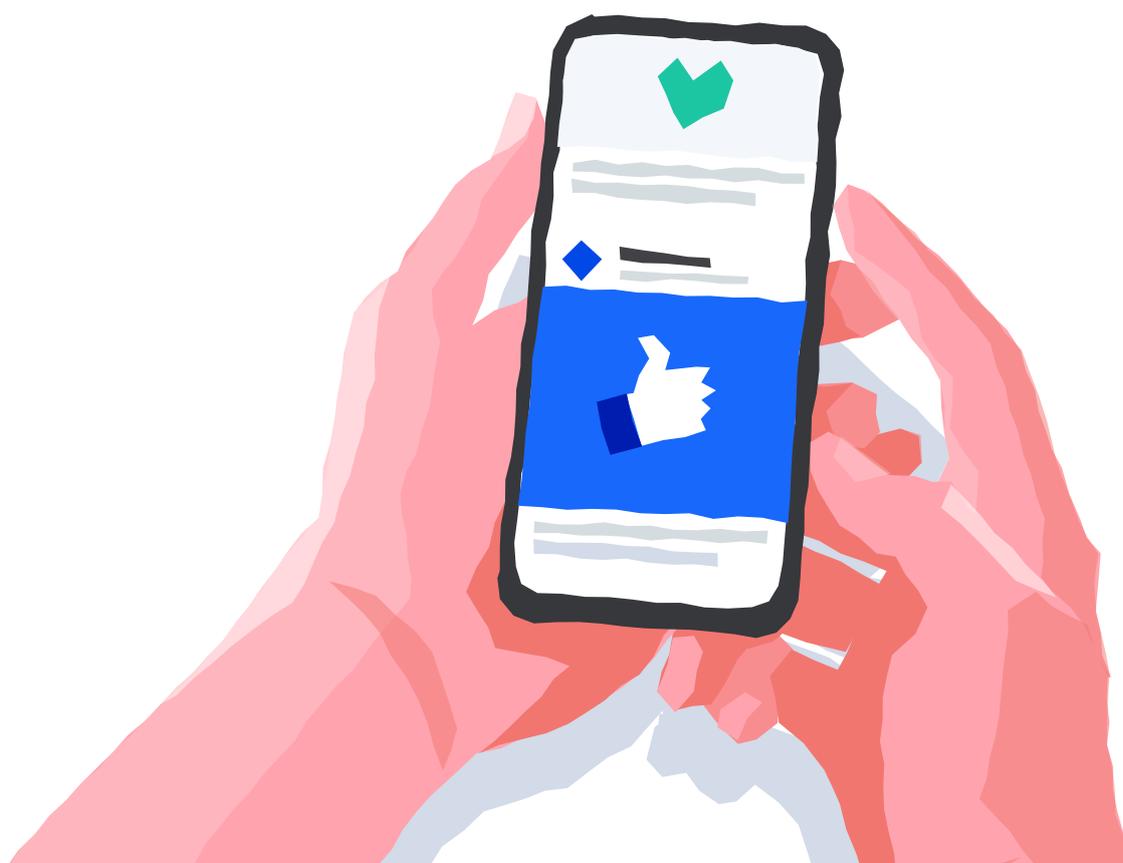


Measuring Broadband New Zealand

Winter Report, August 2020

In 2018, the Commerce Commission appointed SamKnows to measure New Zealand's internet performance. The programme, called Measuring Broadband New Zealand, gives internet users in New Zealand access to the SamKnows platform to measure the quality of their fixed-line internet. The aim of the programme is to increase transparency about actual in-home broadband performance and provide consumers with independent information about internet performance across different providers, plans, and technologies, to help them choose the best broadband for their homes. It will also encourage providers to improve and compete on their performance.

This report provides an overview of the findings from data collected during May 2020.



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Overview

This report presents key indicators of consumer internet performance in New Zealand. Highlights include:

1. Testing of popular video conferencing applications.
2. Testing of several widely-used social media, online gaming, and video streaming services.
3. Continued monitoring of the performance of different plans and RSPs.

Previous reports in this series have examined topics including internet performance during online broadcasts of the Rugby World Cup 2019, internet performance following New Zealand's Level 4 Alert in response to COVID-19, and how many people in a household can watch Netflix at the same time.



We still need New Zealanders to take part!

We still have plenty of Whiteboxes to give out; these are the plans and RSPs that we need more volunteers on:

2degrees	ADSL / VDSL		
MyRepublic	Fibre 100		
Orcon	ADSL / VDSL	Fibre 100	Gigantic Fibre*
Skinny	Wireless 4G		
Slingshot	ADSL / VDSL	Fibre 100	Gigantic Fibre*
Spark	VDSL		
Trustpower	ADSL / VDSL	Fibre 100	Fibre Max*
Vodafone	UltraFast HFC Max	Rural Broadband	Home Wireless Broadband

The recent Alert Level 4 and global COVID-19 situation has highlighted how important it is to have reliable telecommunications infrastructure which serves New Zealanders everywhere. If we've sent you a Whitebox in the past which is now unplugged, we'd love to see you contributing data again; get in touch with SamKnows to update your details: <https://measuringbroadbandnewzealand.com/contact>.

If you're new to the program and want to get involved please sign up here: www.measuringbroadbandnewzealand.com/sign-up

The Measuring Broadband New Zealand project has a code of conduct, the purpose of which is to ensure that parties involved in the MBNZ programme act in good faith and in accordance with principles relating to data validation, 'gaming' of results, and appropriate public usage of the MBNZ results. A list of signatories is included in the code, including the Commission and SamKnows. All tested RSPs complied with the code of conduct, including validation of data for this report. You can see the code of conduct on our website: <https://comcom.govt.nz/regulated-industries/telecommunications/monitoring-the-telecommunications-market/monitoring-new-zealands-broadband>

*All references to Fibre Max in this report encompass packages derived from 'gigabit' wholesale products, in particular: 2degrees' Ultimate, MyRepublic's Fibre Pro/Gamer Pro, Orcon and Slingshot's Gigantic Fibre, Spark's Fibre Max, Trustpower's Fibre Max, and Vodafone's Fibre Max packages.

Executive Summary

COVID-19

1. New Zealand was able to reduce its Alert Level from 4 to 3 on 27th April 2020, and subsequently to 2 on 13th May 2020. The data which forms the basis of this report was collected between 1st May and 31st May 2020. Compared against previous data collected during the Alert Level 4 period, overall internet performance has remained stable for the vast majority of households. There have been changes in the performance of Fibre Max plans, which are discussed further below, but these cannot be conclusively attributed to changing usage patterns in response to COVID-19.

Application Performance

1. **Video Conferencing:** Fibre plans are most likely to connect to video conferencing providers' servers with latency low enough to support uninterrupted calls. The average latency to Google Meet, Microsoft Teams, Skype and Zoom servers is within a usable range for all plans.
2. **Social Media:** The latency between households in New Zealand and Snapchat's servers in the USA is higher than to other social media applications (Facebook, Instagram, Whatsapp, and Twitter) which host servers in Oceania.
3. **Online Gaming:** Fibre plans are most likely to connect to game servers with latency low enough that lag should be infrequent. DSL plans are more likely to support acceptable latency to game servers hosted in New Zealand, such as FIFA 18/19 and Playstation, as opposed to other games which are hosted overseas.
4. **Video Streaming:** Fibre plans are able to stream Netflix in Ultra High Definition nearly all of the time. DSL and Fixed Wireless are more likely to struggle with Ultra High Definition but will generally support High Definition.

Benchmarking

1. The average Fibre Max download speed has decreased since the previous reporting period. This drop is apparent for all RSPs and wholesalers, so cannot be attributed to any single provider or geographical area, although there is lower performance in the South Island. The Commission and SamKnows are leading further tests on Fibre Max plans with input from industry stakeholders.
2. Most RSPs can deliver average Fibre 100 speeds as advertised. Average Fibre 100 download speed is slightly lower in the South Island than in the North Island.
3. Latency and packet loss test results are consistent with data collected for previous reports: Fibre will generally support latency-sensitive applications better than DSL or Fixed Wireless.

Package Comparison

ADSL

Remains suitable for traditional services like web browsing, email, and basic video streaming for single-user households. Less likely to be suitable for video conferencing.

Fixed Wireless (4G)

Can offer higher download speeds than ADSL, but with higher latencies due to the cellular technology underlying these plans. Fixed Wireless connections will be more likely to experience issues with latency-sensitive applications such as online gaming or video conferencing.

VDSL

Performance can be comparable to lower-speed Fibre packages, however this varies widely from line to line. Consider Fibre if available, particularly for households with multiple users, but remember that you may not need to get the highest speed on offer.

Fibre 100

Supports latency-sensitive applications such as online gaming. Fibre 100 will also support data-heavy applications such as Ultra High Definition streaming with multiple concurrent users or video conferences with a large number of participants. Fibre 100 will cover most users' requirements; if you have a very specific reason to then consider looking into Fibre Max.

