Measuring Broadband New Zealand

Autumn Report, May 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 during February 2020 with some additional analysis on March and April 2020.

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Overview

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

1. Internet performance during the first four weeks of New Zealand's nationwide lockdown in response to the COVID-19 pandemic.
2. A detailed insight into how social media applications like Facebook serve different kinds of content.
3. Comparison of the latency of different gaming services by package.

Previous reports in this series have examined topics including internet performance during online broadcasts of the Rugby World Cup 2019, how many people in a household can watch Netflix at the same time, and the speed of accessing content hosted overseas.

We still need New Zealanders to take part!

These are the plans and RSPs that we need more volunteers on:

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

Now more than ever, we need accurate data to ensure that vital services such as telecommunications are serving New Zealanders everywhere. If we've sent you a Whitebox in the past that's no longer plugged in, we'd be absolutely stoked to have you back contributing to the results; 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: https://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.*

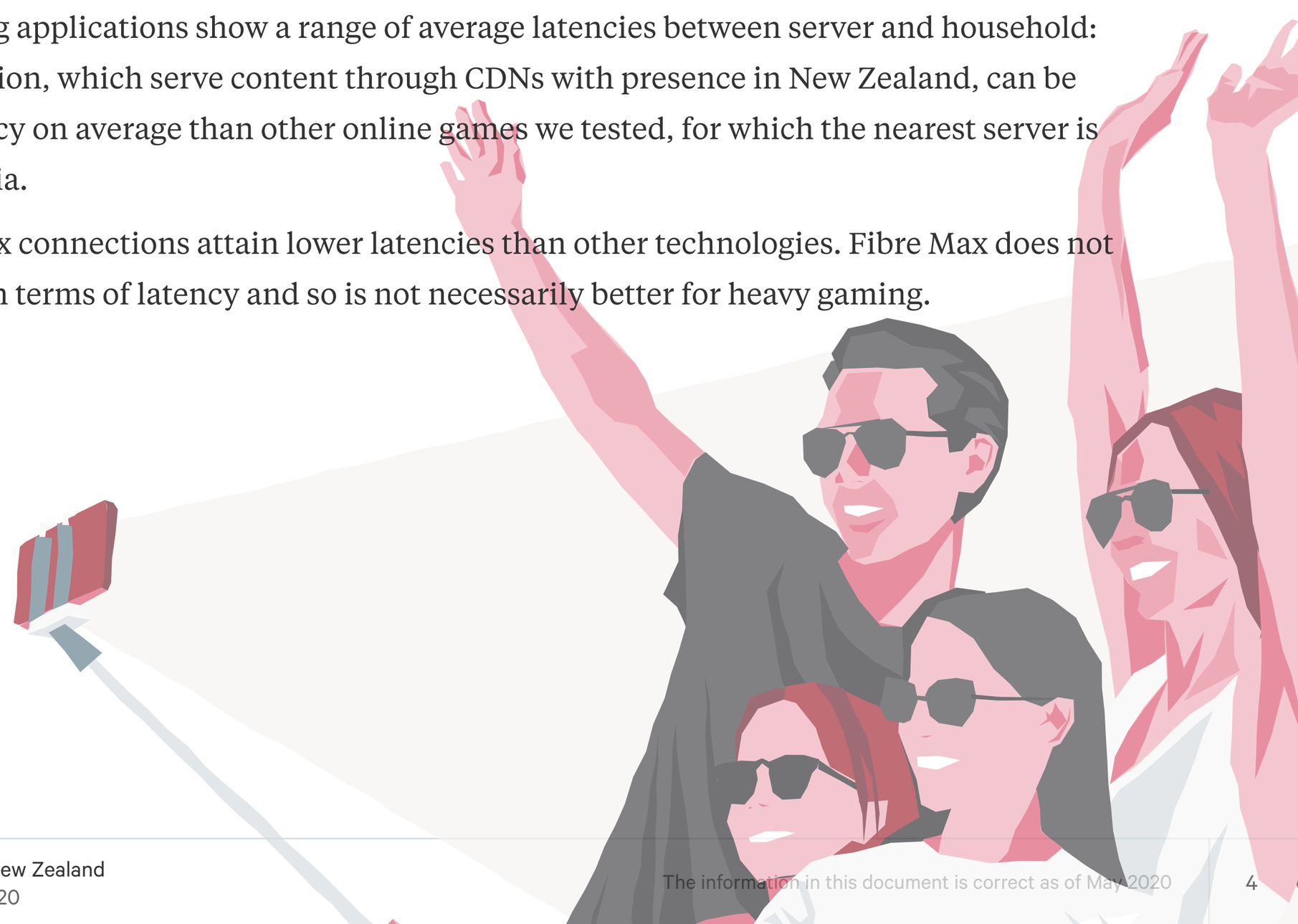
Executive Summary

COVID-19

1. New Zealand entered Alert Level 4 on 26th March 2020. Chorus, the main fibre wholesaler, reported record levels of traffic during the first week of lockdown as people began working from home and using their internet more.
2. On average, fixed line broadband connections experienced no significant drops in download speed during the first week of lockdown. Download speeds for DSL and Fibre 100 packages remained unaffected on average. Average download speeds for Fibre Max packages decreased, although not materially. Average download speeds for Fixed Wireless plans did decrease by 20-to-25%.
3. Fibre Max and Fixed Wireless download speeds saw the peak period extend into the afternoon (12pm to 6pm) as opposed to seeing a dip in speed during the typical evening peak. Any decreases in speed during the afternoon were at around the same level as during the regular evening peak.
4. Please note that the March and April analysis only uses data from panellists whose February details had been validated by their RSP and whose speed test results had not changed so much as to suggest that they might have changed plan. Furthermore it only uses data from Whiteboxes which had submitted some data during March and each week of lockdown, so that a consistent set of Whiteboxes are used for comparison.

Social Media and Gaming

1. Different social media applications show a range of average latencies to households. Facebook, Instagram, and Twitter, which host parts of their content in New Zealand, can be accessed with lower latencies than WhatsApp and Snapchat which host all content overseas. This pattern is not the same across image and text media, since large applications often serve different parts of their content from different places.
2. The presence of Facebook caches in most RSPs' networks mean that connections in the South Island experience a slight latency penalty when compared to the North Island, though at a level which would not affect user experience.
3. Different online gaming applications show a range of average latencies between server and household: FIFA 18/19 and Playstation, which serve content through CDNs with presence in New Zealand, can be accessed at lower latency on average than other online games we tested, for which the nearest server is often hosted in Australia.
4. Fibre 100 and Fibre Max connections attain lower latencies than other technologies. Fibre Max does not outperform Fibre 100 in terms of latency and so is not necessarily better for heavy gaming.



