



Measuring Broadband Australia



Report 18, August 2022

In 2017, the Australian Competition and Consumer Commission (ACCC) appointed SamKnows¹ as an independent testing provider to conduct internet performance tests for the Measuring Broadband Australia project. SamKnows supplies Whiteboxes² to internet users in Australia, which perform tests using SamKnows's testing infrastructure³ to measure internet performance. In 2021, the Measuring Broadband Australia program was renewed and has expanded to cover additional market segments, such as NBN fixed wireless services, and fixed-line services provided by other superfast access networks.

The goal of Measuring Broadband Australia is to increase transparency and encourage greater performance-based competition and better internet performance throughout the country. The program provides Australian consumers with accurate and independent information about broadband performance to assist their purchasing decisions.

SamKnows prepares these reports each quarter for publication by the ACCC. The metrics are also presented by the ACCC in a public dashboard available 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/>.

¹ <https://samknows.com/>

² A Whitebox is a purpose-built hardware measurement agent manufactured by SamKnows, installed in volunteers' homes.

³ SamKnows-maintained test servers hosted within Australia

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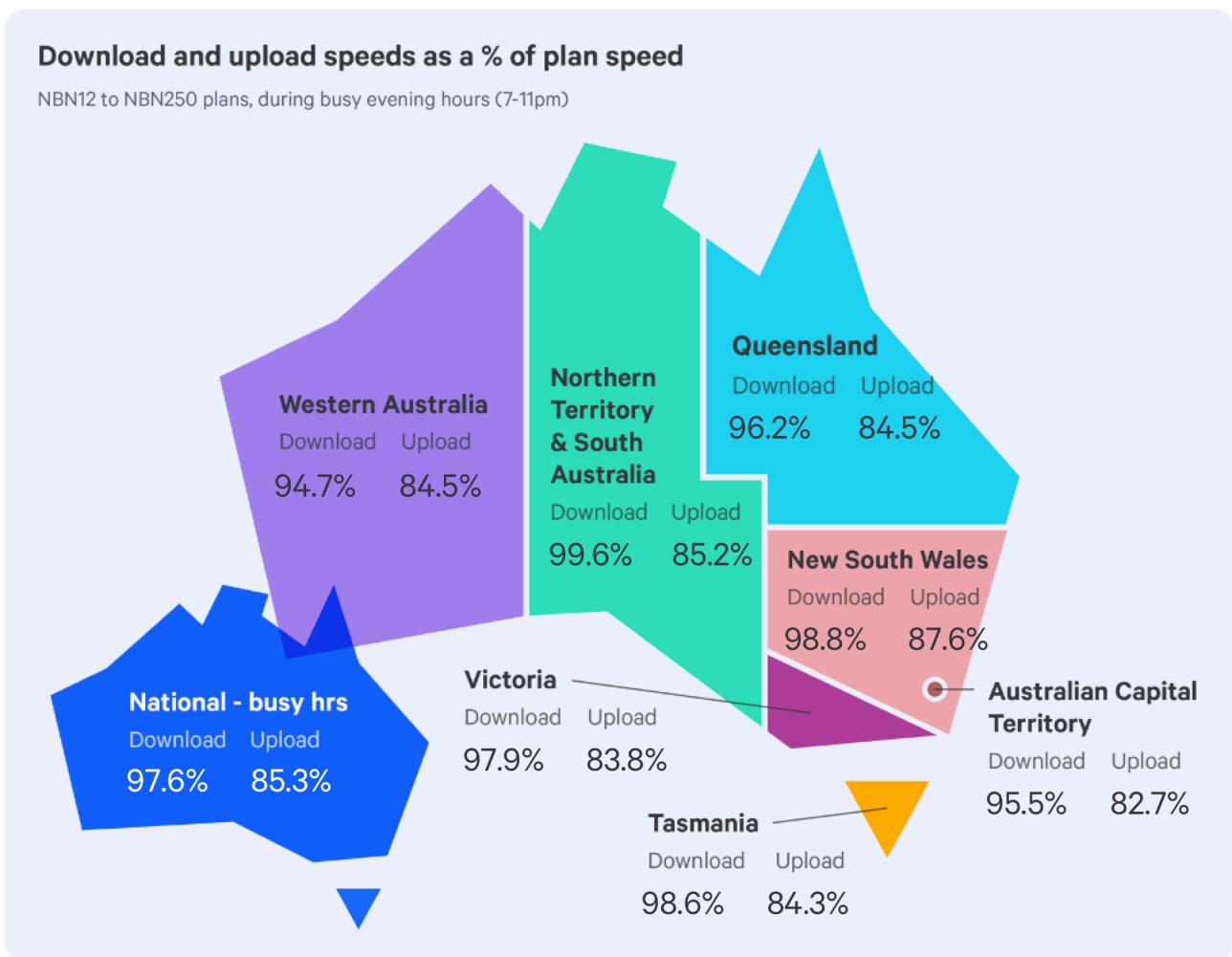
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Measuring Broadband Australia

Report 18 Key Results

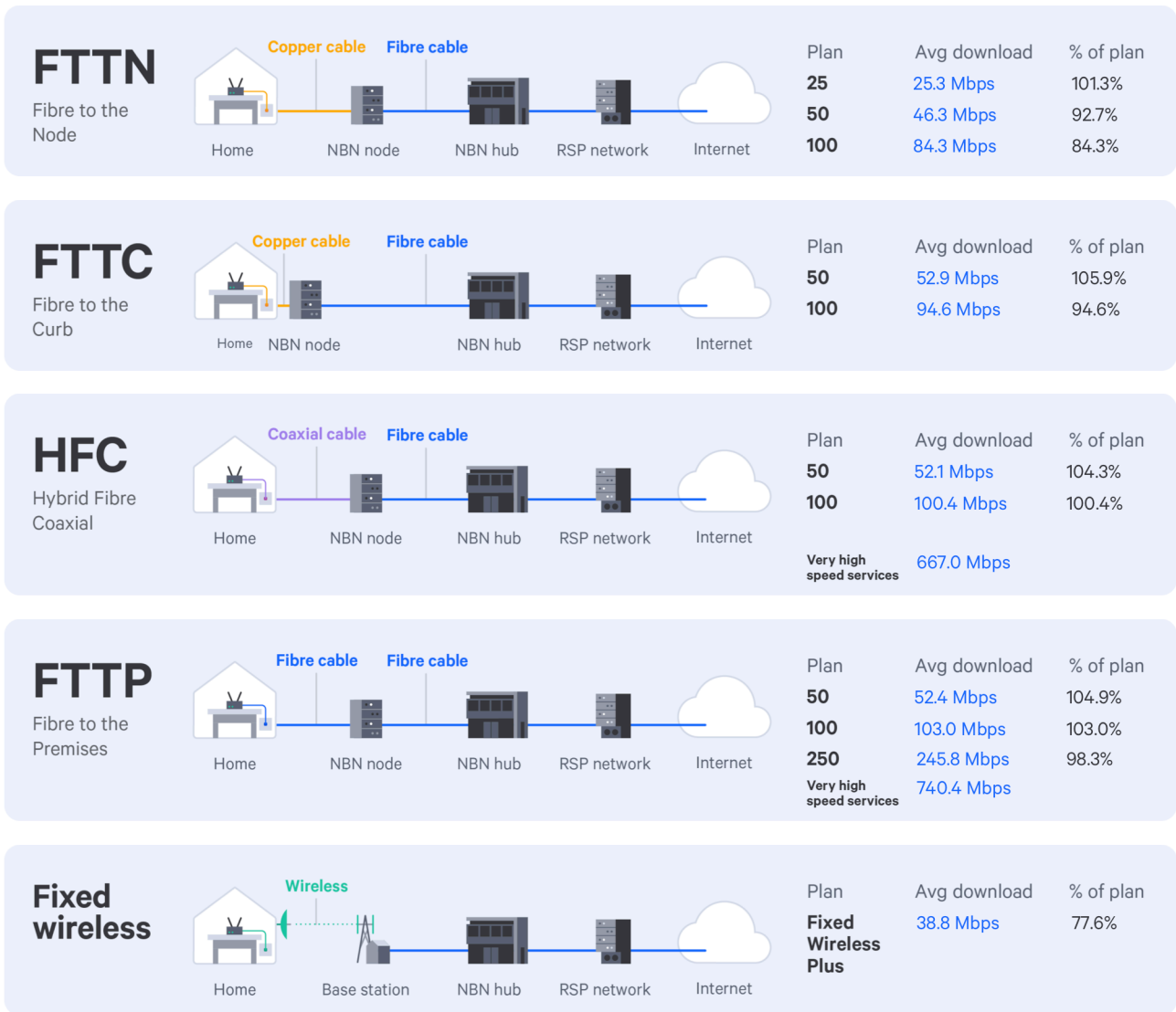
Geographical

Average NBN fixed-line performance during busy hours by State/Territory, May 2022. Including underperforming and impaired services.



NBN access technology⁴

Download speeds during busy hours, May 2022. Including underperforming and impaired services.



⁴ Results presented for speed tiers and technologies having a sufficient panel size.

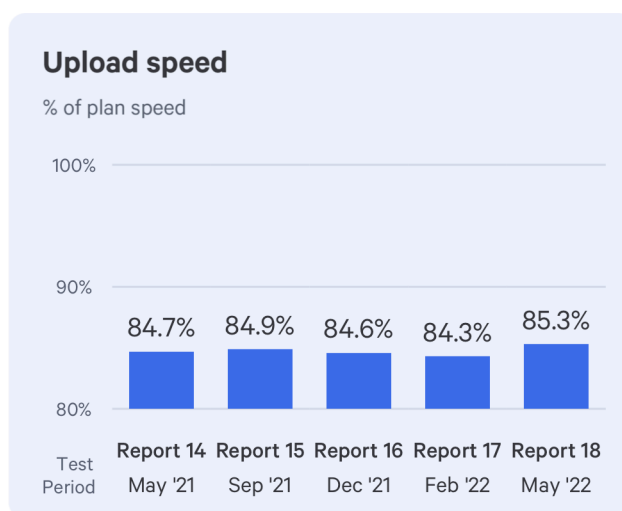
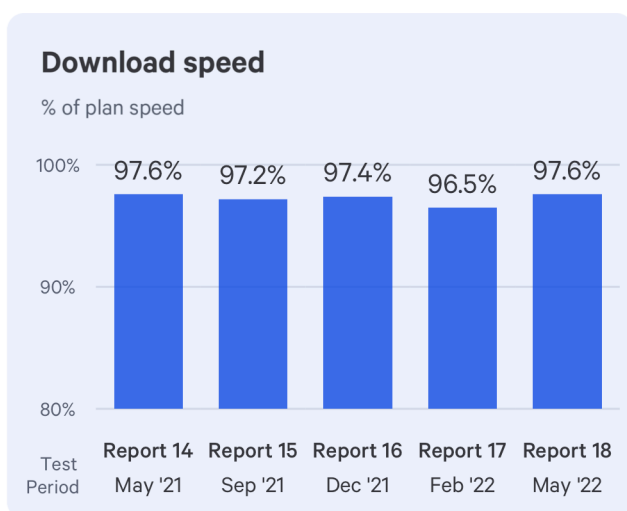
Quality of Experience

Streaming high definition (HD) and ultra-high definition (UHD) video during busy hours, May 2022. Including underperforming and impaired services.

NBN plan speed	% that can reliably stream HD & UHD videos from Netflix							
25	HD	HD	HD	HD	HD	HD	HD	7+ Concurrent HD video streams
	100.0%	100.0%	100.0%	100.0%	100.0%	98.9%	93.5%	91.3%
50	UHD	UHD	UHD	UHD	UHD	UHD	UHD	1-2 Concurrent UHD video streams
	100.0%	76.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
100	HD	HD	HD	HD	HD	HD	HD	7+ Concurrent HD video streams
	100.0%	100.0%	100.0%	100.0%	99.8%	99.8%	99.5%	99.5%
250	UHD	UHD	UHD	UHD	UHD	UHD	UHD	3-4 Concurrent UHD video streams
	99.8%	97.2%	84.4%	64.8%	0.0%	0.0%	0.0%	0.0%
Fixed Wireless Plus	UHD	UHD	UHD	UHD	UHD	UHD	UHD	6-7 Concurrent UHD video streams
	100.0%	99.2%	97.8%	91.5%	86.2%	76.2%	66.5%	41.5%
Fixed Wireless Plus	UHD	UHD	UHD	UHD	UHD	UHD	UHD	7+ Concurrent UHD video streams
	98.7%	98.7%	98.7%	96.2%	93.6%	92.3%	92.3%	91.0%
Fixed Wireless Plus	UHD	UHD	UHD	UHD	UHD	UHD	UHD	1-2 Concurrent UHD video streams
	83.3%	51.7%	26.7%	8.3%	3.3%	0.0%	0.0%	0.0%

Long-term Trends

NBN fixed-line services⁵, during busy hours. Including underperforming and impaired services.



⁵ Please note that the figures for May 2021 - September 2021 include only NBN12 to NBN250 plans, while the figures for February 2022 and May 2022 also include data for plans with a retail download speed above 250 Mbps but under 1000 Mbps.

Overview

1 May 2022 to 31 May 2022

This is the eighteenth report issued as part of the Measuring Broadband Australia program. The main metrics of this report are based on measurements collected over the month of May 2022, a 31-day period.

The impact of NBN's overprovisioning on download performance

As a feature for this report, we have included charts comparing the distribution of download performance as a percentage of plan download speed from February 2020 and May 2022 to illustrate that as a result of NBN overprovisioning the download component of certain fixed-line speed tiers, the majority of services on the panel now attain average download speeds above the plan download speed. In contrast with this, the upload performance in May 2022 remains under 100% of the plan upload speed as NBN does not overprovision the upload component.

Volunteers using speed constrained in-home equipment

Similarly to previous reports, this report will also include all services and plans that may be affected by a 100 Mbps link within their home. A common cause of this is Customer Premises Equipment (CPE)⁶ or other network devices that have Ethernet ports with a physical limit of 100 Mbps. Other potential sources of links constrained at 100 Mbps are damaged Ethernet cables, intermediate devices that only support 100 Mbps (such as old switches and hubs), and configuration of network equipment within the home. These consumers are unable to receive the full benefit of plans with download speeds above 100 Mbps when there is a 100 Mbps link in the path. The ACCC has engaged with RSPs to encourage them to reach out to their customers who may be using a constrained network 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>.

The following pages define and explain the significance of various important terms used throughout the report.

⁶ Network equipment provided by an RSP (generally including a home router/gateway).

Important terms

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

Term	Definition	Significance
Impaired service	Fibre to the node services where the maximum attainable download speed measured by NBN Co is below the plan download speed.	Consumers on an impaired service are unable to achieve the full download speed of their plan (see underperforming services). These services require rectification of technical issues to improve performance. Alternatively, if this is not possible, it may be advisable for the consumer to move to a lower speed plan that their service can achieve. This report presents results both including and excluding impaired and underperforming services. This information allows consumers to better understand the reported download and upload speed measures by removing the effect of services which, due to physical limitations, would be better assigned to another plan. At the same time, this comparison provides stronger incentives for service providers to improve service quality for customers on underperforming services.
Latency	The average time required to send a packet of data to the SamKnows test server and back to the consumer's computer, measured in milliseconds (ms).	The lower the latency, the better. Lower latency will result in faster responses, providing a more reliable experience when using real-time applications such as video conferencing and online gaming.
NBN fixed-line	Refers to monitored connections on NBN Co's fixed-line footprint, that is to say, households served via fibre to the premises (FTTP), fibre to the curb (FTTC), fibre to the node (FTTN), fibre to the building (FTTB) and hybrid fibre-coaxial (HFC) access technologies. In this report, the NBN fixed-line section includes results for major NBN plans up to 600 Mbps download speed. It excludes results from very high speed services as these are presented separately. For the report, FTTN and FTTB access technologies are treated as identical.	
NBN fixed wireless	Refers to monitored connections on NBN Co's fixed wireless footprint.	This type of service is more prevalent in regional and remote areas, as it allows households to be connected without having to establish a physical, wired connection, but it is not exclusive to these areas. Consumers in outer metropolitan centres may also use NBN fixed wireless connections.
NBN very high speed services	Refers to services on the NBN Ultrafast plan, which has a download/upload speed range of 500-990/50 Mbps.	
Other superfast access networks	Refers to households served by fixed-line networks other than NBN, for example, Uniti Group's LBNC0 and OptiComm fixed-line networks.	

Term	Definition	Significance
Outages	The outages metric tracks how many times per day a broadband connection goes offline for at least 30 seconds. Outages between 12am and 5am are excluded from this metric as this is when network maintenance typically occurs.	Outages can impact user experience, subject to their frequency and duration.
Overprovisioning	This refers to NBN Co providing higher data rates than the plan speed.	The purpose of overprovisioning is to accommodate protocol overhead. Protocol overhead is the portion of the bandwidth taken up by information that helps ensuring that the message reaches the destination, rather than the message itself. Overprovisioning intends to compensate for the bandwidth taken up by protocol overhead as it enables consumers to experience speeds closer to the maximum of their plan. Currently, NBN Co overprovisions certain plans on the downlink only. Hence download speeds may be closer to, or above plan speed, whereas upload speeds remain below plan speeds.
Packet loss	Packet loss counts packets that are sent over a network and don't make it to their destination, measured as a percentage of packets lost out of all packets sent.	At levels above 1%, packet loss can cause issues for certain types of applications. This may be detrimental to user experience.
Plan and plan speed	Plan refers to the retail broadband product. Each plan has an associated download and upload speed. For example, plan speeds for NBN50 are 50 Mbps down and 20 Mbps up. This is also sometimes referred to as a 50/20 Mbps plan.	RSPs may advertise a maximum attainable speed and also state a different typical busy period speed that consumers are likely to experience, which may be the same or lower than the maximum attainable speed.
Underperforming 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.	This metric effectively identifies services with maximum attainable speeds that fall closer to the maximum speed of a lower plan than to the maximum speed of the consumer's current plan. This is often, but not always, caused by a known physical impairment to FTTN services (see impaired services).
Video streaming (Netflix)	The number of Netflix videos at High Definition (HD) and Ultra High Definition (UHD) that can be streamed on a certain plan simultaneously.	
Webpage loading time	The time it takes for a specific webpage to fully load. This is a combination test that includes download, latency and DNS in one test that accurately mimics real-world usage. This metric combines test results for eight popular Australian-based webpages.	

