Measuring Broadband

New Zealand

Summer Report, April 2021

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 1st December and 31st December 2020. No unusual results were found around the Christmas period; from an internet performance perspective December 2020 was a representative month.

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Overview

This report presents the most recent key indicators of consumer internet performance in New Zealand.

Highlights include:

1. A comparison of Fibre Max plans across RSPs for the first time.

2. Results from Cable plans for the first time.

3. The differences in latency between paid and free versions of the most common video conferencing services.

4. Improvements in Netflix performance to households on slower plans following a change in how Netflix content is distributed worldwide.

The last report, (https://comcom.govt.nz/__data/assets/pdf_file/0008/230030/MBNZ-Spring-Report-2020-9-December-2020.pdf) published on 9th December 2020, took an in-depth look at the Copper and Fixed Wireless technologies. These technologies remain the only options for connectivity in certain parts of the country.

A companion piece to the last report, entitled 'Fibre Max Status Report', (https://comcom.govt.nz/__data/assets/pdf_file/0014/230027/MBNZ-Fibre-Max-Status-Update-9-December-2020.pdf) addressed the performance issues seen for Fibre Max. The under-performance of these plans had been monitored by MBNZ since the start of the programme. The Commission formed a working group with members of the industry and SamKnows, its testing partner, to investigate these performance issues. The significant performance increases which resulted from this collaboration are detailed further in this report.

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

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

Executive Summary

Benchmarking

1. The performance of Fibre Max[1] has improved substantially since the previous report, as the result of a collaboration between the Commission, SamKnows, and industry. Overall performance is now more in line with the advertised headline speeds for these packages, the effect of evening peak hours has been reduced, and the differences in performance across different parts of the country have been smoothed.

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, GoToMeeting, and Webex (new to this report) is within a usable range for all plans. Fibre plans remains more likely to support a lower latency.

2. Video Streaming: Higher speed plans remain able to stream Netflix in Ultra High Definition nearly all of the time. Netflix has introduced changes to the way that its High Definition and Ultra High Definition videos are encoded, which means that more households on lower speed plans are able to watch Ultra High Definition content.

3. Online Gaming and Social Media: Results were consistent with those seen in previous reports. Charts of the performance of gaming and social media applications have been omitted from this report.

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1 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.

Package Comparison

ADSL

Remains suitable for traditional services like web browsing, email, and basic video streaming, particularly when there's only one person using the connection. Due to physical limitations, the highest-performing ADSL lines will never achieve download speeds higher than ~25 Mbps. The distance from house to exchange has a big effect on attainable speeds, with most ADSL lines in New Zealand averaging under 8 Mbps download. Coupled with the higher latency inherent to the technology, this does make ADSL less suitable for upload-heavy applications and multi-user households.

VDSL

There is a range in performance: some lines will achieve download/upload speeds indistinguishable from ADSL, whereas a small proportion of lines will achieve speeds comparable with Fibre 100, and certainly with lower speed Fibre plans. Lower speed lines will be less suitable for applications which use a lot of data, such as video conferencing and Ultra High Definition streaming, whereas higher speed lines will generally support more data-heavy applications.

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.

Fibre Max

Higher download and upload speeds than Fibre 100. The latency to internet applications, such as online games, through a Fibre Max line is the same as through any other Fibre package. Performance varies depending on RSP and is slightly lower in the South Island than in the North Island. Fibre 100 will support all modern internet applications and multi-user households, so Fibre Max is still only recommended in cases where there is a genuine need for more bandwidth e.g. frequently uploading or downloading large files.

Cable

Available in some areas (Wellington, Upper & Lower Hutt, the Kapiti Coast, and parts of Christchurch). Cable is also referred to as Hybrid Fibre-Coaxial (HFC) and DOCSIS. Vodafone is the only provider operating a Cable network in New Zealand. Two plans are available: UltraFast HFC Max and UltraFast HFC 200. Due to the limited coverage of the Cable network, MBNZ doesn't collect enough data to formally report on the performance of the UltraFast HFC 200 plan.

Fixed Wireless (4G)

Can offer higher download speeds than ADSL, but with higher latencies due to the cellular technology underlying these plans. Fixed Wireless has the highest latency of all technologies apart from Satellite (not currently reported on by MBNZ). Fixed Wireless connections will be more likely to experience issues with latency-sensitive applications such as online gaming or video conferencing. Fixed Wireless connections can also be affected by congestion (for example average download speeds dropped by 25% in the March 2020 COVID-19 lockdown because of increased congestion). 5G Fixed Wireless plans (not currently reported on by MBNZ) are at present only available in limited areas, but would offer higher bandwidth than existing 4G plans.

Other packages

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

Speed Tests
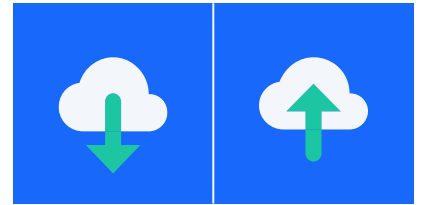
Figures 1 and 2 present an overview of download and upload speed across the country. These are included in every report in order to provide a benchmark that can be tracked over time. Peak hours are the times when people typically use the internet; in New Zealand this is 7pm to 11pm on Monday-Friday. 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. Error bars show 95% confidence intervals.
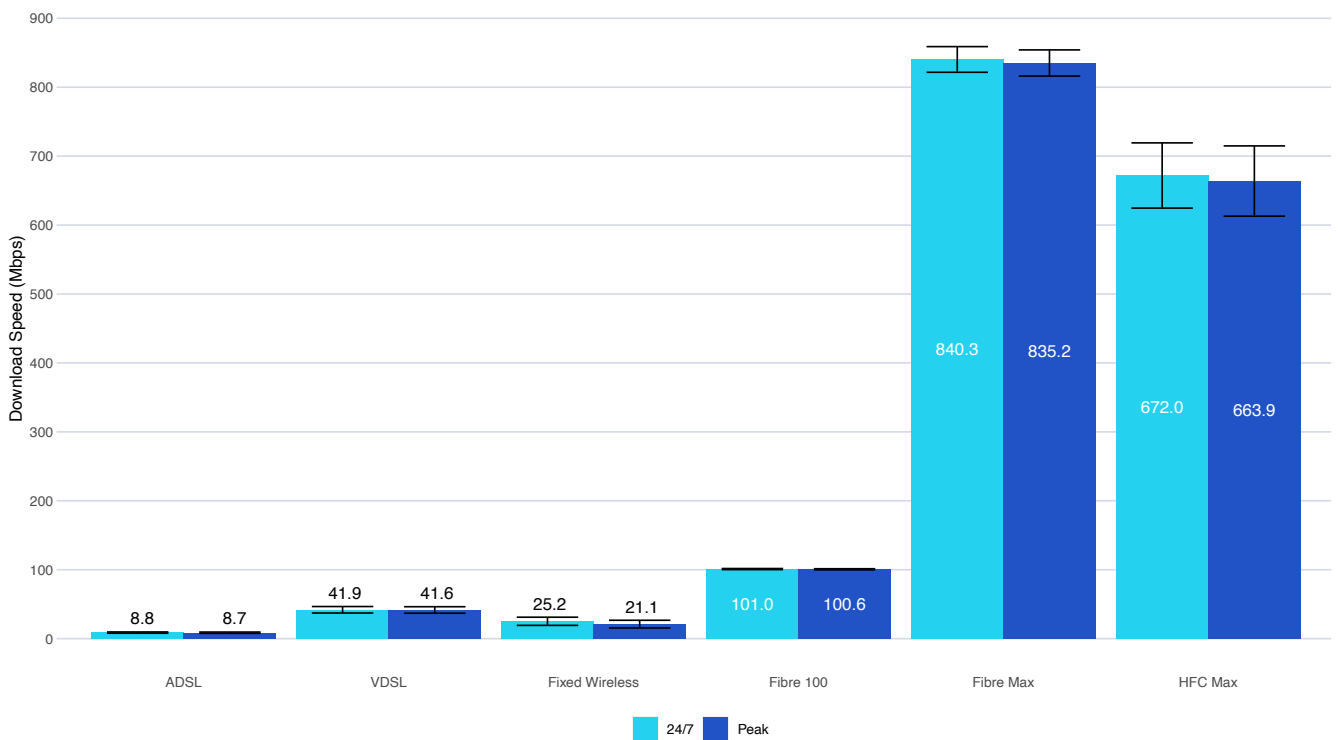
Fibre Max had been identified as under-performing in previous reports. These results show a large improvement in Fibre Max's average download speed.