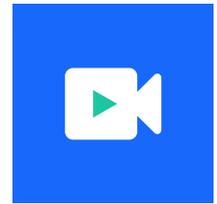
Fibre Max

Provides higher raw speeds than Fibre 100. However, the performance of Fibre Max varies greatly by RSP and across different parts of the country. Fibre Max is only really worthwhile if there is a genuine requirement for additional performance on top of Fibre 100. Fibre Max does not necessarily outperform Fibre 100 for intensive applications like high definition video streaming or online gaming. Examples of situations where Fibre Max might provide benefits over Fibre 100 include frequently uploading large files or using data-heavy applications hosted overseas.

Other packages

There are other packages available, such as Fibre 30, Fibre 50, Fibre 200, Cable (also known as HFC or Hybrid Fibre Coaxial), and satellite packages. Since Measuring Broadband New Zealand collects less data from these packages it is not possible to give any firm advice around their suitability for different applications at this stage.

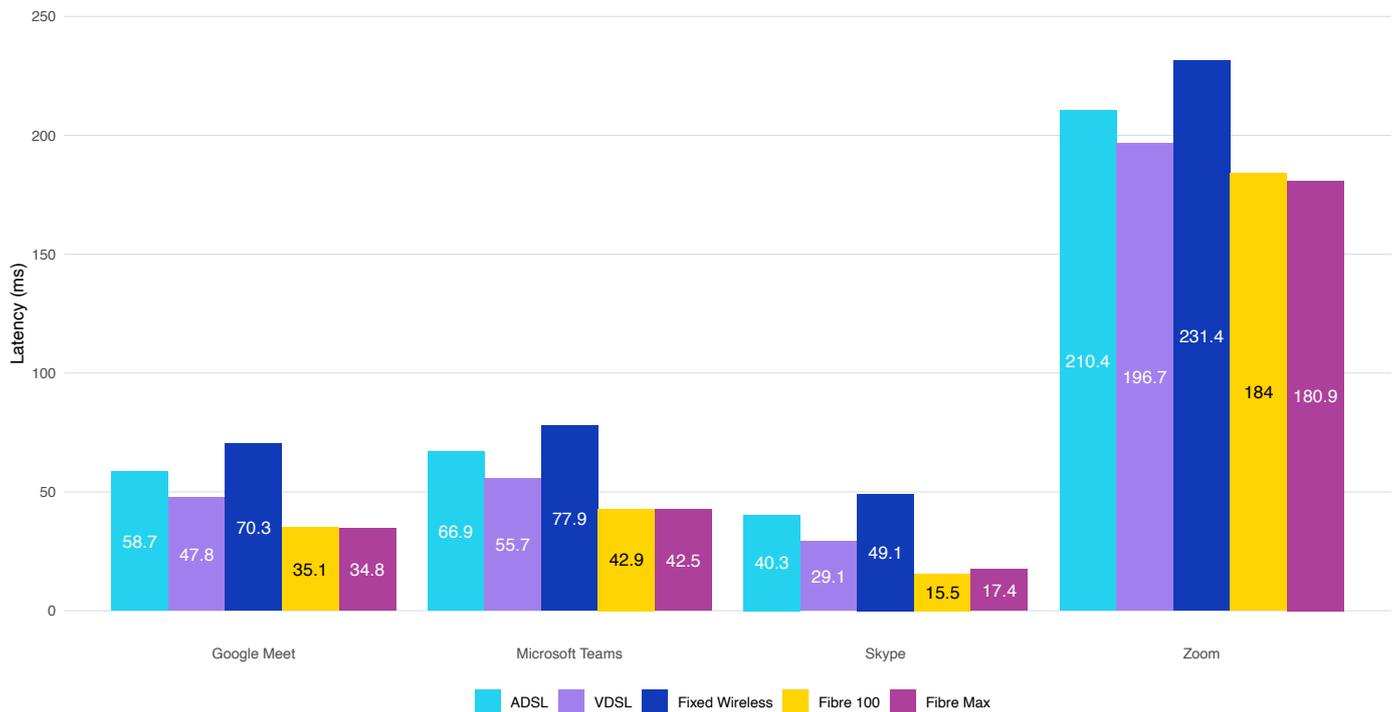
Video Conferencing



MBNZ has started running tests to the most popular video conferencing services used by New Zealanders. This is particularly important as more people begin to rely on these services in order to effectively work and learn from home.

Figure 1
The network latency you would expect to see using a free account for four popular video conferencing services

Average of household average latency to relay services. Lower latency means less delay during calls.



Key observations

- The average latency to Google Meet, Microsoft Teams, Skype and Zoom servers is within a usable range for all plans. With higher average latencies across the board, ADSL, VDSL, and Fixed Wireless are more likely than Fibre to experience delays during a call.
- Zoom free services leverage data centres in the United States, which results in an average latency approximately a tenth of a second higher, compared to the paid version of Zoom which makes use of Zoom’s global data centres, including Australia. The impact of the additional network latency in routing via the USA is imperceptible to most end-users and in rare occasions it may impact end user experience. It should be noted that network latency is just one factor that affects end user experience. For example, the use and efficiency of video compression will also have an impact on user experience.

These four providers occupy a large share of video call traffic; we are developing tests of other services which will be included in the next report.

Social Media

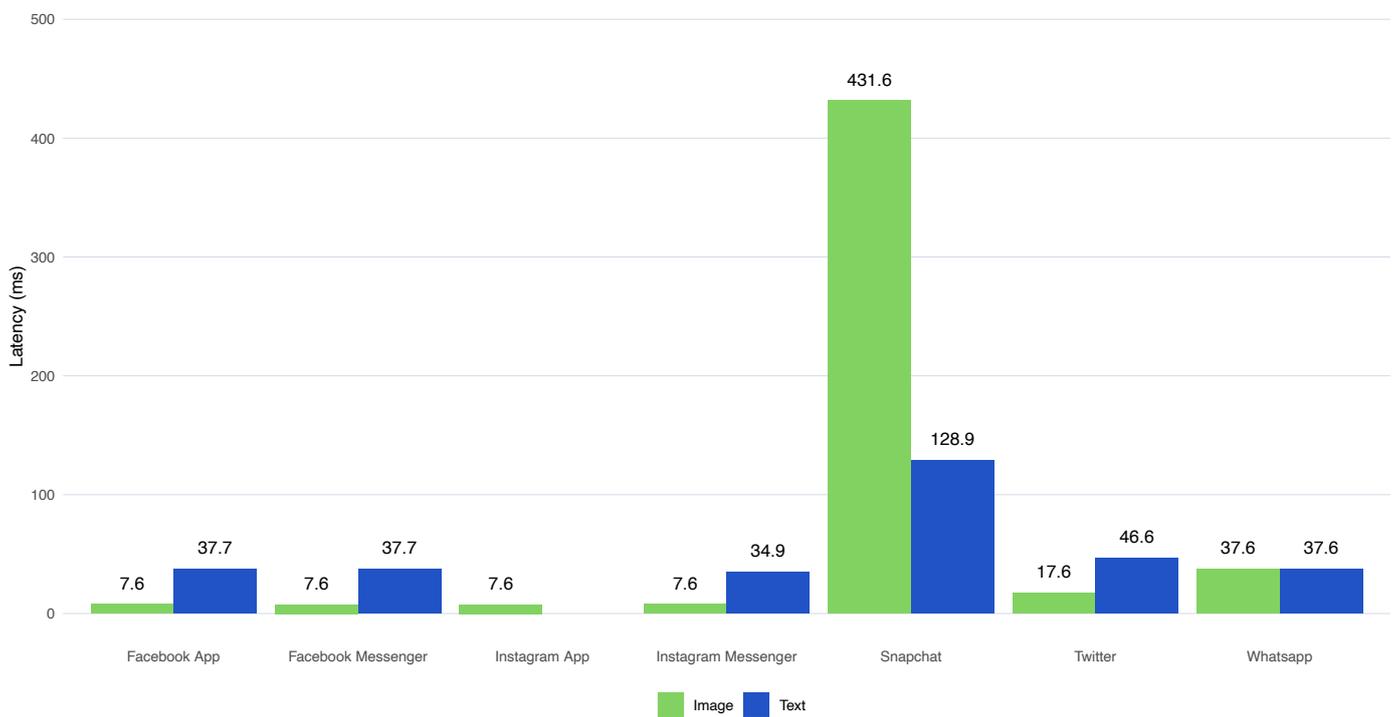


The Instagram app is a new addition to this MBNZ report. Social media applications generally involve fetching a large number of relatively small pieces of information (single images, short pieces of text, and so on). Due to this, latency to the server will be a large determinant of how responsive social media applications will be.