NBN fixed-line services⁷

Download speed test results

Figure 1: Average download speed by RSP

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

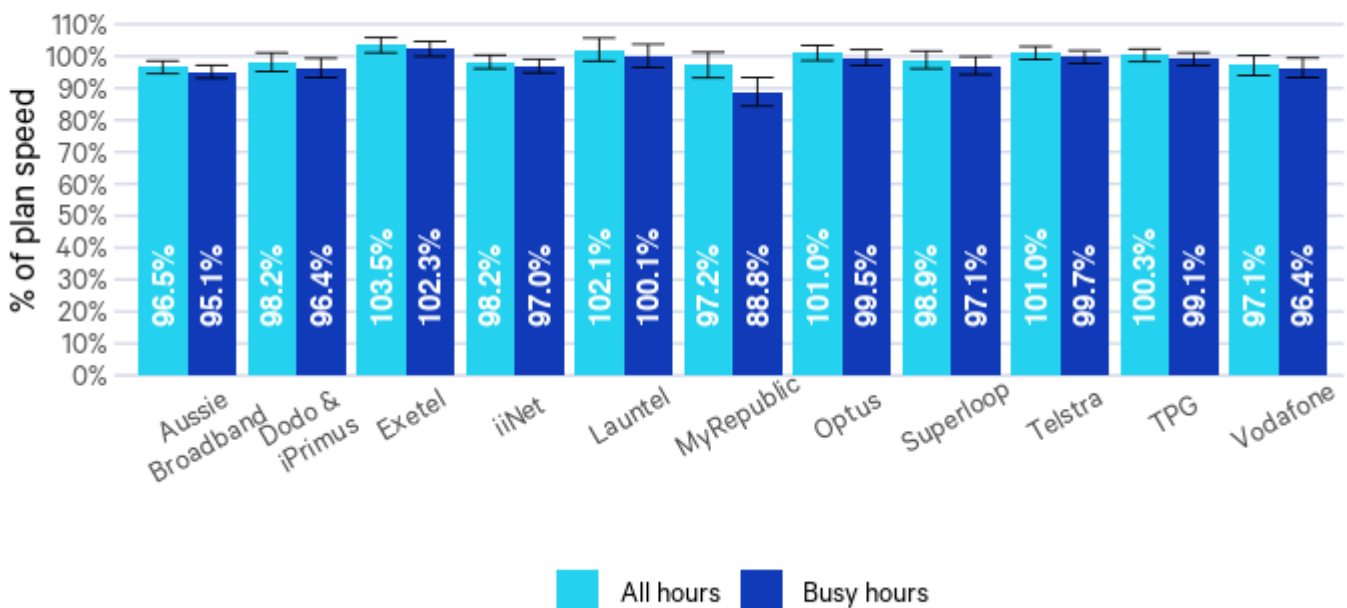


Figure 1 shows the average download speed attained during all hours and busy hours by RSPs. During the May 2022 measurement period, users on NBN fixed-line services attained an average download performance of 99.3% of plan speed during all hours, decreasing to 97.6% during the busy hours (between 7pm and 11pm) which is when networks experience higher user activity.

⁷ This section includes results for major NBN plans up to 600 Mbps. It excludes results from very high speed services as these are presented separately.

These results are similar to the last (17th) Measuring Broadband Australia report. The corresponding figures in the last report were 97.9% of plan speed during all hours and 96.5% during busy hours.

Figure 2: Busiest hour average download speed by RSP

NBN fixed-line plans. Including underperforming services.

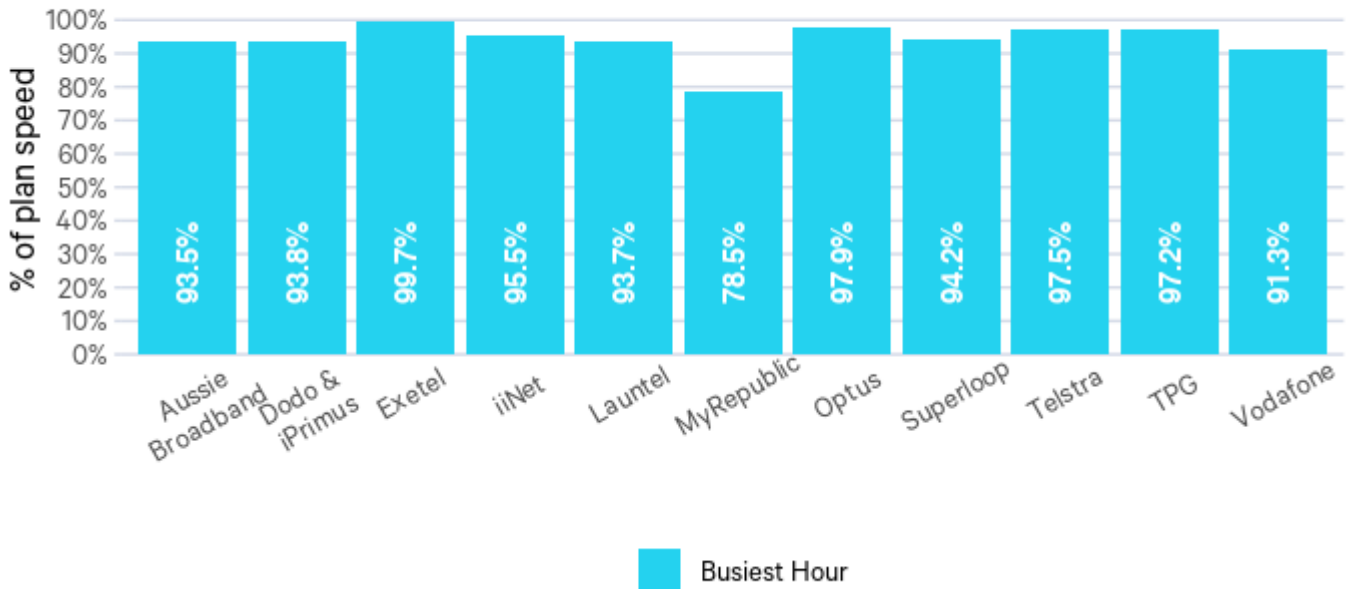


Figure 2 shows RSP results in the ‘busiest hour’, which is the fifth-lowest hourly average download speed across each busy hour by RSP in May 2022. The May 2022 measurement period had a total of 31 days with 4 busy hours each, totalling 124 busy hours in the month. The busiest hour download speed results 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.

The range of speeds by RSP during the busiest hours varied from between 78.5% to 99.7% 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. Most RSPs achieved busiest hour speeds above 90% of plan speed, which is in line with the previous report.

Figure 3: Average hourly download speed by plan

NBN fixed-line plans. Including underperforming services.

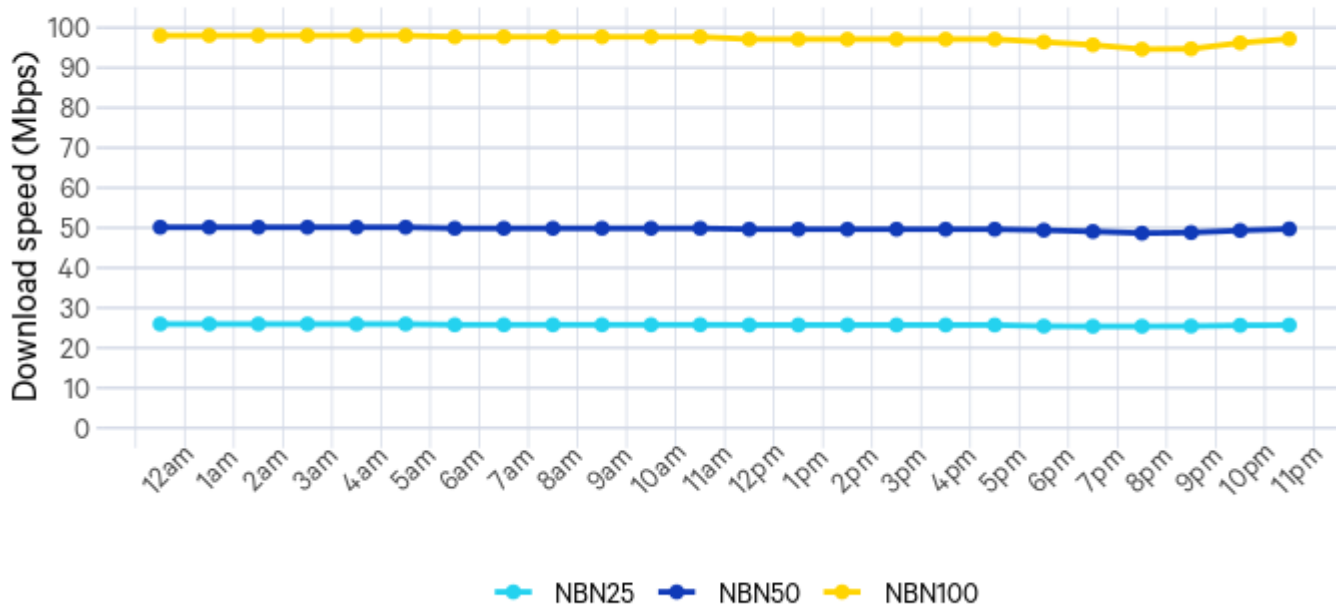


Figure 3 shows download speeds averaged across the month for each hour in the day. Average download speeds held steady throughout the day for users on most NBN plans. The 100 Mbps NBN plans remain the most affected by increased user activity in the evening hours, speeds typically started to decrease during the evening, dipping to 3.4 Mbps below the day’s maximum by 8pm, and would recover to higher levels during the night. The average dip in NBN100 speeds is slightly lower than that observed in the previous report (3.9 Mbps).

Figure 4 shows that during this reporting period, 433,353 download speed tests were performed across 1,209 Whiteboxes connected to fixed-line NBN infrastructure.

Of these tests, 68.6% achieved at least 100% of plan speed; for reference, 65.6% 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 1.8% in this reporting period; for reference, 2.3% of tests failed to meet the 50% mark in the previous reporting period.

Figure 4: Frequency of download speeds attained during tests

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

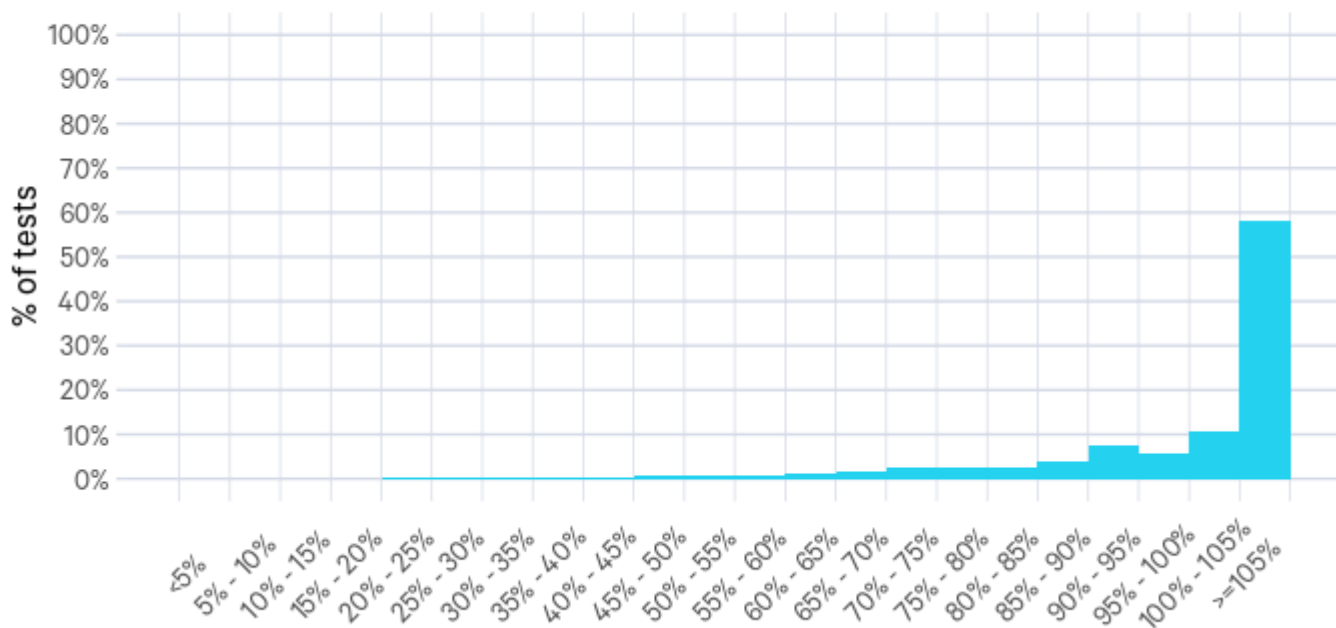
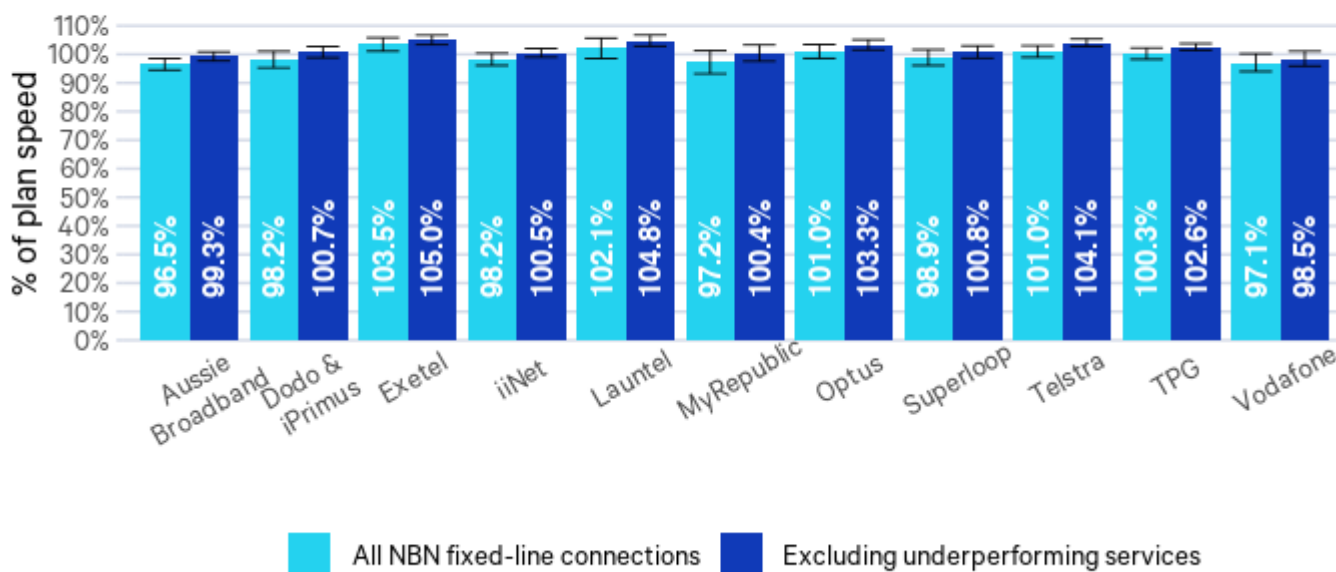


Figure 5: Average download speed by RSP - inclusive and exclusive of underperforming services

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



As in previous reports, we present separate measures of download performance exclusive of underperforming services. Underperforming services represented 6.0% of the 1,209 NBN services that were tested for this report.

FTTN services make up 93% of underperforming NBN services in our sample.

The NBN50 and NBN100 plans account for 95% of the underperforming NBN services in our sample.

Figure 5 shows that once underperforming services are excluded, the average download performance during all hours is 101.8% as against the 99.3% 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 2.5 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 6: Average download speed by plan and technology

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

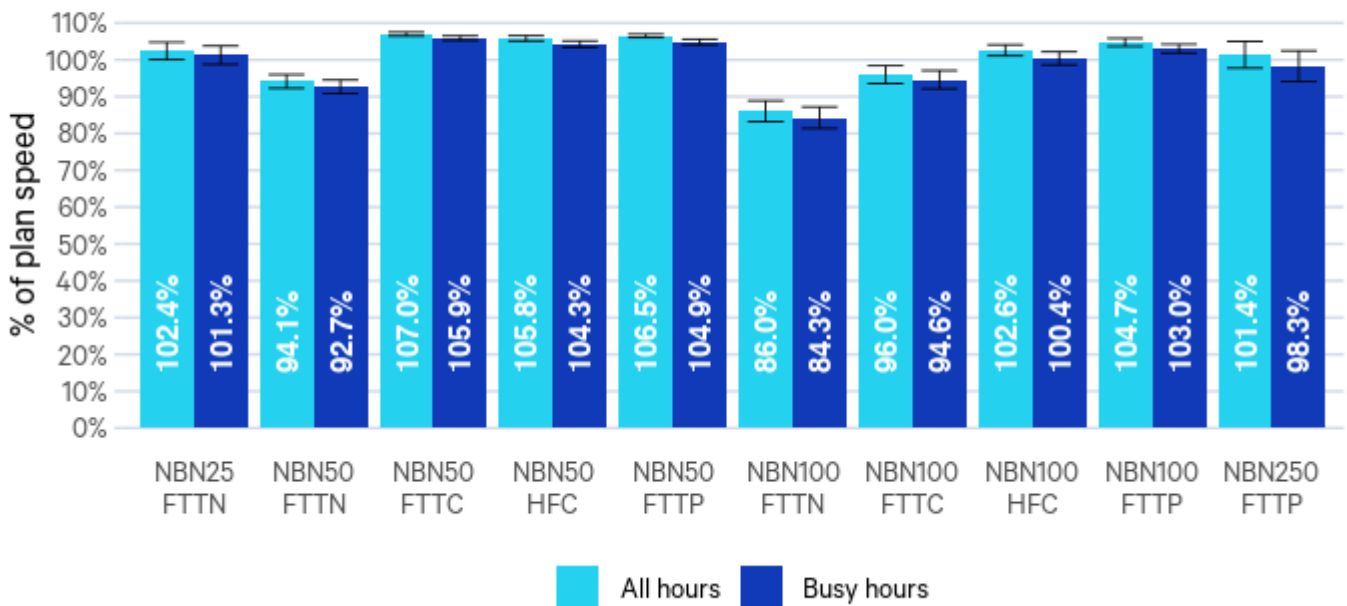


Figure 6 shows average download speed for different access technologies for different NBN plans. Within the NBN50 plan, FTTN services had an average download speed around 6 Mbps lower than other technologies, a difference of 12% when comparing in percentage terms. Within the NBN100 plans, FTTN services had an average download speed around 16 Mbps lower than other technologies.

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

Figure 7: 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.