Executive Summary (continued)

Benchmarking

1. 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.
2. The average Fibre Max download speed has increased since the previous reporting period. This jump in performance is mainly due to network changes that one particular RSP made, which is pulling up the average.
3. Most RSPs can deliver average Fibre 100 speeds as advertised. There is a definite, but small, difference in the average download speed of Fibre 100 connections between the South Island and the North Island.
4. 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.

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 calls.

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 (for instance frequently uploading large files). Fibre Max does not necessarily outperform Fibre 100 for intensive applications like high definition video streaming or online gaming.

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 we aren't able to give any firm advice around their suitability for different applications at this stage.

What's next

This is the fourth of many reports to be issued by the MBNZ project: future reports will continue to track internet performance as the COVID-19 pandemic evolves globally, compare the performance of more applications (including video chat services) and break results down for more providers and packages.

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.

Sign up

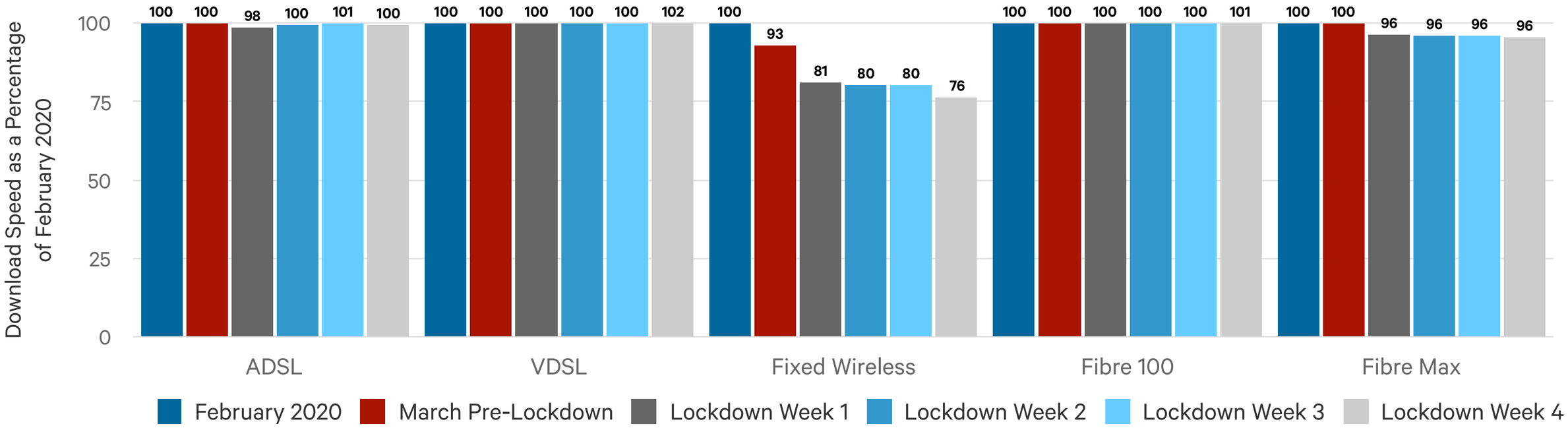
www.measuringbroadbandnewzealand.com

Impact of COVID-19

1st February - 22 April, 2020

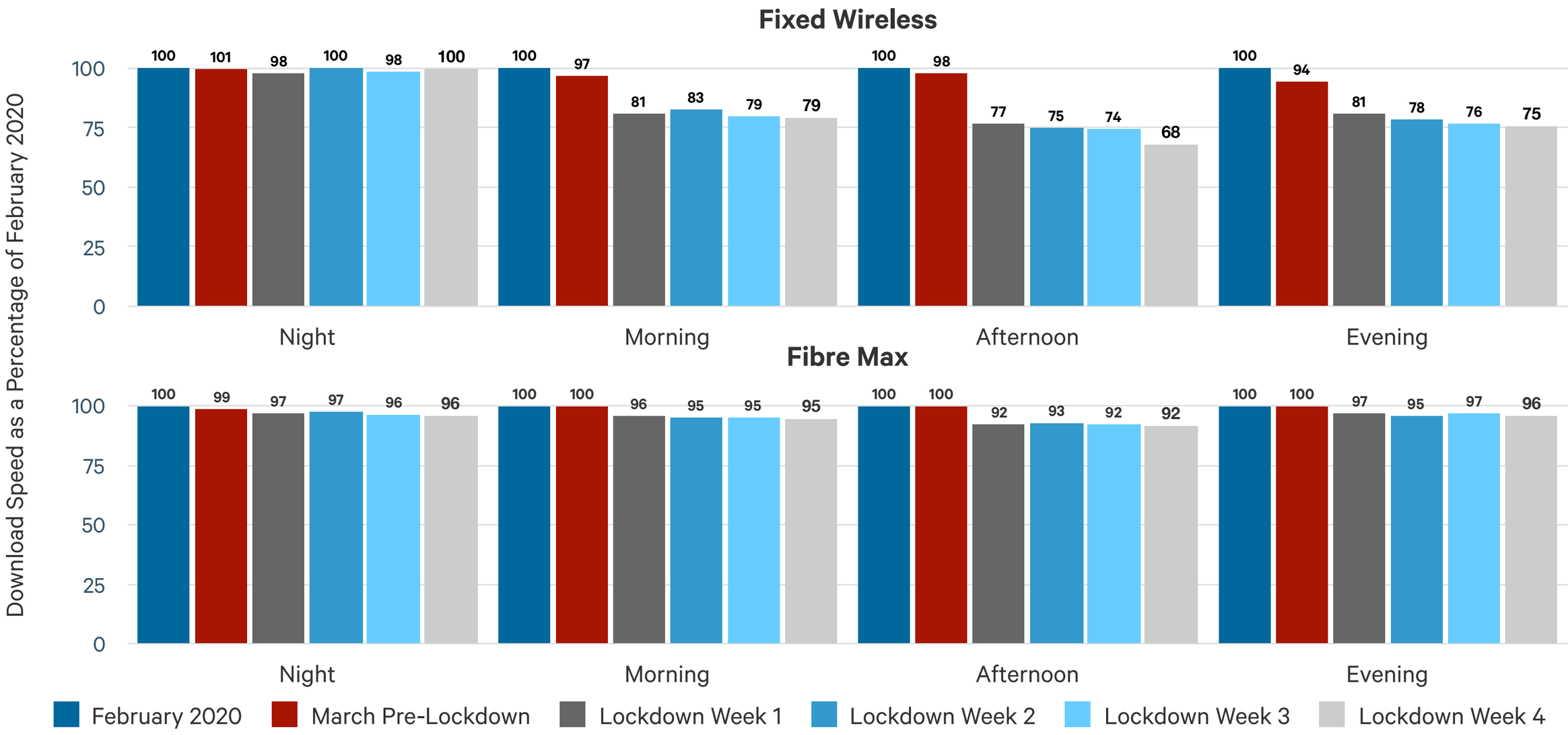
New Zealand entered Alert Level 4 in response to the COVID-19 pandemic on 26th March 2020. During the first week of lockdown, wholesale provider Chorus released regular reports on the volume of traffic passing through its network; internet usage was at a record high immediately following lockdown, but levels had stabilised after 7-to-8 days. Throughout, Chorus reported that while traffic volume was high, it was within the range designed to be accommodated by its network. The main observation from data collected by MBNZ during this time is that download speed has stayed fairly steady for most households, as shown in Figure 1:

Figure 1: Download Speed by Plan since February 2020, Indexed to February 2020



Fixed Wireless and Fibre Max connections experienced decreases in average speed following the start of New Zealand's lockdown, but other packages remained unaffected overall. Figure 2 shows that the decreases in download speed experienced by Fibre Max and Fixed Wireless connections were more pronounced in the morning and afternoon and continued into the evening peak.

Figure 2: Download Speed by Time of Day since February 2020, Indexed to February 2020



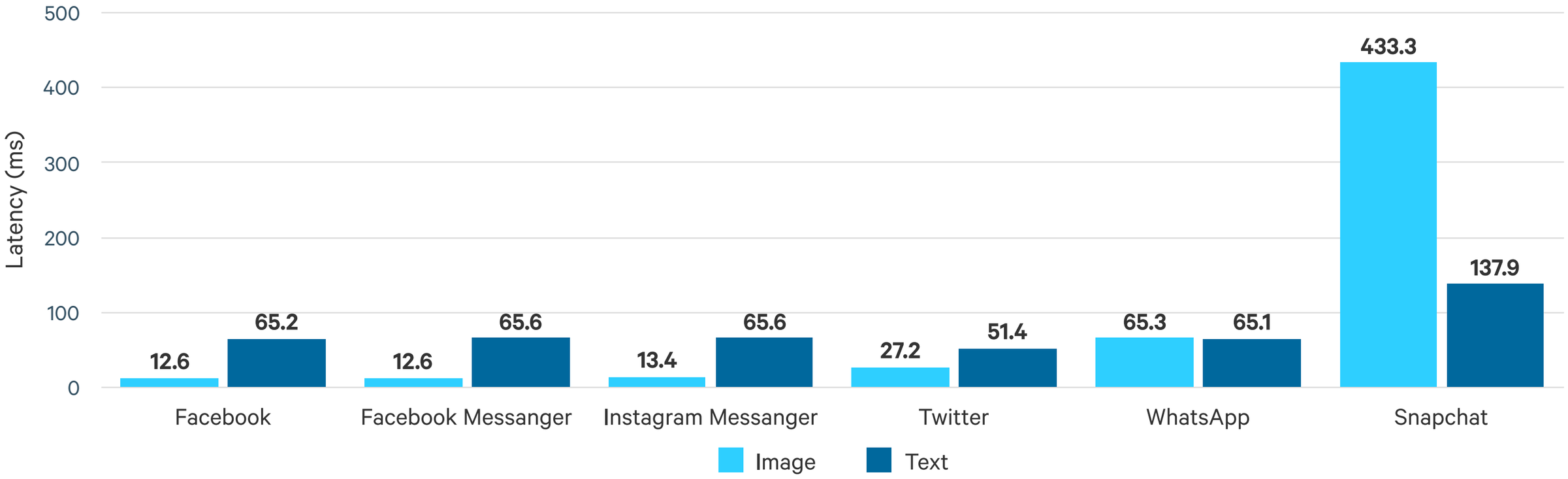
Under normal circumstances, the number of people using the internet is highest between about 6pm and 10pm each evening. In all, any performance drops during the first week of lockdown were at broadly the same level as those experienced during regular daily evening peak hours. Additional tests that measure important services for working from home have been written by the SamKnows team and we will look to include results from Microsoft Teams, Zoom, Google Meet, Cisco Webex, and Skype in the next report. **The remainder of this report deals with data from the month of February 2020.**

Social Media

1st February - 29th February, 2020

MBNZ has started running tests to various popular social media services to gain insight on the performance of more real-world internet applications. When using the larger social media applications, it's common for different parts of the same page to come from different servers. For example when you look at a page on Facebook, the images come from a different server to the text; if you play a video hosted on Facebook then it will come from yet another server. Servers for different types of media can be hosted in different places, and so some parts of the page might get to your device faster than others. Figure 3 shows the latency to image and text servers for several popular social media applications.

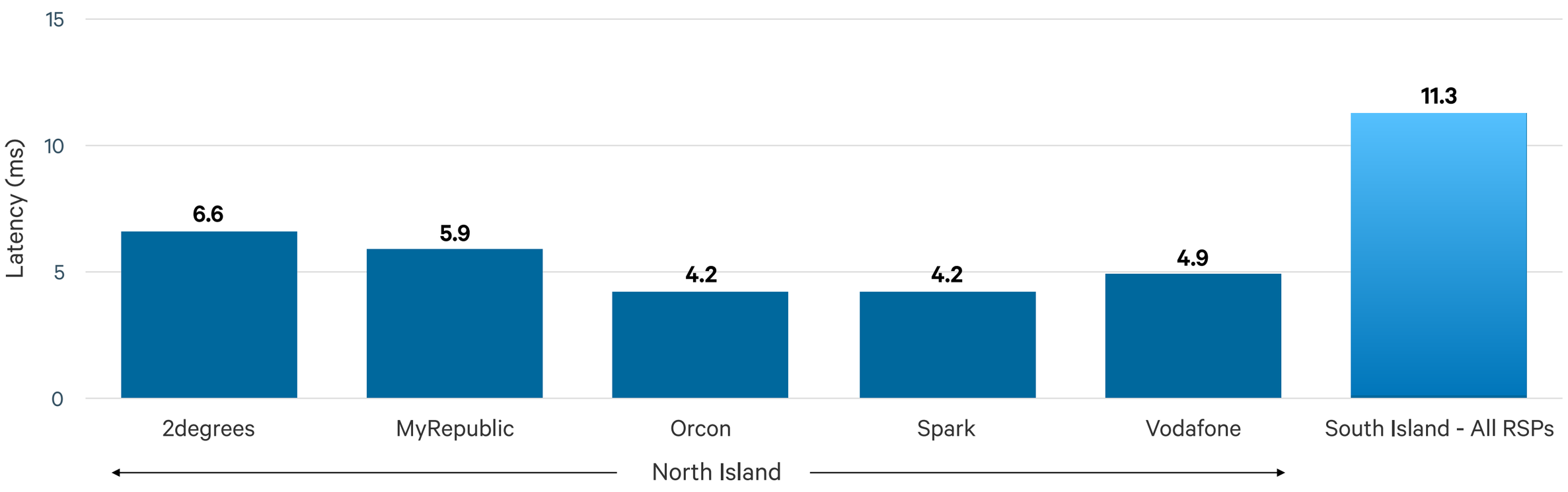
Figure 3: Social Media Latency by Service - Text Download and Image Download



Facebook and Instagram images are served from servers within New Zealand, and so the average latency to Facebook and Instagram image servers is around 13ms compared to 65-66ms for text servers. At the other end of the scale, typical latencies to Snapchat image servers, which are hosted in America, can be as high as 400ms. For exchanging messages with other people in New Zealand, Snapchat is more likely to perform slowly than the other applications benchmarked.