These results are shown with error bars representing the 95% confidence interval for each plan's average speed. If we had repeated our measurements 100 times, we would expect average speeds to have fallen within the black bands in at least 95 cases. Other graphs throughout the report display similar confidence intervals, which carry the same interpretation.

Speed Tests (continued)

Key observations

- The average speed of Fibre Max plans has increased by over 200 Mbps, or 35%, since the previous report. This increase affects a large number of people across the country - the Commission's Annual Telecommunications Monitoring Report 2020 (https://comcom.govt.nz/__data/assets/pdf_file/0030/247377/2020-Annual-Telecommu-nications-Monitoring-Report-Revised-version-16-March-2021.pdf) reports that there are 118,000 residential Fibre Max connections across New Zealand. The improvement can be attributed to network changes made by several parties in the latter part of 2020, as detailed in the MBNZ Fibre Max Status Update published 9th December 2020 (https://comcom.govt.nz/__data/assets/pdf_file/0014/230027/MBNZ-Fibre-Max-Status-Update-9-December-2020.pdf). There is no noticeable dip in performance during peak hours, another improvement on previous reports.

- HFC Max[2], new to this report, has download speeds at the higher end of the scale, although below those of Fibre Max (which is the comparative plan for Fibre).

- The average speed of other plans has remained consistent with speeds observed in previous reports.

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2 Results for HFC Max are based on a sample size of 30 Whiteboxes. This accounts for the wider confidence intervals for HFC Max results. Since 30 is lower than the usual minimum used in reporting, we should caveat that the results may not be representative of all HFC Max connections. The low sample size can be attributed to the relatively small coverage area of Vodafone's Cable network and the competing influence of Copper, Fibre and Fixed Wireless in those areas.

Speed Tests (continued)

Upload speeds should be considered alongside download speeds. The main applications where the impact of upload speed is apparent are file transfers and remote storage. For example, a lower upload speed will mean that it takes longer for files to sync or email attachments to be applied.

Average Upload Speeds by Plan

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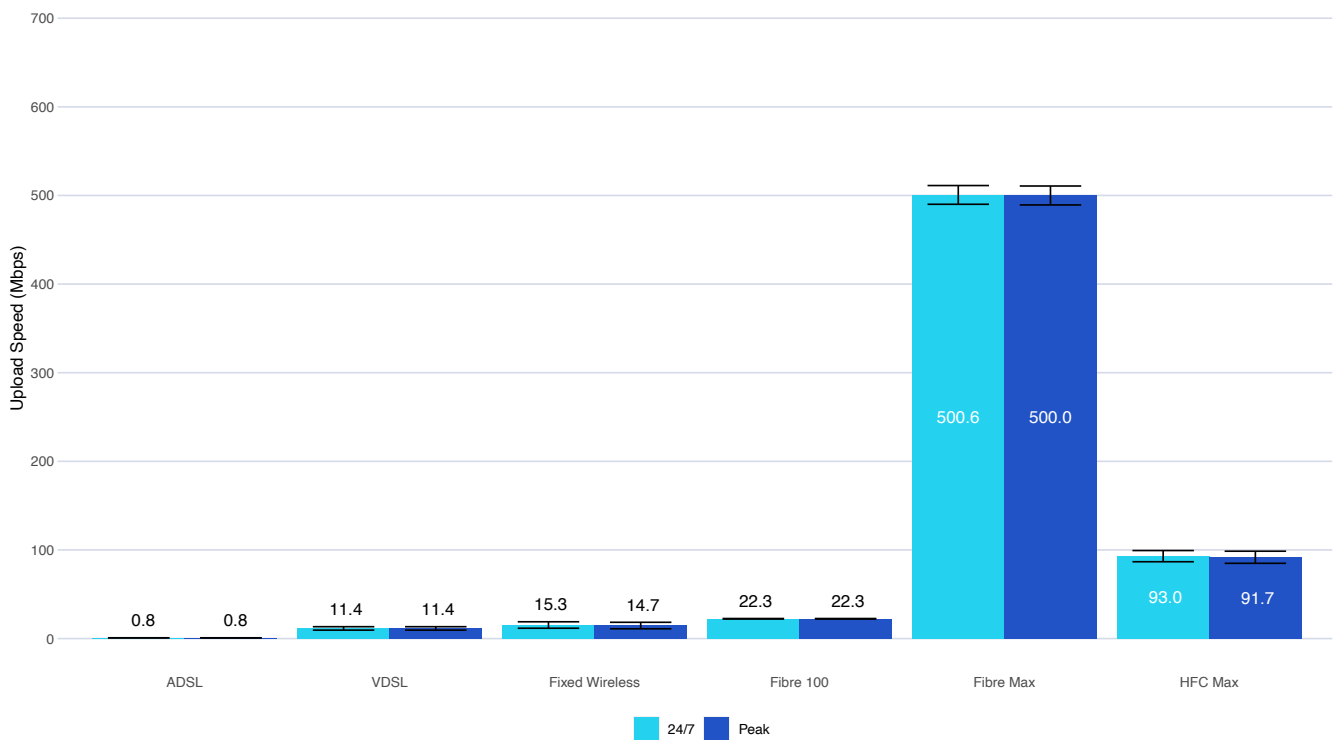
Key observations

- Fibre Max upload speeds have increased slightly, by around 16 Mbps against the previous report. Fibre Max upload performance had historically been more in line with the speeds advertised by RSPs than download.

