

## Measuring Broadband

# NEW ZEALAND

Spring Report, December 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 SamKnows Whiteboxes 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 between 24th July and 24th August 2020.



# Contents

1. Overview	3
2. We still need New Zealanders to take part!	4
3. Executive Summary	5
4. Package Comparison	6
5. Speed Tests	7
6. Distribution of Fibre Max Results	9
7. Fibre Max Breakdown by Island	10
8. Fibre 100 Breakdown by RSP	11
9. Fibre 100 Breakdown by Region	12
10. Distribution of Average Copper Download Speeds	14
11. Comparison between Copper and Fixed Wireless	15
12. Video Conferencing	17
13. Social Media	18
14. Online Gaming	19
15. Video Streaming	20
16. Latency	21
17. Packet Loss	23

## Appendix

1. How we test	24
2. Our tests	25
3. Glossary	26

# Overview

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

1. **Continued monitoring of the performance of different plans and RSPs.**
2. **More detailed analysis of the performance of Copper and Fixed Wireless plans.**
3. **Testing of more video conferencing and online gaming applications.**

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.

Other reports released by the MBNZ project can be found here: <https://comcom.govt.nz/regulated-industries/telecommunications/monitoring-the-telecommunications-market/monitoring-new-zealands-broadband/Reports-from-Measuring-Broadband-New-Zealand>



# We still need New Zealanders to take part!

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

2degrees	ADSL / VDSL		
MyRepublic	Fibre 100		
Orcon	ADSL / VDSL	Fibre 100	
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](http://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. This period of data collection coincided with Auckland temporarily moving to Alert Level 3, with restrictions on travel and therefore probably greater reliance on the internet for work, study, and socialization.
2. While the performance of Fibre Max plans (detailed below) did decrease, this decrease was not isolated to Auckland and so cannot be attributed solely to changing usage patterns.
3. The performance of other dominant broadband plans remained stable on previous measurements; the broadband network in New Zealand has continued to perform well through the evolving response to COVID-19.

## Fibre Max

1. There has been an investigation into the performance of Fibre Max, the outcome of which has resulted in changes being implemented by a number of parties. These changes took place after the data collection period for this report, so are not reflected here. However a Fibre Max Status Update has been released alongside this report which shows some of the improvements recorded. We expect to see further improvements reflected in the next report.
2. More detailed information on the specific changes made by industry participants can be seen in the Fibre Max Investigation Report.

## Benchmarking

1. The average Fibre Max download speed has decreased since the previous reporting period.
2. The performance of other plans has remained stable.
3. Latency and packet loss test results are consistent with data collected for previous reports: Fibre will generally support latency-sensitive applications better than Copper or Fixed Wireless.

## Application Performance

1. Video Conferencing: The average latency to the free services of Google Meet, Skype, Zoom, and GoToMeeting (new to this report) is within a usable range for all plans. Fibre plans remains slightly more likely to support a lower latency.
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: FIFA 18/19 and Playstation, which are hosted in New Zealand, can be reached with lower latency than other games such as Dota 2, Fortnite, Apex Legends, and League of Legends, which are hosted overseas.
4. Video Streaming: Higher speed plans remain able to stream Netflix in Ultra High Definition nearly all of the time.

# 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.

## 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

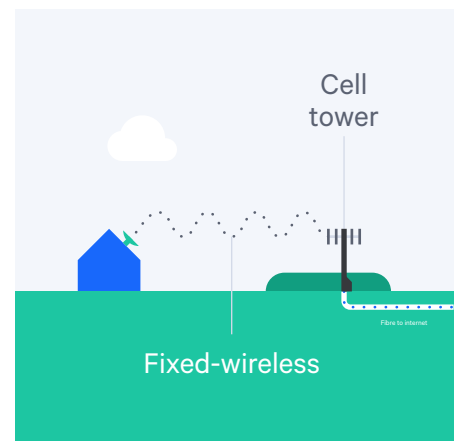
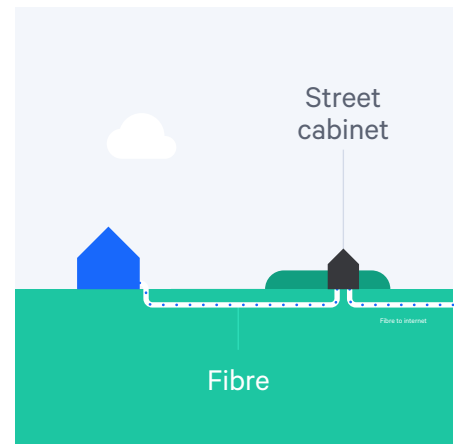
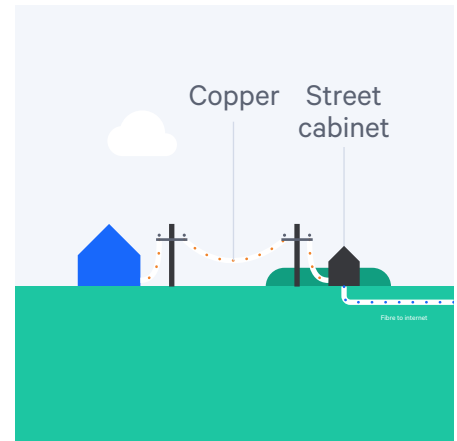
Almost always offers higher bandwidth than Fibre 100, but performance varies across different providers and parts of the country. Fibre Max performance in the South Island is lower than in the North Island. The Commission has worked with industry to address these points, which we expect to be reflected in the next report. Fibre 100 will support all modern applications and multi-user households; Fibre Max is recommended in cases where there is a genuine need for more bandwidth e.g. frequently uploading large files or downloading large files hosted overseas.

## 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.

## 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.



# Speed Tests

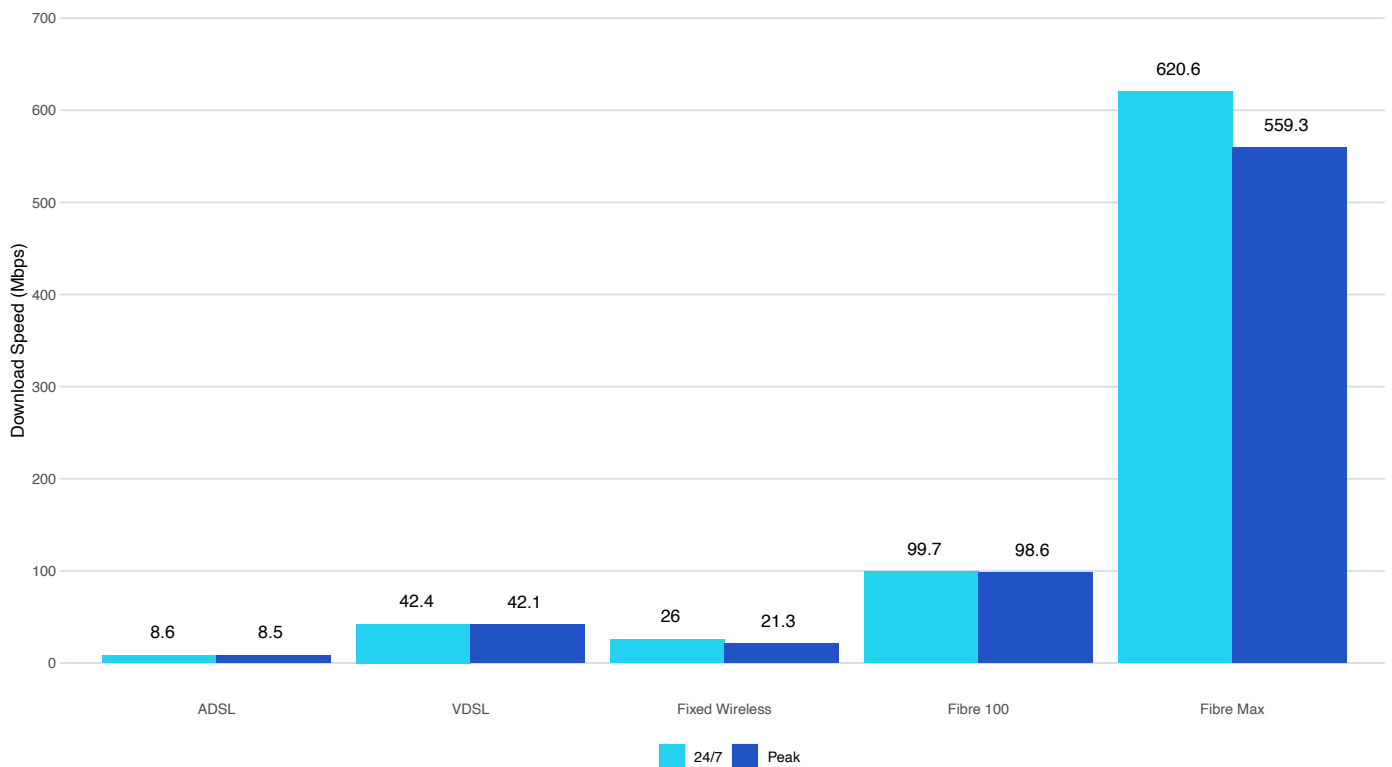


Figures 1 and 2 present an overview of download and upload speed across the country. These are included in every report in order to provide a benchmark that can be tracked over time. Peak hours are the times when people typically use the internet; in New Zealand this is 7pm to 11pm on Monday-Friday. Following New Zealand’s response to COVID-19, which has involved higher rates of working and studying from home, 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 1 and 2 is kept to mean Monday-Friday 7pm-11pm.