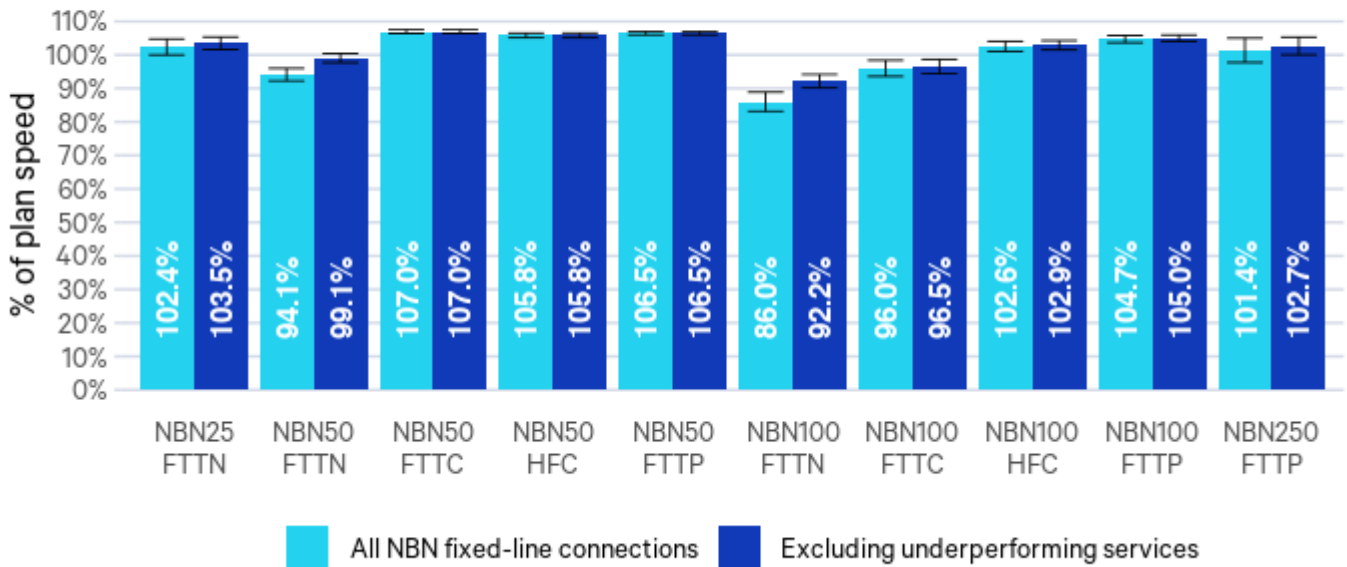
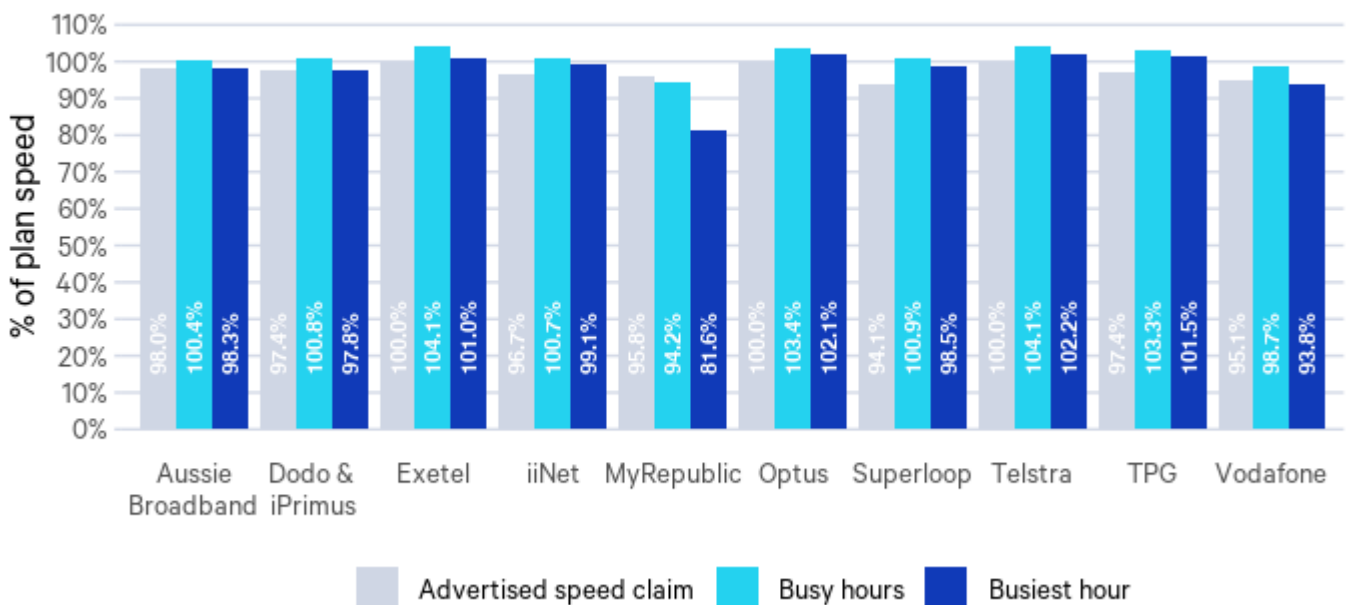


Figure 7 shows the impact of underperforming services on average download speed across different plans and technologies. FTTN services continue to account for the bulk of the impact from underperforming services across both the NBN50 and NBN100 plans.

Figure 8: Advertised speeds and average download speeds by RSP

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



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

Figure 8 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, across all fixed-line technologies. The busy hour and busiest hour download performance is calculated against the nominal plan download speed (50 Mbps and 100 Mbps respectively), rather than the advertised speed claim.

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

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

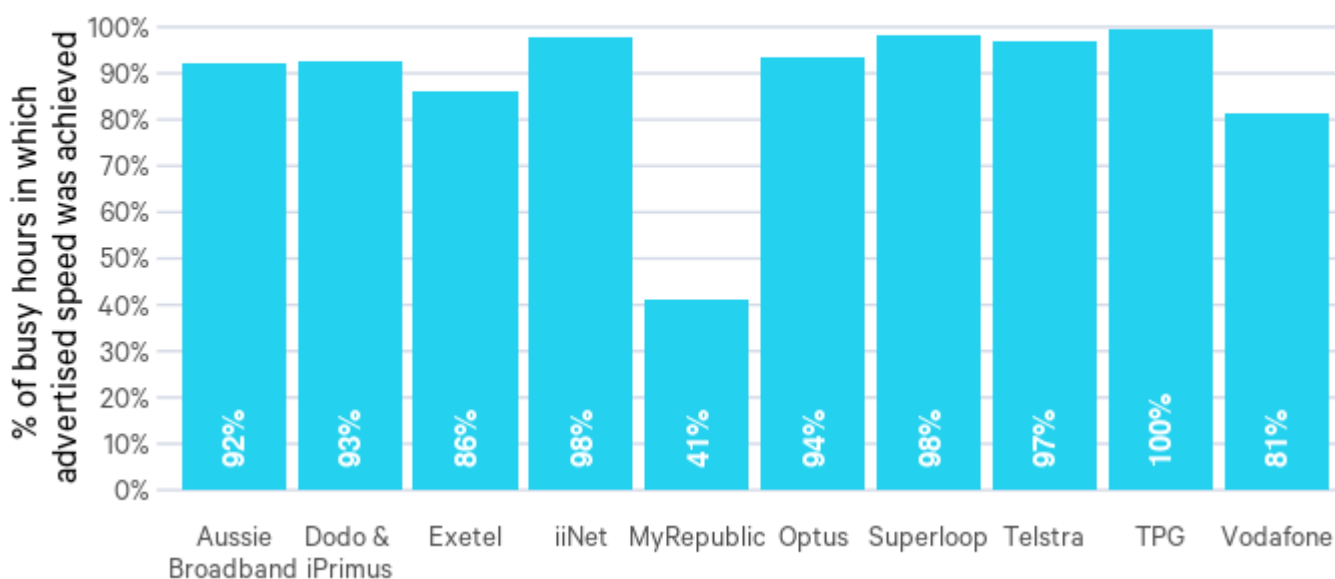


Figure 9 shows the percentage of busy hours during the period in which test speeds for NBN50 and NBN100 products met or exceeded the speeds advertised by RSPs. If all underperforming services and impaired services had been remediated – or moved to a more appropriate plan - then the proportion of busy hours when RSPs met their advertised speed claims would have been no lower than 81% for the majority of providers.⁸

⁸ MyRepublic had lowered its advertised NBN50 speed claim from 50 Mbps to 47 Mbps and its NBN100 speed claim down from 93 Mbps to 90 Mbps towards the end of May or early June. The reported 41% is calculated using MyRepublic’s original speed claim valid

Note that Figure 9 shows the proportion of busy hours where the advertised speed claim was achieved, rather than the proportion of busy hours where the nominal plan download speed was achieved. This means that an RSP advertising lower speed claims may achieve their advertised speed claim in a greater proportion of busy hours even when their busy hour download performance is lower. Conversely, another RSP advertising higher speed claims may only achieve their advertised speed claims in a lower proportion of busy hours even when their busy hour download performance is higher.

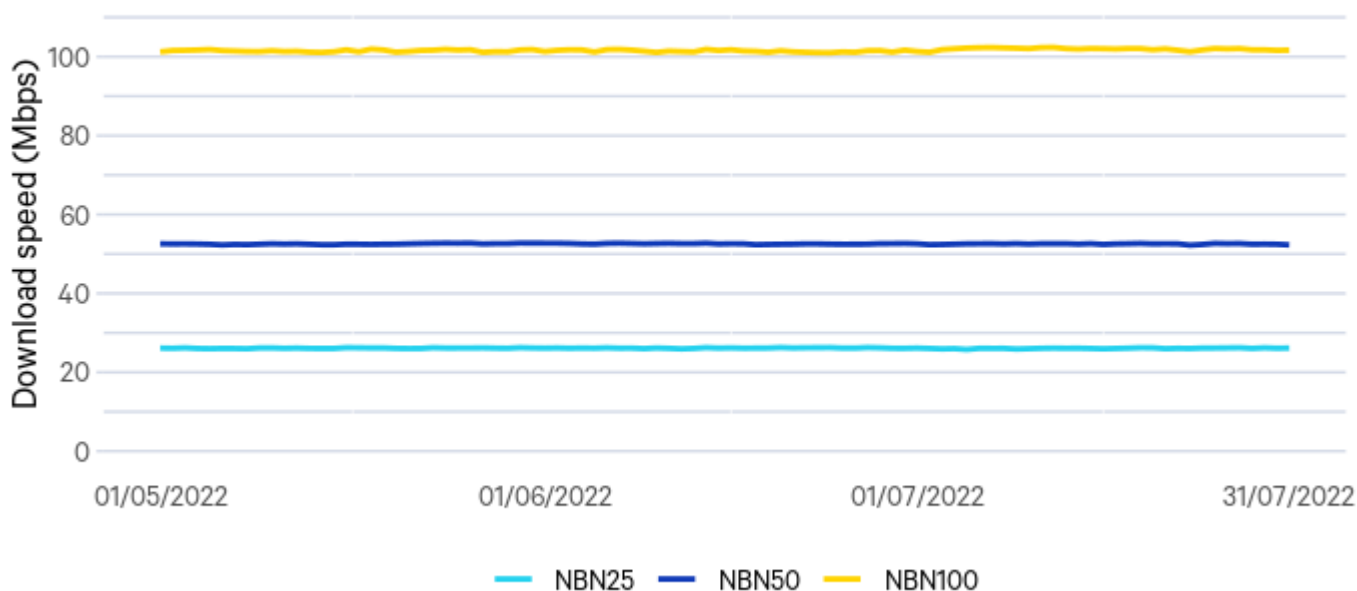
Daily average download speeds by plan

NBN fixed-line plans from 1 May 2022 to 31 July 2022

Figures 10 and 11 show the average daily download speeds⁹ for the NBN25, NBN50 and NBN100 fixed-line plans. Performance is broadly stable for all plan speeds during all hours. There is more variability in network performance during busy hours compared with all hours, particularly for NBN100 plans.

Figure 10: Average daily download speeds during all hours by plan

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

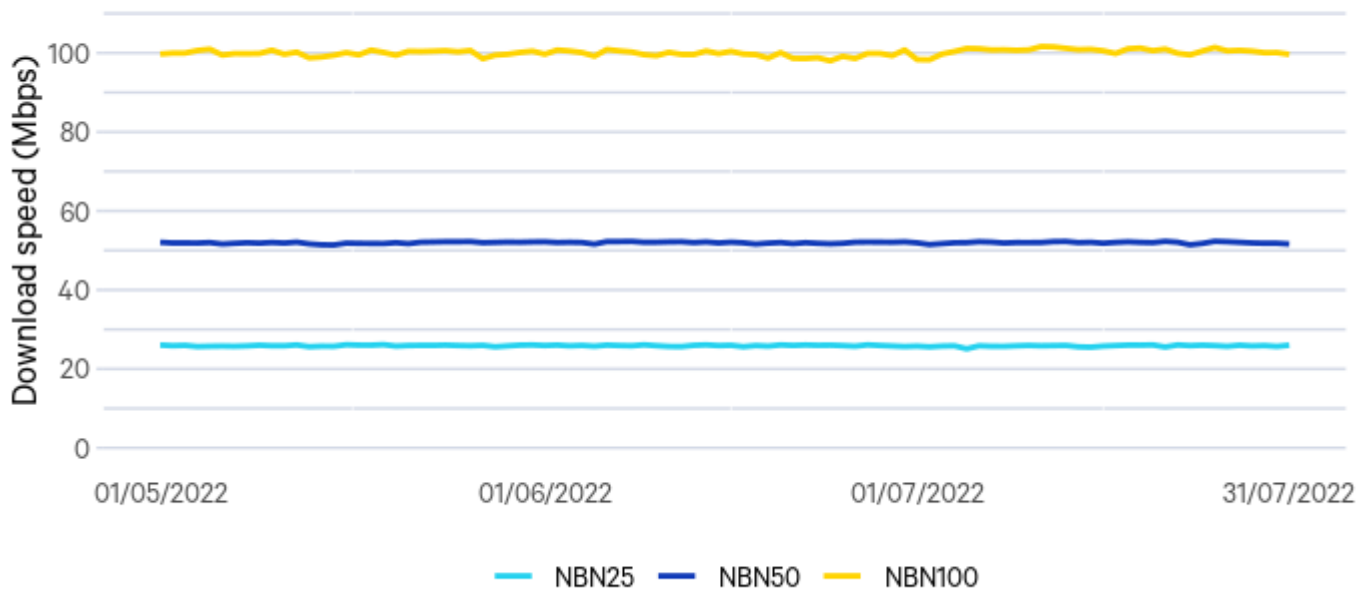


during most of May; when assessed against the new speed claims valid from the end of May/beginning of June, MyRepublic's download speed would have exceeded this in 54.0% of May busy hours.

⁹ 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 11: Average daily download speeds during busy hours by plan

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



Upload speed test results

Figure 12: Average upload speed by RSP

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

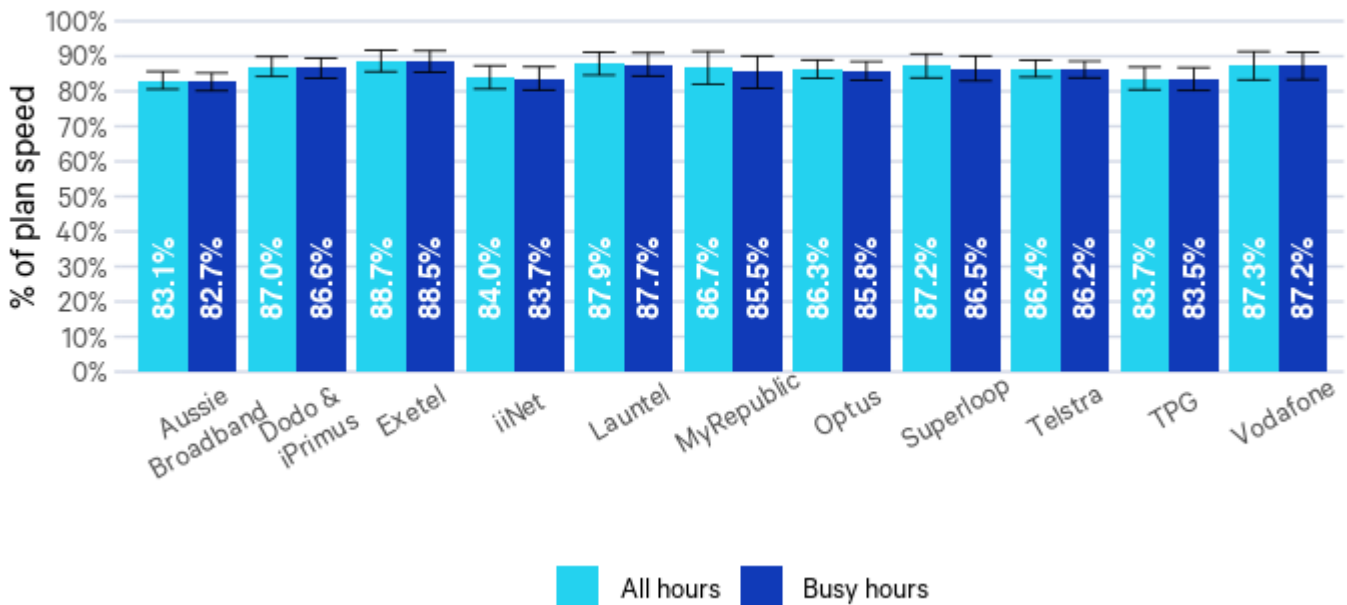
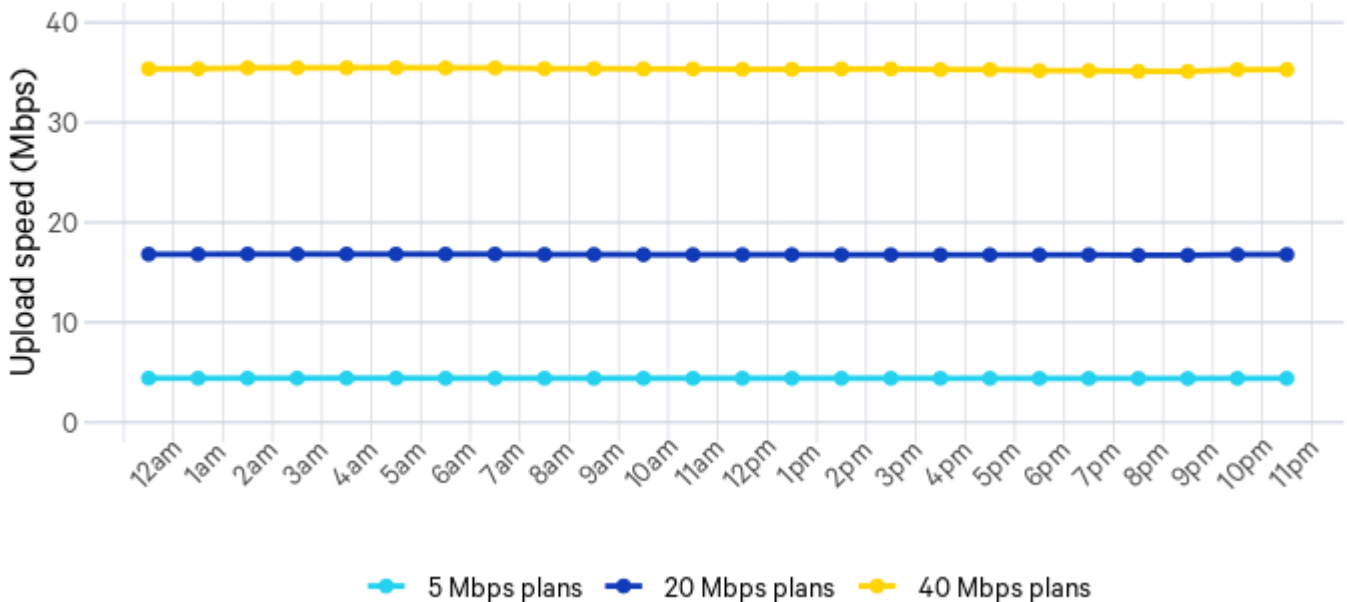


Figure 13: Average hourly upload speed by plan

NBN fixed-line plans. Including underperforming services.