Even within New Zealand, the location of Facebook caches within each RSP's network can affect the latency to content servers from different parts of the country. Figure 4 shows that Fibre connections in the North Island have lower latency to Facebook image download servers than connections in the South Island:

Figure 4: Facebook Image Download Latency by Island by RSP - Fibre only



We were not able to break results out for the South Island by RSP since there were not enough South Island volunteers with each provider to give statistically sound results. Nevertheless, average Facebook image download latency in the South Island is nearly double that in the North Island. In practical terms this difference in latency would have no effect on user experience, but it does illustrate that latency to real applications is not always the same across both islands.

Online Gaming

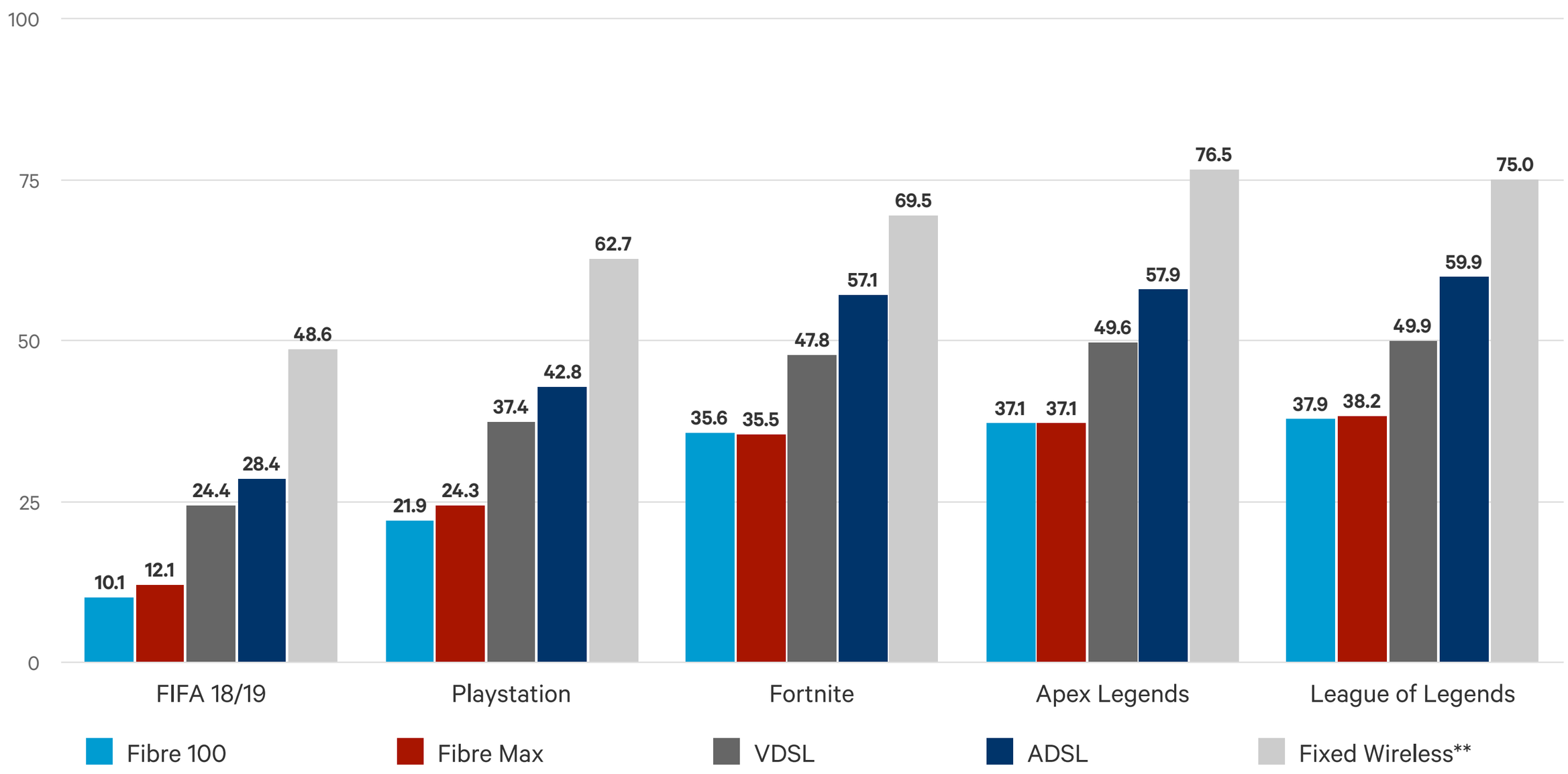
1st February - 29th February, 2020

The MBNZ program has started testing some popular games, including FIFA 18/19, League of Legends, Fortnite, Apex Legends, and Playstation*. Most online gaming applications involve a number of players connected to a central server. If the game requires quick responses from those playing, then higher latency between a player and the server can result in disruptive lag or stuttering.

Games which host content in New Zealand, such as FIFA 18/19 and Playstation (which are served through Content Distribution Networks – CDNs – with presence in New Zealand) had lower latency than games for which the nearest server was hosted overseas. Any latency below 100ms is likely to provide an acceptable experience for fast-action online gaming, and so servers don't necessarily need to be hosted in the same country as the user for acceptable performance

Figure 5 shows the average latency to servers for several popular online games.

Figure 5: Online Gaming Server Latency by Technology



Across all games tested, Fibre plans experienced the lowest latencies (with no real differences between Fibre 100 and Fibre Max), VDSL and ADSL experienced higher latencies, and Fixed Wireless higher still.

Fixed Wireless connections can always be expected to experience higher latency to a common server than fixed line broadband. All Fixed Wireless communications must traverse a wireless access layer, which adds more latency than a copper or fibre access layer. There is no difference in average latency between Fibre 100 and Fibre Max since both plans use the same fibre access layer, and so Fibre Max will not necessarily result in better performance for online gaming than other Fibre plans.