Figure 2

The performance you would expect to see when accessing these social media platforms

Average of household average latency to content servers. Fibre plans only. Lower latency means that it takes time to fetch each image or piece of text.

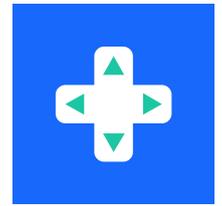


Key observations

- Latency to Snapchat image servers - which are hosted in the United States - remain around four tenths of a second on average. This would introduce slower performance for two people in New Zealand exchanging messages with one another compared to other chat services such as Whatsapp or Facebook/Instagram Messenger. Latency to servers for the Instagram app (as distinct from Instagram messenger, which uses different servers) track alongside those for the Instagram app.

Not charted here, ADSL and VDSL plans' average latency is around ~20ms higher than Fibre to each service, and Fixed Wireless' average around ~40ms higher than Fibre. These differences are not enough to create a perceptible difference in application response for an end user, and so there is no case for purchasing a Fibre plan with the aim of improving the experience of social media applications.

Online Gaming

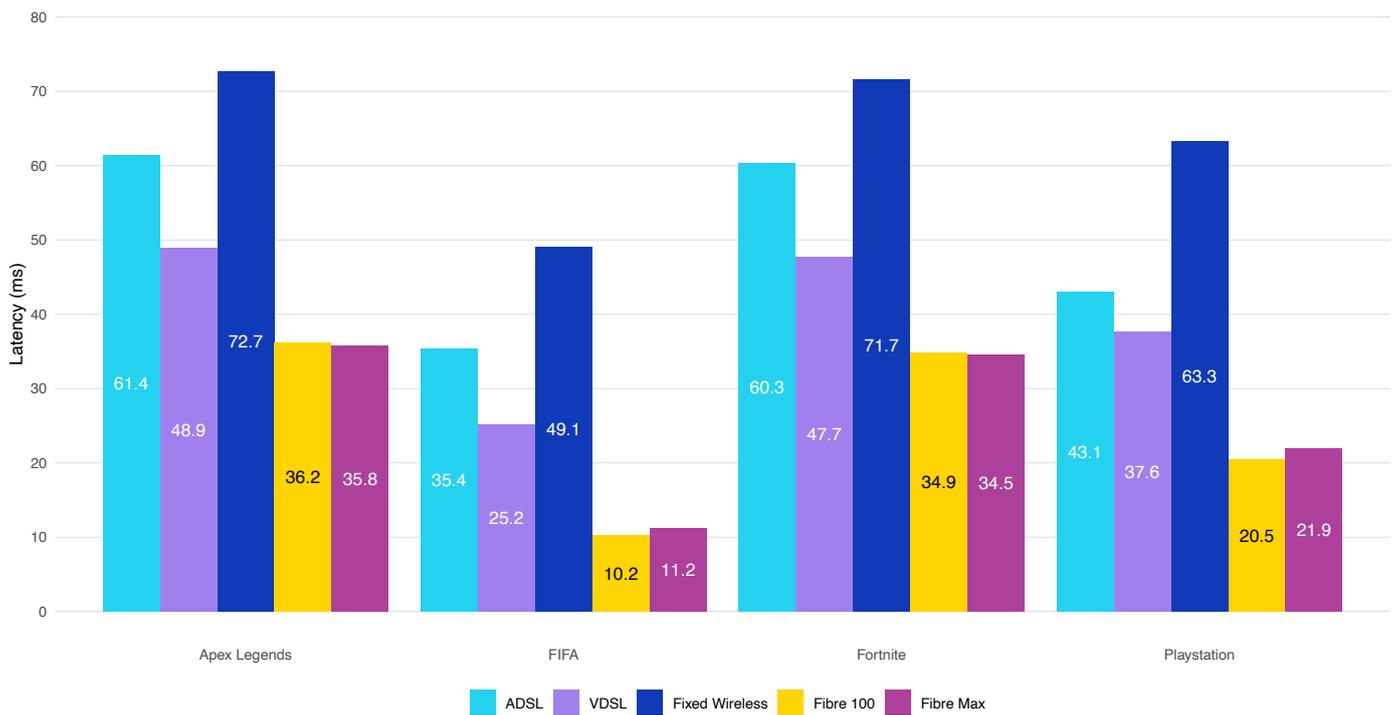


Online gaming applications require low latency between users' machines and the central server host server. If it takes a long time to pass messages between players and server then disruptive stuttering or lag will result.

Figure 3

The performance you would expect to get from different online games

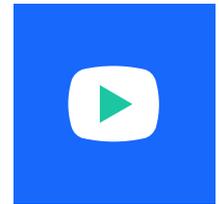
Average of household average latency to gaming servers. Lower latency means that lag is less likely.



Key observations

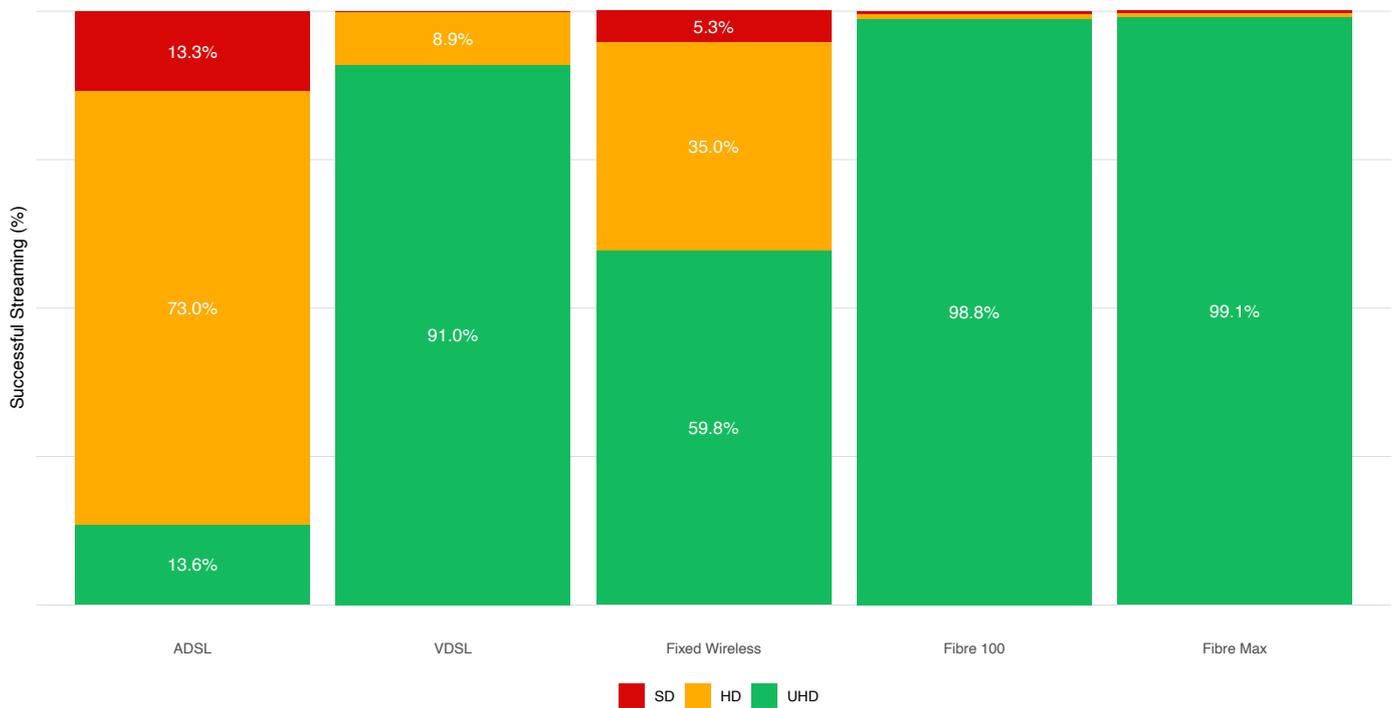
- Fibre plans had the lowest latency to each game's servers on average. ADSL, VDSL, and Fixed Wireless plans achieved acceptable latency on average but, due to the variability of performance within these plans, are more likely to experience high latency and lag.

Video Streaming



Video streaming is a good example of an application in which the quality of a user’s experience is more affected by bandwidth than by latency. Since higher quality video takes up more data than lower resolution video, higher bandwidth plans such as Fibre 100 and Fibre Max are able to reliably stream from Netflix in Ultra High Definition more of the time.

Figure 4
The highest Netflix video quality that could be streamed reliably
Average percentage of the time that a household could stream in either Standard Definition (SD), High Definition (HD) or Ultra High Definition (UHD).