- HFC Max, new to this report, has upload speeds generally between those of Fibre 100 and those of Fibre Max.

- Upload performance results from other plans remain consistent with those seen in previous reports.

Latency
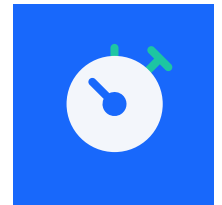
Latency is another key factor that should be considered when assessing broadband performance. The time it takes to transmit and receive messages between household and server limits the responsiveness of realtime applications such as interactive webpages or video calls.

For somebody playing an online game, higher latency introduces more delay between the time that they press a button and that action being registered by other players. If latency is too high then this can result in stuttering and unintended behaviour within the game, generally referred to as lag. Similar problems can arise in video calls. If baseline latency to a video conferencing server is higher, then the call may run with a more noticeable delay and be more susceptible to jumps and dropouts.

A disrupted video call can have serious impact when the technology is used in situations like job interviews, legal proceedings, and medical consultations. The importance of a reliable internet connection has been highlighted during the COVID-19 pandemic; high latency in these cases can be even more damaging than before.

As well as tests to specific applications, which are detailed further in this report, MBNZ runs tests to SamKnows servers hosted in New Zealand. This gives a generic indication of the differences in latency to real applications across plans.

Figure 3

Average Latency to Test Servers by Plan. Lower is better.

Average of monthly household averages. Peak hours are Monday - Friday, 7pm - 11pm. Error bars show 95% confidence intervals.
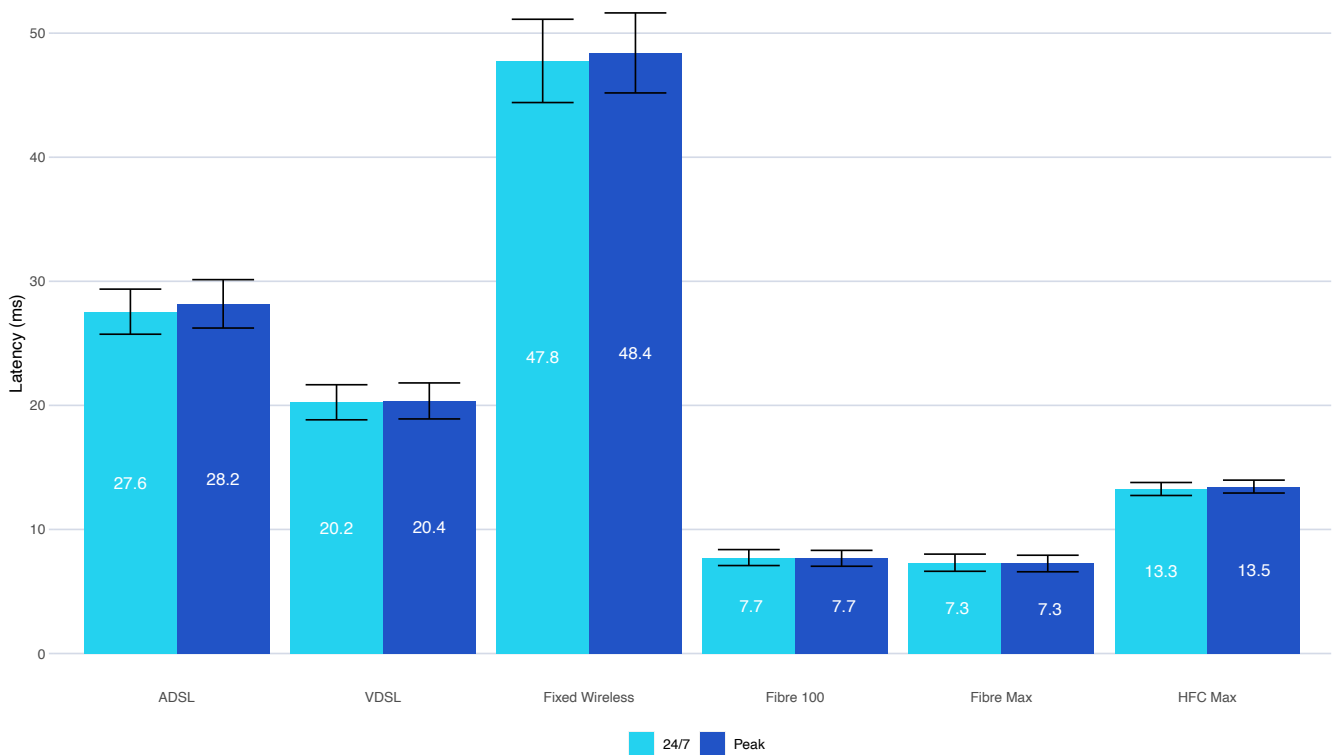
Latency (continued)

Some plans show a wider variation of latency than others: latency across a Fixed Wireless line will generally be more variable than over a Fibre line. These ranges have been reported explicitly in previous reports.

Key observations

- Latency over Fixed Wireless is higher than over Copper, Cable, or Fibre. Fibre is faster due to both the lower latency over fibre optics and to the more recent infrastructure that underpins the Fibre network.

- HFC Max, new to this report, has an average latency between that of Fibre and that of Copper.

- There is no difference in latency across different Fibre plans, since latency is independent of bandwidth. A Fibre Max plan will not necessarily result in more responsive performance of interactive applications than a Fibre 100 plan.

Past Performance of Fibre Max
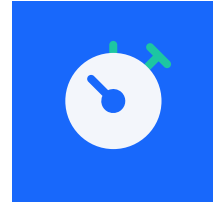
Fibre Max has had a varied set of results over the course of the MBNZ programme. Following the network improvements detailed in the Fibre Max Status Update, published 9th December 2020, the average performance is now in line with expectations.