Figures 12 and 13 show upload speeds for the main NBN fixed-line RSPs and plans. Unlike download speeds, the upload component of NBN speed tiers is not overprovisioned. Upload performance remained similar when compared to the previous report - February 2022: NBN services achieved an overall average upload performance of 85.6% during all hours, as against 84.7% in the previous report. During busy hours, NBN fixed-line services achieved an

average upload performance of 85.3%, as against 84.3% 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 83.1% and 88.7% during all hours across RSPs.

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

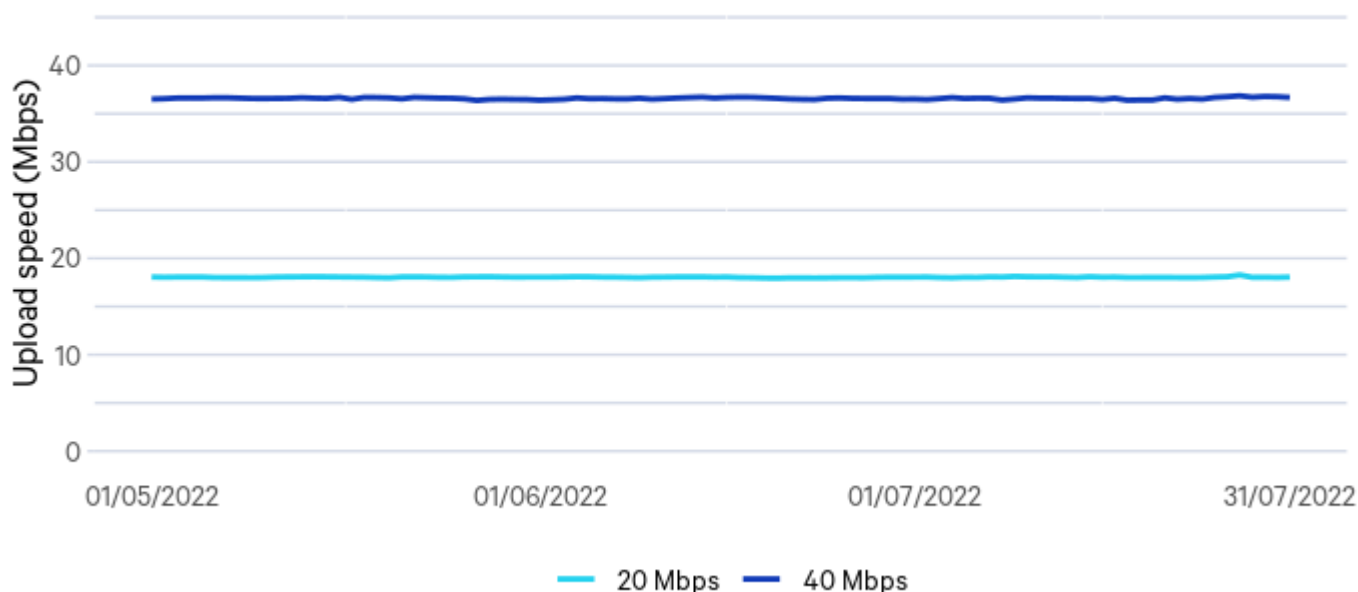
Daily average upload speeds by plan

NBN fixed-line plans from 1 May 2022 to 31 July 2022

Figures 14 and 15 show average daily upload speeds for the 20 Mbps and 40 Mbps NBN fixed-line upload speed tiers.¹⁰ Upload performance for both speed tiers was stable between May and July 2022.

Figure 14: Average daily upload speeds during all hours by plan

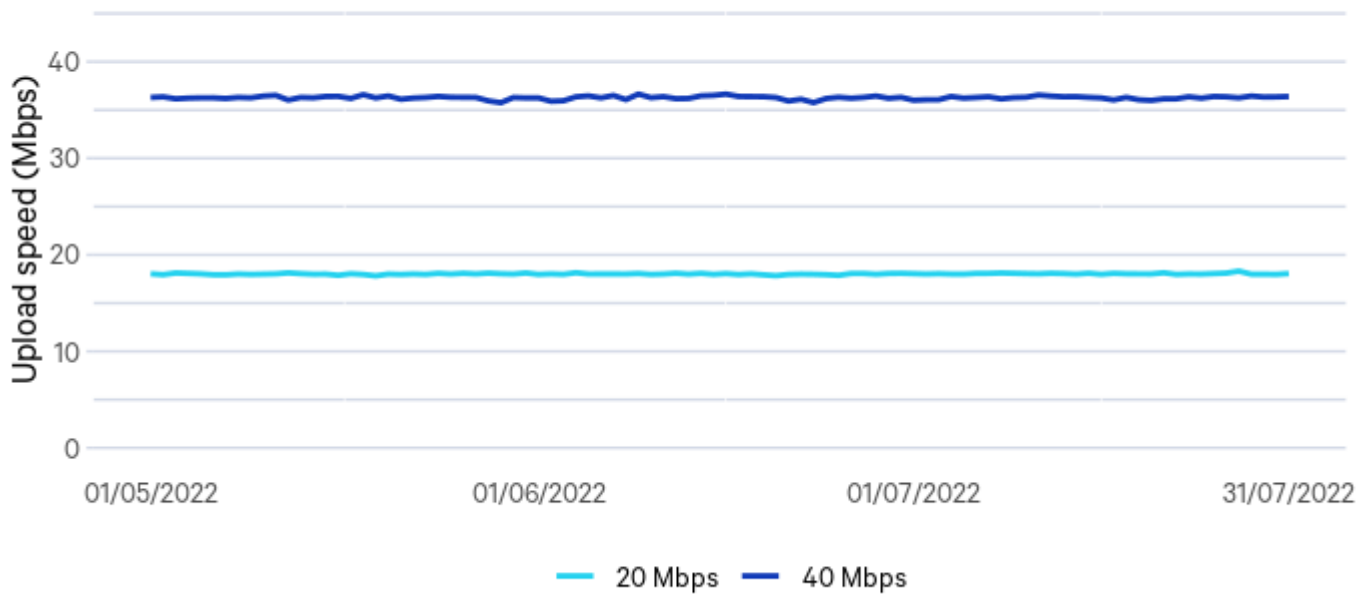
NBN fixed-line plans. Excluding underperforming and impaired services.



¹⁰ 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 15: Average daily upload speeds during busy hours by plan

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



The effect of overprovisioning on download performance

The COVID-19 pandemic led to a major shift in home internet usage patterns globally, and Australia was no exception to this trend. With more people working and learning from home, the pressure on telecommunications networks increased rapidly as lockdowns were introduced. One of the measures NBN put in place to support consumers as reliance on internet increased was overprovisioning the download component of certain NBN fixed-line speed tiers by approximately 15%. This measure was rolled out between June and August 2020 and is still in place.

The Measuring Broadband Australia program has previously reported on the resulting increase in the number of services measuring average download speeds above the nominal download plan speed:

- MBA Report 10¹¹ reported on data collected between 22nd May and 20th June 2020, when NBN started applying the 15% overprovisioning. This report found that a small number of services on the panel were able to attain higher download speeds than the plan download speed, but the majority of services on the panel were still limited by the plan speed at this time.
- MBA Report 11¹² reported on data collected during the month of October 2020. At this point in time, the 15% overprovisioning was widely applied, and this was reflected in the results. This report found that over half of NBN fixed-line services on the panel attained an average download speed higher than the plan speed in October as a result of overprovisioning.

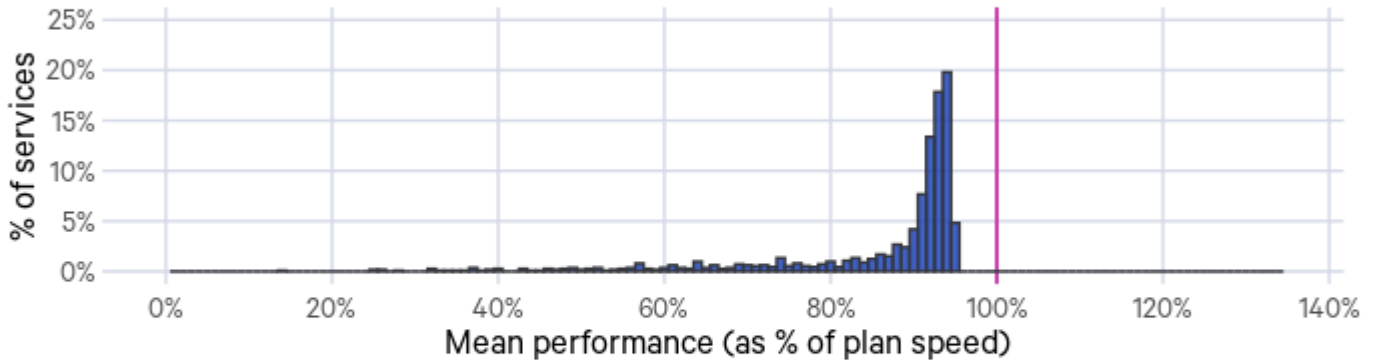
¹¹ https://www.accc.gov.au/system/files/Measuring%20Broadband%20Australia%20-%20Report%2010%20-%20September%202020_1.pdf

¹² https://www.accc.gov.au/system/files/Measuring%20Broadband%20Australia%20-%20Report%2011%20-%20December%202020_0.pdf

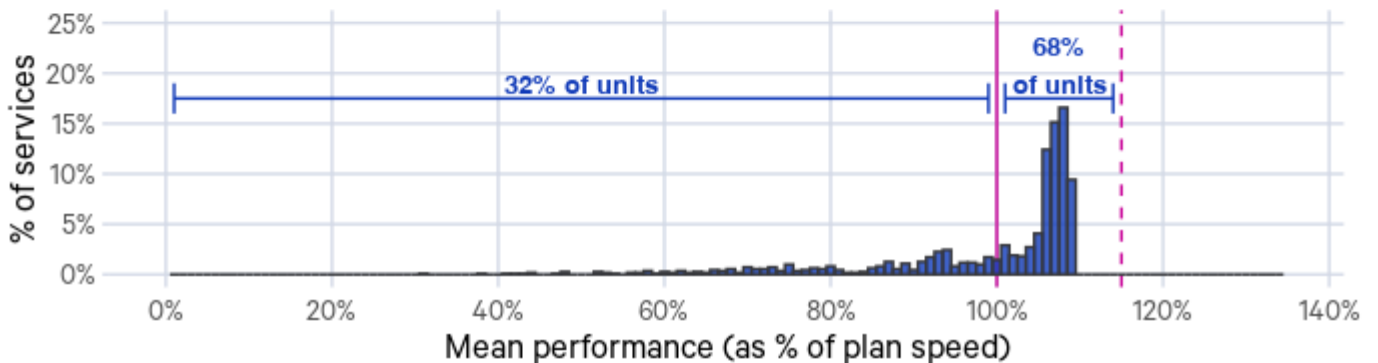
Figure 16: The effect of overprovisioning on download performance

Comparing data from February 2020 (MBA Report 9) against current data from May 2022. All hours. 25/10 Mbps, 50/20 Mbps, 100/20 Mbps, 100/40 Mbps, 250/25 Mbps and 250/100 Mbps plans. Charts A-D show the distribution of services attaining a certain % of plan speed on average. Solid line marks the nominal plan speed (100% performance), dashed line marks the overprovisioned maximum speed.

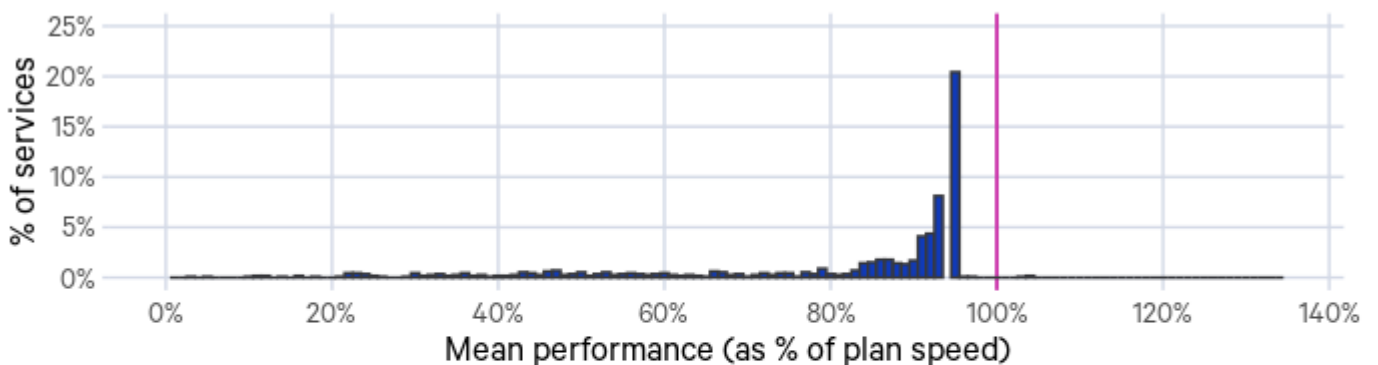
A - Download performance without any overprovisioning provided by NBN (February 2020)



B - Download performance with 15% overprovisioning provided by NBN (May 2022)



C - Upload performance without any overprovisioning provided by NBN (February 2020)



D - Upload performance without any overprovisioning provided by NBN (May 2022)

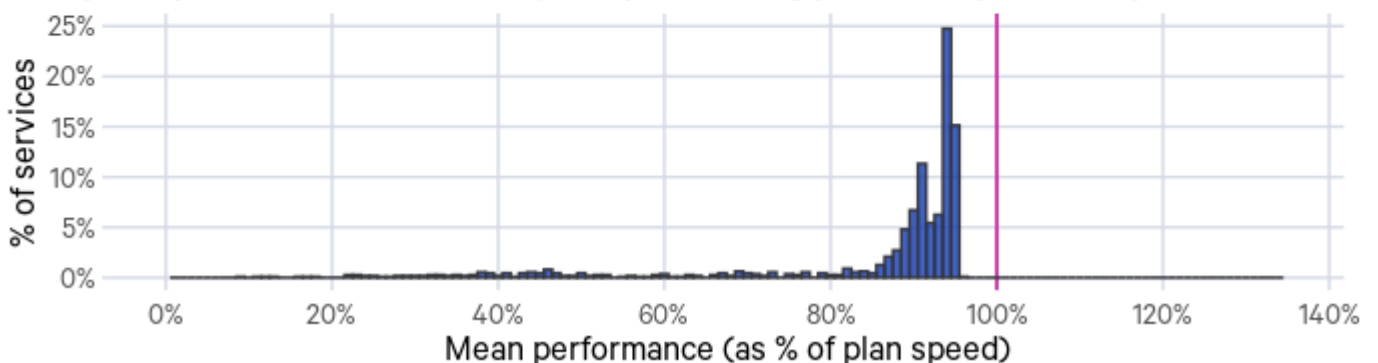


Figure 16 shows a comparison of download and upload data from February 2020¹³ which was collected before NBN implemented the 15% overprovisioning, against the current download and upload data from May 2022 to illustrate the effect of overprovisioning on the download speed. When expressing speed results as a percentage of plan speed, small absolute differences in speed can translate to high differences in performance when the plan speed is relatively small. To avoid any distortions resulting from this, the data presented here only includes speed tiers having a plan upload speed of at least 10 Mbps. To ensure a higher degree of comparability between the February 2020 and the May 2022 results, the charts showing results from May 2022 (Charts B and D) only include services on the 25/10 Mbps, 50/20 Mbps, 100/20 Mbps, 100/40 Mbps, 250/25 Mbps and 250/100 Mbps NBN fixed-line speed tiers.

Chart A shows the distribution of average download performance measured in February 2020. At this point in time, NBN provided the nominal plan download speed. Due to a small part of the provided bandwidth being taken up by protocol overhead, the measured download speeds for all services remained under the nominal plan download speed. The upload performance in February 2020 showed a similar pattern: due to the lack of overprovisioning and the protocol overhead, services on the panel were not able to attain upload speeds above the plan upload speed.

Chart B shows the distribution of average download performance measured in May 2022, almost two years after NBN started to increase the download allowance on certain NBN fixed-line plans. At 15% overprovisioning, over two-thirds of services attained an average download speed at or above the nominal plan download speed.

Charts C and D show that the distribution pattern of the average upload performance measured in May 2022 remained qualitatively similar to the upload performance measured in February 2020, as expected. As NBN continues to not apply any overprovisioning to the upload component, the average upload speeds measured in May 2022 remain under the nominal plan upload speed for all services included in this analysis.