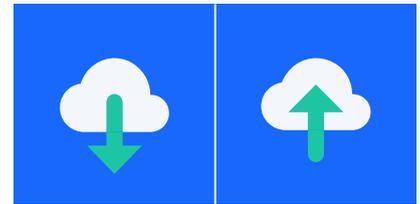


Key observations

- ADSL and Fixed Wireless connections may still be able to attempt Ultra High Definition but are more likely to encounter stalls or long loading times. Switching down to a lower quality level should improve performance for users with a lower-bandwidth plan.
- VDSL is generally able to support Ultra High Definition, however since the actual bandwidth available through a VDSL line can range from 10 Mbps to 100 Mbps, lower-bandwidth lines may have similar experiences to ADSL lines.
- Fibre plans are able to support Ultra High Definition nearly all the time.

YouTube results were extremely similar to those in previous reports and have not been included in this report.

Speed Tests

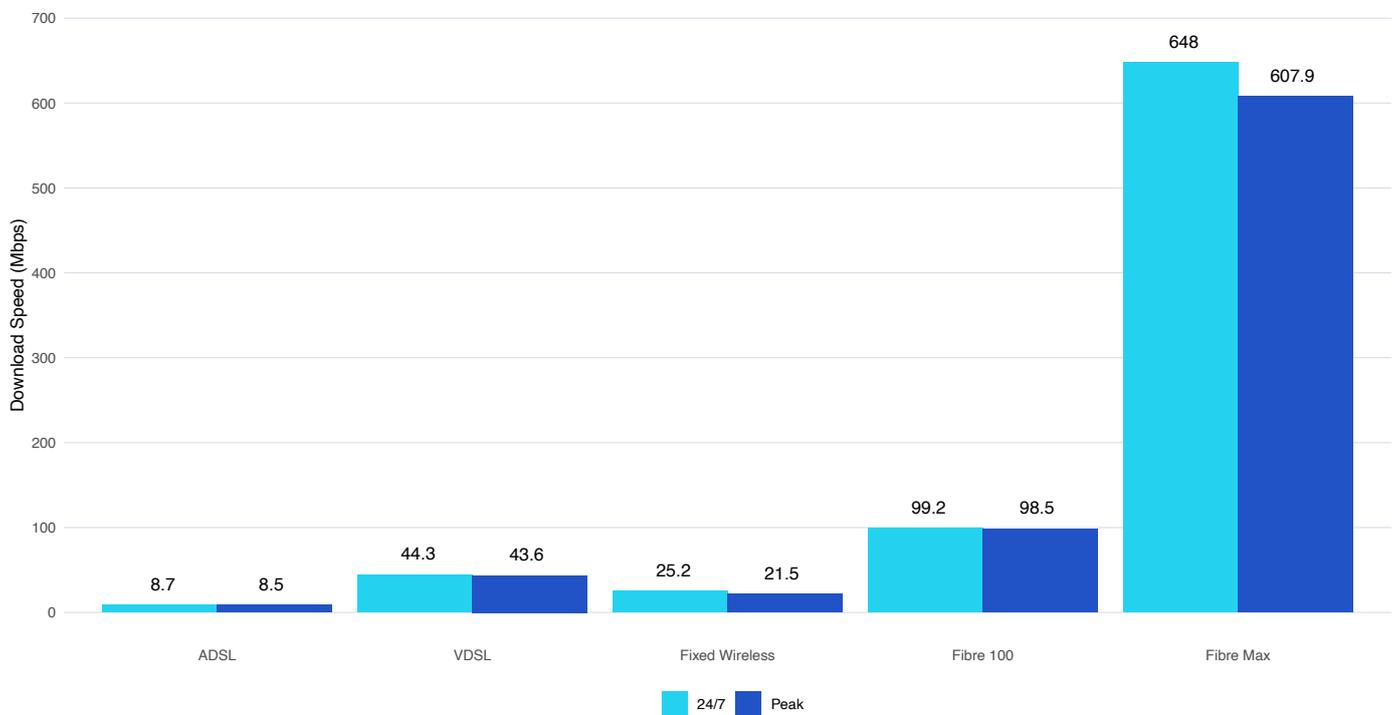


Figures 5 and 6 present an overview of download and upload speed across the country. These are included in every report in order to provide a benchmark that can be tracked over time. Peak hours are the times when people typically use the internet; in New Zealand this is 7pm to 11pm on Monday-Friday. Following NZ’s Alert Level 4 in response to COVID-19, the actual peak usage period has widened to include parts of the day. In order to make consistent comparisons against data released in previous MBNZ reports, ‘Peak’ in Figures 5 and 6 is kept to mean Monday-Friday 7pm-11pm.

Figure 5

Average Download Speeds by Plan

Average of monthly household averages. Peak hours are Monday - Friday, 7pm - 11pm



Key observations

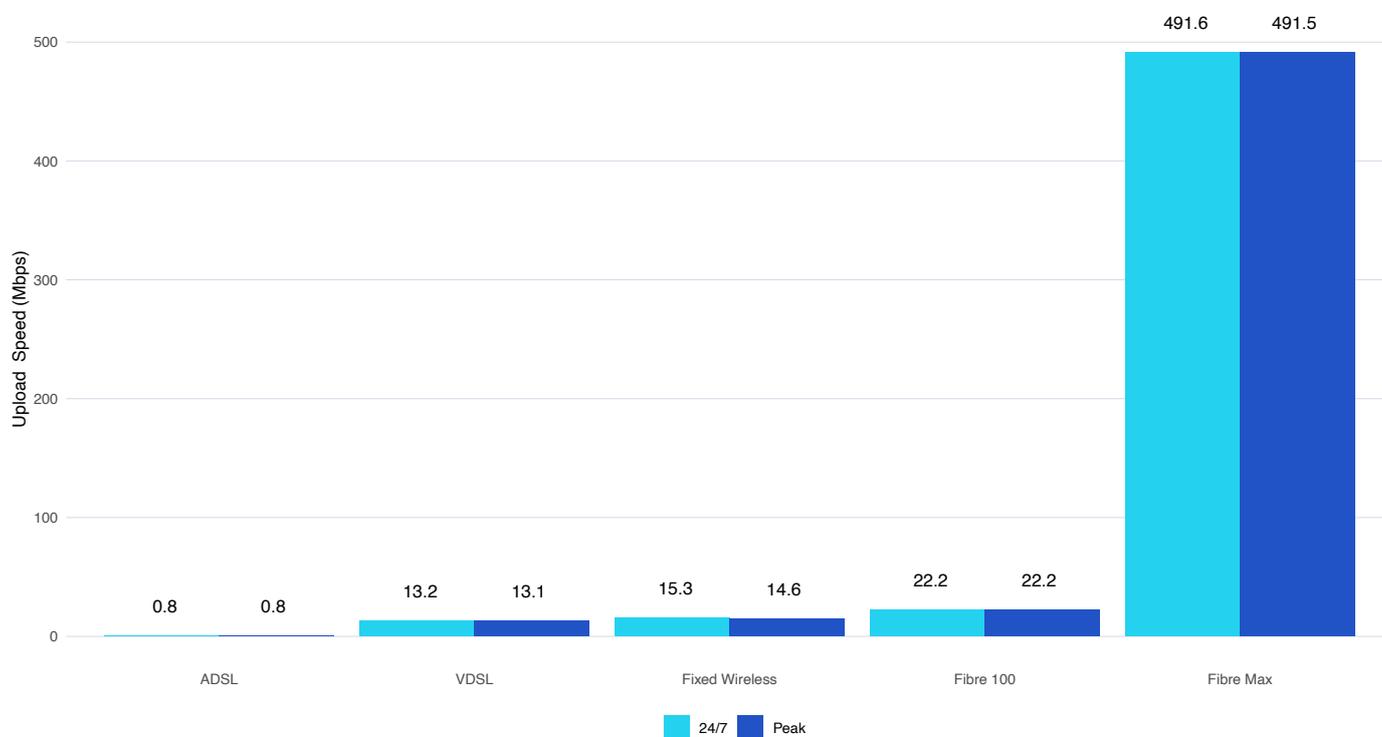
- Fibre Max delivers an average download speed of 648 Mbps, over six times the speed of Fibre 100. ADSL is lowest at 8.7 Mbps.
- The average Peak speed of Fibre Max plans has decreased by around 66 Mbps, or 10%, since the previous report. A decrease in 24/7 speed was expected due to the change in internet usage patterns following Alert Level 4 in late March-2020, but this decrease during evening hours does suggest a real drop in Fibre Max’s performance. This drop is apparent for all RSPs and wholesalers, so cannot be attributed to any single provider. The Commission and SamKnows, its testing partner, are running further experimental tests on Fibre Max plans with input from RSPs and fibre wholesalers. The results from these targeted measurements will give more information about the performance of Fibre Max plans under different conditions.

Speed Tests (continued)

Figure 6

Average Upload Speeds by Plan

Average of monthly household averages. Peak hours are Monday - Friday, 7pm - 11pm



Key observations

- Fibre Max upload speeds are highest on average and ADSL's are the lowest. No plan's upload speeds changed noticeably since the previous report.