** Technical details: Apex Legends, FIFA 18/19, League of Legends, and Playstation tests are based on ICMP ping round trip time, while the Fortnite test uses UDP. Apex Legends and League of Legends servers are hosted in Australia, FIFA 18/19 and Playstation are served over CDNs, and Fortnite tests were run to the lowest-latency server available, generally in Australia.*

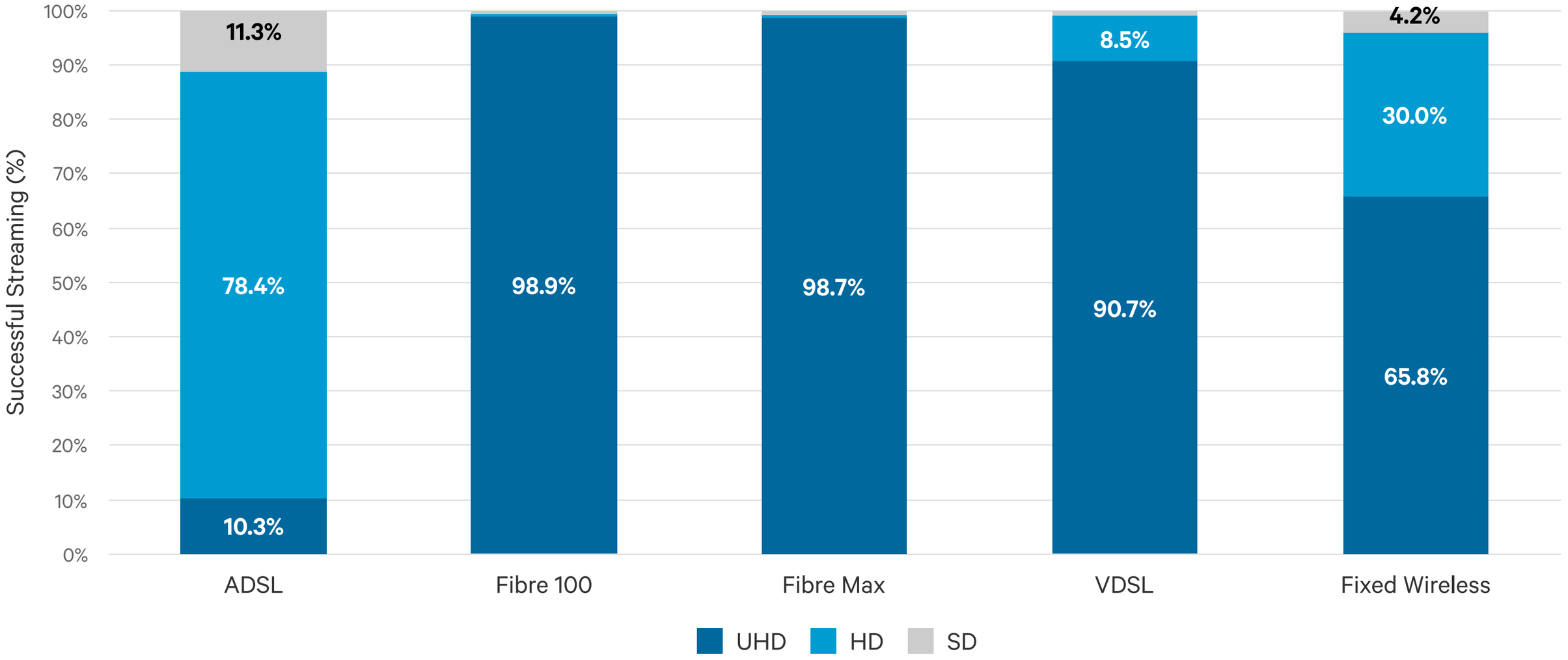
*** Fixed Wireless results were only based on data from 32 Whiteboxes, and so the specific numerical estimates of average latency should be treated as indicative only.*

Video Streaming

1st February - 29th February, 2020

Figure 6 shows how often video could be streamed reliably, without stopping and starting, from Netflix in either Standard Definition (SD), High Definition (HD), or Ultra High Definition (UHD), compared across plans:

Figure 6: Netflix Streaming by Plan



Compared against the previous report, ADSL connections are able to stream Ultra High Definition a slightly lower proportion of the time, while all other technologies are able to stream in at least High Definition over 95% of the time.

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

ADSL and Fixed Wireless connections may still be able to attempt Ultra High Definition but are more likely to encounter annoying buffer stall 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.

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

Speed Tests

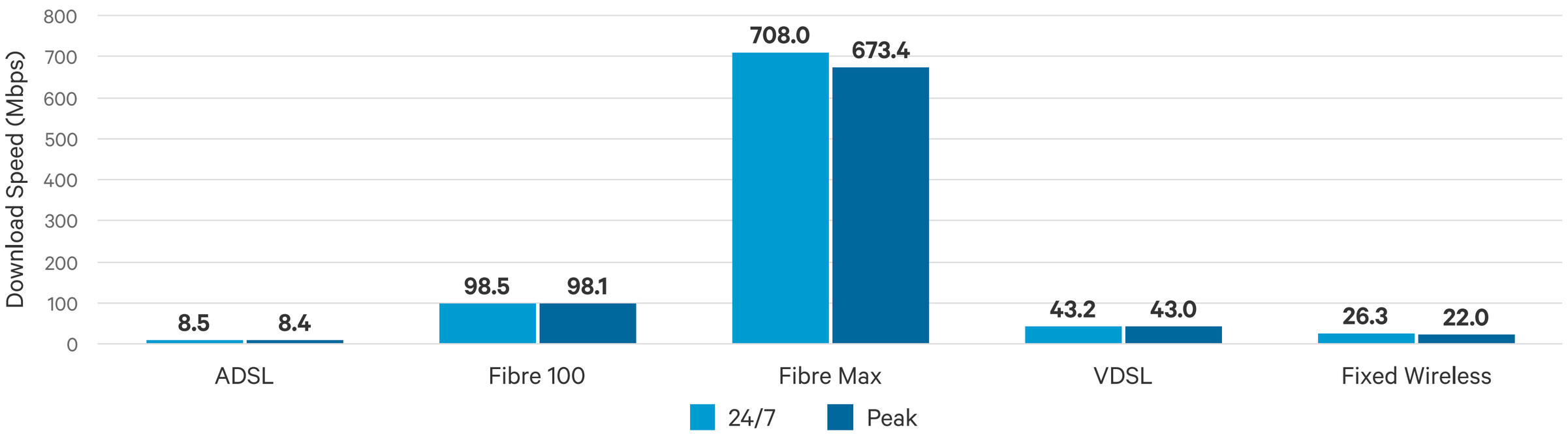
1st February - 29th February, 2020

Figures 7 and 8 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.