Figure 1

## Average Download Speeds by Plan.

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



### Key observations

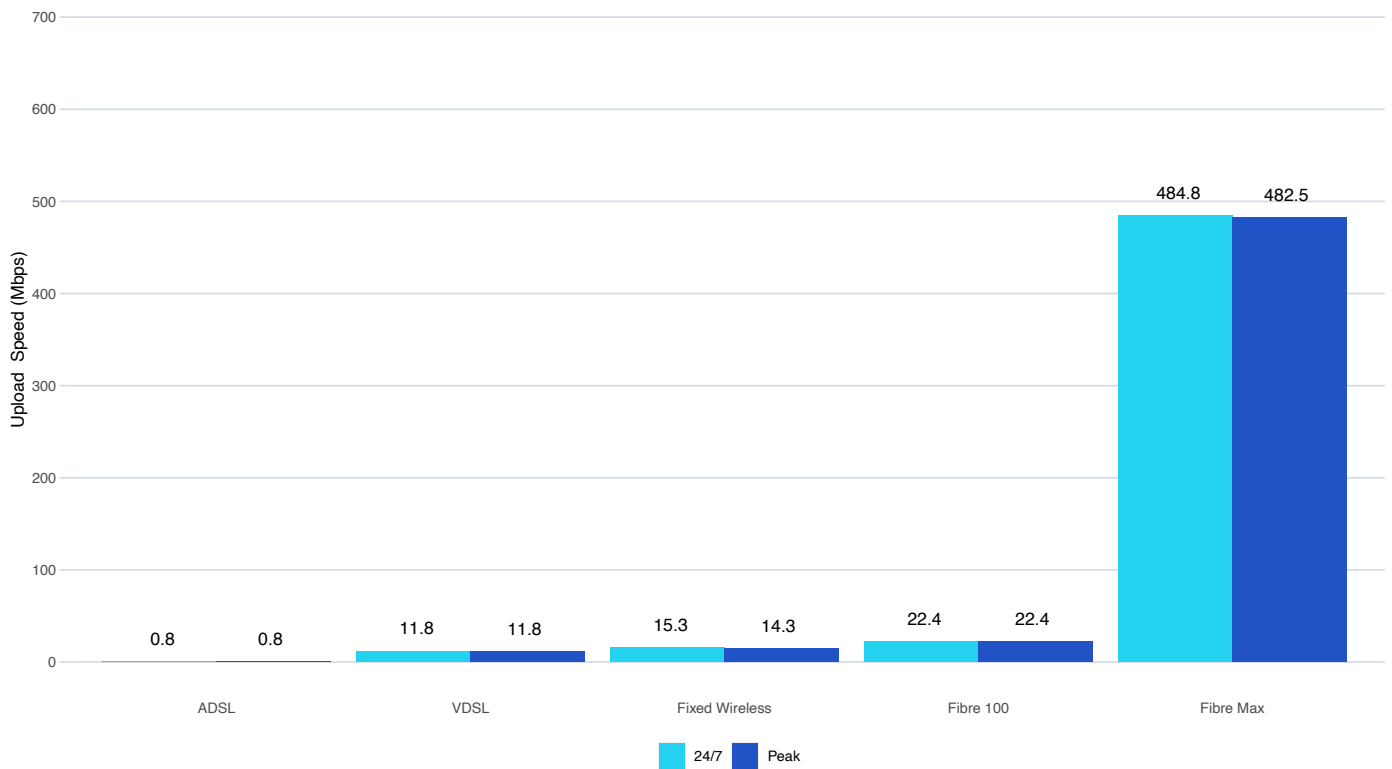
- Fibre Max delivers an average download speed of 620.6 Mbps, over six times the speed of Fibre 100. ADSL is lowest at 8.6 Mbps.
- The average Peak speed of Fibre Max plans has decreased by around 27.4 Mbps, or 4.2%, since the previous report. Since the data for this report was collected, several industry participants have made changes to their networks which have improved Fibre Max’s performance. We expect that the resulting changes will be apparent in the next report.

# Speed Tests (continued)

Figure 2

## 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. The average upload speed of Fibre Max plans decreased by 9 Mbps, or 1.8%, since the previous report; as was the case with download performance, we expect that the changes made to the plan by industry will be apparent by the next report.



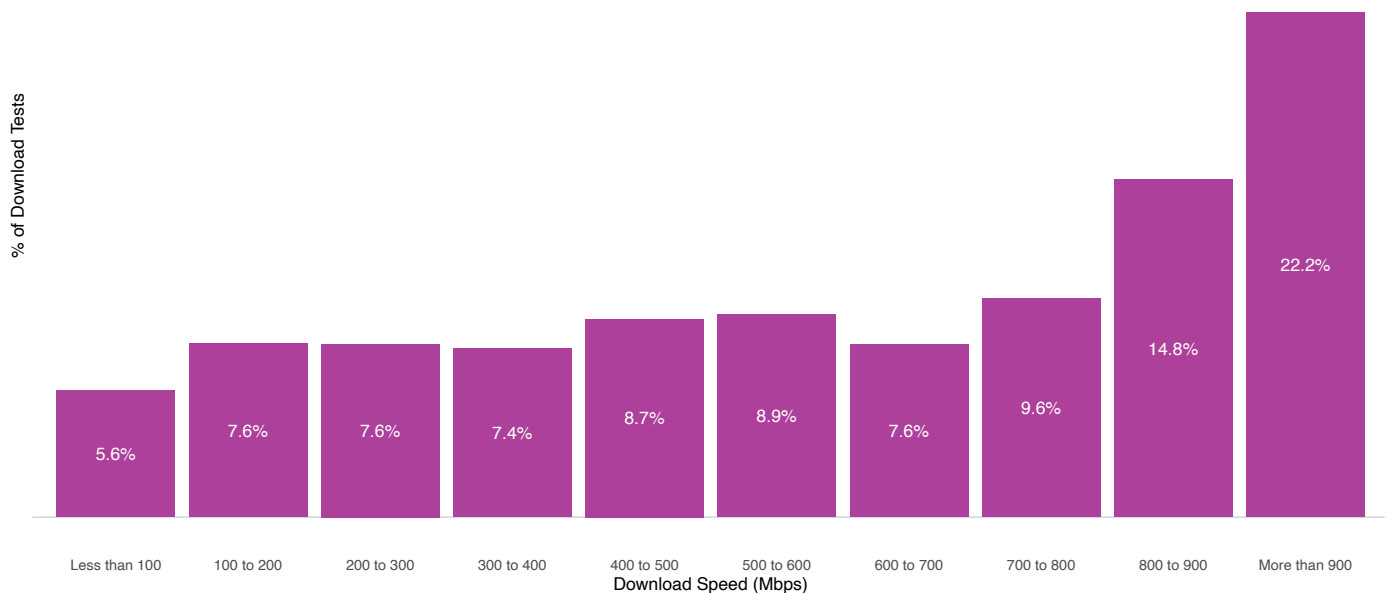
## Distribution of Fibre Max Results

Fibre Max products (which are marketed under different names by RSPs) are derived from 'gigabit' wholesale products and have advertised headline speeds around 900 Mbps. Due to protocol overheads, which are mostly composed of IP packet headers and TCP segment headers, the highest possible measurable speed test result for a gigabit wholesale product is around 940 Mbps. In reality, many of the Fibre Max lines tested for the MBNZ project have average speeds below this theoretical maximum, and below advertised plan speeds.

Figure 3

### Download speeds on Fibre Max plans.

Distribution of test results. Advertised average download speeds for Fibre Max plans range between 700Mbps and 950Mbps; this varies by RSP and over time.



### Key observations

- The performance of Fibre Max plans varies widely. While 22% of tests recorded download speeds above 900 Mbps, the majority recorded speeds below 700 Mbps.
- Within this range of test results, only 35% of households which are subscribed to a Fibre Max plan had an average download speed higher than 800 Mbps.