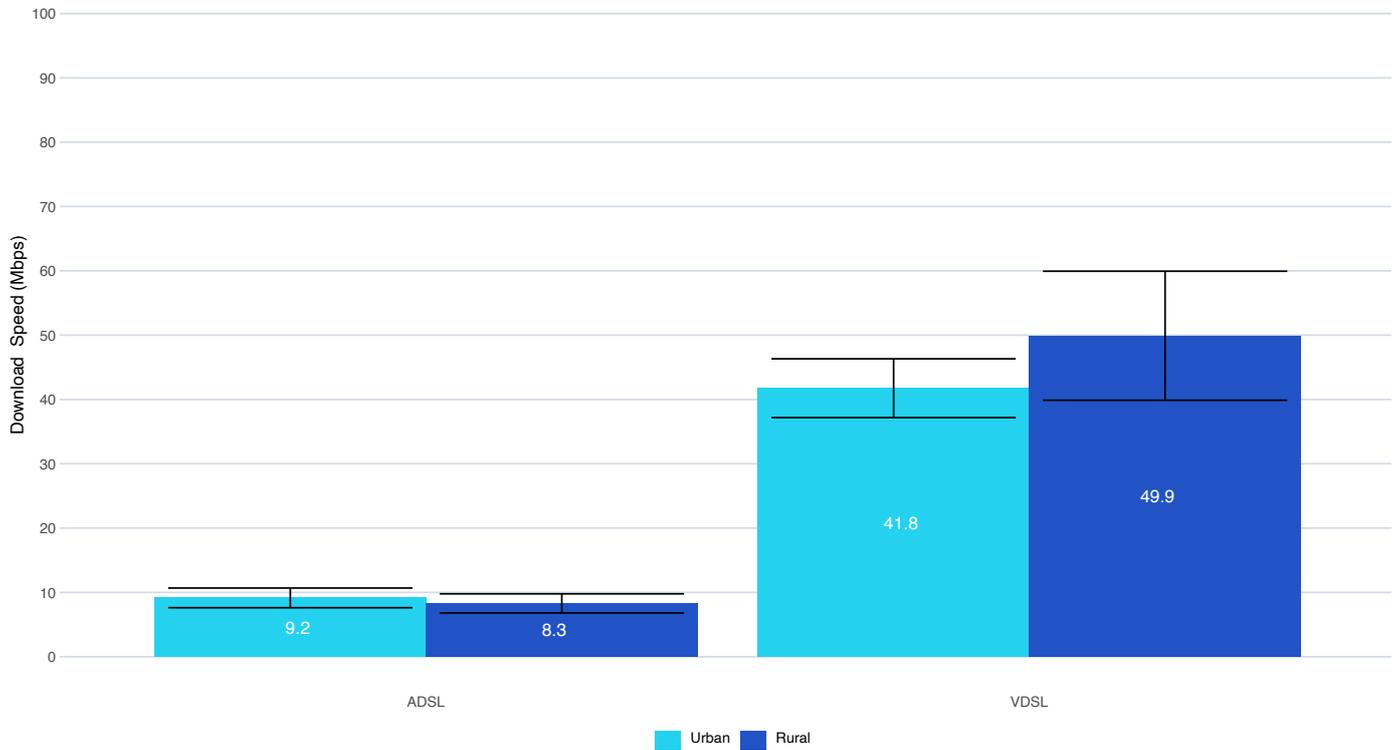
Urban vs Rural split for Copper Broadband Plans

Copper broadband plans are ADSL and VDSL, these are often the only choice for rural customers where fibre is not available.

Figure 7

Comparison of average download speeds between urban and rural areas on ADSL and VDSL plans.

Average of monthly household averages. Peak hours are Monday - Friday 7pm - 11pm. Error bars indicate 95% confidence intervals of the mean.



Key observations

- There is a large significant difference between average ADSL and VDSL download speeds (as expected), however there is no significant difference between average urban and rural download speeds for either ADSL or VDSL plans.

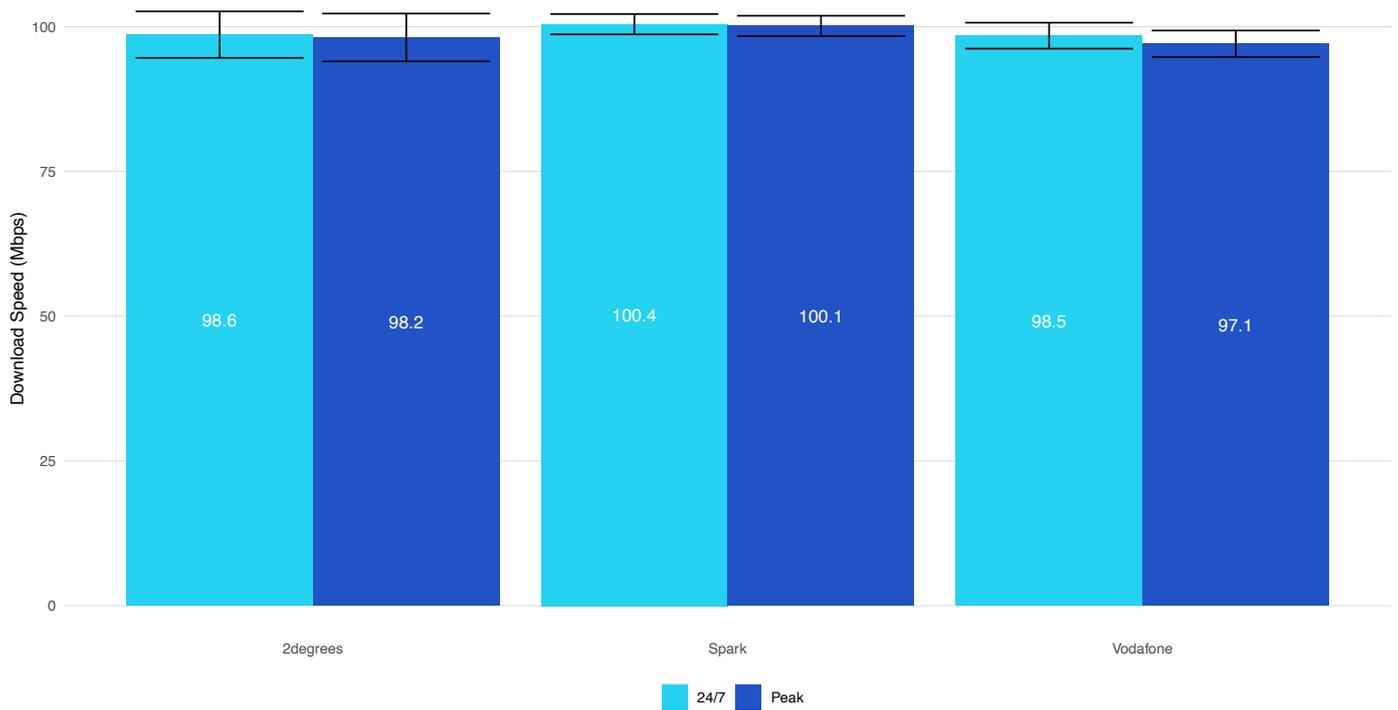
Results are plotted with error bars showing the 95% confidence interval for each plan's average speed. If we had repeated our measurement 100 times, we would expect average speeds to have fallen within the black bands in at least 95 cases. Since there is overlap between the 95% confidence intervals for Urban and Rural averages, we cannot conclude there is actually a difference in average performance, despite the fact that we observed a difference of 8.1Mbps between average VDSL speeds in urban and rural areas.

Fibre 100 Breakdown

The speeds under which Fibre 100 is advertised to consumers are 100 Mbps download and 20 Mbps upload. In practice, since the provisioned speed is set slightly higher to allow for extra bandwidth used up by network protocol overhead, it's quite common to see measured speeds close to or slightly above 100 Mbps.

Figure 8
Comparison of average Fibre 100 download speeds across RSPs

Average of monthly household averages. Peak hours are Monday - Friday, 7pm - 11pm. Error bars indicate 95% confidence intervals of the mean.



Key observations

- 2degrees, Spark and Vodafone's average Fibre 100 download speeds are consistent with those seen in the last report.

Results are plotted with error bars showing the 95% confidence interval for each RSP's average speed. If we had repeated our measurement 100 times, we would expect average speeds to have fallen within the black bands in at least 95 cases.