Figure 4

Past Performance of Fibre Max

Average download speed reported in each MBNZ report. No Fibre Max result was available from the first report (October 2018).
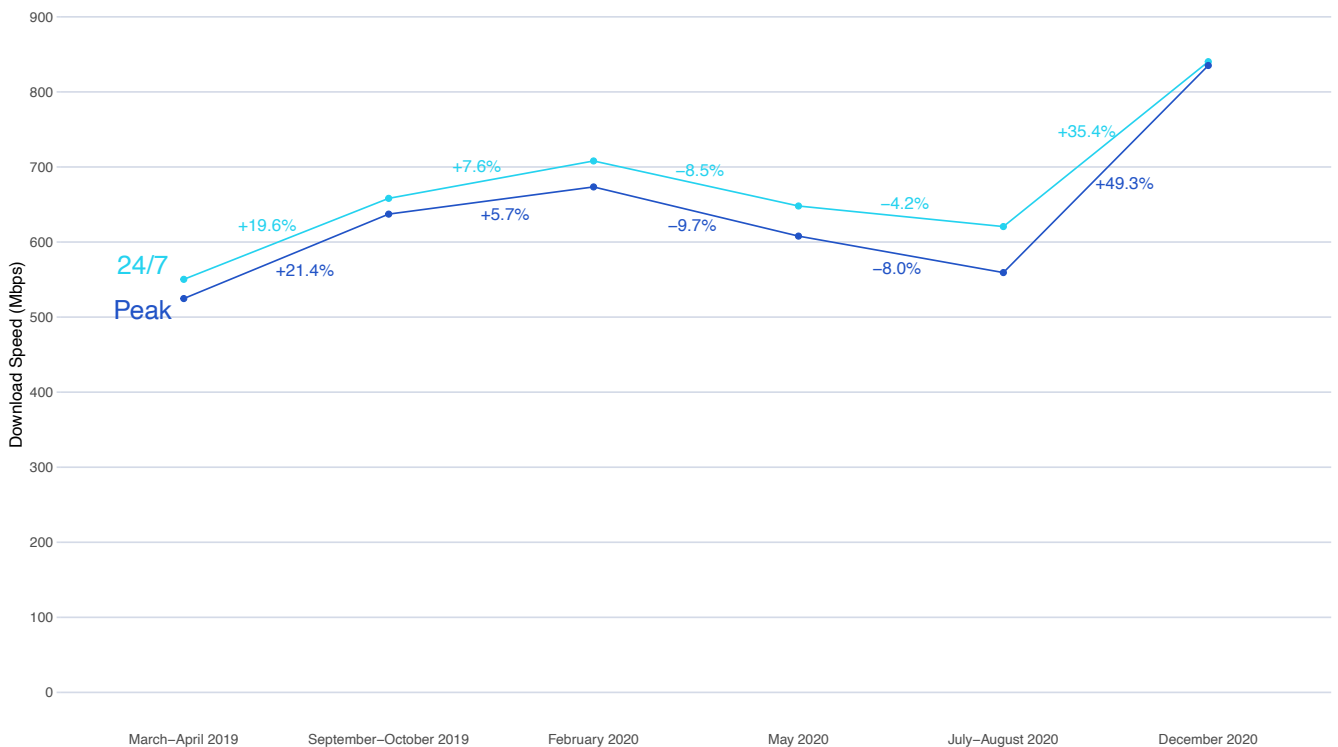
Key observations

- Results improved between the March-April 2019 period and the September-October 2019 period. This was largely due to a single RSP resolving an interconnectivity issue.

- Throughout 2019 Fibre Max performance remained below par. Unpublished data at the time indicated that performance issues were not limited to any particular RSP, LFC, or geographical area. The Commission, SamKnows, and several industry stakeholders formed a working group to investigate the causes of the under-performance.

- New Zealand's response to COVID-19 saw record traffic volumes crossing the network as most people worked, studied, and socialized from home. This had little impact on the performance of lower speed plans, but had an small impact on Fibre Max.

- By the July-August 2020 period, the working group had developed a detailed understanding of the problem. Fixes were applied to the network at several levels between August and November, and by the December 2020 period average download speeds had arrived at a higher level, with results improving for all measured RSPs.

Fibre Max Breakdown by RSP

Fibre Max plans are generally advertised to the public with headline download speeds between 750 Mbps and 950 Mbps. Fibre Max plans are derived from 'gigabit' wholesale products but, since around 6% of the data in HTTP traffic is given over to protocol overhead (IP packet headers etc.), the highest speed test result that can theoretically be achieved by a Fibre Max line is around 940 Mbps.

Figure 5

Average Fibre Max Download Speed by RSP

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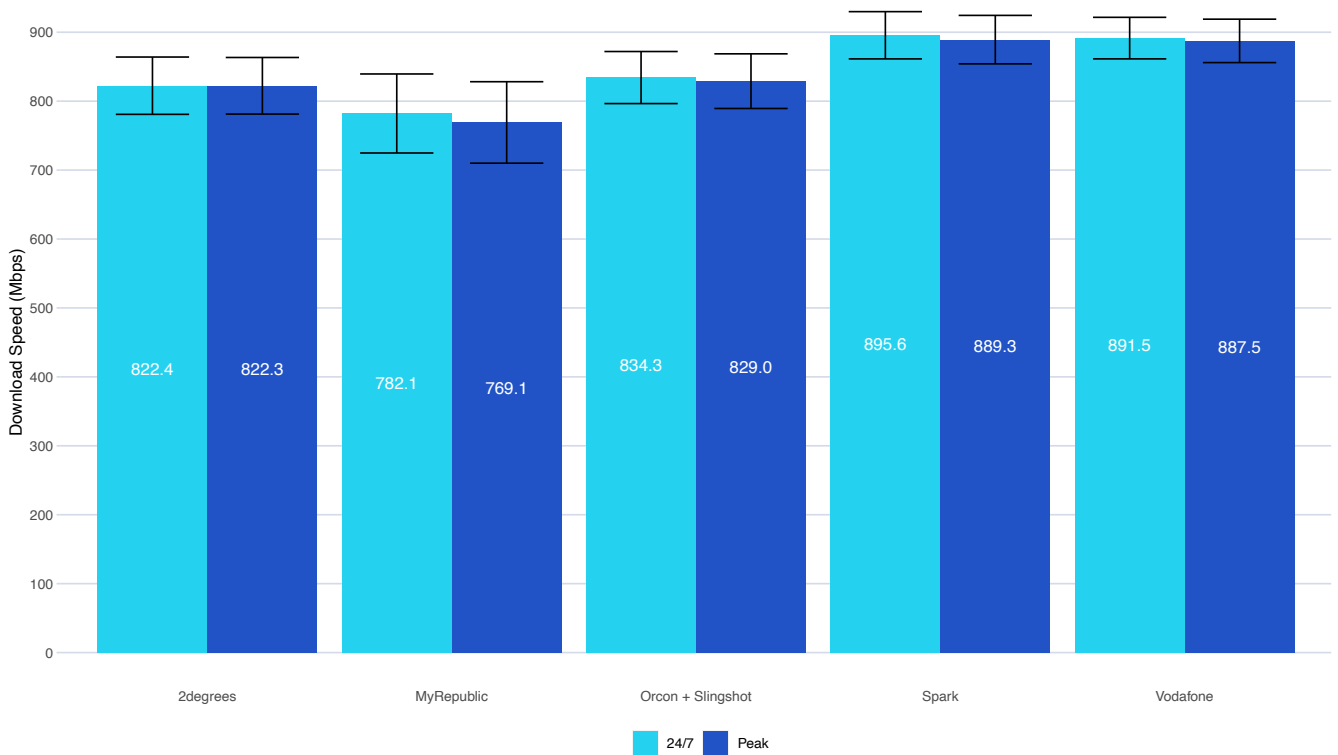
Key observations