¹³ MBA Report 9, https://www.accc.gov.au/system/files/MBA_Report%209_0.pdf

Latency, webpage loading time, and packet loss by plan

Figure 17: Average latency by RSP

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

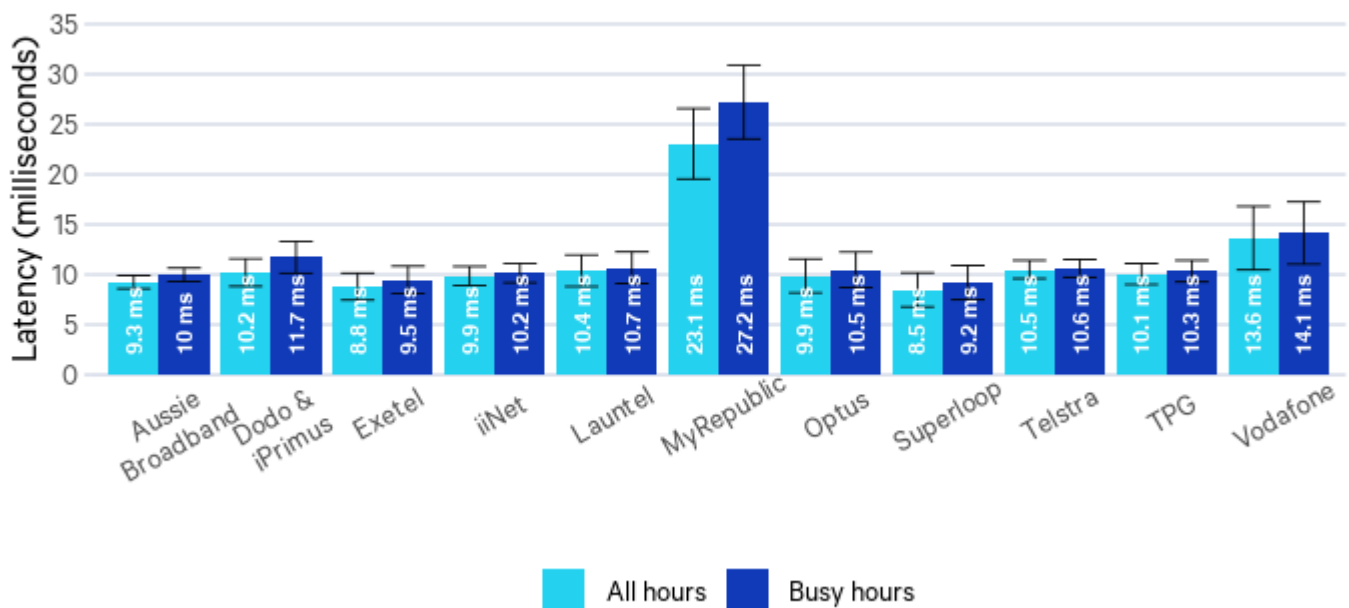


Figure 17 shows that latency results from this period remained in line with the previous report. These latency values are low enough that their effect is unlikely to be noticed by a typical end user, even when using more latency-sensitive applications (such as videoconferencing services or online gaming).

Figure 18 shows that the average time needed to load a website for each RSP has increased slightly compared to the values cited in 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 18: Average webpage loading time by RSP

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

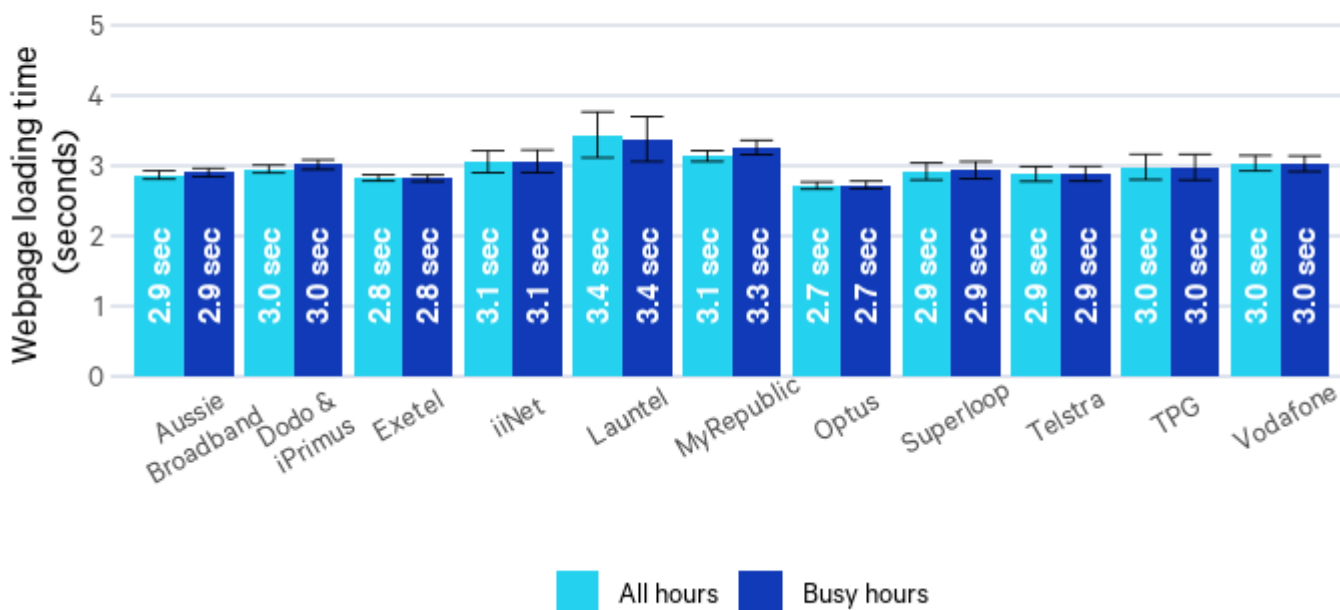


Figure 19: Frequency of packet loss rates observed during tests

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

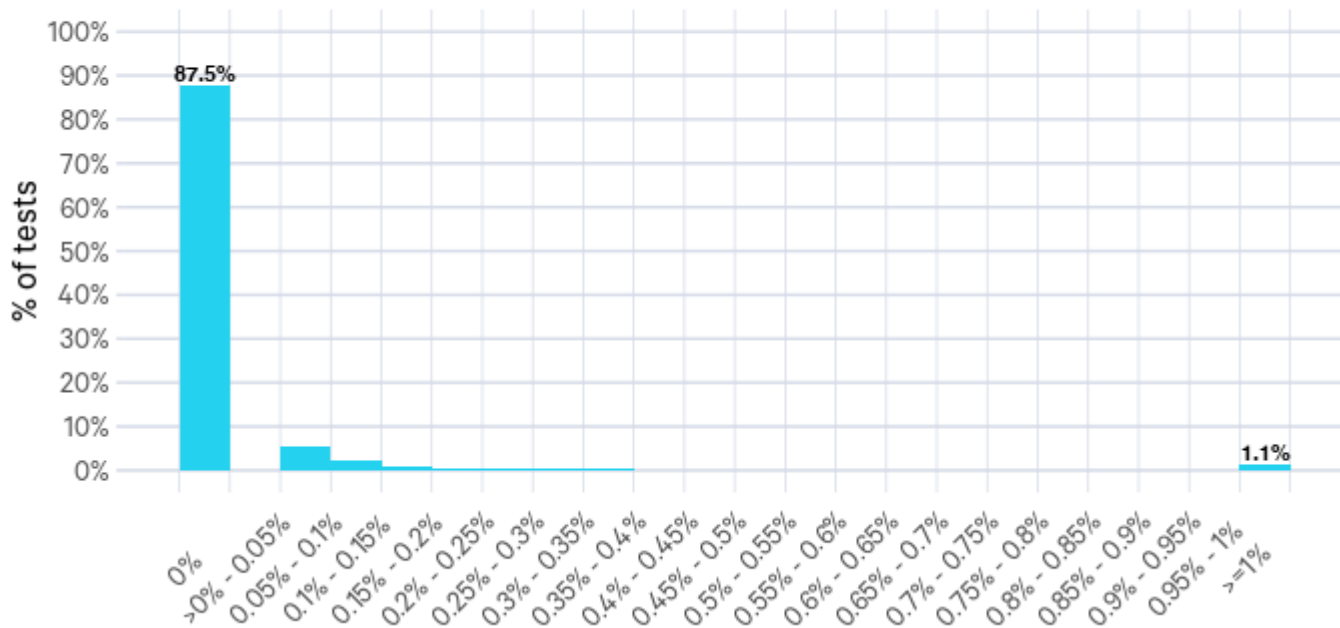


Figure 19 shows the frequency at which different levels of packet loss occurred during tests.

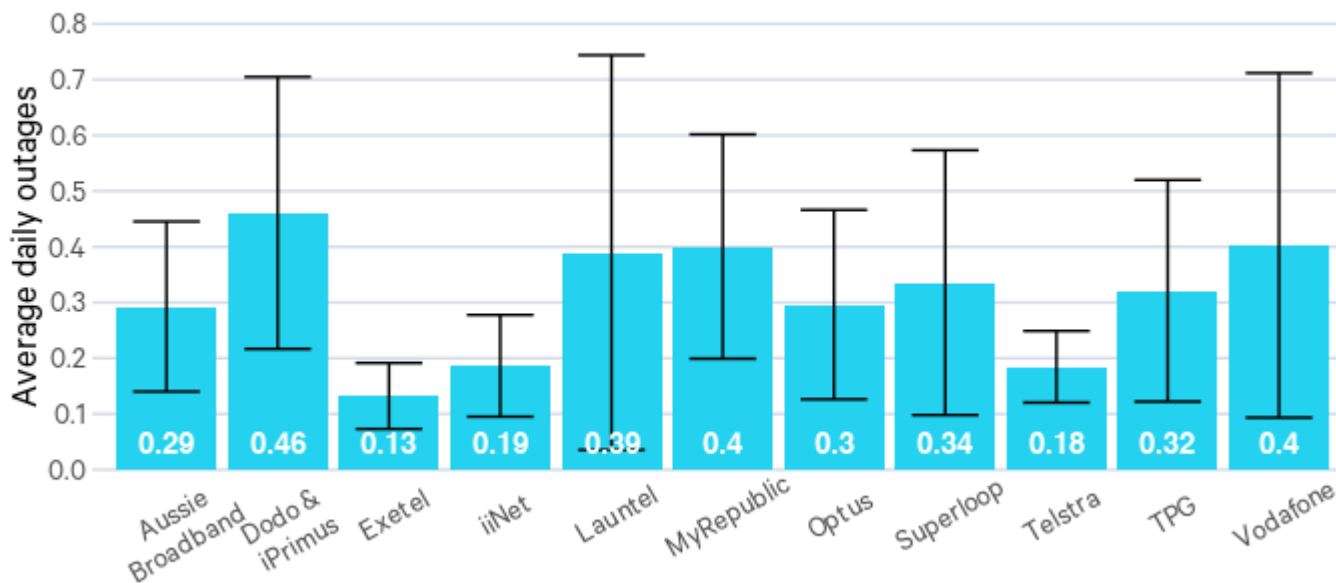
A total of 804,283 packet loss tests were conducted over the measurement period. 87.6% of these tests had packet loss of either zero or less than 0.05%. For reference, in the previous report 86.4% of tests had packet loss below 0.05%.

At the other end of the scale, 1.1% of tests had packet loss greater than 1% as against 1.5% 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

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

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

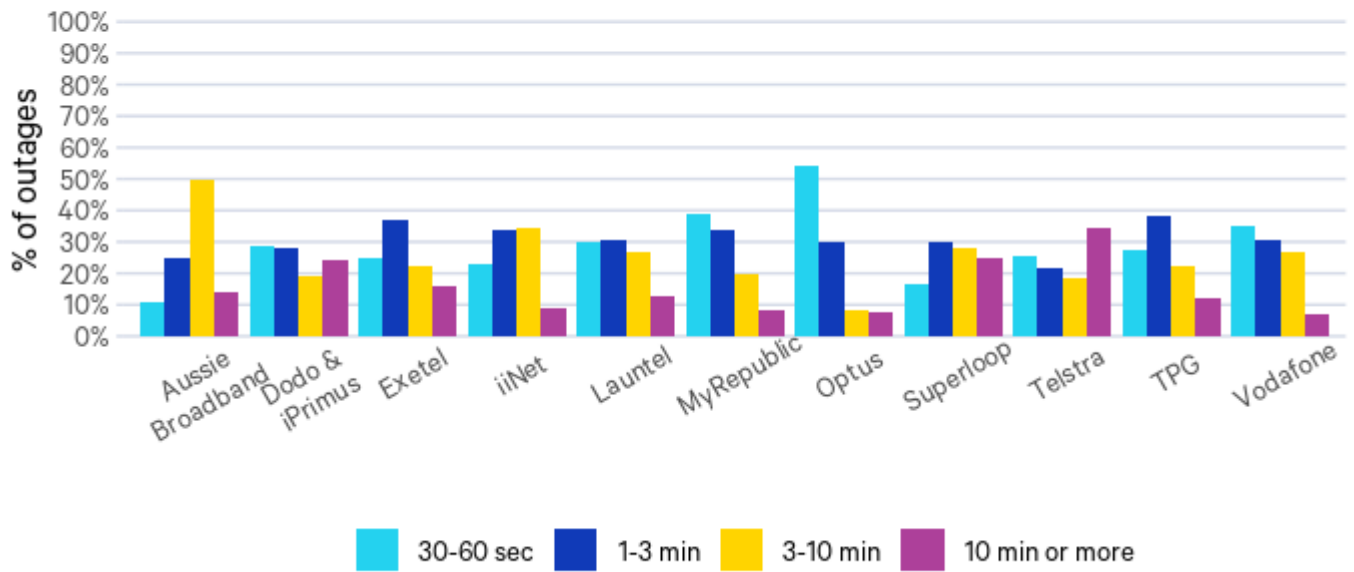


Figures 20 and 21 show, for each RSP, the average rate of daily outages for a service, indicating how often outages occurred and the distribution of outage duration, indicating the severity of outages' impact on user experience.

All RSPs' rates of outages were relatively low. Across all RSPs, the average rate of outages per day on NBN plans was an average of 0.29 ± 0.05 outages per day. As the majority of outages last for no more than 3 minutes, outages are likely to have little material impact on end user experience.

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

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



Other superfast access networks

This section of the report presents data on 40 services on other superfast access networks on a variety of plans: 12/1 Mbps (1 unit), 25/5 Mbps (4 units), 50/20 Mbps (8 units), 100/20 Mbps (10 units), 100/40 Mbps (11 units), 250/25 Mbps (3 units) and 250/100 Mbps (3 units). The results presented are aggregated across various fixed-line networks. Download and upload speeds are expressed as a percentage of the nominal plan speed.

The results presented in this section are indicative only, and firm inferences about the performance of other superfast access networks should not be made from these results.

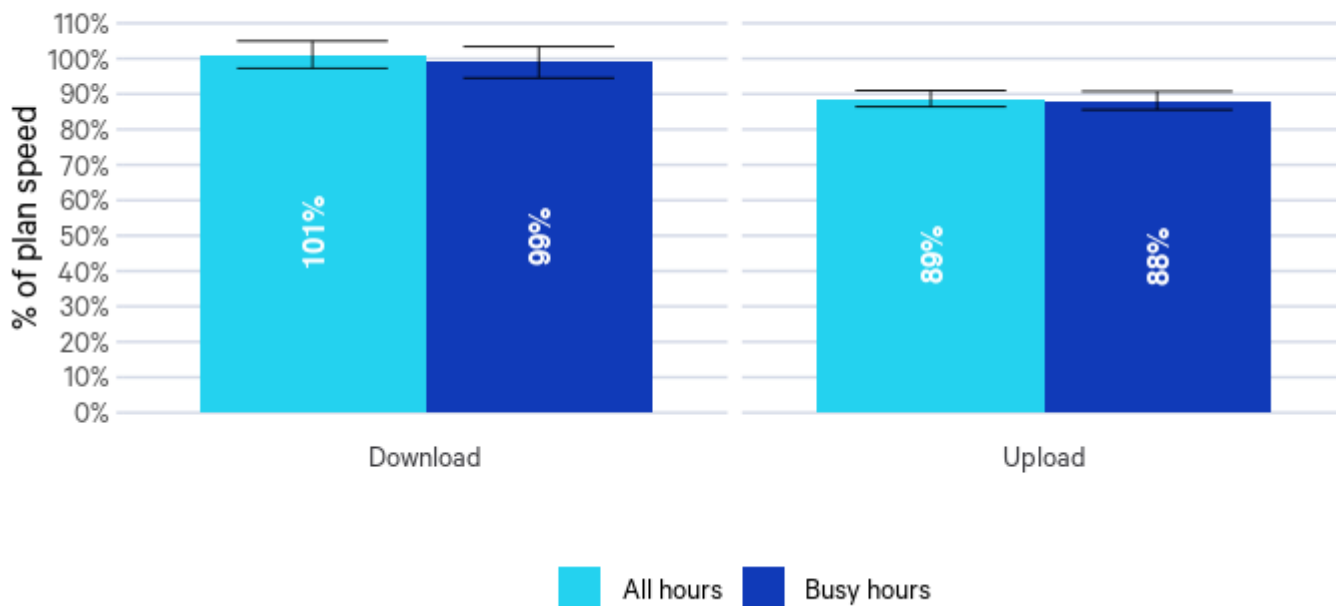
Speed test results

Figure 22 shows that during this period, the sampled households on other superfast access networks attained an average download performance of 101% of plan speeds during all hours and 99% during the busy hours (between 7pm and 11pm).

The sampled services on other superfast access networks attained an average upload performance of 89% of plan speeds during all hours and 88% during the busy hours (between 7pm and 11pm).

Figure 22: Average download and upload speeds

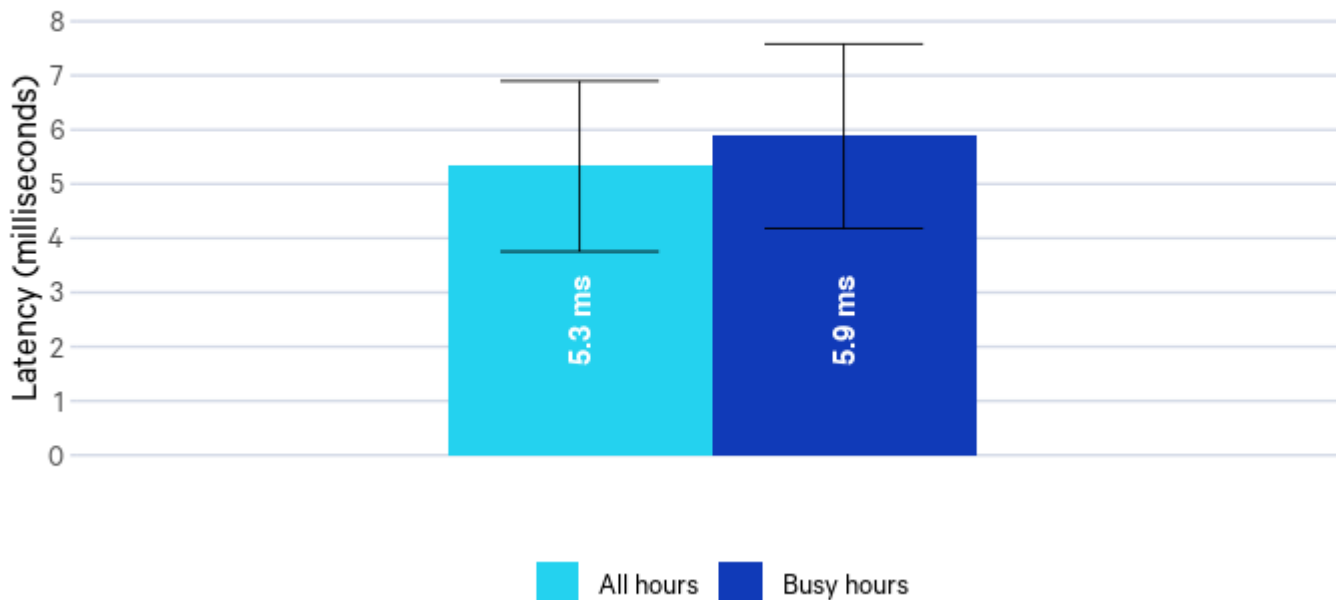
Other superfast access networks. Error bars indicate 95% confidence intervals of the mean.