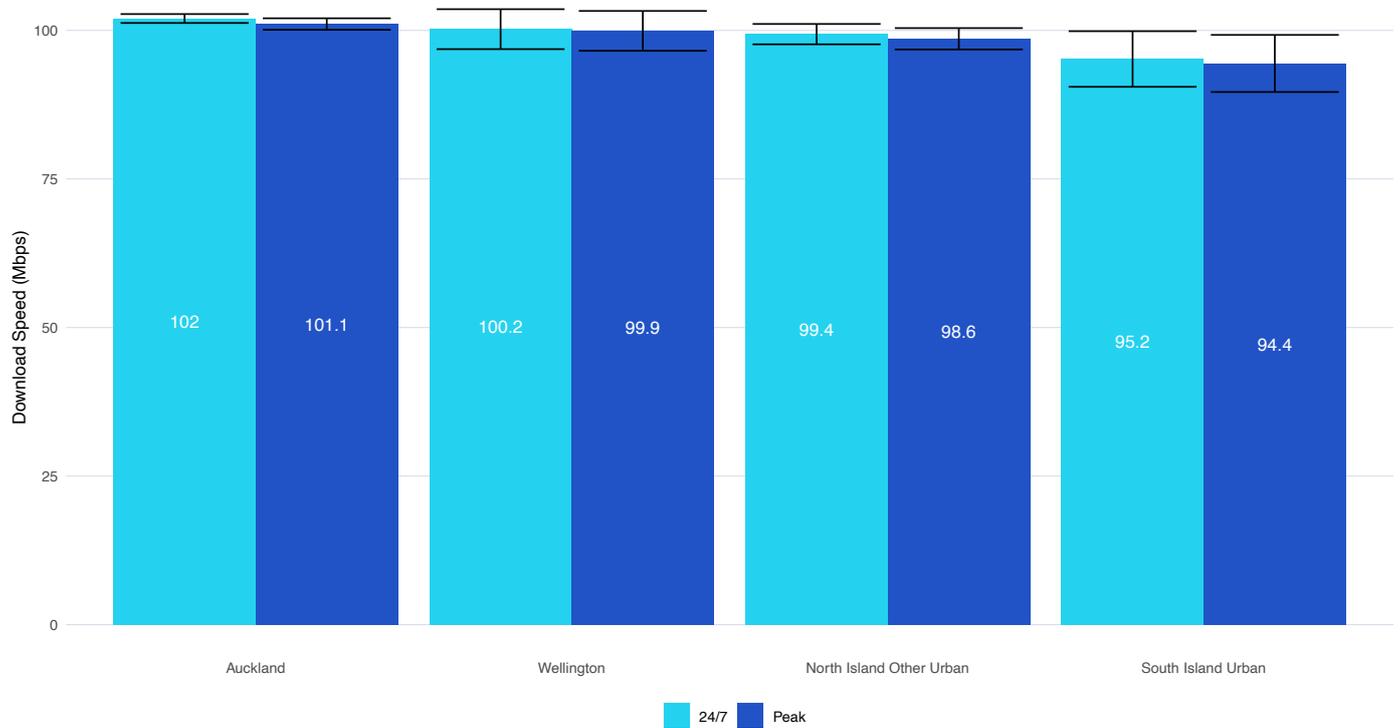
There were not enough volunteers connected to MyRepublic, Orcon, Slingshot, or Trustpower in May to report results for those RSPs. Those RSPs are included in the overall Fibre 100 results shown previously.

Fibre 100 Breakdown (continued)

Figure 9

Comparison of average Fibre 100 download speed across different parts of New Zealand

Average of monthly household averages. Peak hours are Monday - Friday 7pm - 11pm. Error bars indicate 95% confidence intervals of the mean



Key observations

- There is a small but definite difference in average speed between Auckland and the South Island, but on the whole Fibre 100 performance is comparable across different parts of the country.

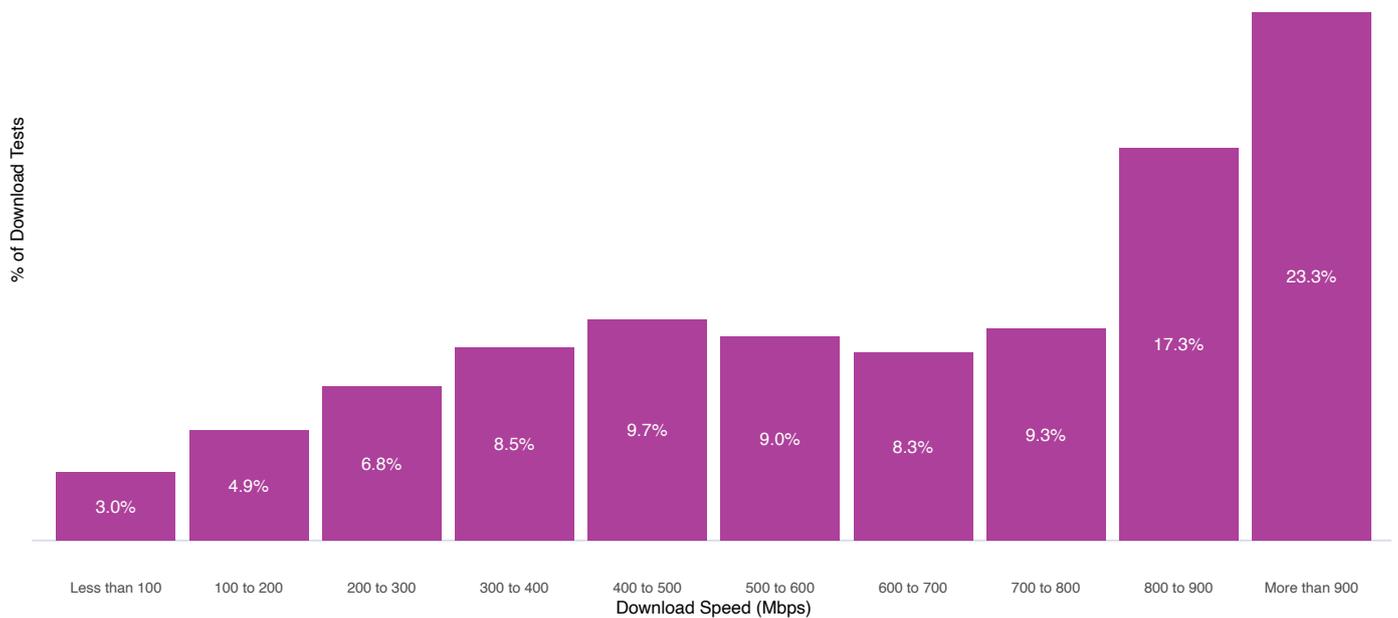
Distribution of Fibre Max results

Fibre Max is a popular plan in New Zealand and is advertised differently by various RSPs. This chart looks at the distribution of test results collected over the month long period for all Fibre Max plans across all measured RSPs.

Figure 10

The distribution of download test results on Fibre Max plans

Fibre Max plans generally advertised average download speeds between 700Mbps - 950Mbps; this varies by RSP and over time.



Key observations

- Fibre Max users could experience varied performance on this tier, as demonstrated above. Whilst 23.3% of tests recorded were over 900Mbps, 62.1% of tests recorded were between 300Mbps to 900Mbps.

Within this wide range of test results, just under half of individual households using a Fibre Max plan had average download speeds in the expected 800-940Mbps range. In general households which achieved an average speed higher than 800Mbps had more stable results and would see results close to the average consistently throughout the month. On the other hand households with a lower average speed were more likely to see intermittent drops in download speed test results.

The Commerce Commission and SamKnows are working with industry to investigate the cause of the variance for this product and hope to include an update on future reports.