- Vodafone and Spark's average download speeds across Fibre Max lines are slightly higher than for other RSPs, but this difference is not statistically significant.

- All RSPs' average Fibre Max download decrease somewhat during the peak. None of the decreases are large enough to materially impact performance.
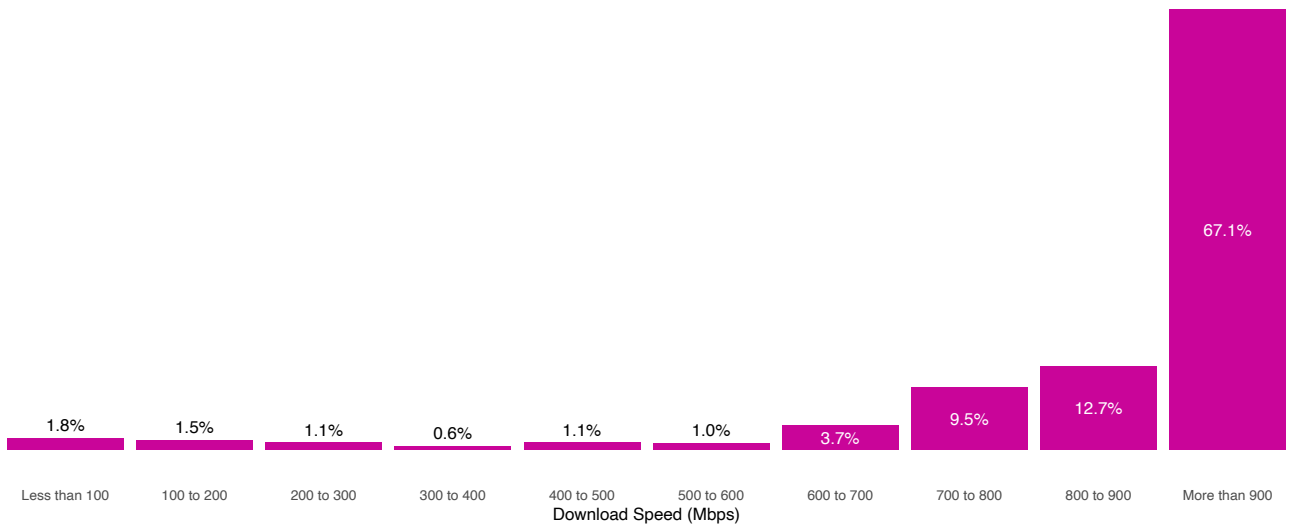
There were not enough Fibre Max volunteers connected to Trustpower during the measurement period to report results for those RSPs. All RSPs are included in the overall Fibre Max results shown in Figures 1 and 2.

Distribution of Fibre Max Results

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.


Distribution of test results showing download speeds (Mbps):
- Less than 100: 1.8%
- 100 to 200: 1.5%
- 200 to 300: 1.1%
- 300 to 400: 0.6%
- 400 to 500: 1.1%
- 500 to 600: 1.0%
- 600 to 700: 3.7%
- 700 to 800: 9.5%
- 800 to 900: 12.7%
- More than 900: 67.1%

Download Speed (Mbps)

Key observations

- 67% of speed tests run over Fibre Max lines now achieve download speeds above 900 Mbps, up from 22% in the previous report.

- A total of 80% of **tests** run on Fibre Max achieve download speeds above 800Mbps up from 37% in the previous report.

- Within the range of test results, 78% of tested Fibre Max **households** had an average download speed higher than 800 Mbps, up from 35% in the previous report.

Fibre Max Breakdown by Island

Average Fibre Max Download Speed by Island

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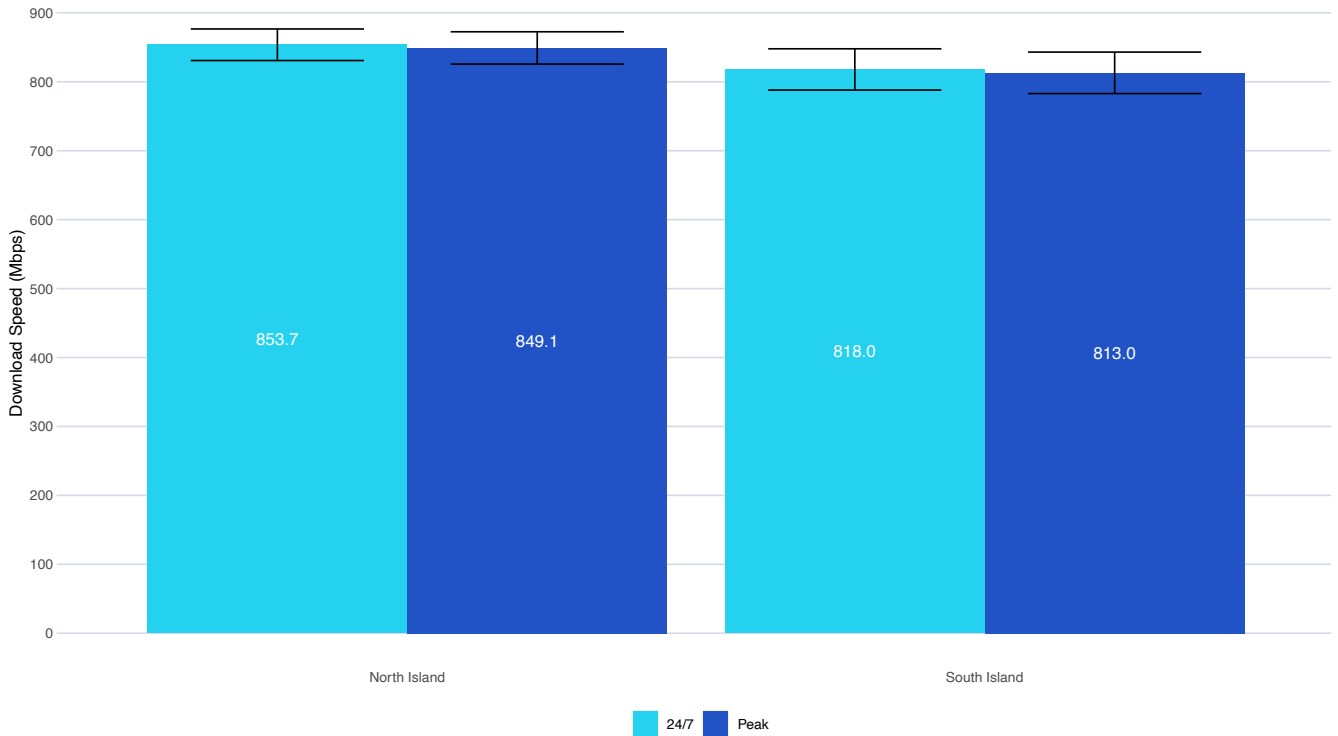
Key observations