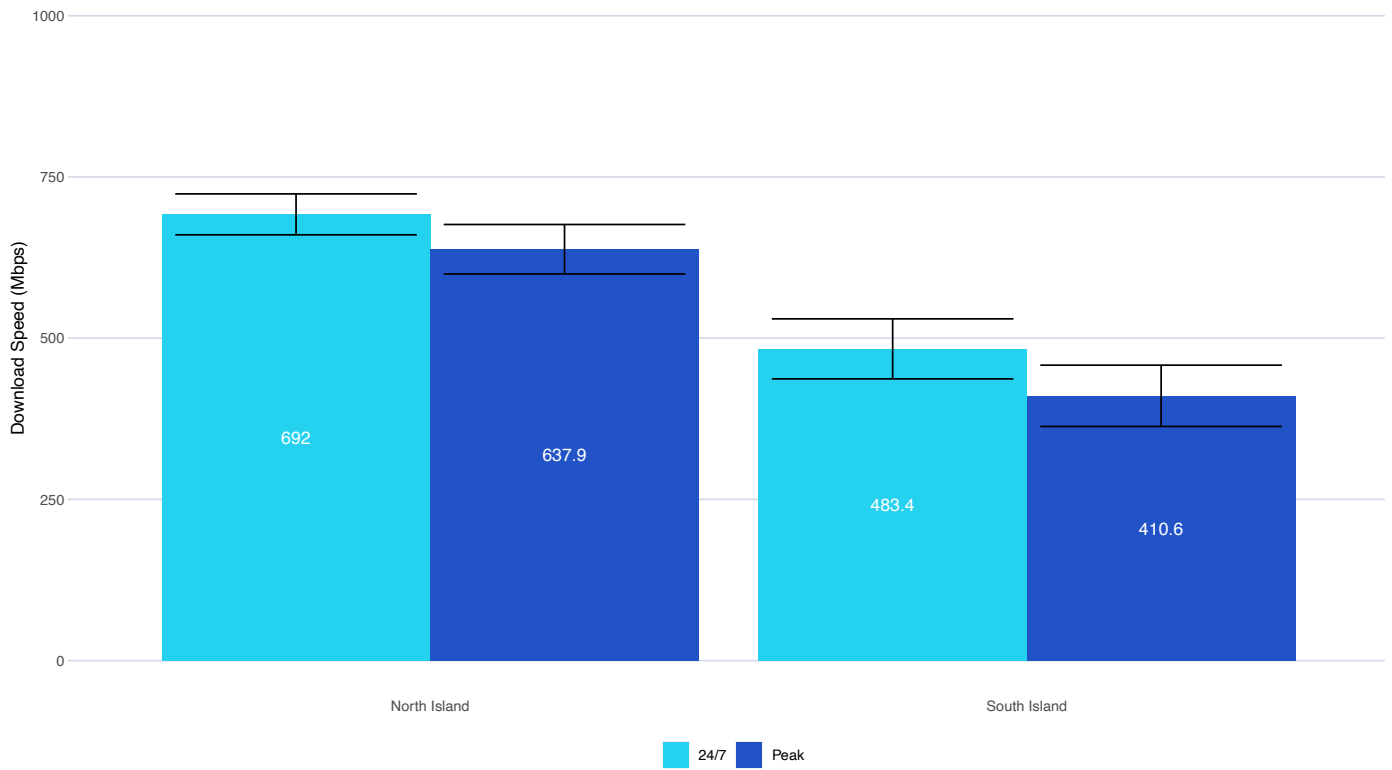
As mentioned previously the investigation into Fibre Max performance has concluded and changes have been deployed since this data was collected. Future reports will track changes.

# Fibre Max Breakdown by Island

Figure 4

## Comparison of average Fibre Max download speeds between Islands.

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

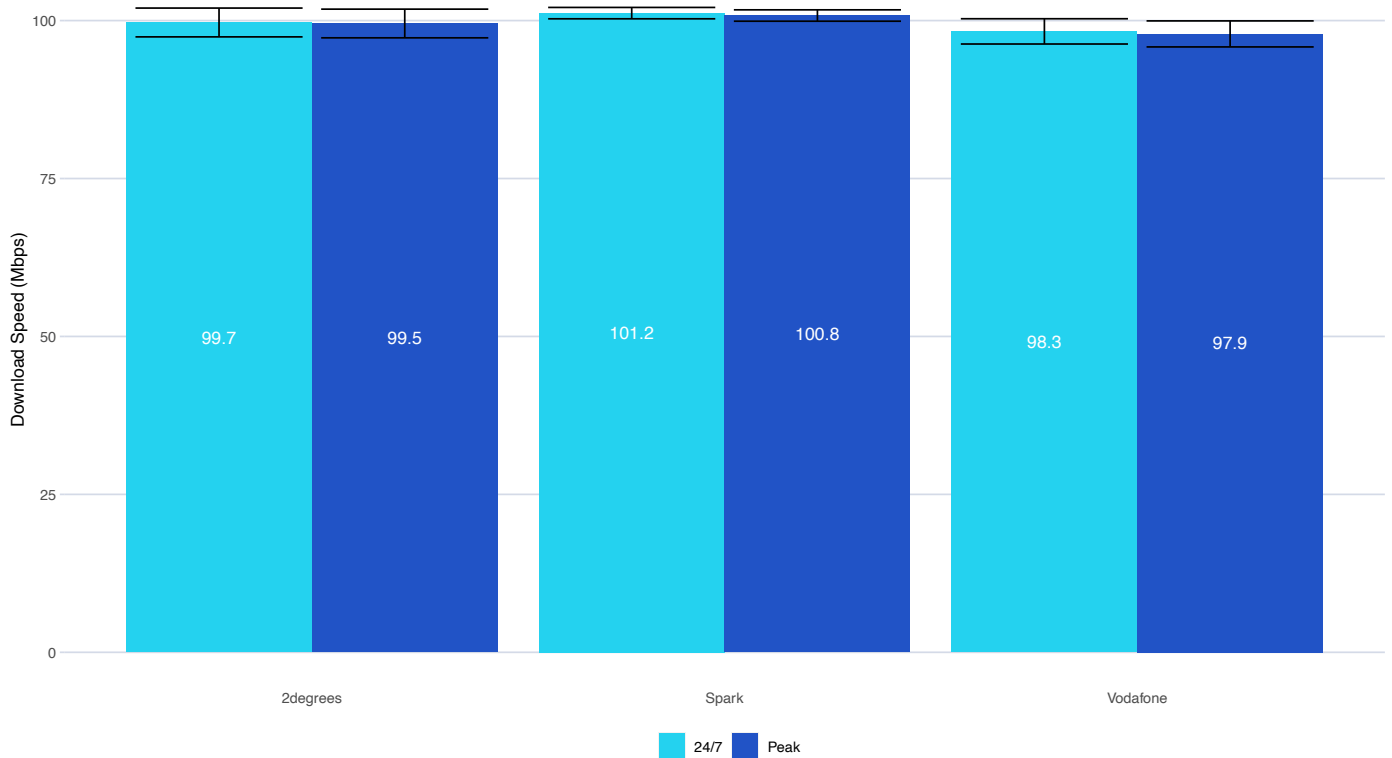
# Fibre 100 Breakdown by RSP

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

Figure 5

## 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.

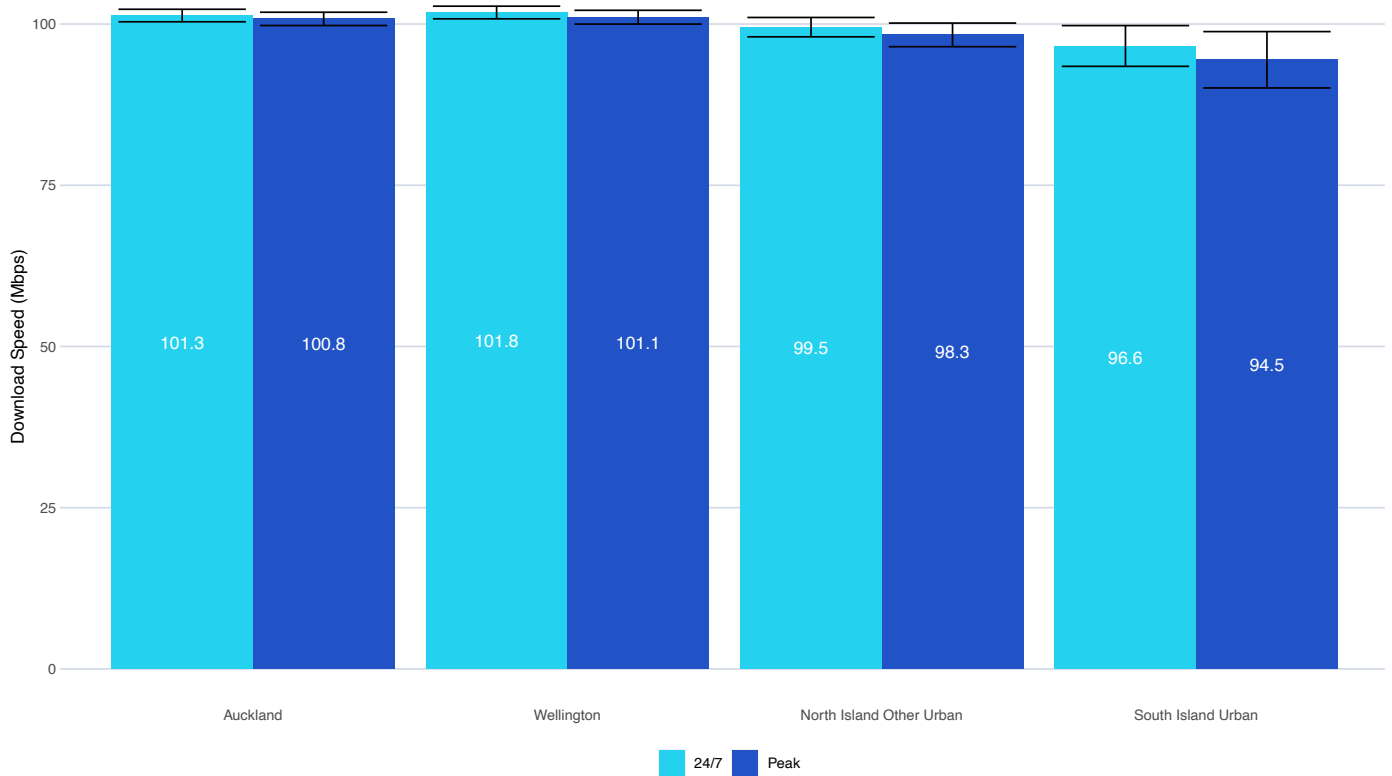
There were not enough volunteers connected to MyRepublic, Orcon, Slingshot, or Trustpower in July/August to report results for those RSPs. Those RSPs are included in the overall Fibre 100 results shown in Figures 1 and 6.

# Fibre 100 Breakdown by Region

Figure 6

## 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/Wellington and the South Island, but on the whole Fibre 100 performance is comparable across different parts of the country.