Figure 7 shows average download speeds by plan. Fibre Max delivers an average download speed of 708 Mbps, nearly seven times the speed of Fibre 100. ADSL is lowest at 8.5 Mbps.

Peak hours are the times when people typically use the internet; in New Zealand this is 7pm to 11pm on Monday-Friday. Average download speeds for all technologies do not decrease substantially during the peak.

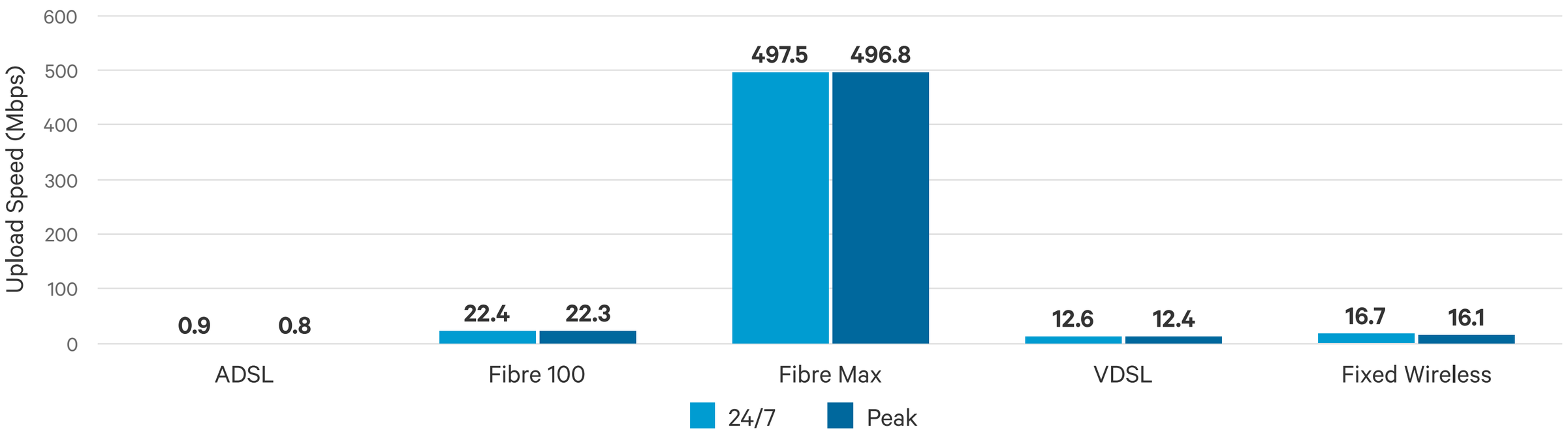
Figure 7: Download Speeds - Peak vs. 24/7



The average 24/7 speed of Fibre Max packages has increased by around 50 Mbps since the previous report; other plans' download speeds have stayed at the same levels as observed in previous measurement periods. This jump in Fibre Max performance is mainly due to network changes that one particular RSP made, which is pulling up the average.

Figure 8 shows upload speeds by technology. Fibre Max upload speeds are highest on average and ADSL's are the lowest. Average upload speeds do not decrease substantially during the peak for any technology.

Figure 8: Upload Speeds - Peak vs. 24/7

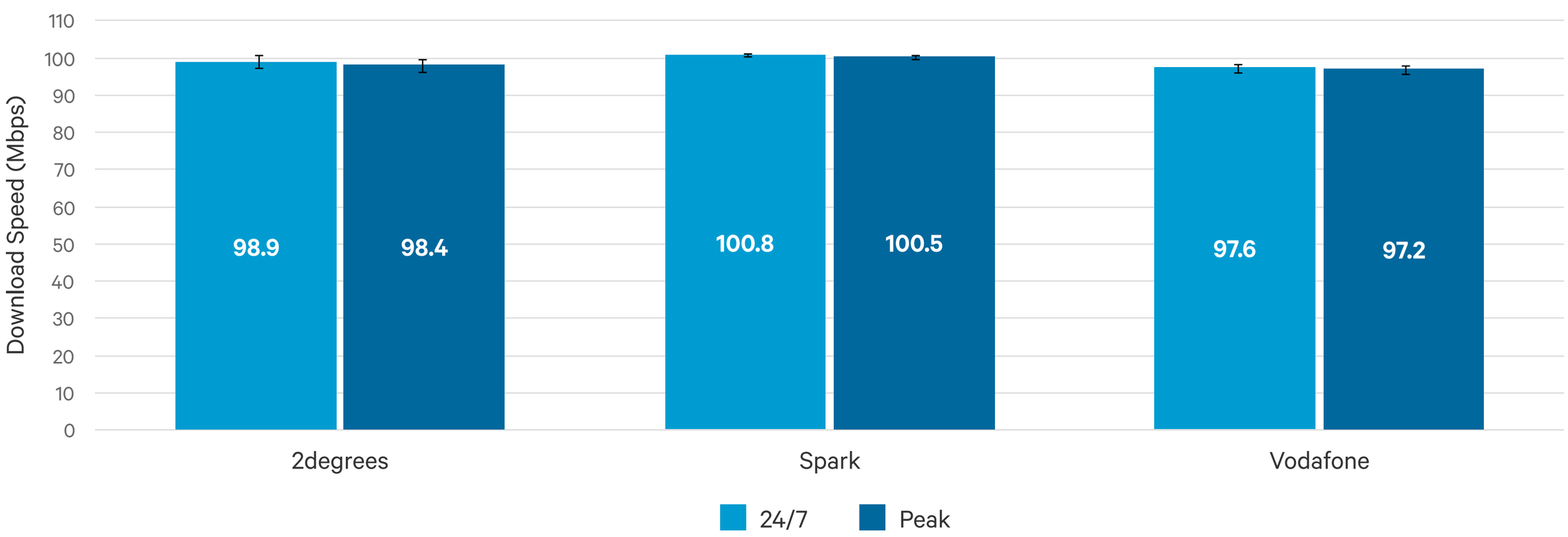


Fibre 100 Breakdown

1st February - 29th February, 2020

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's quite common to see measured speeds close to or slightly above 100 Mbps. Figure 9 compares the average Fibre 100 download speed for different RSPs. Compared to the previous report the RSPs included show no significant movement and download speeds have largely stayed the same, within 1-to-2 Mbps.