- Fibre Max results in the South Island remain lower than those in the North Island. The difference between islands is far less than existed before the network adjustments that raised Fibre Max performance as a whole. Performance in the South Island improved by a greater amount in percentage terms (+70% since the previous report) than in the North Island (+23% since the previous report).

- Average Fibre Max speeds in Auckland are slightly lower than in the rest of the North Island, but this difference is not statistically significant.

- Both the North Island and South Island saw a dip in performance when comparing average 24 hour speeds to peak hour speeds.

The SamKnows test servers used for these speed tests are located in Auckland and Wellington. Since tests are run to the nearest server (in latency terms), tests originating in the South Island will generally use the Wellington server. Real internet traffic originating in the South Island will often remain within the South Island. To test whether this has an impact on speed test results, the Commission and SamKnows are deploying a third test server location in Christchurch. Results from this server will be reflected in MBNZ reports starting from this year's Winter report.

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 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 speed across RSPs.

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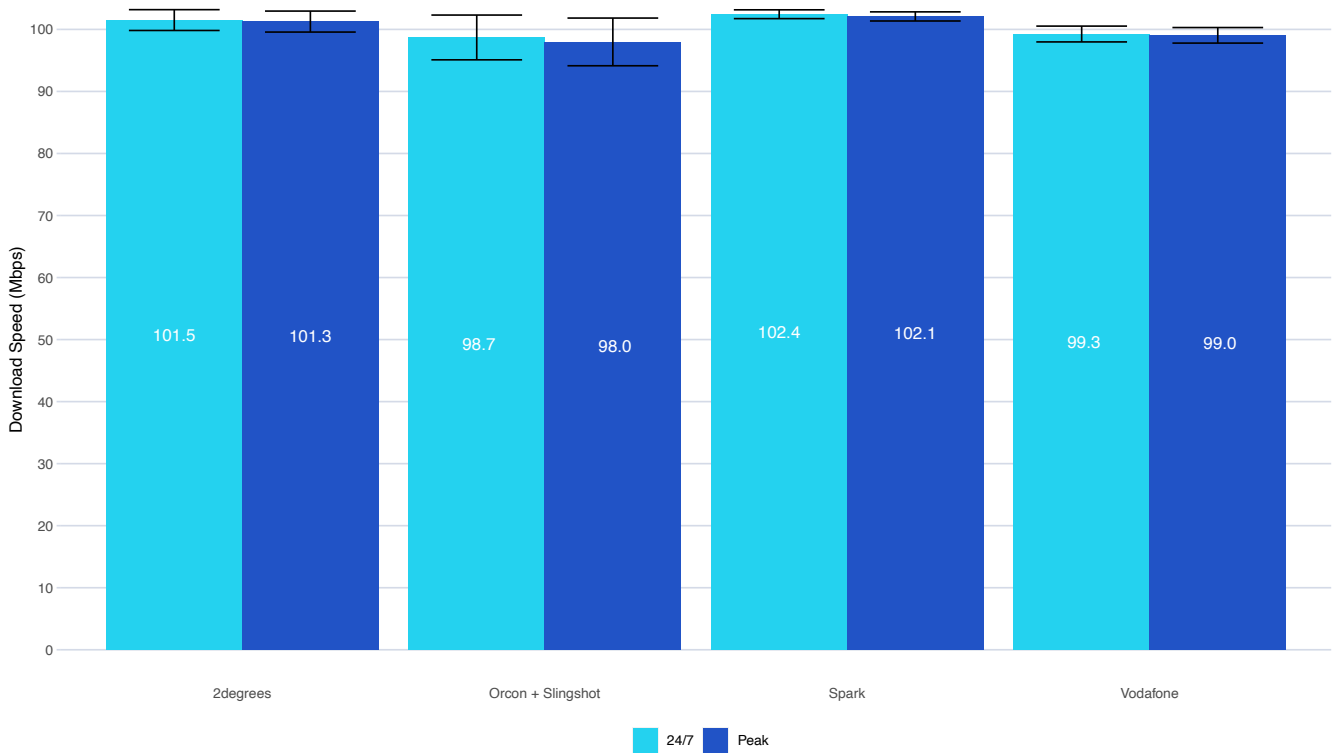
Key observations

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

- Vocus (Orcon + Slingshot), whose results had not been published in previous reports, have average results in line with the plan's advertised speed of 100 Mbps.

