NBN fixed-line connections with a 95% confidence interval of ±0.8%. If we were to repeat our sampling 100 times, we expect that this average would fall between 103.5% and 105.2% (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	104.3%	6.7%	103.5% - 105.1%	254	52,976
All Hours	Fibre to the curb - FTTC	101.6%	6.2%	100.4% - 102.8%	104	21,394
All Hours	Hybrid fibre-coaxial - HFC	103.2%	9.5%	102.0% - 104.4%	230	46,008
All Hours	Fibre to the node - FTTN	93.2%	17.1%	91.8% - 94.6%	556	118,830

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	103.3%	8.4%	102.2% - 104.3%	254	15,138
Busy Hours	Fibre to the curb - FTTC	100.9%	6.6%	99.6% - 102.1%	104	6,145
Busy Hours	Hybrid fibre-coaxial - HFC	102.2%	10.2%	100.9% - 103.5%	230	13,281
Busy Hours	Fibre to the node - FTTN	92.4%	17.1%	91.0% - 93.8%	554	33,786

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	91.2%	9.1%	90.1% - 92.3%	252	52,488
All Hours	Fibre to the curb - FTTC	91.5%	5.9%	90.3% - 92.6%	104	21,370
All Hours	Hybrid fibre-coaxial - HFC	89.5%	9.8%	88.3% - 90.8%	230	45,706
All Hours	Fibre to the node - FTTN	79.0%	21.2%	77.2% - 80.8%	556	118,431

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	91.0%	9.3%	89.9% - 92.2%	251	15,010
Busy Hours	Fibre to the curb - FTTC	91.2%	5.7%	90.1% - 92.3%	104	6,116
Busy Hours	Hybrid fibre-coaxial - HFC	88.7%	10.2%	87.4% - 90.0%	230	13,181
Busy Hours	Fibre to the node - FTTN	78.9%	21.1%	77.1% - 80.6%	555	33,625

Technology	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Fibre to the premises - FTTP	0.19	0.55	0.12 - 0.25	254
Fibre to the curb - FTTC	0.27	0.79	0.11 - 0.42	104
Hybrid fibre-coaxial - HFC	0.18	0.41	0.13 - 0.24	230
Fibre to the node - FTTN	0.23	0.57	0.18 - 0.27	556

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	48.9%	25.1%	19.9%	6.1%
Fibre to the node - FTTN	30.1%	27.2%	32.5%	10.2%
Fibre to the premises - FTTP	42.4%	30.7%	17.6%	9.3%
Hybrid fibre-coaxial - HFC	32.0%	35.4%	19.8%	12.9%

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 97.7% of plan speed for NBN fixed-line services in WA, with a 95% confidence interval of ±3.1%. If we were to repeat our sampling 100 times, we expect that this average would fall between 94.6% and 100.9% (rounded to 1 decimal place) in at least 95 cases.

Period	State/Territory	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	NSW	99.5%	14.2%	98.0% - 100.9%	367	78,085
All Hours	ACT	95.9%	16.5%	91.3% - 100.4%	51	10,305
All Hours	VIC	98.8%	12.8%	97.3% - 100.2%	305	63,728
All Hours	QLD	96.5%	15.4%	94.4% - 98.7%	206	41,830
All Hours	WA	97.7%	15.4%	94.6% - 100.8%	94	19,842
All Hours	TAS	97.9%	14.5%	93.8% - 102.0%	47	9,940

Period	State/Territory	Download Average % of Plan Speed (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	NT + SA	100.4%	10.9%	97.9% - 102.9%	74	15,478

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 tier (excluding underperforming and impaired services).