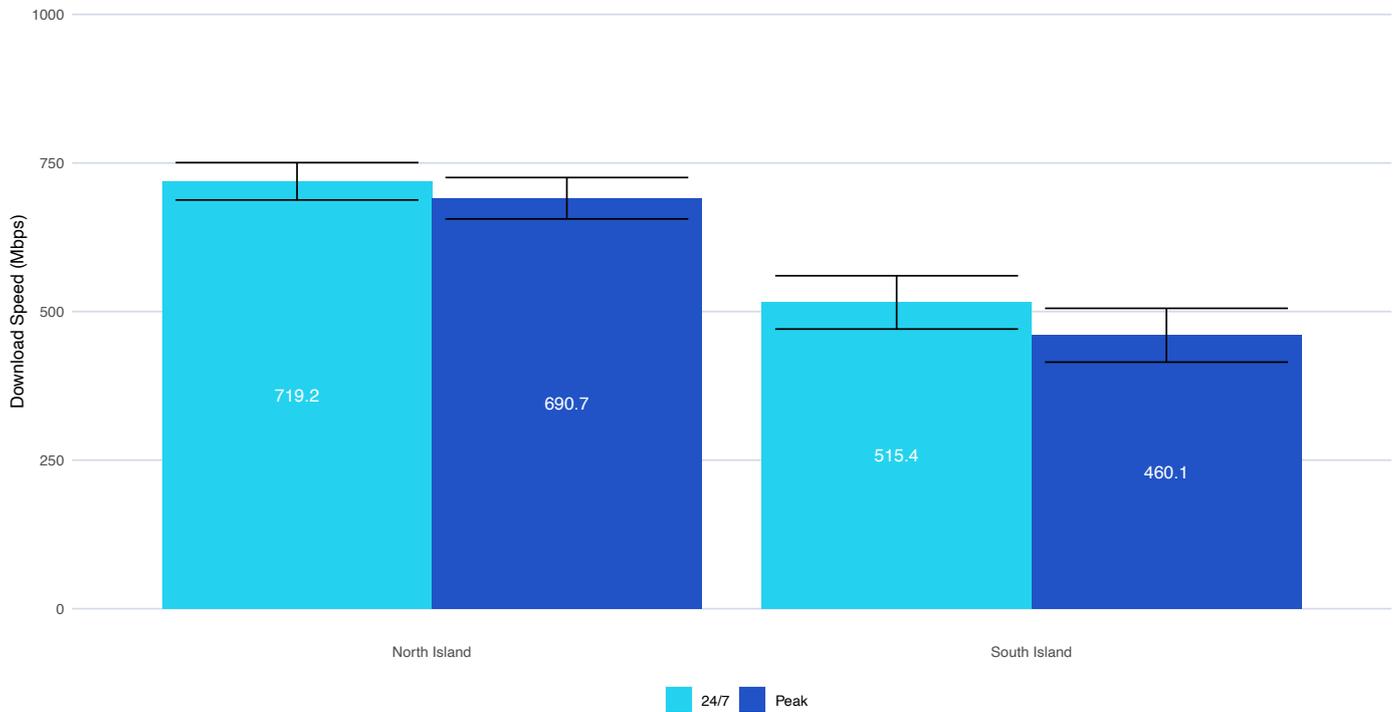
We encourage additional volunteers on Fibre Max products to sign up so that results split by RSPs can be included in future reports.

North Island vs South Island split for Fibre Max

Figure 11

Comparison of average Fibre Max download speeds between islands.

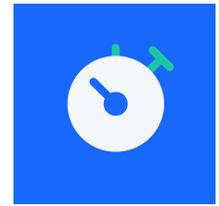
All RSPs and wholesalers. Average of monthly household averages. Peak hours are Monday to Friday, 7pm - 11pm. Error bars indicate 95% confidence interval of the mean.



Key observations

- Fibre Max results were approximately 200Mbps higher for those located on the North Island compared to the South Island.
- Both the North Island and South Island saw a dip in performance when comparing average 24 hour speeds to peak hour speeds with a fall of 55.3Mbps for the South Island and a fall of 28.5Mbps for the North Island.

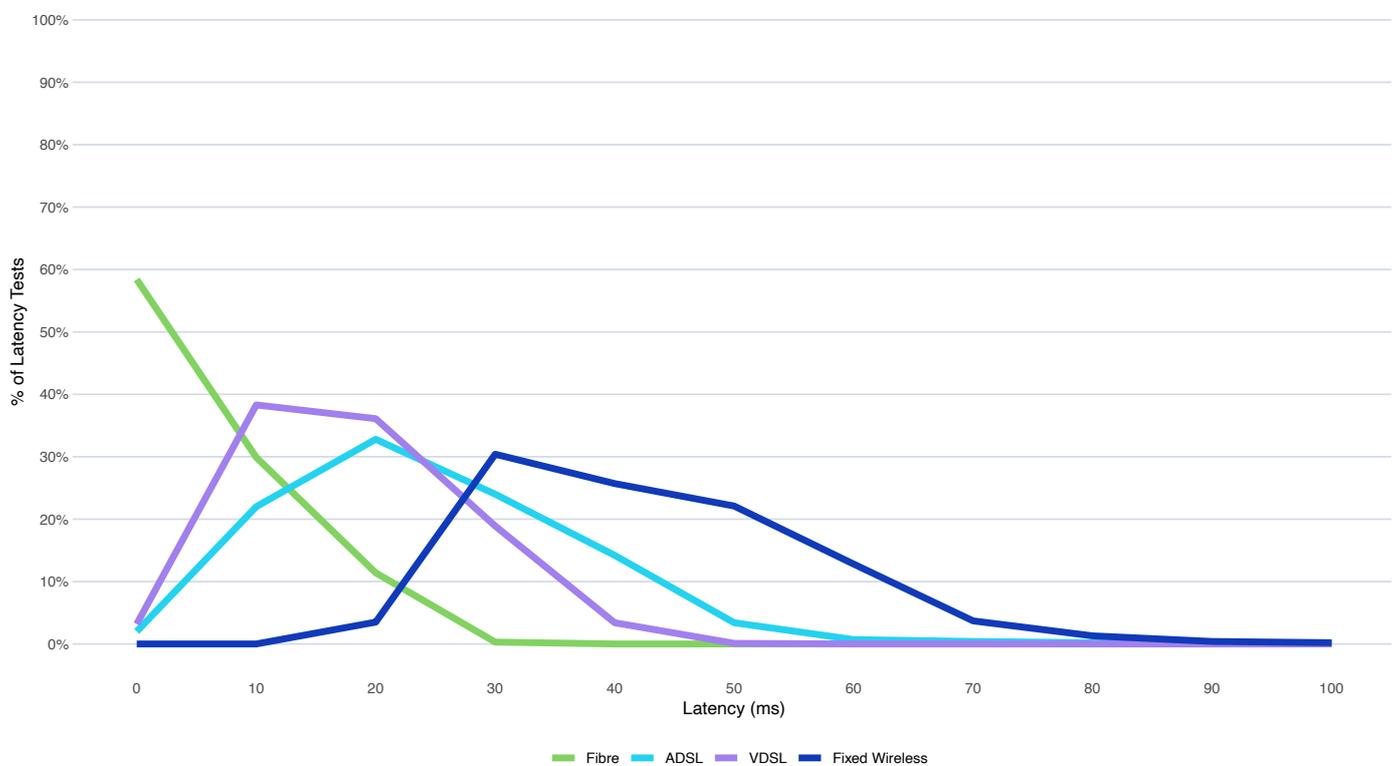
Latency



The discussions of Video Conferencing, Online Gaming, and Social Media illustrated the point that differences in latency can affect the behaviour of specific applications. Other latency-sensitive applications which have not been tested individually for this report include cloud-based interactive web applications, remote learning tools, and even common search engine performance. As a generic indicator of the performance of latency-sensitive applications, MBNZ runs tests to SamKnows servers hosted in New Zealand.

Figure 12
Distribution of latency between households and test servers hosted in New Zealand

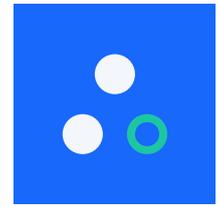
Lower is better.



Key observations

- ADSL, VDSL, and (particularly) Fixed Wireless connections remain more likely to have high latency to internet servers. The exact level of latency required for acceptable performance will differ by application but, as a general observation, Fibre will be least likely to experience issues relating to high latency.
- The general distributions of latency results for each technology are consistent with those seen in previous reports.