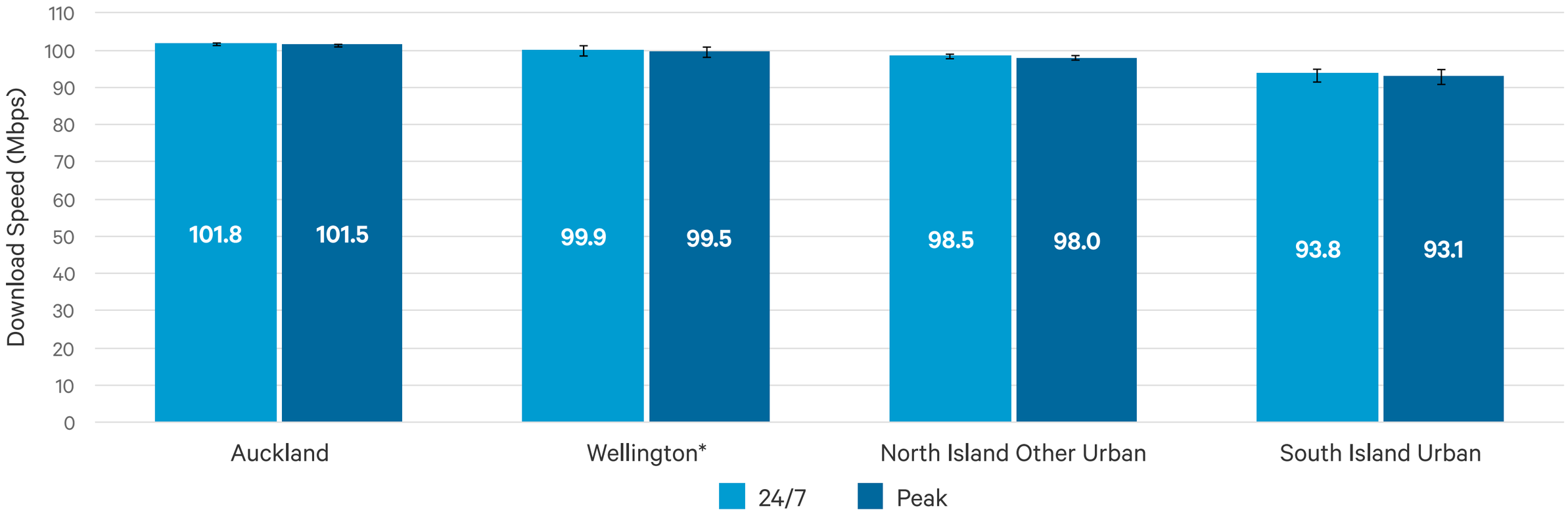
Figure 9: Fibre 100 Download Speed by RSP - Peak vs. 24/7



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. For the RSPs where sufficient data is available, Fibre 100 download speeds have stayed at the same levels as seen in the previous MBNZ report. There were not enough volunteers connected to MyRepublic, Orcon, Slingshot, or Trustpower in February to report results for those RSPs. Those RSPs *are* included in the overall Fibre 100 results shown previously.

Figure 10 compares the average Fibre 100 download speed across different parts of New Zealand (for all RSPs):

Figure 10: Fibre 100 Download Speed by Region - Peak vs. 24/7



The average Fibre 100 download speed in the South Island is significantly lower than in all parts of the North Island, however the difference is not at a level which would have much of an effect on applications.

**Wellington had 33 Whiteboxes online and reporting on the Fibre 100 tier compared to 50 or more for other areas. SamKnows' usual threshold for the number of Whiteboxes needed is 40. Since the results are not significantly different from those in the previous report (February's result is inside the 95% confidence interval of last report's result and vice versa), Wellington has been included in the chart above.*

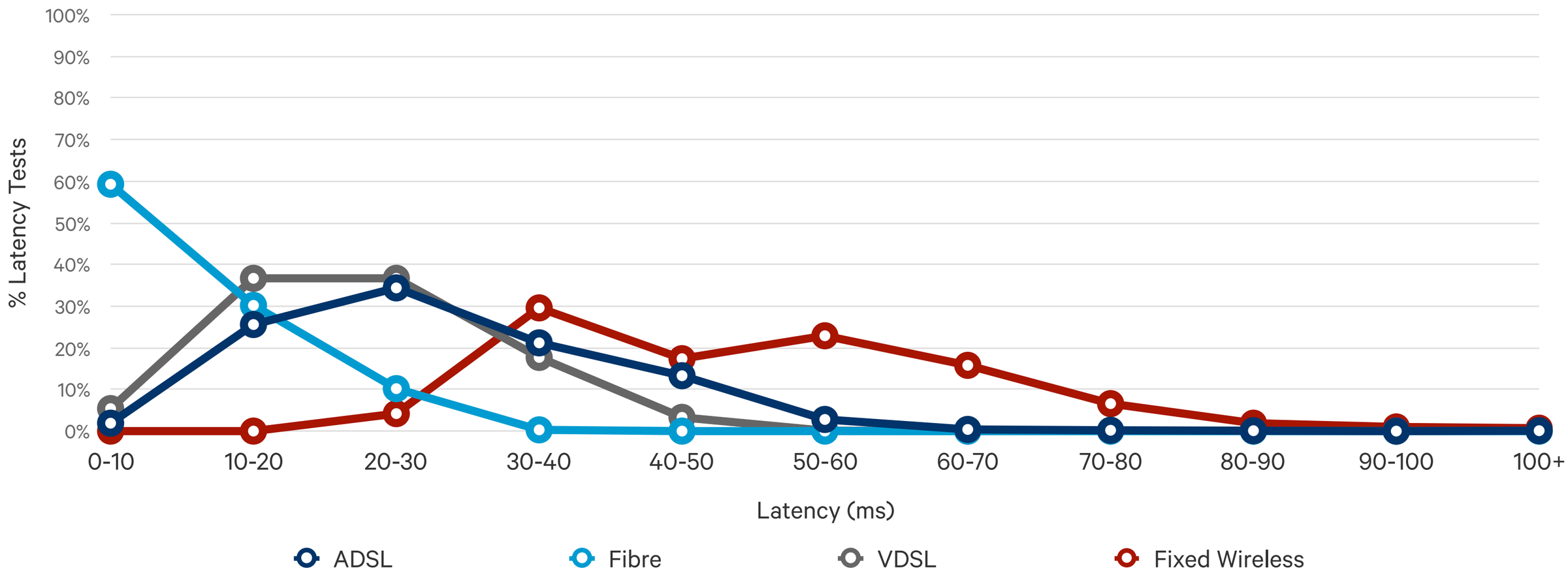
Latency and Packet Loss

1st February - 29th February, 2020

The discussions of 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 voice and video calling, cloud-based interactive web applications, and even common search engine performance.