# Distribution of Average Copper Download Speeds

The two main Copper technologies available in New Zealand are:

- ADSL, in which the physical infrastructure is copper the whole way from the house to the exchange.
- VDSL, in which the physical infrastructure is Copper from from the cabinet to the home, but Fibre from the exchange to the cabinet.

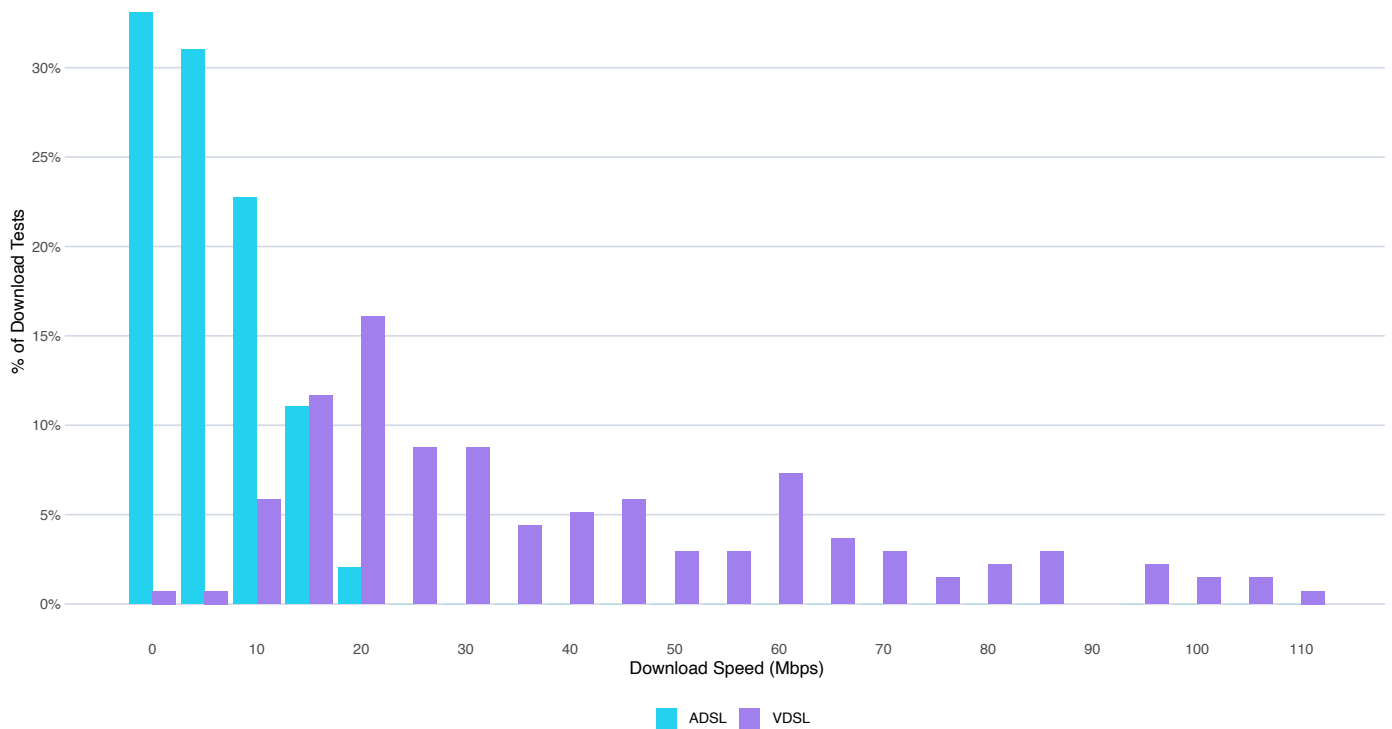
A large determinant of the speed of ADSL lines is how far away a house is from its local exchange, whereas the performance of VDSL is more determined by the capacity between the cabinet and the local exchange.

The following chart shows the variability in average download speed across subscribers to ADSL and VDSL plans in New Zealand.

Figure 7

## Copper Download Speed Distributions - ADSL vs. VDSL.

*Distributions of monthly household averages.*



### Key observations

- There is an overlap between the low end of VDSL and the high end of ADSL; in some cases the performance of the two technologies is indistinguishable.
- On the other hand, some VDSL lines attain download speeds which are comparable with lower speed Fibre Plans.

# Comparison between Copper and Fixed Wireless

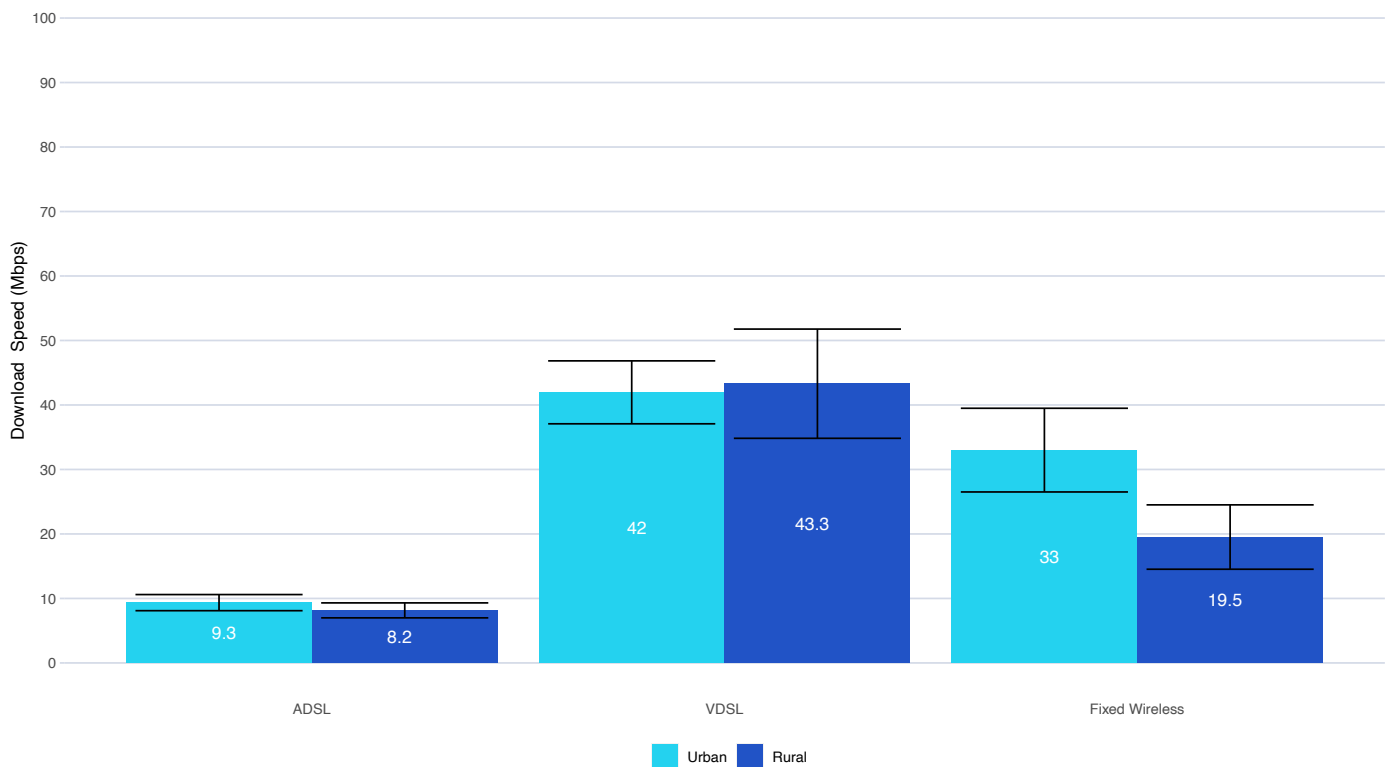
Fixed Wireless services often purchased by households in the more remote areas in which Fibre is not available and Copper may or may not reach. As such it is of interest how these services measure up to the fixed line technologies available in other parts of the country.

The previous report established that there is no significant difference between the average performance of urban ADSL lines and rural ADSL lines. Around 97% of ADSL speed tests were no higher than 15 Mbps, and so to compare Fixed Wireless to ADSL we can use 15 Mbps as a benchmark.

Figure 8

## Download speeds for Copper and Fixed Wireless plans across urban and rural areas.

Average of household averages. Error bars indicate 95% confidence intervals of the mean.