Packet Loss

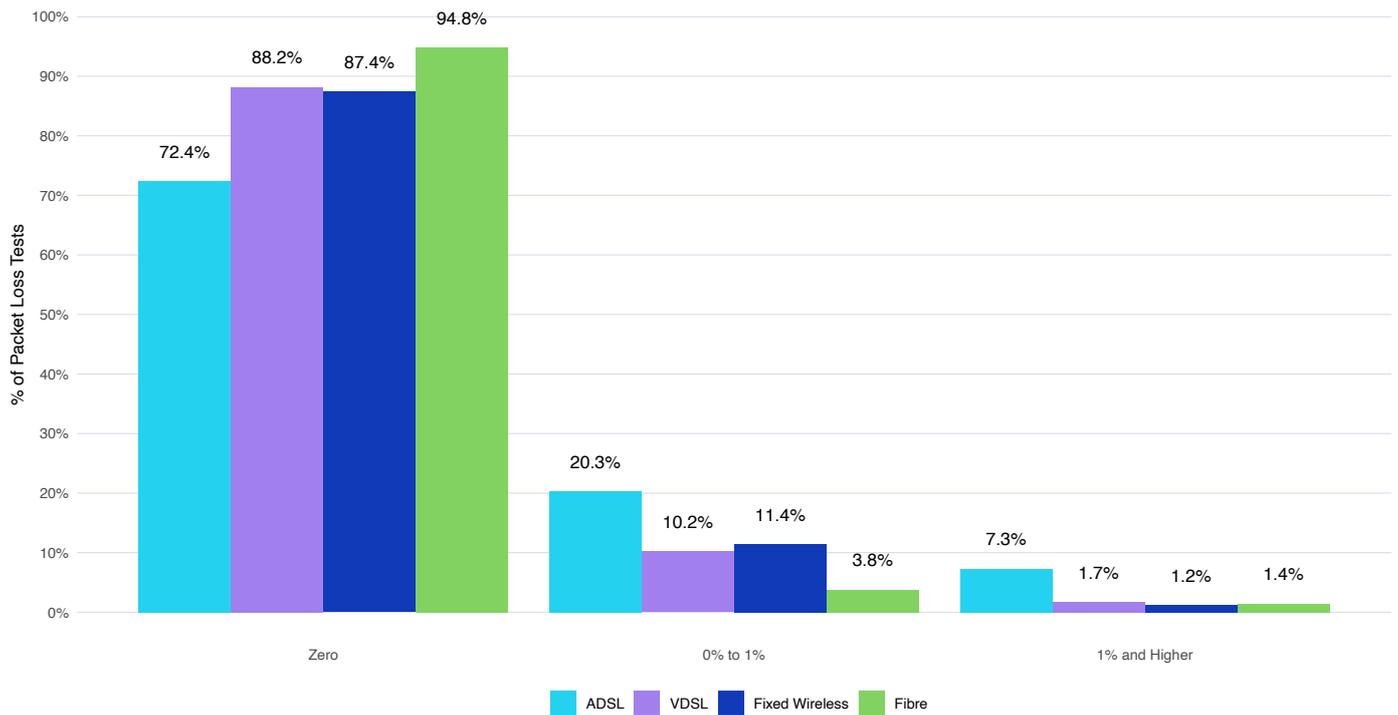


As well as the latency between household and server, MBNZ also records the proportion of packets which are transmitted but fail to arrive (also known as packet loss).

Figure 13

Distribution of packet loss rates between households and test servers hosted in New Zealand

If less than 1% of packets are lost between origin and destination then this will usually have no effect on application performance

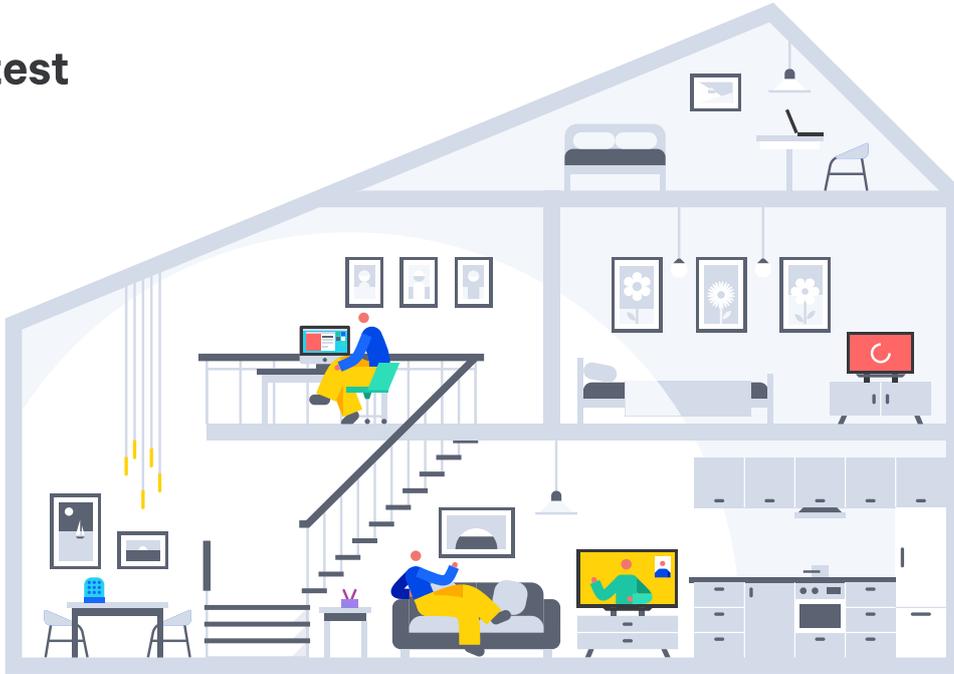


Key observations

- ADSL was the most likely technology to see packet loss at a level which might affect loading webpages or video calling.
- The rates of high packet loss for each technology are consistent with those seen in previous reports.

High packet loss is especially disruptive to video calling since, if a frame of audio or video doesn't make it through, then the video conferencing application must either wait for it to be retransmitted (introducing delay or stalls) or skip it (which makes the call jump).

How we test



Measuring homes across New Zealand

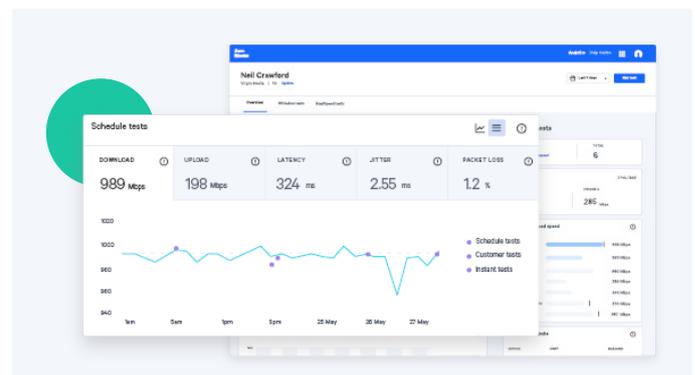
- The SamKnows Whitebox is a purpose-built testing agent that connects to your router.
- Measures every aspect of your internet service delivered to your home.
- Runs at regular intervals when you're not using the internet.

SamKnows One analytics

- View all your data in one place.
- Create customised charts and save the results that mean the most to you.
- Track changes in your connection over time.

Sign up

Please participate by volunteering to receive a Whitebox. The more volunteers we have, the more information we can provide to consumers in New Zealand in future reports: www.measuringbroadbandnewzealand.com/signup



SamKnows One stores all your home broadband performance data for easy analysis and detailed investigations

Our tests

Metric		Definition
	Download	The speed data travels from our test server to your device, measured in bits per second.
	Upload	The speed data travels from your device to our test server, measured in bits per second.
	Latency	How long it takes a data packet to go from your device to our test server and back to your device.
	Jitter	Measures the amount of difference between packet delays, or the stability of your latency.
	Packet Loss	When a packet of data becomes lost (does not arrive for two seconds) measured as a percentage of packets lost out of packets sent.
	Video Conferencing	Measures round-trip latency and reachability of a selection of video conferencing services.
	Social Media	Measures round-trip latency and reachability of a selection of major social media services.
	Online Gaming	Measures performance for a number of major games and supporting services, such a game distribution platforms.
	Video streaming	Measures the highest bitrate you can reliably stream for the most popular video in your country.
	Web browsing	Measures how long it takes to fetch the HTML and referenced resources of a popular website.
	CDN Measurements	Measures download performance for the same (or very similar) object from a variety of popular Content Delivery Networks over HTTP.
	Voice over IP	Measures the suitability of a broadband connection for VoIP calls.

Glossary

Term	Definition
ADSL	Asymmetric digital subscriber line. A broadband connection that uses existing telephone lines to send data.
Advertised speed	The speed at which broadband services are typically advertised or marketed, usually described in Mbps (megabits per second). On some networks like ADSL or Fixed Wireless, these are not given as a general maximum but vary from line to line as they do not transmit data without depreciation across distance.
Broadband	A network service or connection which is defined as “always on”.
Broadband speed	The speed at which data is transmitted over a broadband connection, usually measured in megabits per second (Mbps).
Download speed	The speed that data travels from our test server to your router. Measured in megabits per second (Mbps); higher is better.
Fibre	A broadband connection that uses fibre-optic cables to send data to and from a property directly. Sometimes referred to as FTTH (Fibre-to-the-home) or FTTP (Fibre-to-the- premises).
Fixed Wireless	A broadband connection that uses radio waves to provide internet access to a premises.
VDSL	Very high speed digital subscriber line. A broadband connection that allows higher speeds than ADSL technologies.
RSP	Retail Service Provider. A company that provides consumers with access to the internet.
Latency	The time it takes for a data packet to travel from your router to our test server and back. Measured in milliseconds (ms); lower is better.
Mbps	Megabits per second. A unit measuring broadband speed. Mbps is the equivalent of 1,000 kilobits per second.
Packet loss	The percentage of packets that were lost somewhere between your router and our test server. Measured as a percentage of all packets sent; lower is better.
Peak hours	The time of day when people are typically using their internet connection, defined in New Zealand as between 7pm and 11pm.
SD	Standard definition. Resolution of video streaming between 640x480 pixels and 858x480 pixels. Often referred to as 480p.
HD	High definition. Resolution of video streaming between 1280x720 pixels and 1920x1080pixels. Often referred to as 720p or 1080p.
UHD	Ultra-high definition. The highest resolution for video streaming, this includes 4K UHD and 8K UHD. Minimum resolution of 3840x2160 pixels.
Upload speed	The speed that data travels from your router to our test server. Measured in Mbps (megabits per second); higher is better.