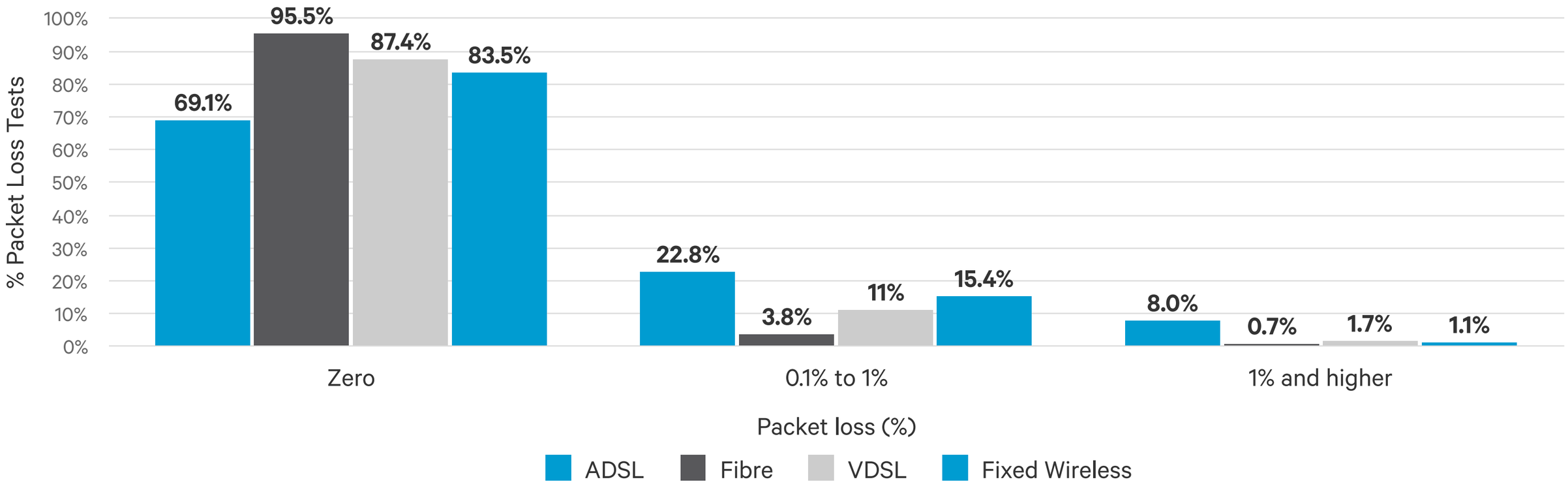
Figure 11 shows the distribution of latency to test servers hosted in New Zealand, by technology. The results from these tests can be used as a generic indicator of the performance of latency-sensitive applications. Results are broadly similar for each technology compared to the previous report.

Figure 11: Distribution of Latency by Technology



Of the latency tests performed through Fibre connections, 90% were below 20ms. By comparison, 96% of Fixed Wireless latency tests were above 30ms. As emphasized in the Online Gaming section, the exact level of latency required for acceptable performance varies by application. Nevertheless, for any online application, Fibre is the least likely to experience issues relating to latency. Figure 12 shows the distribution of packet loss rates recorded in tests, by technology:

Figure 12: Distribution of Packet Loss Rates by Technology



Packet loss below 1% should not cause issues with internet applications. ADSL was the most likely technology to see packet loss at a level which might affect loading webpages or video calling.

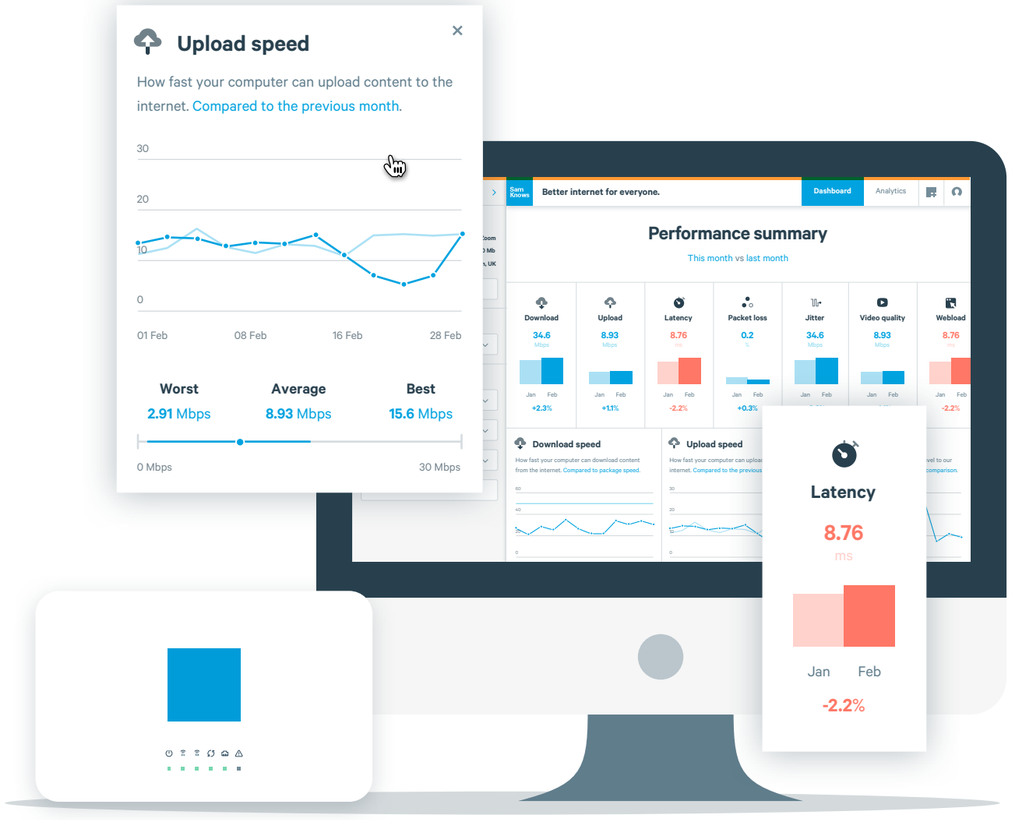
How We Test

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.



Volunteer today!

Our tests

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.
YouTube	Measures the highest bitrate you can reliably stream for the most popular video in your country.
Netflix	An application-specific test, supporting the streaming of binary data from Netflix's servers using the same CDN selection logic as their real client uses. The test has been developed in direct cooperation with Netflix.
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.
Gaming	Measures performance for a number of major games and supporting services, such a game distribution platforms.
Social Media	Measures round-trip latency and reachability of a selection of major social media services.

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.
HD	High definition. Resolution of video streaming between 1280x720 pixels and 1920x1080pixels. Often referred to as 720p or 1080p.
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.
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.
VDSL	Very high speed digital subscriber line. A broadband connection that allows higher speeds than ADSL technologies.