### Key observations

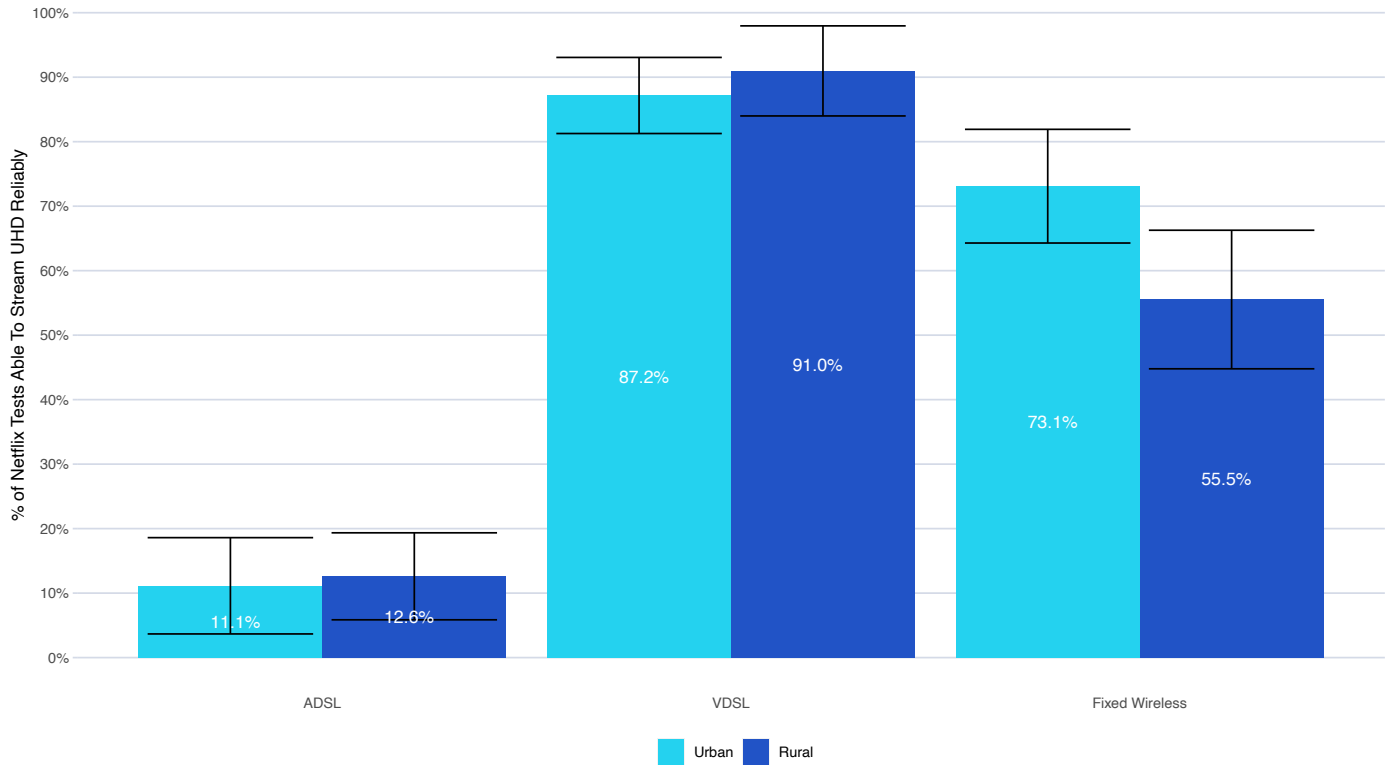
- In rural areas, Fixed Wireless plans attain download speeds roughly between VDSL and ADSL. In urban areas, Fixed Wireless' average download speed is comparable to VDSL, although an individual Fixed Wireless line will experience more variability throughout the day than a Copper line.

# Comparison between Copper and Fixed Wireless (continued)

Figure 9

## How often Netflix will stream in Ultra High Definition for Copper and Fixed Wireless plans.

Average of household averages. Error bars indicate 95% confidence intervals of the mean.



### Key observations

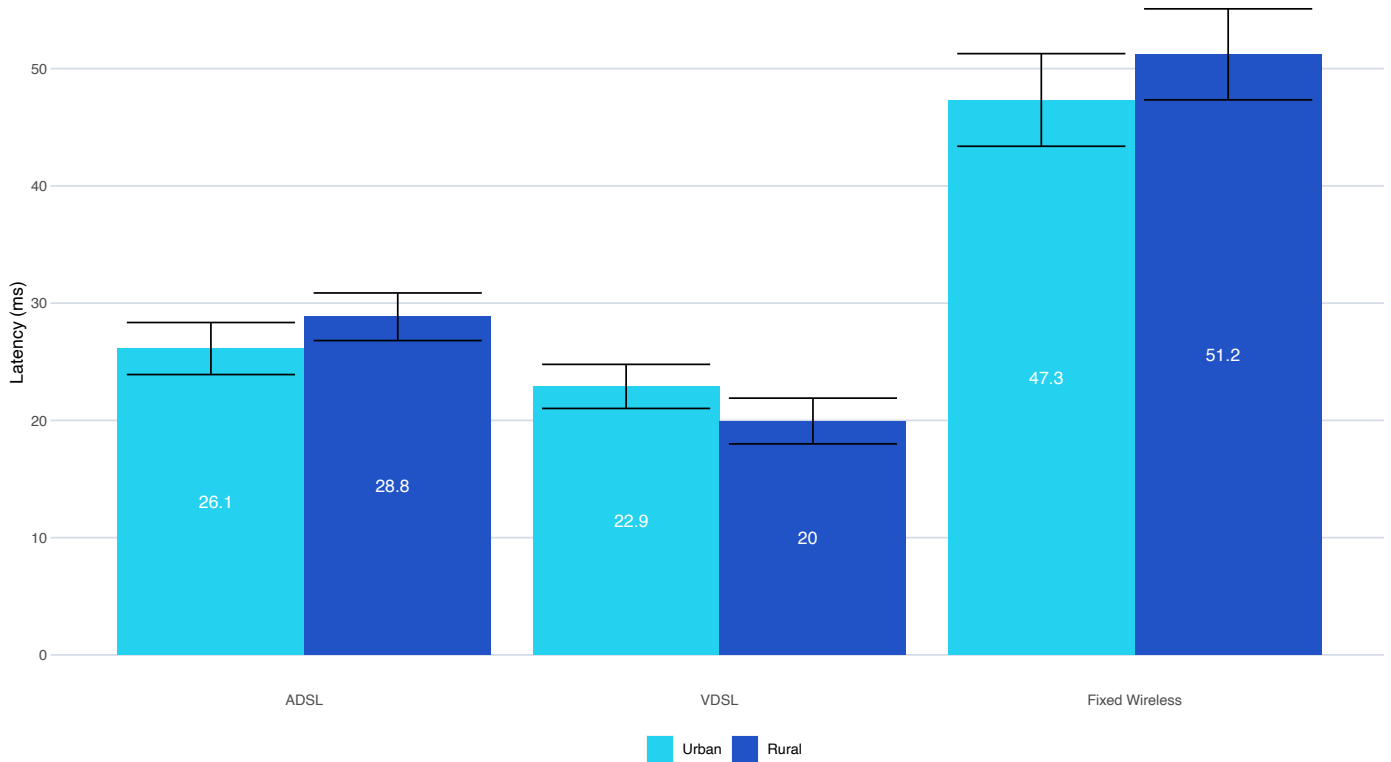
- Netflix will stream at a higher resolution over Fixed Wireless than over ADSL, in both urban and rural areas. However, Ultra High Definition video is less likely to stream reliably over Fixed Wireless than over VDSL, and less so in rural areas.

# Comparison between Copper and Fixed Wireless (continued)

Figure 10

## Latency to test servers for Copper and Fixed Wireless plans. Lower is better.

Average of household averages. Error bars indicate 95% confidence intervals of the mean.



### Key observations

- Fixed Wireless connections generally get higher bandwidth (and consequently video streaming performance) in urban areas than in rural areas, but not lower latency. This is to be expected since cell coverage/capacity is generally better in urban areas.
- In rural areas, VDSL performs significantly better than Fixed Wireless on average. In urban areas, Fixed Wireless can be comparable to VDSL in terms of bandwidth, but not in terms of latency.
- In both urban and rural areas, Fixed Wireless outperforms ADSL in terms of bandwidth but not latency.

At present, all of our Fixed Wireless volunteers use 4G services. 5G coverage is currently limited only to certain parts of New Zealand. 5G will generally achieve higher bandwidth than 4G, although latency and jitter may still cause difficulty with real time applications. When Fixed Wireless services over 5G are a more widely available proposition, it would be interesting to benchmark 5G as a competitor to Fibre in terms of performance.