There were not enough volunteers connected to MyRepublic or Trustpower to report results for those RSPs. Those RSPs are included in the overall Fibre 100 results shown in Figures 1, 2, and 3.
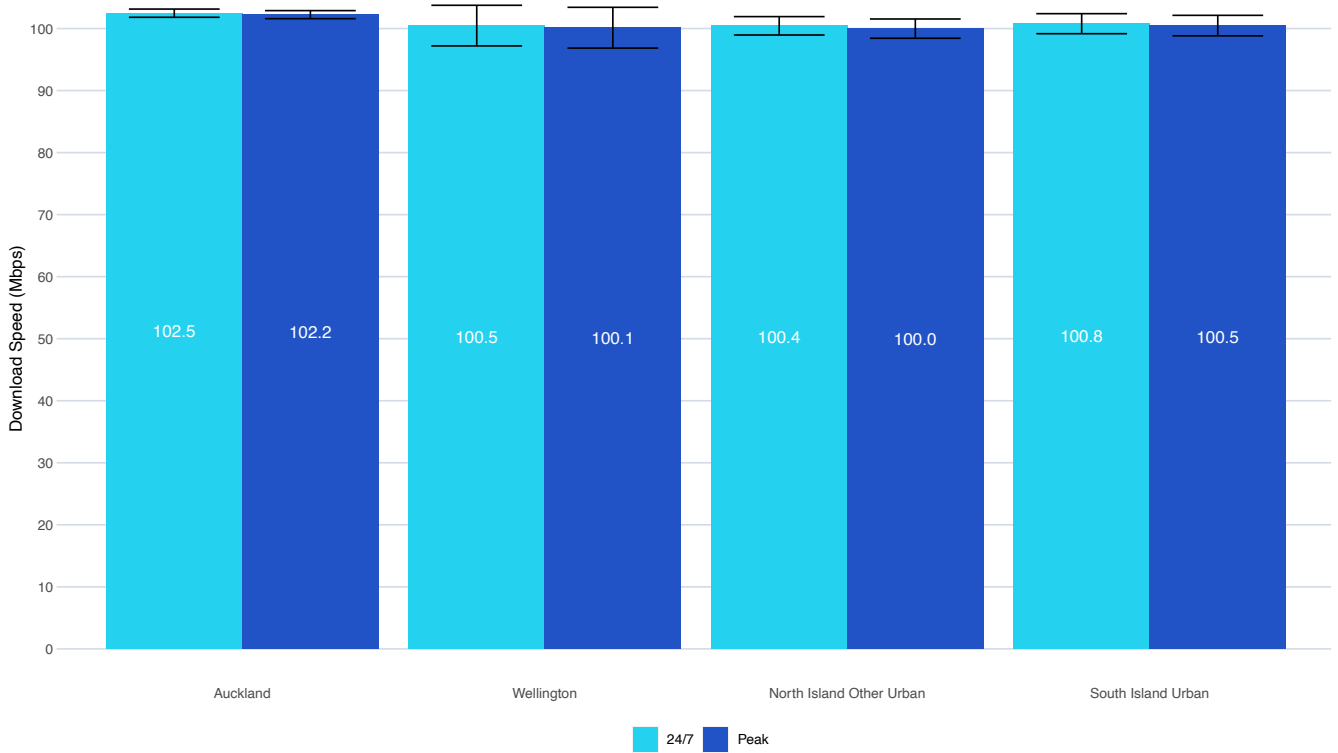
Fibre 100 Breakdown by Region

Comparison of average Fibre 100 download speeds for different parts of New Zealand.

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

Key observations

- The difference that previously existed between the South Island and North Island has disappeared since the previous report. The difference between islands that had been reported previously was always on the borderline for statistical significance, so the improvement could be a coincidence. We will continue to track the performance across both islands in future reports.

Video Conferencing

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

The latency to servers using a free or paid account for popular video conferencing services. Lower is better.

Average of household average latency to relay services. Lower latency means less delay during calls. Error bars show 95% confidence intervals.
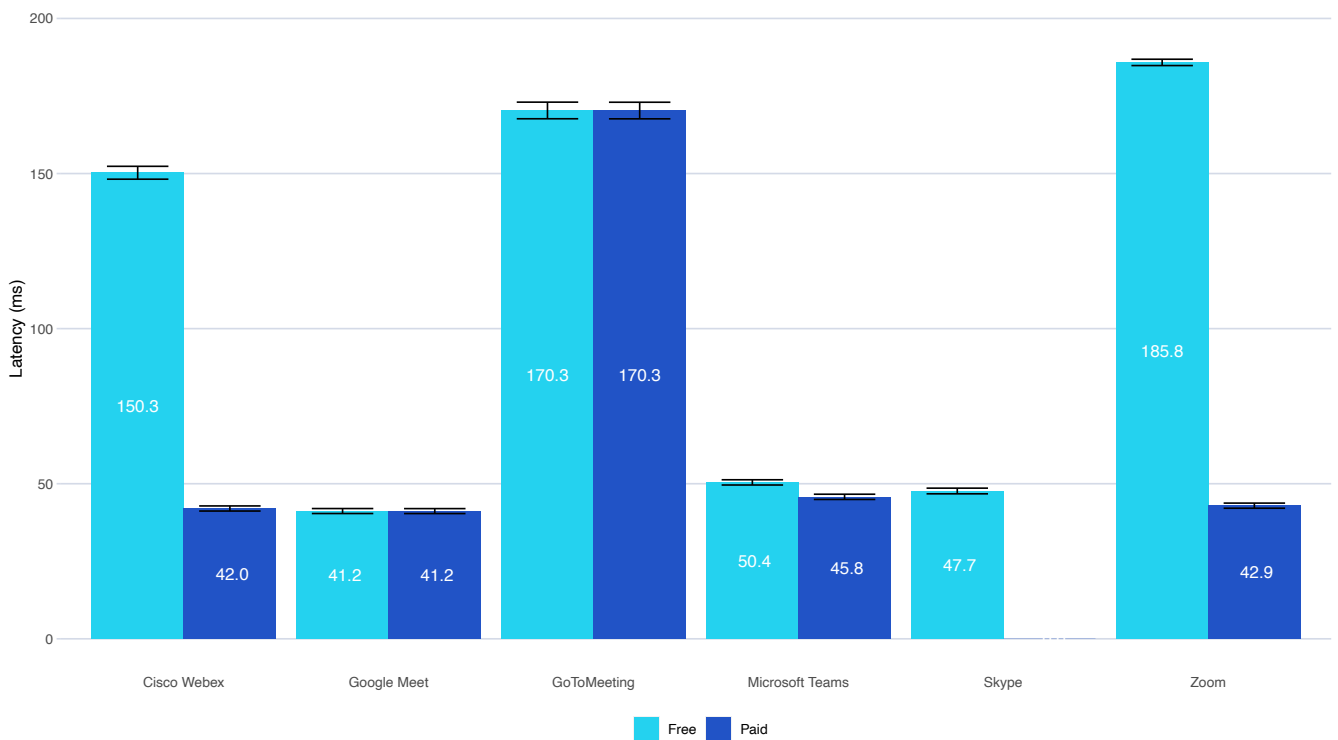
Latency is not the only factor impacting on the quality of a video call. Packet loss and jitter can result in stuttering and dropouts, and these are not captured in the round trip times measured here. Application specific attributes such as audio/video encoding and proprietary communication protocols can lead to different performance characteristics for different services.

No results were collected for the paid version of Skype. The paid version of the service, Skype for Business, is planned to be combined with Microsoft Teams later this year.

Video Conferencing (continued)

Key observations

- Zoom and Cisco Webex both provide paid subscribers with geographically nearer servers than unpaid subscribers. This results in lower latency for paid subscribers. Although a significant difference is shown in the chart, both paid and unpaid subscribers of Zoom and Webex would likely experience similar performance when on a video conference call, assuming normal network conditions. Latency is only one factor that affects video conferencing quality of experience. Other differences between free and paid accounts such as holding longer meetings or inviting more participants aren't included here.