Latency, packet loss and outages

Figure 23: Average latency

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



As Figure 23 shows, the average latency for services on other superfast access networks was recorded as 5.3 ms during all hours, rising slightly to 5.9 ms during busy hours. Although this is lower than the latency measured for NBN fixed-line services over FTTP connections

(8.8 ms during all hours and 9.4 ms during busy hours), both results are so low that the difference would not be noticeable to a typical end-user.

Figure 24 shows the distribution of packet loss frequencies. During this measurement period, 25,816 packet loss tests were conducted through services on other superfast access networks. Of these tests, 68.8% had packet loss of either zero or less than 0.05%. At the other end of the scale, 1.9% of tests had packet loss greater than 1%.

Figure 24: Frequency of packet loss rates observed during tests

Other superfast access networks. All hours.

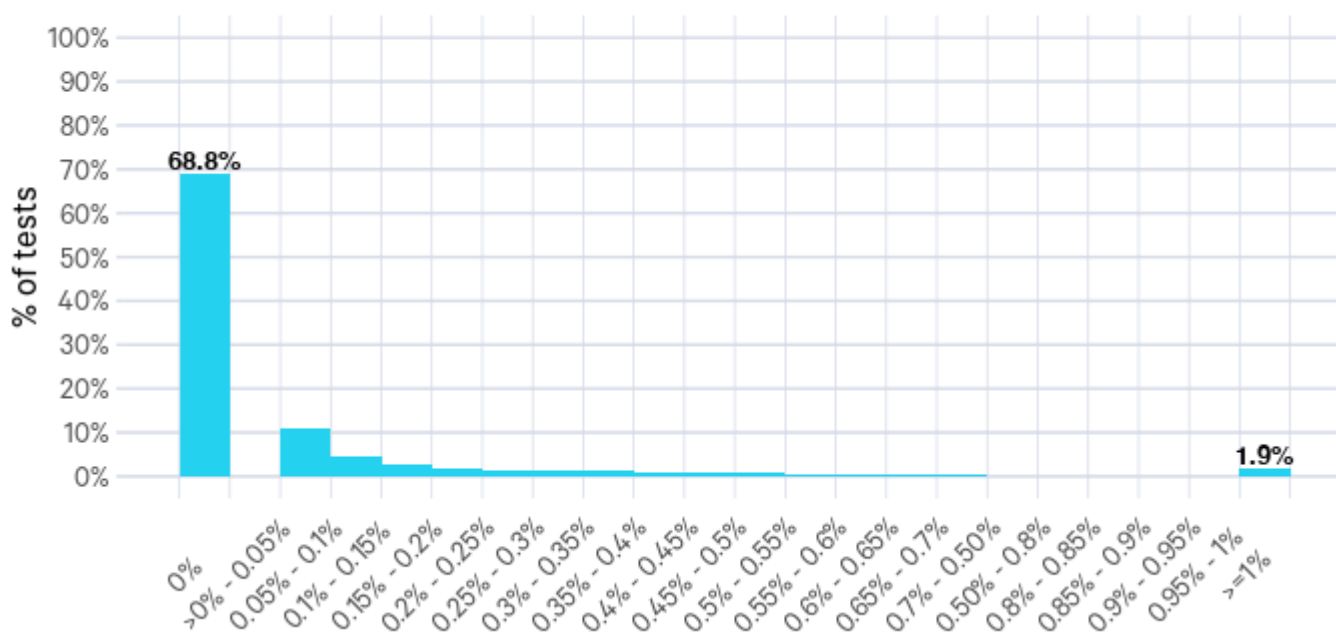
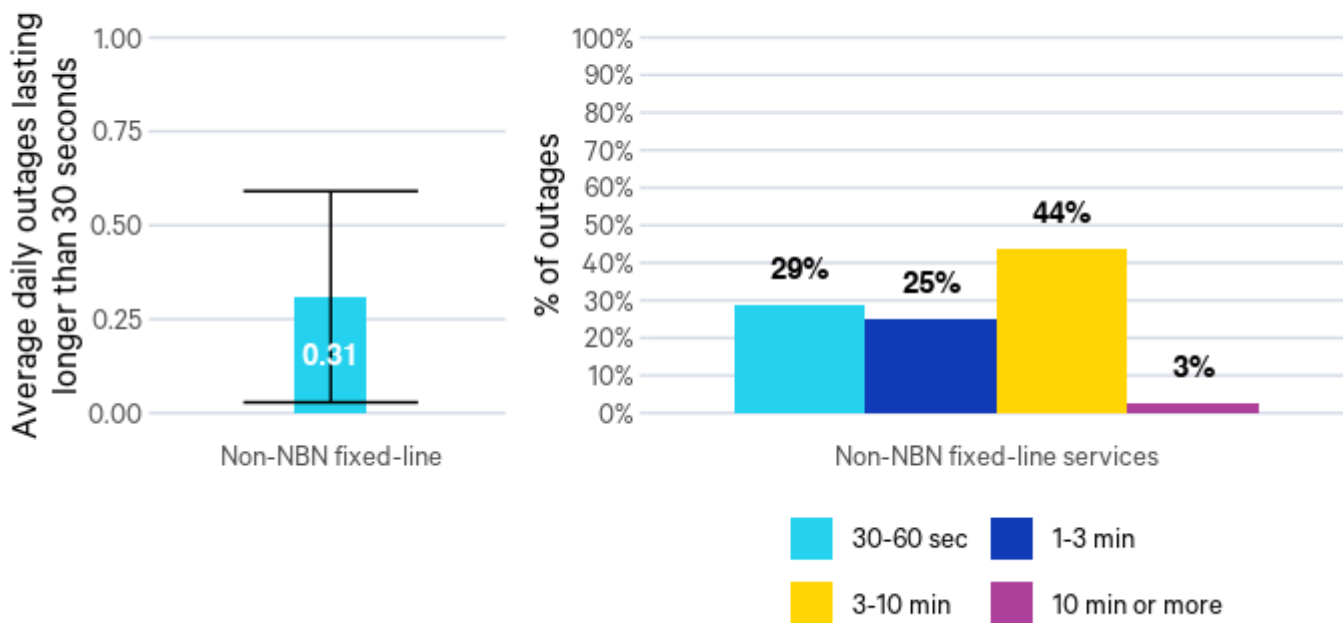


Figure 25 shows the average rate of daily outages for a service and the distribution of outage duration for other superfast access networks, during all hours. During May 2022, there was an average of around 0.3 outages per day on other superfast access networks.

The daily rate of outages varies strongly between households, from units experiencing no such event during the whole measurement month to units experiencing multiple outages per day on average. As a result of this, the uncertainty with which the average daily rate of outages can be determined for a small sample set remains large.

Figure 25: Outage characteristics

Other superfast access networks. All hours.



NBN very high speed services

This section presents results for NBN fixed-line very high speed services for the same period, May 2022, as for other fixed-line results. Very high speed services refer to plans where the underlying wholesale product sold by NBN Co has a download/upload speed range of 500-990/50 Mbps (referred to by NBN Co as “Ultrafast”). This section is based on a total of 121 monitored very high speed services, across both FTTP and HFC technologies.

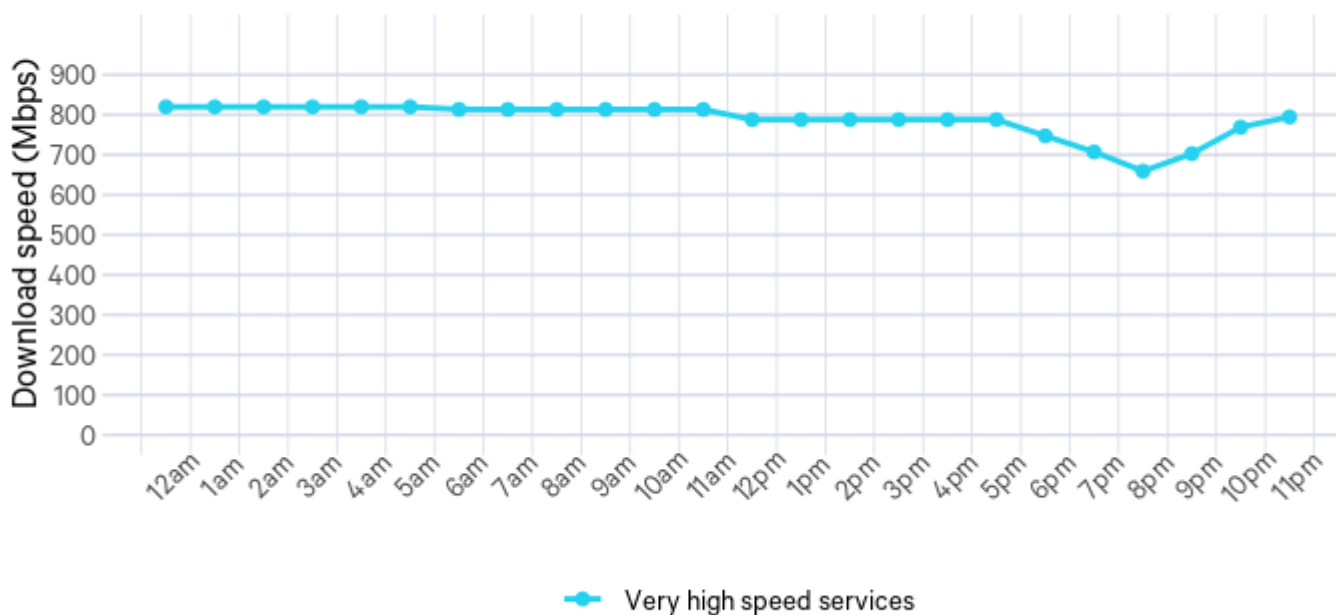
We note that currently, unlike other NBN plans, NBN Co does not overprovision on the download component of very high speed services. Coupled with the fact that the Whitebox connects via gigabit Ethernet to the home gateway, this means that the end-to-end link is limited to 1 Gbps. After network/transport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

The hourly average download speeds attained by NBN very high speed services ranged across the day between 659 Mbps and 820 Mbps. 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 are in line with the previous results.

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

NBN very high speed services.



As shown in Figure 26, average download speeds showed considerable variation throughout the day for very high speed services: speeds typically started to decrease during the evening, dipping to 161 Mbps 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 affected by congestion during busy periods than lower speed plans.

Figure 27 shows that during this reporting period 41,656 download speed tests were performed across 121 Whiteboxes connected to fixed-line NBN infrastructure. Of these tests, 45.5% of tests conducted achieved a download speed of at least 900 Mbps.

Figure 27: Frequency of download speeds attained during tests of very high speed services

NBN very high speed services. All hours.

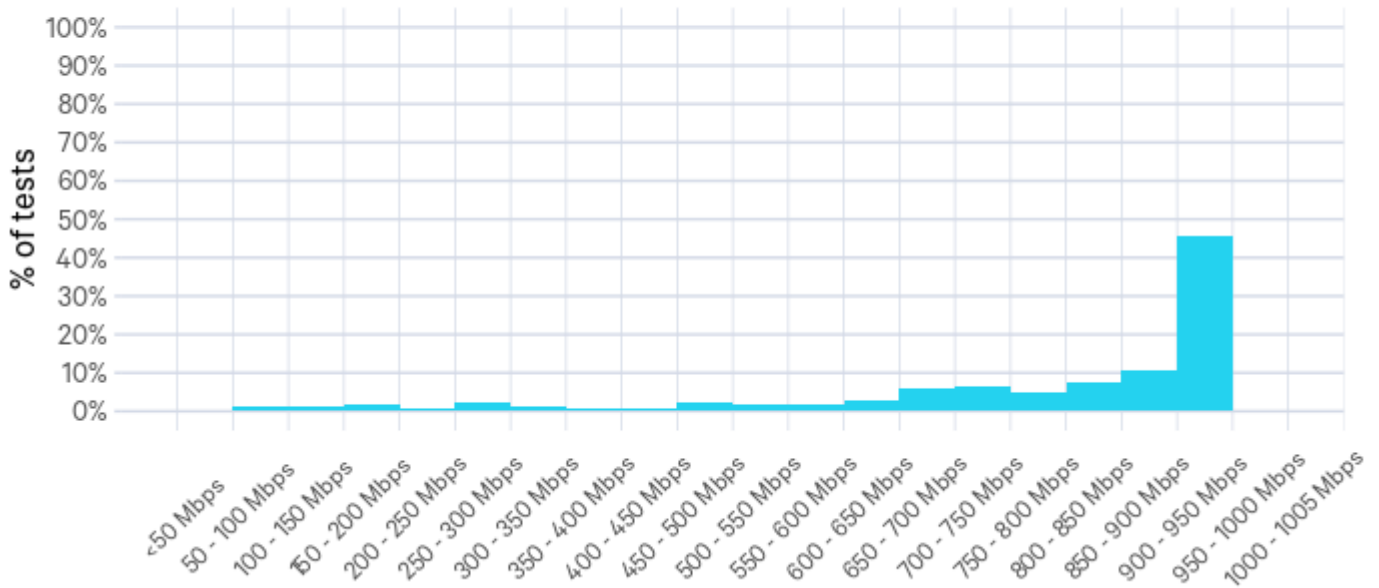


Figure 28: Average hourly upload speed for very high speed services

NBN very high speed services.

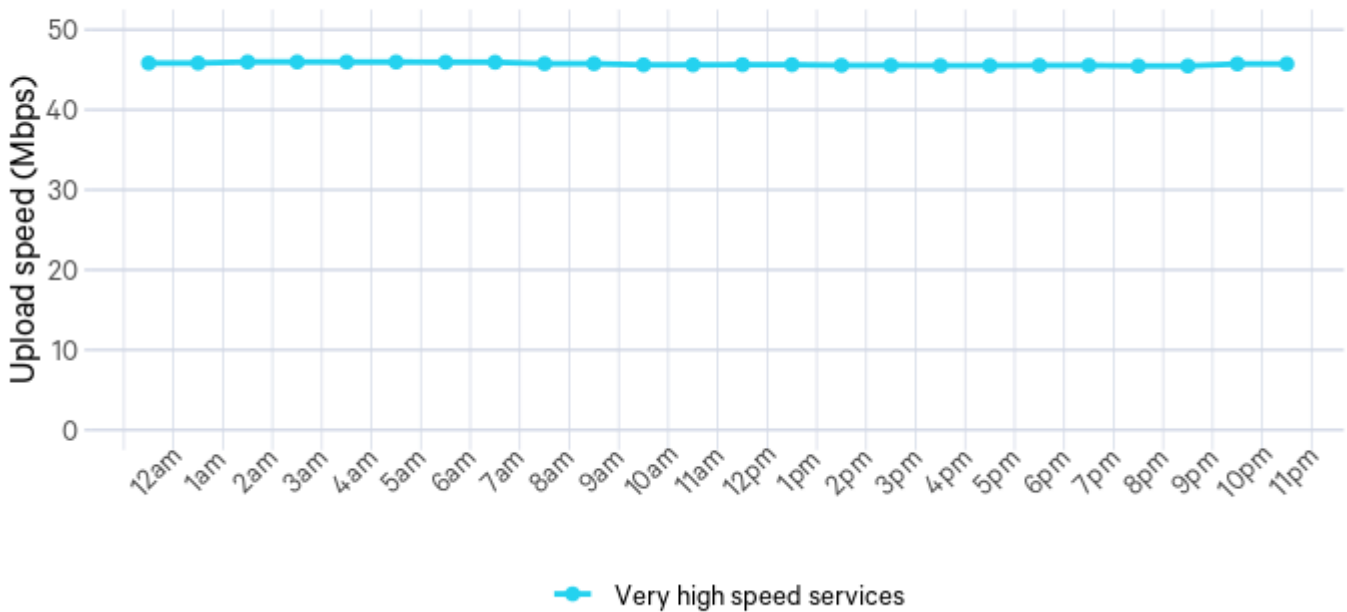
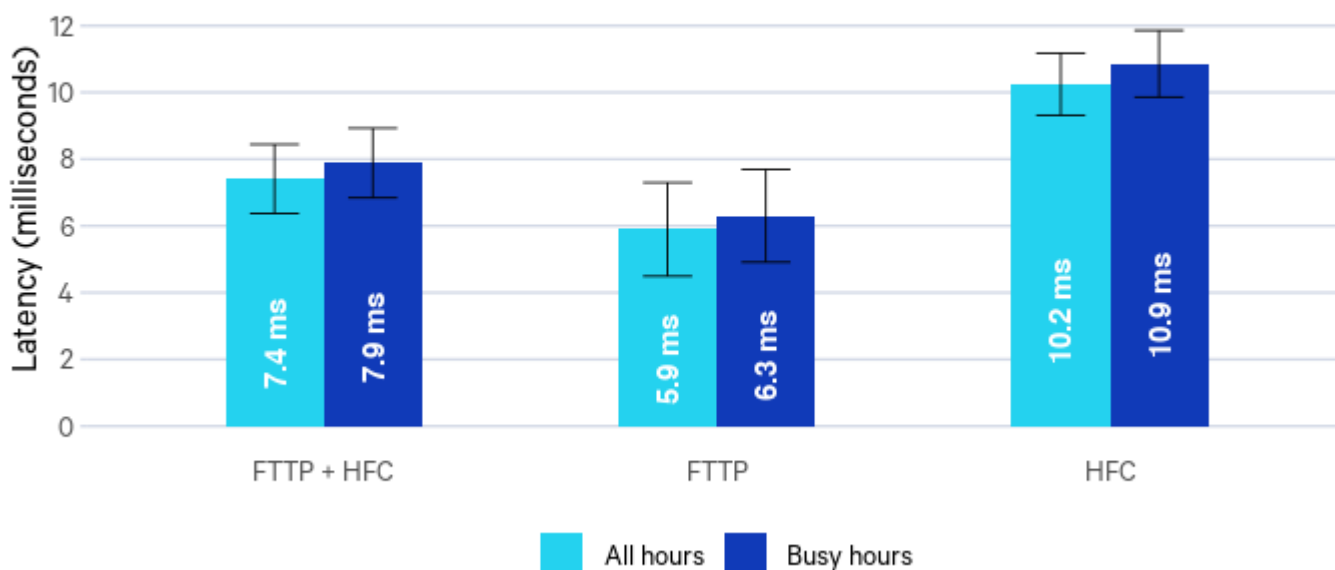


Figure 28 shows that upload speeds for very high speed services show little variation throughout the day.