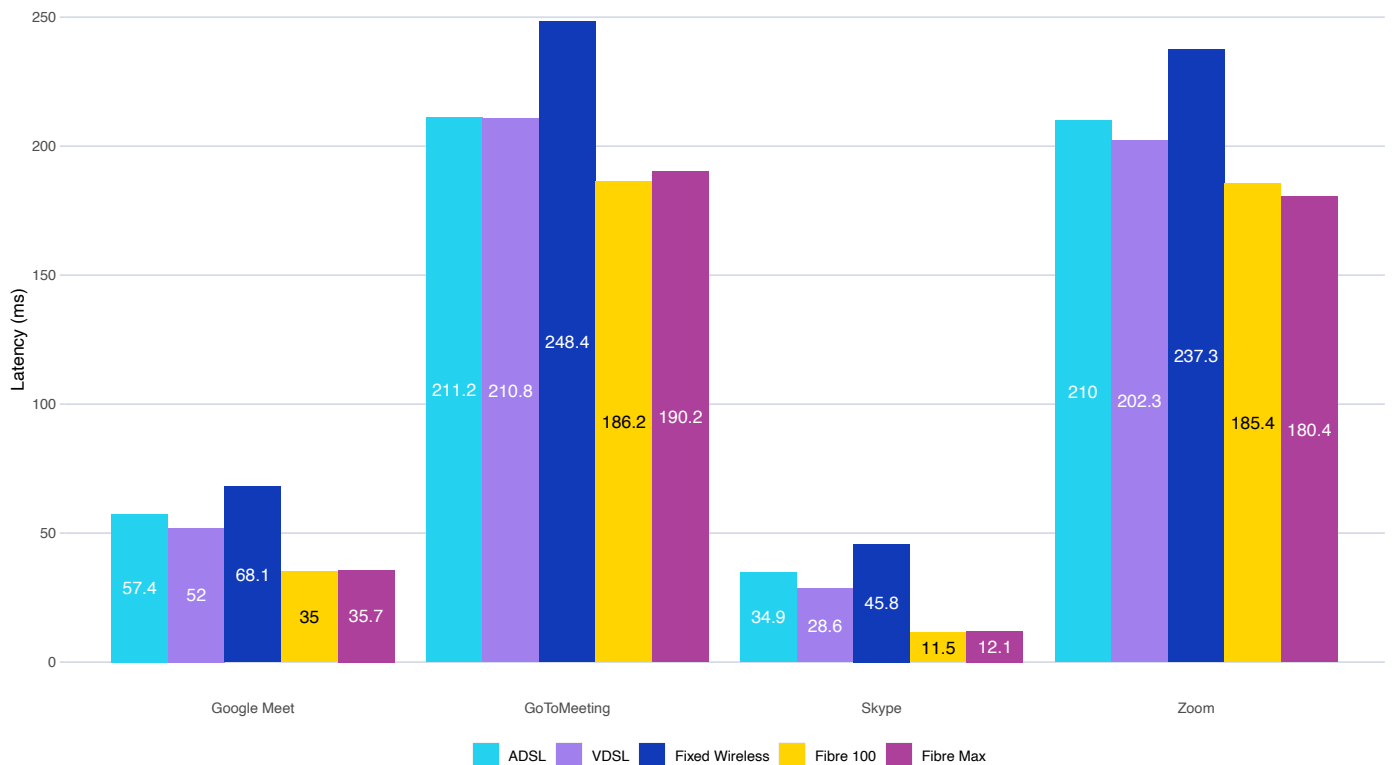
# Video Conferencing



Video conferencing is now established as a service which the majority of internet users will encounter. MBNZ measures the latency to the video relay servers of these applications when using the service for free, rather than on a paid-for plan, which gives an indication of the delay between audio/video being sent by one party and received by another.

Figure 11

**The latency to servers using a free account for popular video conferencing services. Lower is better.**  
*Average of household average latency to relay services. Lower latency means less delay during calls.*



## Key observations

- The average latency to Google Meet, GoToMeeting, 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.
- The average latency to Zoom and GoToMeeting is over a tenth of a second higher than to other services. In the case of Zoom, all traffic is routed via servers in Singapore (though note that the paid version of Zoom’s service allows users to select relay servers in Sydney) however this additional latency would be imperceptible to end users for both Zoom and GoToMeeting. For other services, the relay servers are located closer to New Zealand. 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.

Data from Microsoft Teams has not been included in this report due to an insufficient number of samples.

# Social Media

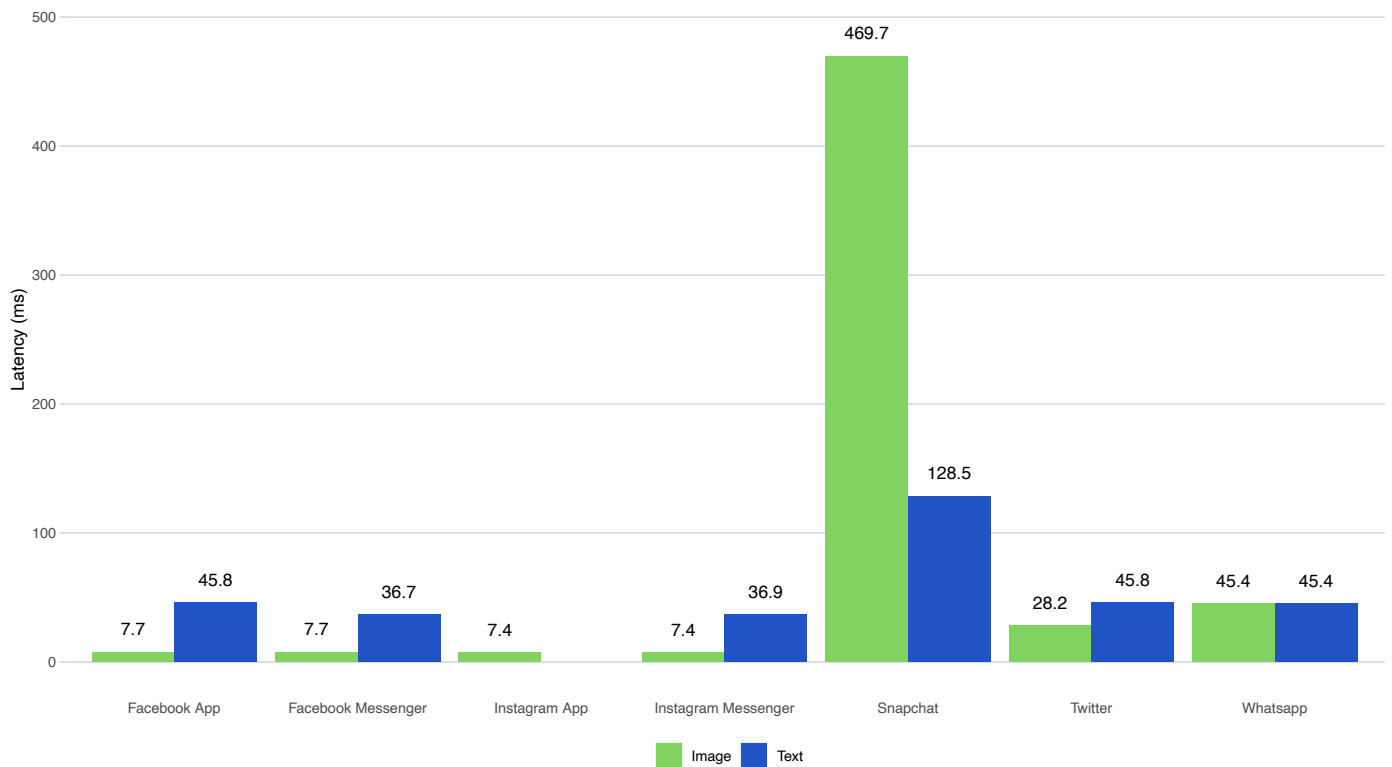


Social media applications generally involve fetching a large number of relatively small pieces of information (single images, short pieces of text, and so on). Applications such as Facebook serve different types of content from different servers - for example an image will come from one server while its caption will come from a different server. Due to this, latency to the server will be a large determinant of how responsive social media applications will be.

Figure 12

## The latency to servers of different social media platforms.

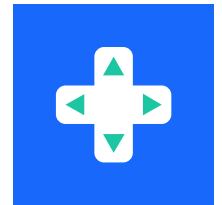
Average of household average latency to content servers. Fibre plans only.



### Key observations

- Latency to Snapchat image servers, which are hosted in the USA, remain around four tenths of a second on average. This would introduce slower performance for two people in New Zealand exchanging images, compared to other chat services like Whatsapp or Facebook messenger.
- Facebook and Instagram use Facebook CDN caches within RSPs networks to serve images, which results in lower latency when accessing an image. Text is not served from these caches, which results in higher latency.

# Online Gaming

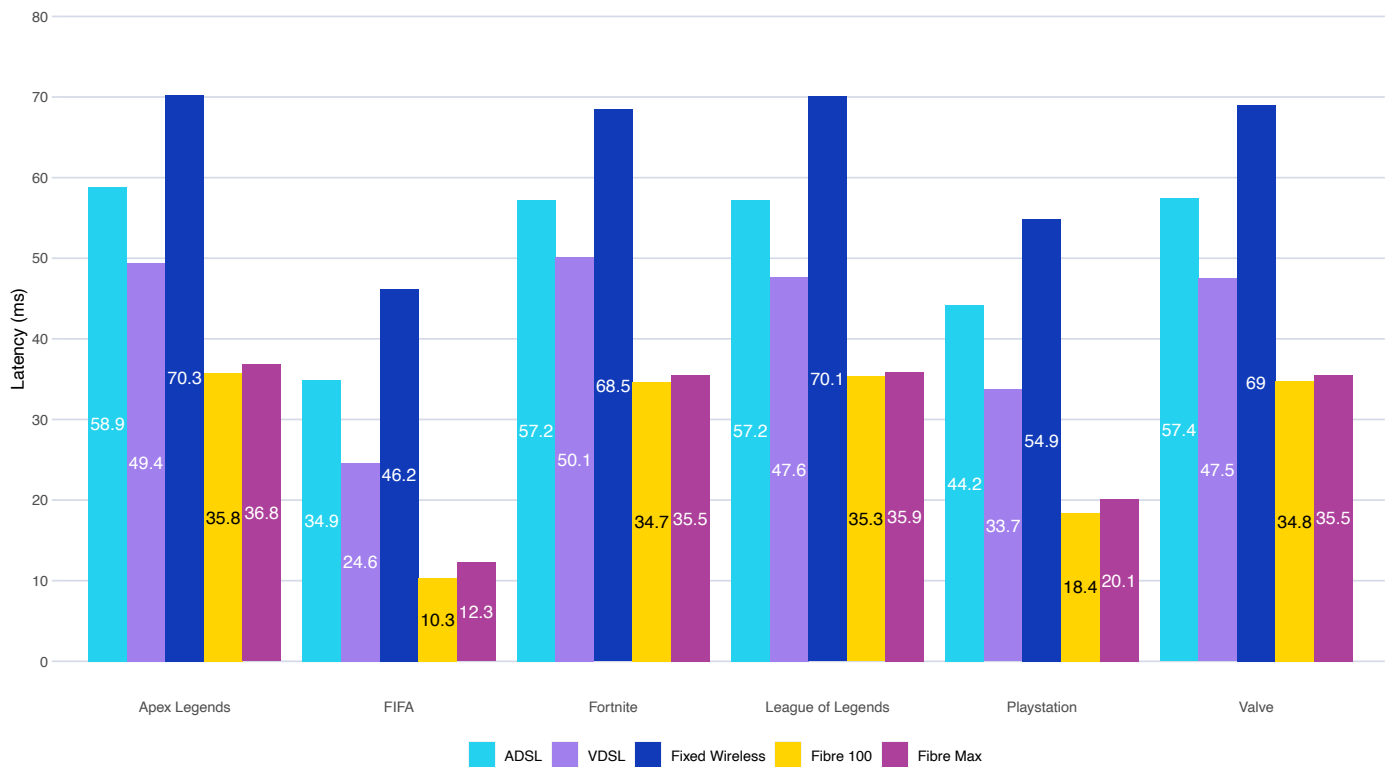


Online gaming applications require low latency between users' machines and the central server which is hosting the game. If it takes a long time to pass messages between players and server then disruptive stuttering or lag will result.