These results have been averaged across all plans measured by MBNZ. This has been done for clarity, since the purpose of this graph is to compare video conferencing services more than individual plans. There are differences in latency to each service between plans and technologies, as noted in previous reports, which follow the general pattern of Figure 3.
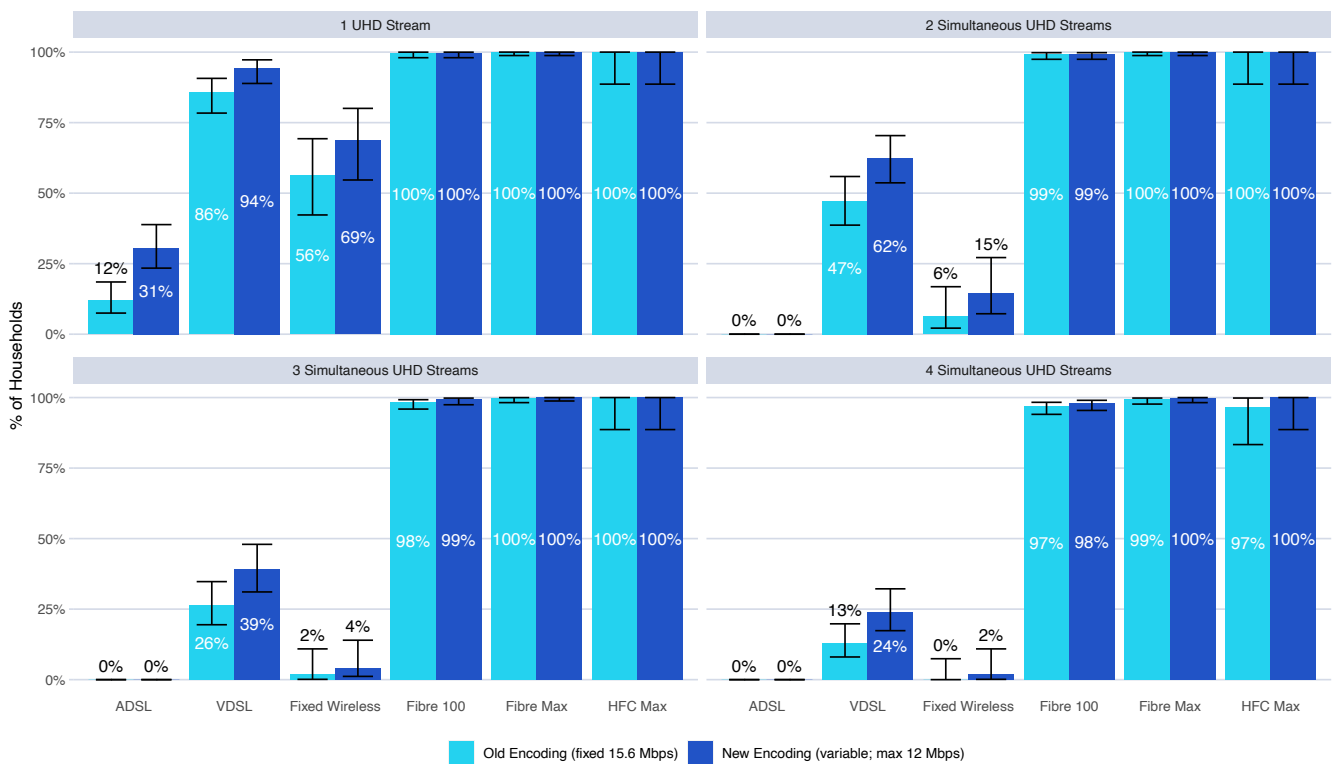
Video Streaming

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. Netflix has recently introduced a change to the way its high definition and 4K video is encoded. Video is now delivered at a variable bitrate depending on the complexity of the video being transmitted. This means that a program with fewer colours and less movement, like a cartoon, will be encoded at a lower bitrate than a fast-paced action film. In practical terms, if 4K video was encoded at 15.6 Mbps previously, it would now be transmitted at no more than 12 Mbps as a worst case. This has little effect on higher speed Fibre plans, but does mean that a number of households on Copper and Fixed Wireless plans will be more likely to be able to watch an Ultra High Definition video, or even support multiple streams running simultaneously.

Figure 11

The proportion of households able to stream 1, 2, 3, or 4 simultaneous Ultra High Definition videos from Netflix

Based on the average download speed to Netflix servers for each household. Error bars show 95% confidence intervals.

It should be noted that these percentages refer to the proportion of households which can stream in 100% UHD following the changes Netflix have made to the way they deliver content.

Video Streaming (continued)

Key observations

- A larger fraction of households on VDSL and Fixed Wireless plans are now able to stream an additional screen of Netflix content in UHD.

- 31% of ADSL households can now reliably stream UHD video compared to 12% previously. The same figure for VDSL is 94% (against 86% previously), and 69% (against 56% previously) for Fixed Wireless.

- Most households on VDSL would already be able to reliably stream at least one UHD video. 62% of VDSL households can now run two UHD videos simultaneously (as against 47% previously), as can 15% of Fixed Wireless households (as against 6% previously).

- A higher fraction of VDSL households can now stream three or four simultaneous UHD videos. The higher rates of improvement for VDSL reflect the fact that VDSL speeds are distributed along a continuous range. On the other hand, the fundamental constraints on ADSL and Fixed Wireless download speeds mean that these technologies have less room to improve.

How we test

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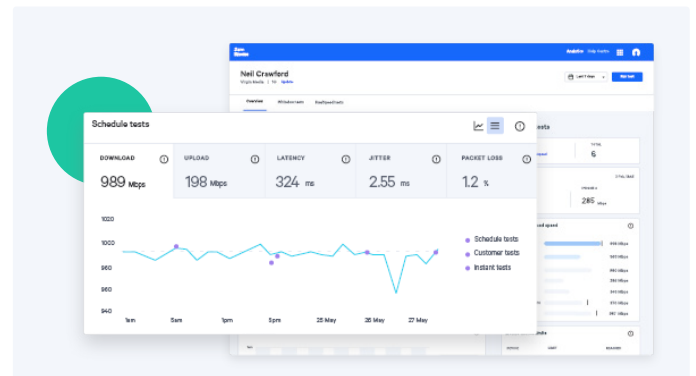
SamKnows One stores all your home broadband performance data for easy analysis and detailed investigations

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/signup

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 3840×2160 pixels.
Upload speed	The speed that data travels from your router to our test server. Measured in Mbps (megabits per second); higher is better.