RSP	NBN50 Advertised % of Plan Speed	NBN100 Advertised % of Plan Speed	Number of NBN100 Whiteboxes (excluding underperforming and impaired services	Number of NBN50 Whiteboxes (excluding underperforming and impaired services	Weighted Advertised % of Plan Speed
Aussie Broadband	100.0%	99.0%	27	24	99.5%
Dodo & iPrimus	100.0%	92.0%	9	12	96.6%
Exetel	96.0%	95.0%	14	22	95.6%
iiNet	96.0%	85.0%	10	3	87.5%
MyRepublic	86.0%	83.0%	18	10	84.1%
Optus	100.0%	100.0%	37	20	100.0%
Superloop	100.0%	100.0%	9	2	100.0%
Telstra	100.0%	100.0%	29	31	100.0%
TPG	96.0%	85.0%	10	10	90.5%
Vodafone	92.0%	85.0%	6	17	90.2%

There were 124 busy hours across the 31 day period from 1st May 2021 to 31th May 2021. The following table shows the proportion of busy hours in which each RSP's average speed for each tier 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	89%	89%
Dodo & iPrimus	85%	85%
Exetel	94%	94%
iiNet	98%	98%
MyRepublic	100%	100%
Optus	93%	93%
Superloop	48%	48%
Telstra	98%	100%
TPG	100%	100%
Vodafone	98%	98%

NBN Whiteboxes connected to underperforming services

The following table shows the number of Whiteboxes on NBN connections 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	202	13	6%
Dodo & iPrimus	56	5	9%
Exetel	66	2	3%
iiNet	150	12	8%
MyRepublic	55	3	5%
Optus	138	6	4%
Other RSPs	42	1	2%
Superloop	57	2	4%
Telstra	190	14	7%
TPG	137	8	6%
Vodafone	51	5	10%
Total	1,144	71	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 speed tier, alongside the number of underperforming services.

Technology	Speed Tier	NBN Whiteboxes	NBN Whiteboxes on underperforming services	% NBN Whiteboxes on underperforming services
Fibre to the node - FTTN	100	121	22	18%

Technology	Speed Tier	NBN Whiteboxes	NBN Whiteboxes on underperforming services	% NBN Whiteboxes on underperforming services
Fibre to the node - FTTN	12	13	0	0%
Fibre to the node - FTTN	25	58	3	5%
Fibre to the node - FTTN	50	354	43	12%
Fibre to the node - FTTN	Other NBN Speed Tiers	10	0	0%
Fibre to the node - FTTN	All NBN Speed Tiers	556	68	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	Speed tier	Download Average Mbps (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Very High Speed	680.7Mbps	242.6Mbps	626.5Mbps - 734.9Mbps	77	14,908

Period	Speed tier	Download Average Mbps (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Very High Speed	647.9Mbps	235.9Mbps	595.2Mbps - 700.6Mbps	77	4,273

Period	Speed tier	Upload Average Mbps (all hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
All Hours	Very High Speed	45Mbps	3.9Mbps	44.1Mbps - 45.9Mbps	77	14,691

Period	Speed tier	Upload Average Mbps (busy hours)	Standard Deviation	95% Confidence Interval of the Mean	Panel Size	Number of Tests
Busy Hours	Very High Speed	44.8Mbps	3.9Mbps	44 - 45.7	76	4,204

Speed tier	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Very High Speed	0.19	0.46	0.09 - 0.29	77

Speed tier	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	14.4%	35.1%	42.5%	7.9%

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	83.7%	22.6%	78.0% - 89.3%	62	12,430

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	71.6%	24.3%	65.6% - 77.7%	62	3,488

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	53.4%	20.6%	48.3% - 58.6%	62	12,414

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	46.5%	21.5%	41.1% - 51.8%	62	3,481

Technology	Average Daily Outages Lasting Longer than 30 Seconds	Standard Deviation	95% Confidence Interval of the Mean	Panel Size
Fixed Wireless	0.16	0.36	0.07 - 0.25	62

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	59.9%	22.2%	8.3%	9.6%

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.
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.
Speed Tier / 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.
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, FTTB, HFC, FTTC, and FTTN 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.