Latency, packet loss and outages

Figure 29: Average latency for very high speed services

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



As shown in Figure 29, average latency for very high speed plans was recorded as 7.4 milliseconds during all hours, rising slightly to 7.9 milliseconds during busy hours. Although the average latency for very high speed services over HFC was almost 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 30 shows that during this measurement period, 78,365 packet loss tests were conducted through very high speed NBN services. Of these tests, 86.7% had packet loss of either zero or less than 0.05%.

At the other end of the scale, 1.3% of tests had packet loss greater than 1%.

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

Figure 30: Frequency of packet loss rates observed during tests of very high speed services

NBN very high speed services. All hours.

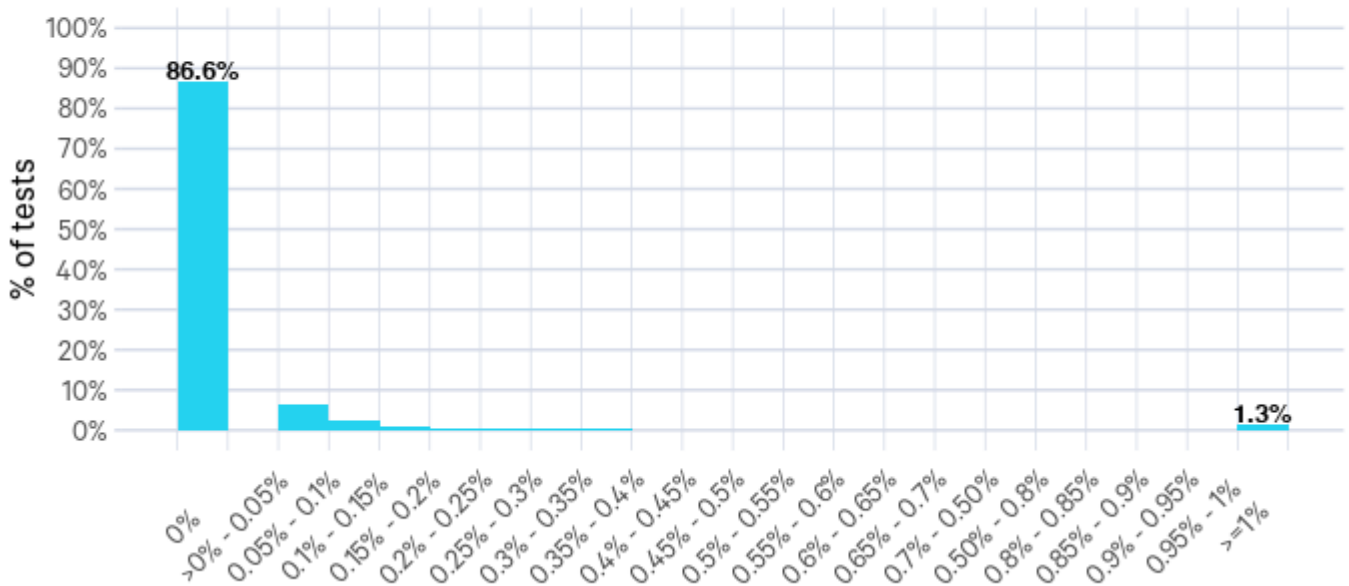


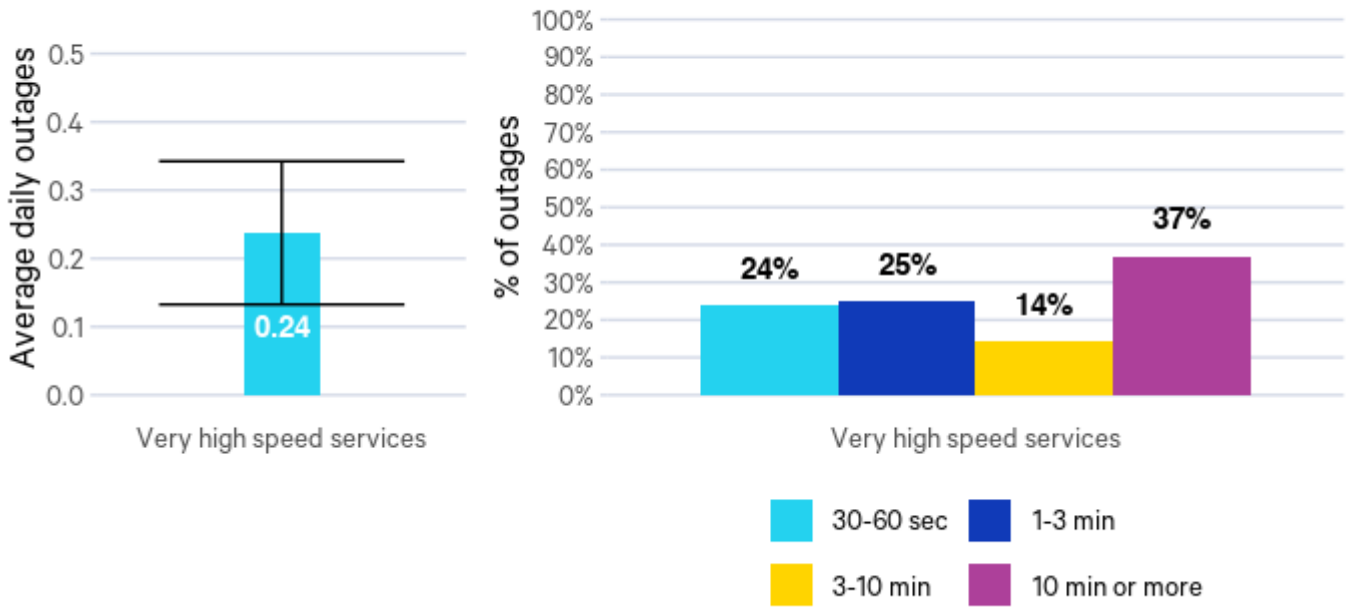
Figure 31 shows the average rate of daily outages for a service and the distribution of outage duration for very high speed services, during all hours. The rate of outages was low and compared favourably to other fixed-line plans.

We note that these results include services where we identified that the volunteer had a 100 Mbps 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 network 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>.

Figure 31: Outage characteristics

NBN very high speed services. All hours.



NBN fixed wireless services

Results for NBN fixed wireless services in this section cover the same period, May 2022, 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 of reporting on fixed wireless performance 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 summary of key metrics from our NBN fixed wireless sample, for both the 25/5 Mbps (13 units) and Fixed Wireless Plus plans (60 units). As the sample number for the 25/5 Mbps plan is very low, all results for this plan should be considered indicative only.

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: FTTP, FTTB, FTTC, FTTN and HFC.

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 limit 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 50/10 Mbps for the Fixed Wireless Plus plan. We express the results of the Fixed Wireless Plus plan along with the 25/5 Mbps fixed wireless plan as a percentage of the service's plan speed.

Figure 32: Average download and upload performance for fixed wireless

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

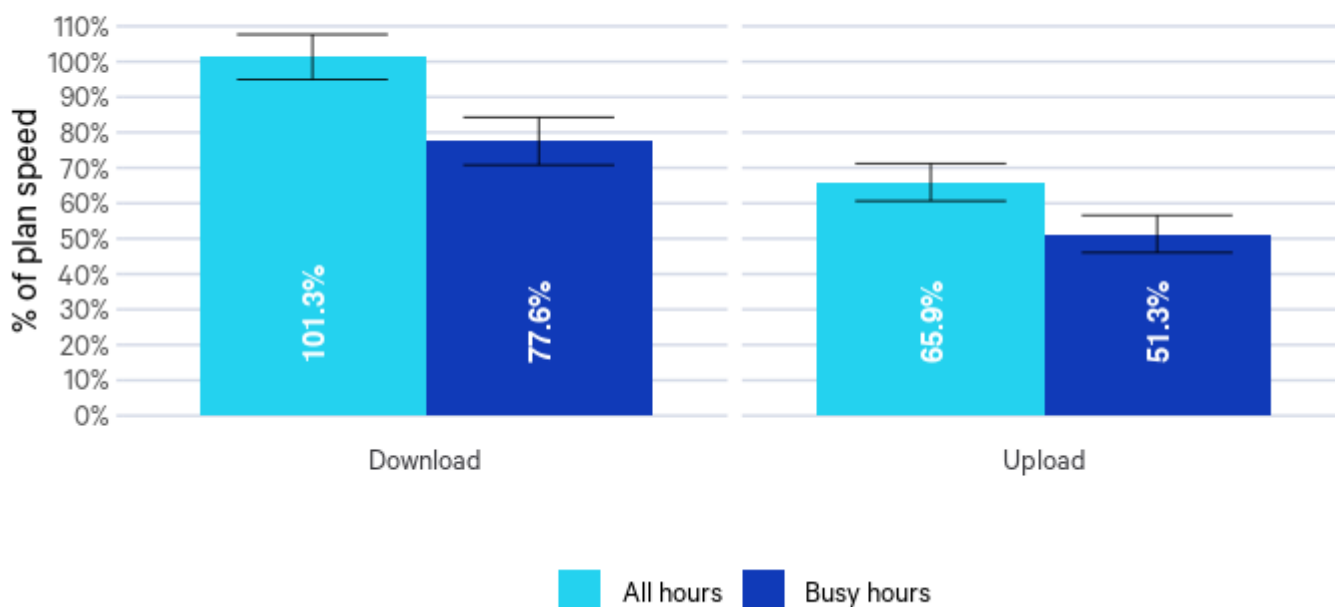


Figure 32 shows the average download and upload performance for fixed wireless services.

The May 2022 results are based on a total of 73 NBN fixed wireless services across both the 25/5 Mbps and Fixed Wireless Plus plans.

During this period, users on NBN fixed wireless services attained an average download performance of 101.3% of plan speeds during all hours, decreasing to 77.6% during the busy hours (between 7pm and 11pm), which is when networks typically experience higher user

activity. This is higher than the February 2022 results, when average download performance was 92.0% of plan speeds during all hours and 74.7% during the busy hours.

The increase in download performance is caused by services on the Fixed Wireless Plus plan having a higher average performance.

In May 2022, NBN fixed wireless services attained an average upload performance of 65.9% of plan speeds during all hours, decreasing to 51.3% during the busy hours (between 7pm and 11pm). In the previous report, concerning February 2022, average upload performance during all hours was 61.3% of plan speeds decreasing to 47.2% during busy hours.

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

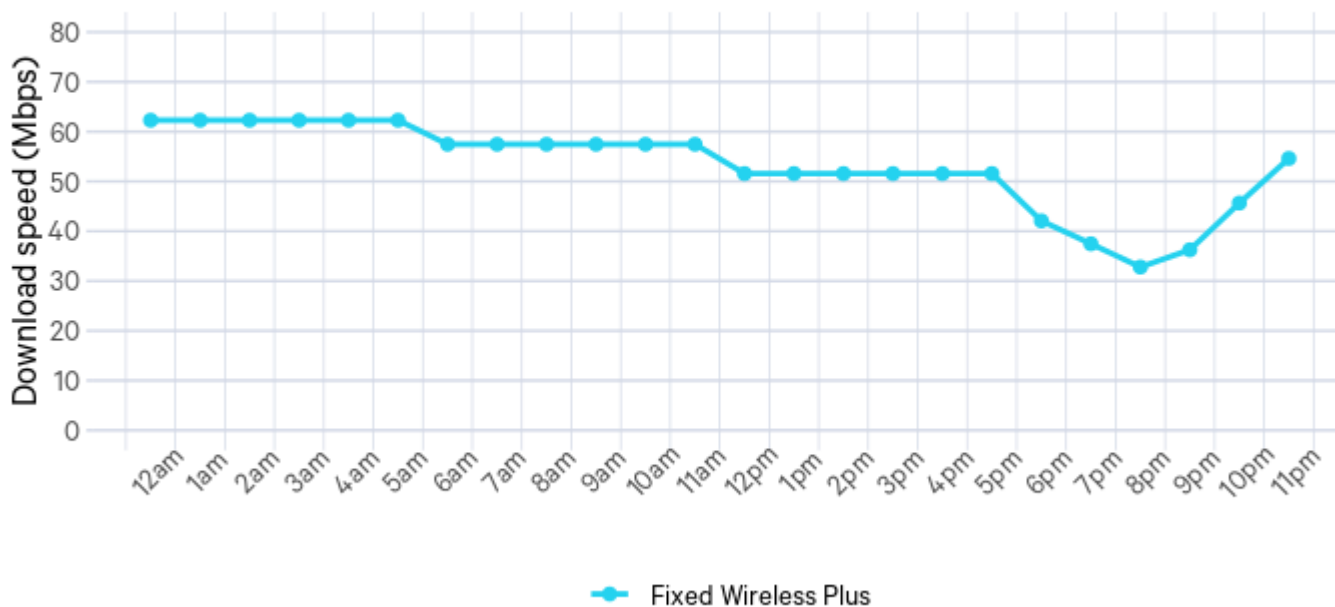


Figure 33 shows the variation in download speed during the day for Fixed Wireless Plus plans. These results are based on a total of 60 NBN fixed wireless services on the Fixed Wireless Plus plan.

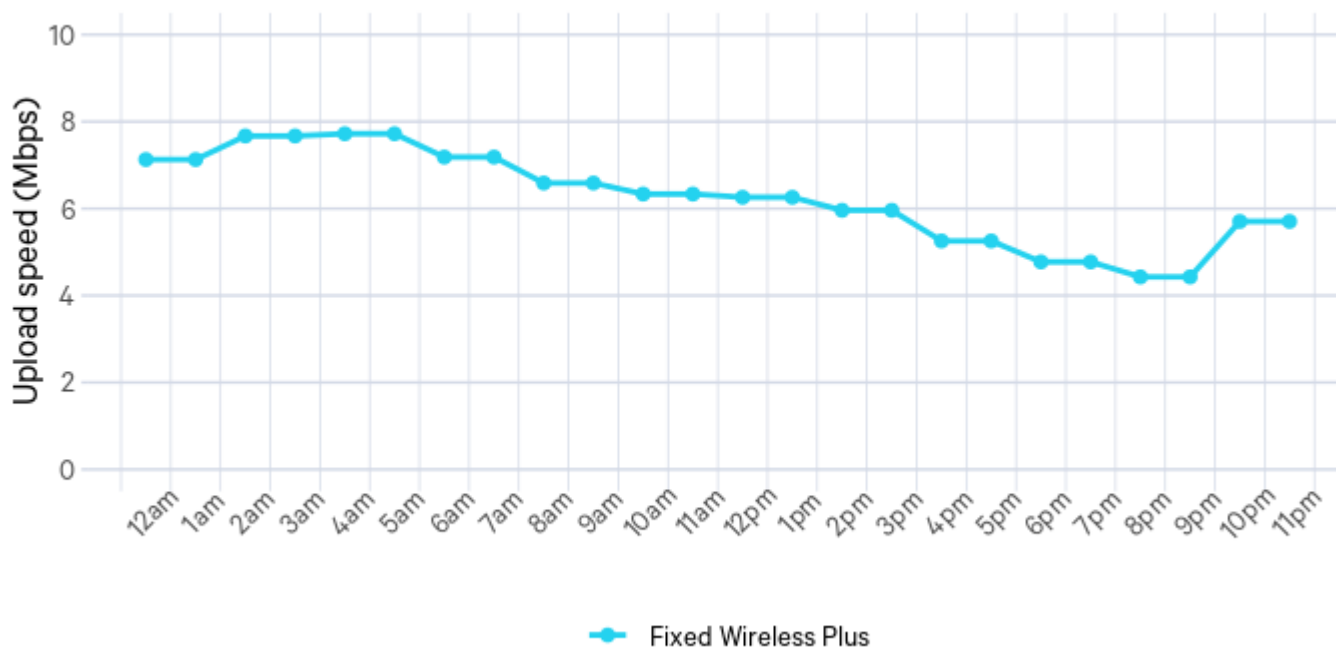
Average download speeds for the Fixed Wireless Plus plan showed considerable variation throughout the day: speeds typically started to decrease during the evening, dipping to 29 Mbps below the day’s maximum speed by 8pm, and would recover to higher levels later at night. The average download speed for the Fixed Wireless Plus plan was 52.2 Mbps during all hours, decreasing to an average of 38.8 Mbps in the busy hours. During February 2022,

the average download speed for the Fixed Wireless Plus plan was 46.4 Mbps during all hours, and 36.8 Mbps during busy hours.

Figure 34 shows that upload speeds followed 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 6.4 Mbps during all hours, decreasing to an average of 4.8 Mbps in the busy hours. During February 2022, the average upload speed for the Fixed Wireless Plus plan was 5.9 Mbps during all hours, and 4.3 Mbps during 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 34: Average hourly upload speed for the Fixed Wireless Plus plan



Daily average download speeds by plan

Figures 35 and 36 track the average daily download speeds for services on the Fixed Wireless Plus plan for the period of 1 May 2022 to 31 July 2022.

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 35: Average daily download speeds during all hours

NBN Fixed Wireless Plus. May to July 2022.