Figure 13

## The latency to various online gaming servers. Lower is better.

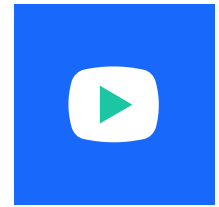
Average of household average latency to gaming servers. Lower latency means that lag is less likely.



### 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.
- FIFA and Playstation are served from CDNs with endpoints in New Zealand, and so the average latency to those services is lower than to other games, which are served from Australia.
- Valve, producer of Dota2, and League of Legends (new as of this report) both have similar profiles to Fortnite and Apex legends.

# Video Streaming

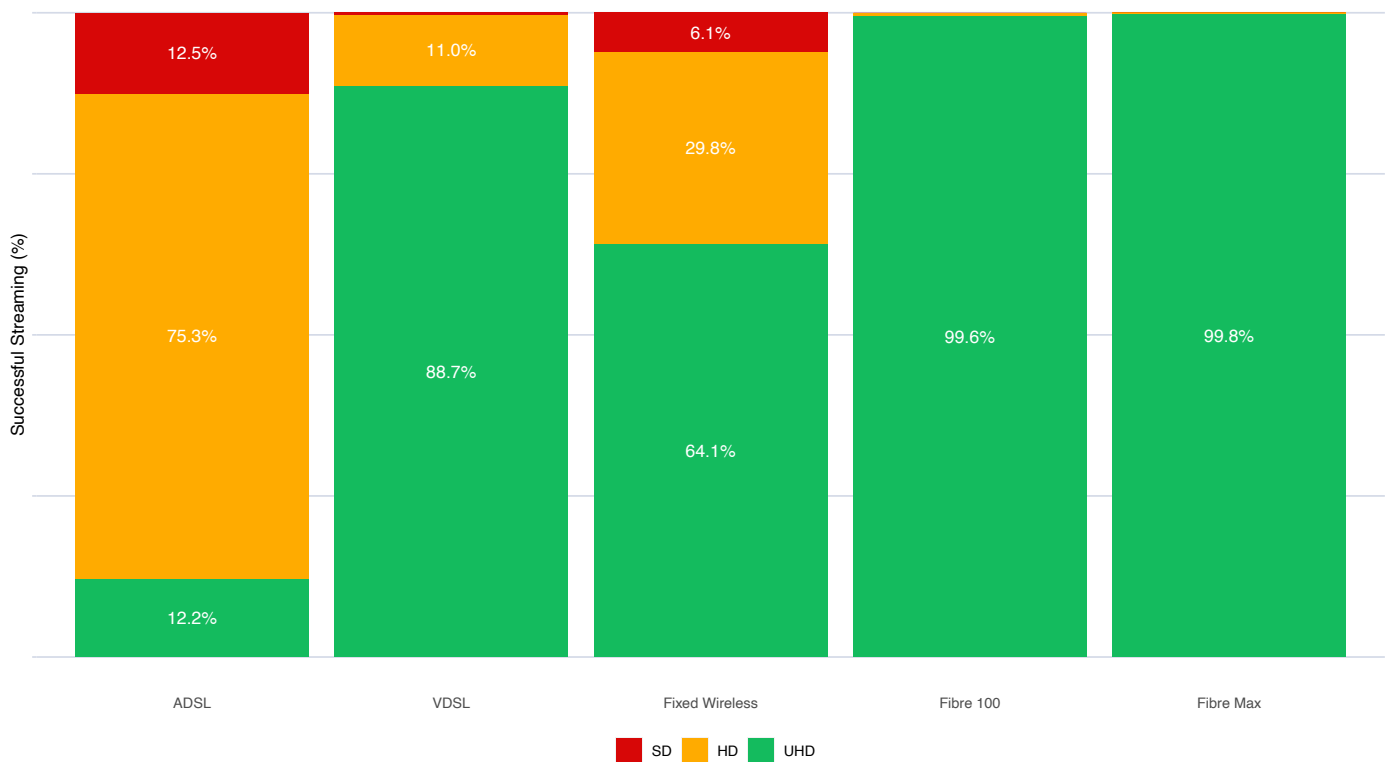


Video streaming is a good example of an application in which the quality of a user’s experience is more affected by bandwidth than by latency. Since higher quality video takes up more data than lower resolution video, higher bandwidth plans such as Fibre 100 and Fibre Max are able to reliably stream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

Figure 14

## The highest Netflix video quality that could be streamed reliably.

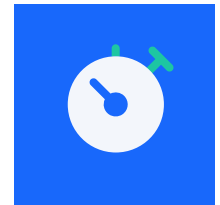
Average percentage of the time that a household could stream in either Standard Definition (SD), High Definition (HD) or Ultra High Definition (UHD).



### 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 will have similar experiences to ADSL lines.
- Fibre plans are able to support Ultra High Definition nearly all the time.

# Latency

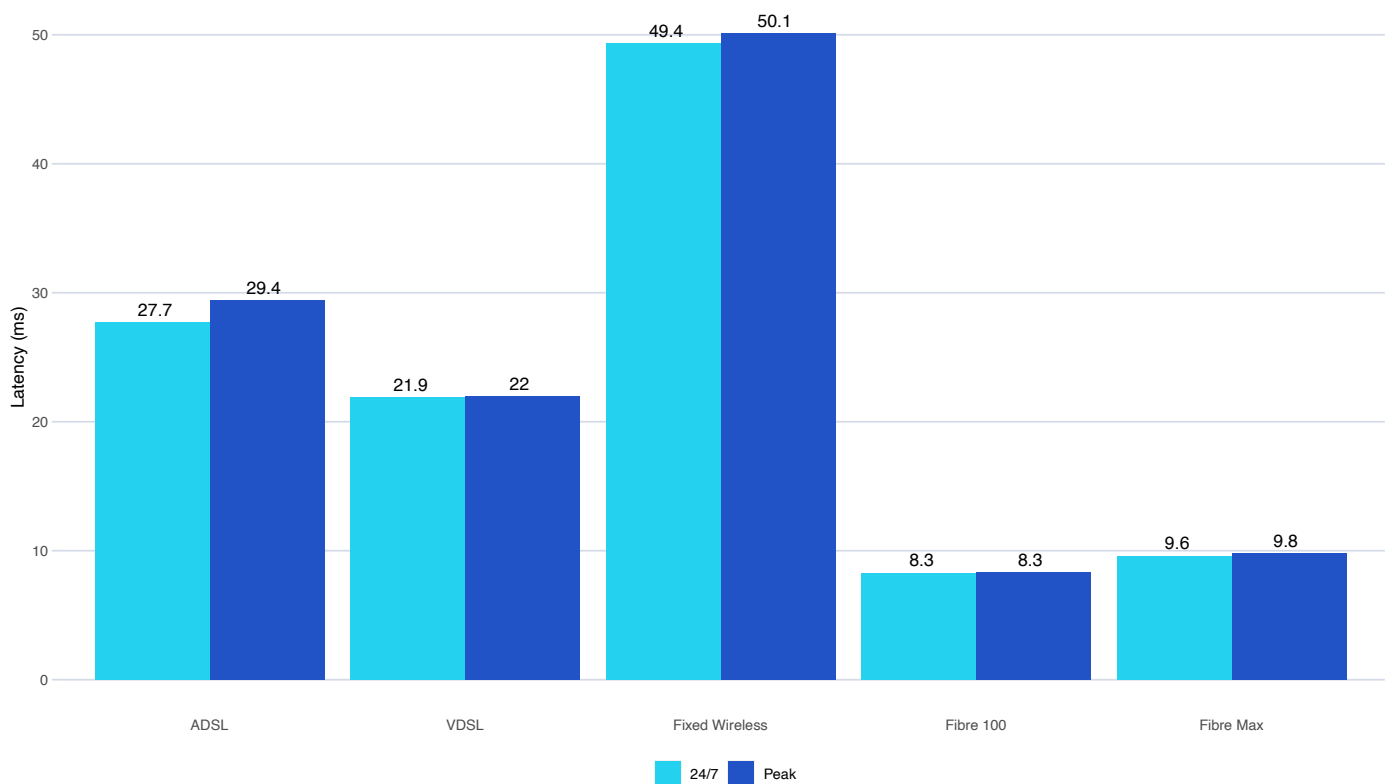


The discussions of Video Conferencing, Online Gaming, and Social Media illustrated the point that differences in latency can affect the behaviour of specific applications. Other latency-sensitive applications which have not been tested individually for this report include cloud-based interactive web 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 15

## Average Latency to Test Servers by Plan.

Lower latency means that applications which transfer data to and from the internet in real time will respond more quickly.