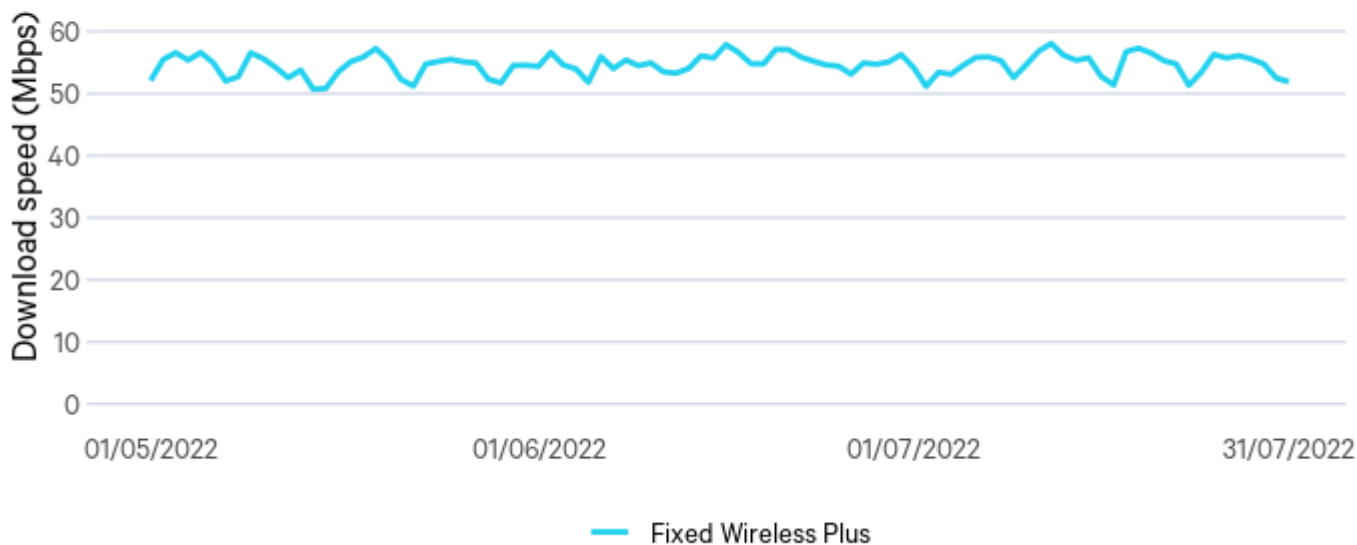
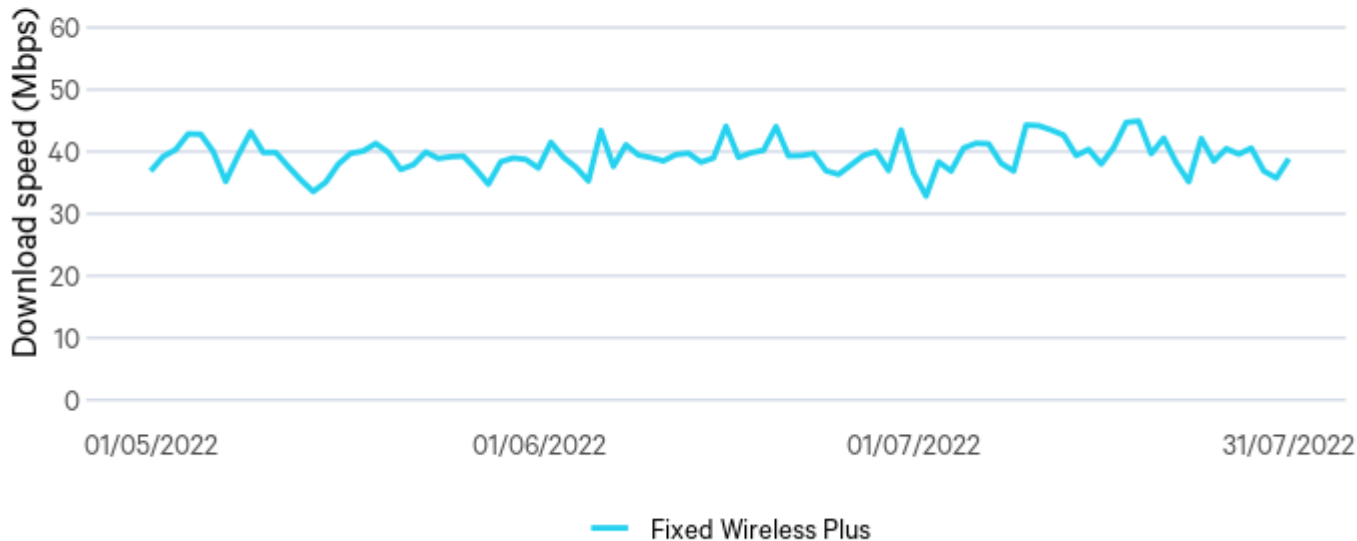


Figure 36: Average daily download speeds during busy hours

NBN Fixed Wireless Plus. May to July 2022.



Daily average upload speeds by plan

Figures 37 and 38 track the average daily upload speeds for services on the Fixed Wireless Plus plan for the period of May to July 2022. For these time series charts, calculations have been conducted for all hours and busy hours (7pm - 11pm) from Monday to Sunday.

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 37: Average daily upload speeds during all hours

NBN Fixed Wireless Plus. May to July 2022.

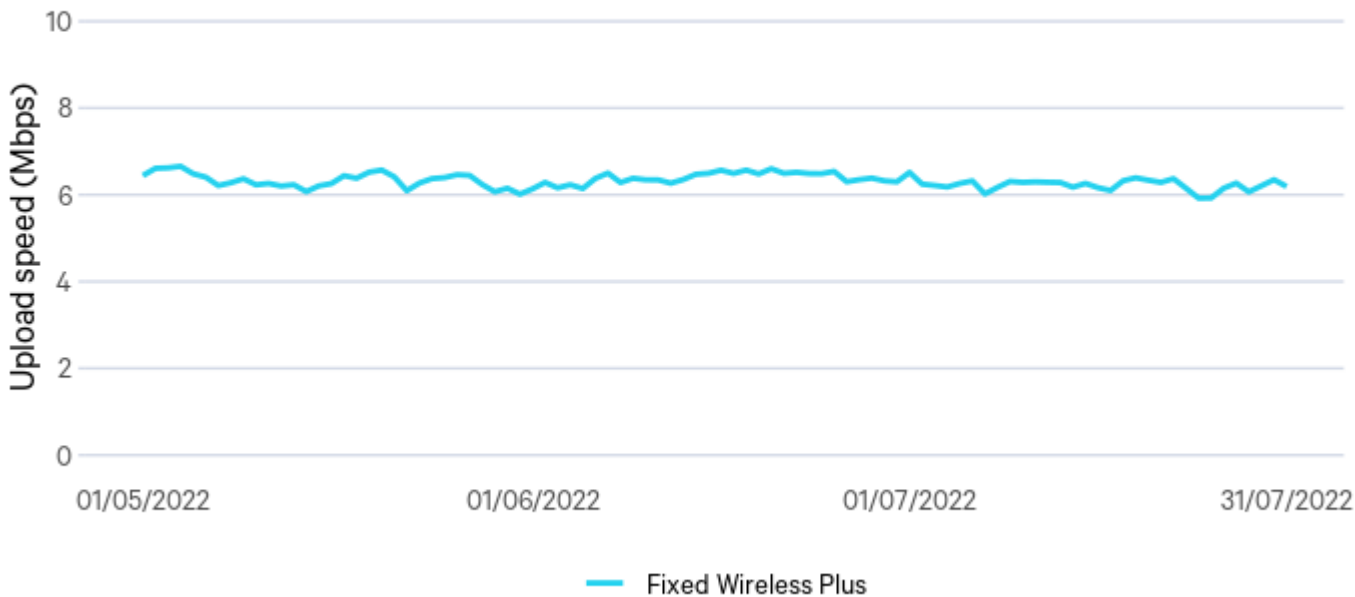
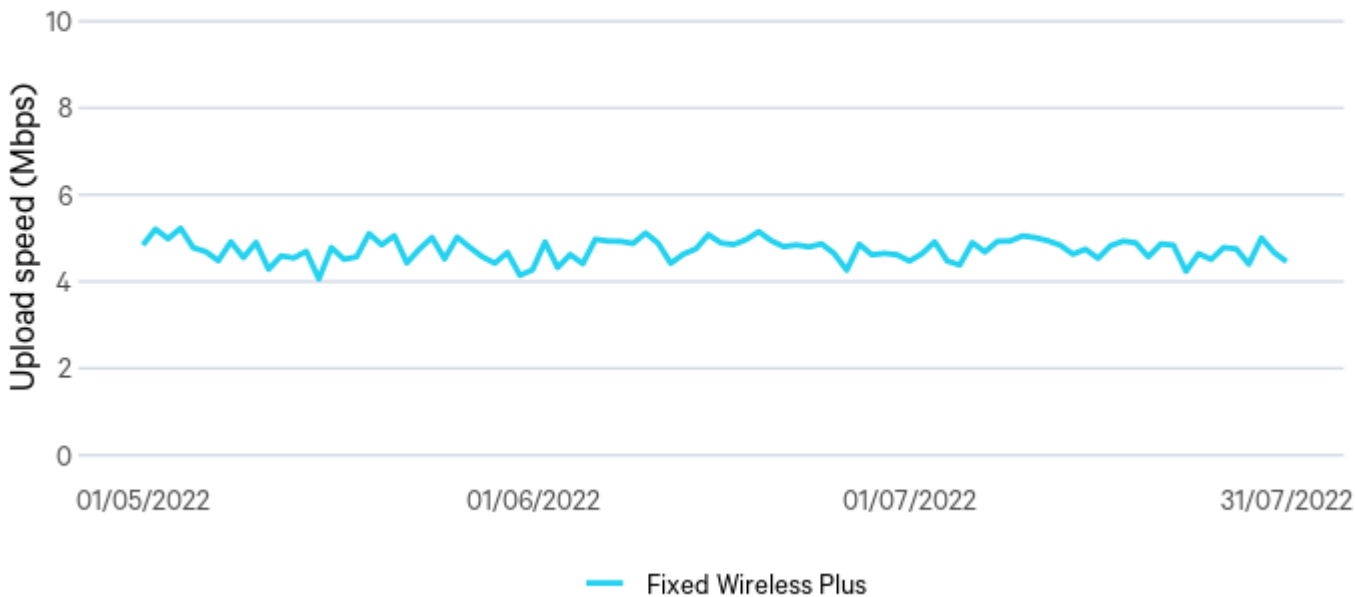


Figure 38: Average daily upload speeds during busy hours by plan

NBN Fixed Wireless Plus. May to July 2022.



Video streaming

Figure 39: Netflix streaming for the Fixed Wireless Plus plan

Busy hours. Including underperforming and impaired services.

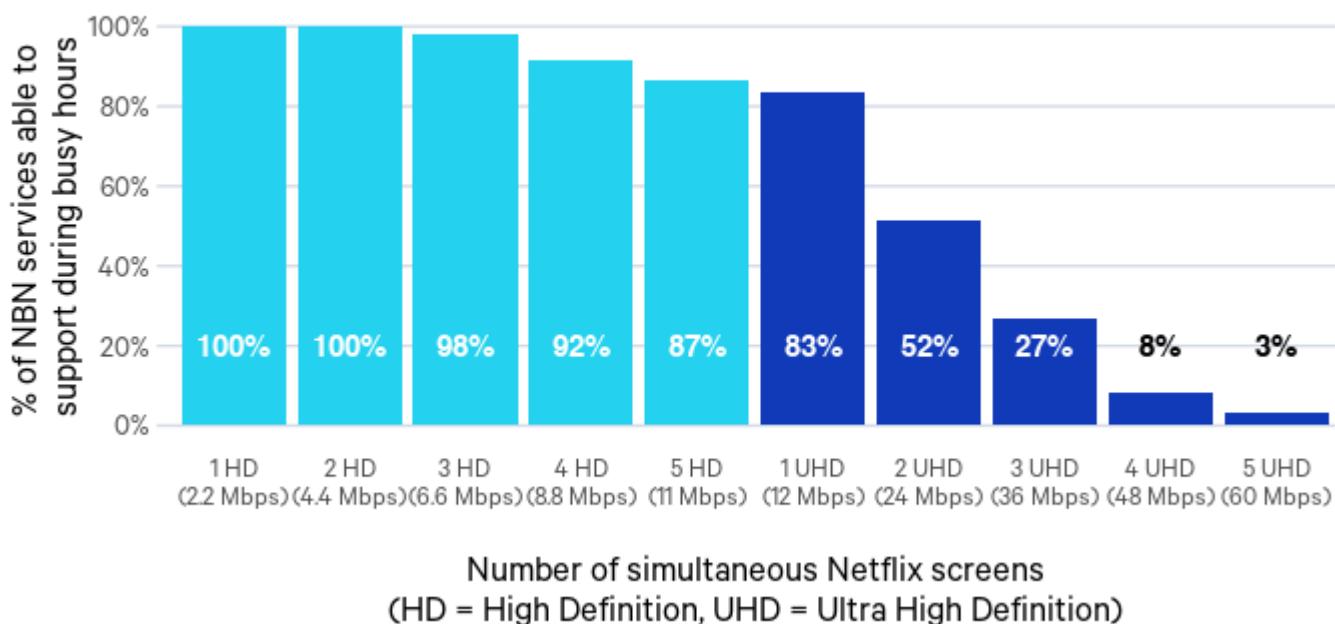


Figure 39 shows the proportion of services on the NBN Fixed Wireless Plus plan which would be able to reliably stream (with a low chance of stopping and starting) a varying number of videos at High Definition and Ultra High Definition from Netflix simultaneously.

We present results for Netflix as it is one of the dominant streaming providers in the Australian market. Netflix has significant traffic over Australian networks and supports our testing of its services. We welcome interest from other streaming providers if they wish to participate in the program.

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):

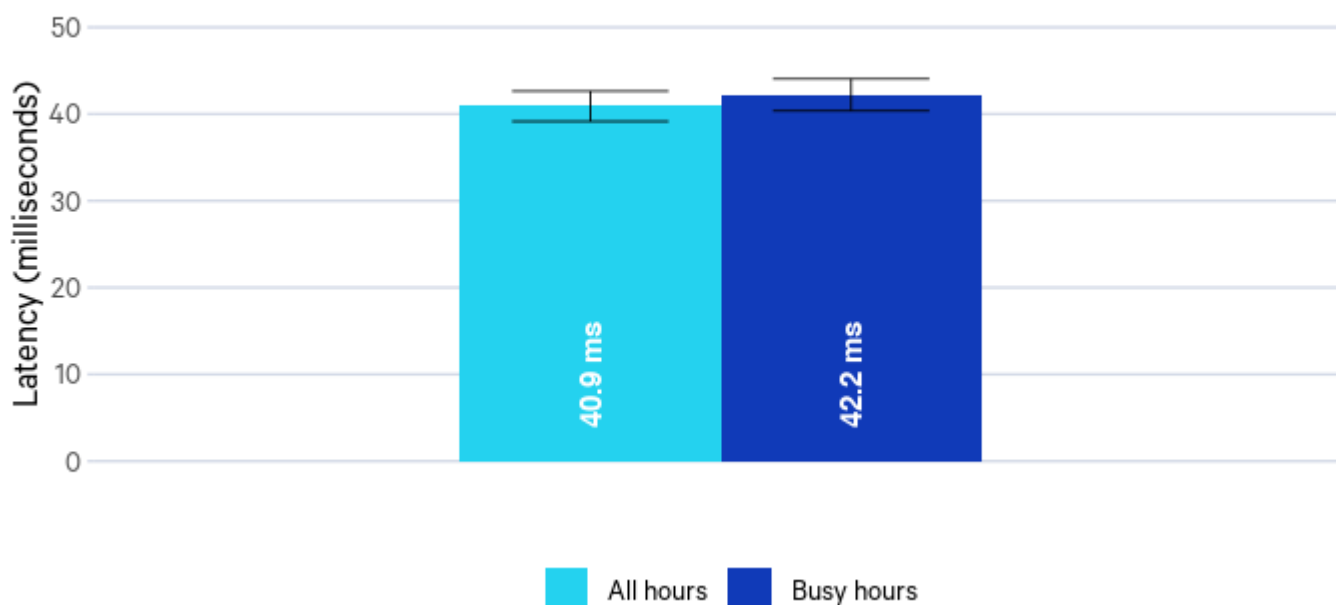
- Most Fixed Wireless Plus plans can support five High Definition, or one Ultra High Definition video stream.
- More than half (52%) of Fixed Wireless Plus plans can support two Ultra High Definition streams.

Please note: fixed-line video streaming analysis is detailed in the appendix due to results being relatively unchanged over recent quarters. For example, NBN50 plans continued to be able to stream over 5 HD Netflix streams simultaneously in line with results from our February 2022 report.

Latency, packet loss and outages

Figure 40: Average latency for fixed wireless

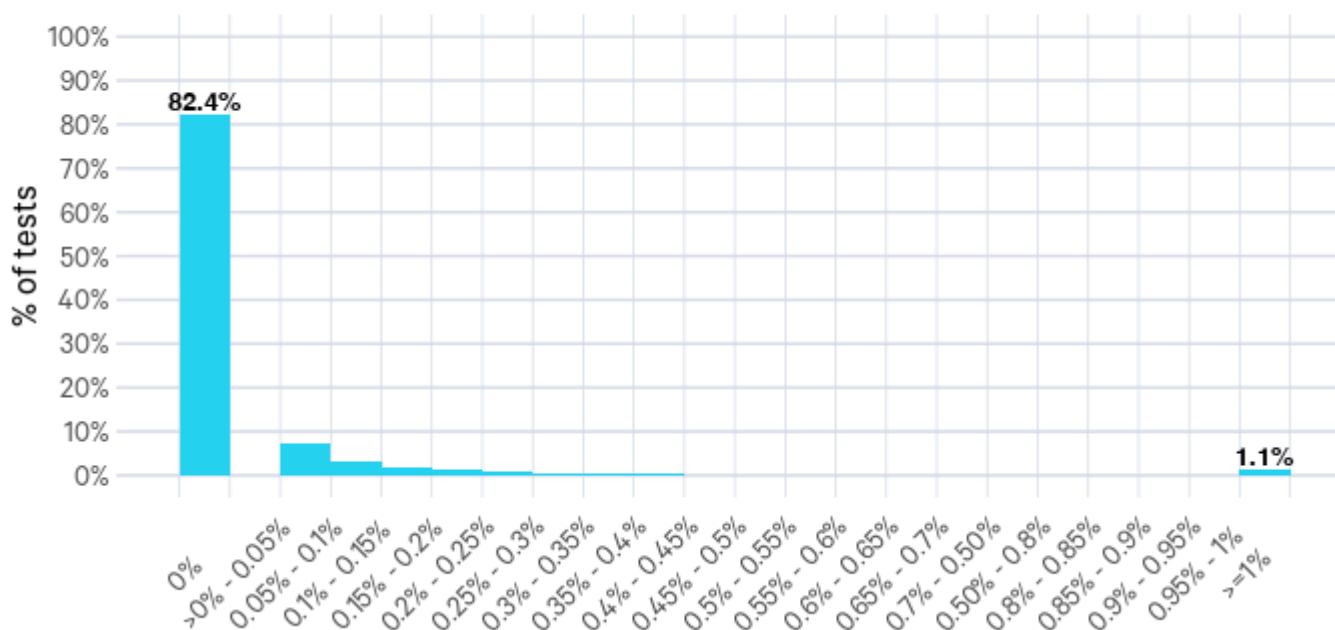
NBN fixed wireless plans. Error bars indicate 95% confidence intervals of the mean.



As shown in Figure 40, average latency for fixed wireless plans was recorded as 40.9 milliseconds during all hours, rising slightly to 42.2 milliseconds during busy hours, broadly in line with the previous report.

Figure 41: Frequency of packet loss rates observed during tests

NBN fixed wireless plans. All hours.



During this measurement period, 48,899 packet loss tests were conducted through fixed wireless services. Of these tests, 82.5% 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 fixed-line services.

Figure 42 shows, 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 42: Outage characteristics

NBN Fixed Wireless. All hours.