### Key observations

- As demonstrated in Figure 10, latency over Fixed Wireless is higher than over Copper. Fibre offers the lowest latency on average, due both to fast transmission over fibre optics and to the more recent infrastructure underlying the Fibre broadband network.

# Latency (continued)

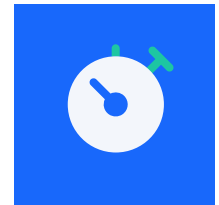
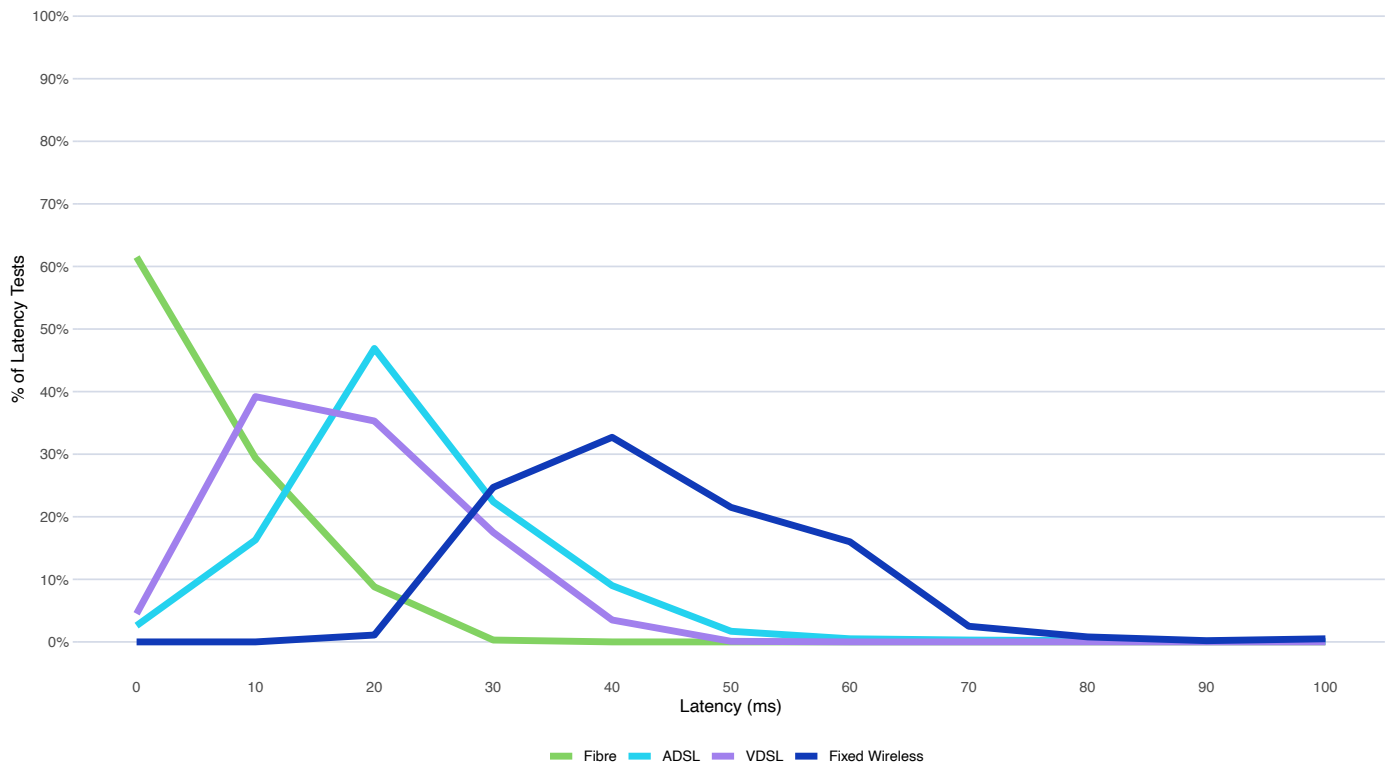


Figure 16

## Distribution of latency between households and test servers hosted in New Zealand.

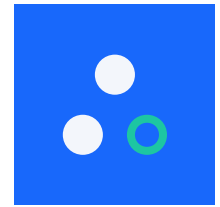
Lower latency means that applications which transfer data to and from the internet in real time will respond more quickly.



### 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.
- Copper and Fixed Wireless plans have a wider range of latency than Fibre; some Copper lines achieve latency comparable with Fibre, whereas almost all latency tests from Fixed Wireless lines took longer than almost all tests from Fibre lines

# Packet Loss

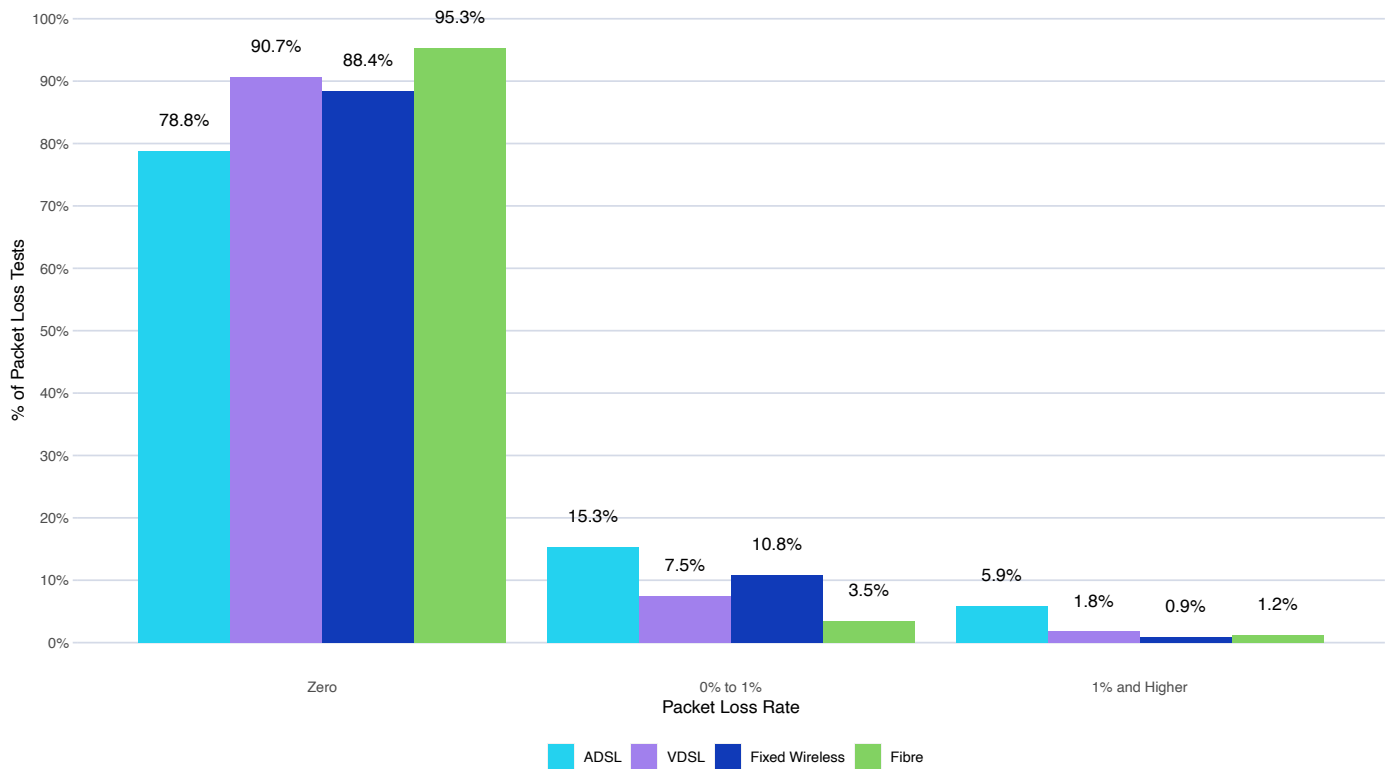


As well as the latency between household and server, MBNZ also records the proportion of packets which are transmitted but fail to arrive (also known as packet loss).

Figure 17

## 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 remains 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

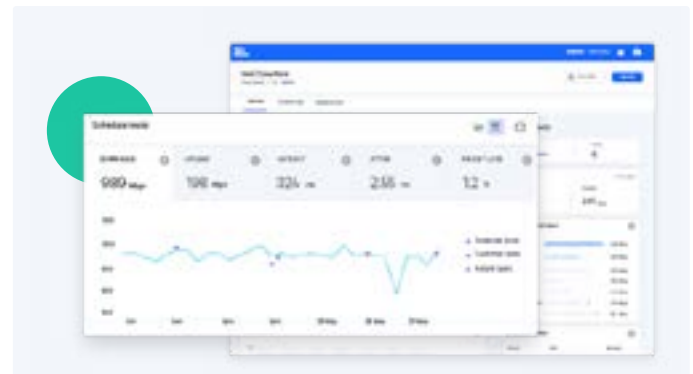


### Measuring homes across New Zealand

- 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.















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

### 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/sign-up](http://www.measuringbroadbandnewzealand.com/sign-up)



## Our tests

Metric		Definition
	Download	The speed data travels from our test server to your device, measured in megabits per second.
	Upload	The speed data travels from your device to our test server, measured in megabits 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 as 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.