REPORT ON NEW ZEALAND BROADBAND QUALITY

JANUARY-JUNE 2010

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COMMERCE COMMISSION

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EXECUTIVE SUMMARY

Since June 2008 the Commission has published reports on the quality of broadband services in New Zealand as measured by Epitiro from selected sites in the main centres. This report covers the six months from 1 January 2010 to 30 June 2010.

Reporting for this period focuses on:

- web browsing speeds (being the most common activity undertaken by internet users)
- the variability of web browsing speeds (over an average day)
- internet availability (expressed as the percentage of time that internet access is available each month).

Key findings are:

- The variability of web browsing speeds over the course of a day reduced considerably, particularly for ISPs who performed poorly in the last report.
- Internet availability continued to improve and only one ISP failed to meet the Commission's monthly availability benchmark of 99.9 per cent[1].
- Vodafone had a noticeable improvement in performance particularly in Auckland where it had the best national web browsing speed.
- TelstraClear's cable broadband continued to show materially faster national browsing speeds than DSL broadband plans in test locations where it was available.
- By the end of the period, DSL plans utilising local loop unbundling were providing national web browsing speeds that were around 20 per cent faster than Telecom Wholesale supplied plans offered by the same ISPs.

Other notable observations about the web browsing performance for the period include:

- The trend to increased use caching techniques[2] appeared to continue.
- Web browsing performance tended to be best in Auckland. Speeds were generally slower the further test sites were from Auckland[3].
- Web browsing performance tended to be relatively worse in central city sites compared to suburban sites, possibly due to age of plant and interference with other services on the copper access lines.
- Some ISPs have improved their Domain Name Server (DNS) response times in cities remote from Auckland but this does not appear to have significantly affected web browsing speeds.

[1] This means that internet access is not available for less than 43 minutes a month per month.

[2] This is the local storage of popular international content to improve web browsing performance for end-users

[3] The reasons for this decline in speed are complex and related to the fact that key equipment and international links are generally located in Auckland.

INTRODUCTION

Background

The Commerce Commission (the Commission) Report on NZ Broadband Quality is a regular report which is part of a continuing series measuring broadband performance in New Zealand and how it has changed over time.

The Commission's objective is to provide a reliable comparison of the technical performance of ISPs in delivering broadband services in New Zealand's major cities. The intention is that ISP's will be able to gauge their relative performance against that of their competitors and identify methods to improve that performance for the benefit of end-users. To help achieve this, the Commission has in some instances developed what it considers achievable performance benchmarks to replace the index that had been used in earlier reports.

Data Sources

The report utilises measurement data from Epitiro's ISP-I platform. The ISP-I platform consists of eleven test sites in five cities, running measurements on each of the ISPs tested. The measurement procedures are run every 15 minutes.

The focus of measurement is on web browsing performance as the ISP-I platform does not currently provide the Commission with data through-put speeds[4]. The Commission is considering testing through-put speed in 2011, when it is likely to update the broadband testing regime.

The five main providers of broadband service in New Zealand, Telecom, TelstraClear Vodafone, Slingshot and Orcon, are tested at all Epitiro locations, with TelstraClear's cable broadband service tested separately in locations where it is available. In addition, seven second tier and regional ISPs are tested at a lesser number of sites, usually one site in the region they are based. For reporting purposes these seven smaller ISPs are sometimes amalgamated and defined as 'Other'.

The major ISPs tested across the country have been given a unique colour in the performance graphs and are named. All the second tier and regional ISP's are generally shown as grey in the graphs as a reminder that they are generally tested only in one location, and are not named. These minor ISP's are distinguished by being given unique numbers.

Performance Benchmarks

Where benchmarks are used they have been set at a standard which is considered by the Commission as 'best practice' for the industry. The Commission expects that over time most ISPs will improve their performance sufficiently to be able to meet the benchmarks set.

The performance measure results demonstrate that service delivery performance is highly complex. Top performance in one measure may not be matched by top performance in another. Performance may be a compromise to enable targeted markets to get the best performance in the measure most valued in those markets.

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[4] Specifically, the data transfer speeds obtained when transferring large files over an internet connection.

SERVICE PERFORMANCE

Web Browsing Speed

Web browsing speed is a measure of the speed at which a webpage loads, and is calculated by taking the size of a specific webpage and dividing it by the time taken to download it. A speed measure for web browsing is considered easier to understand and compare than download time.

The speed of a page download using DSL broadband can be affected by the distance between the test site and the local exchange or cabinet housing the DSL equipment[5]. This is not the case with cable broadband. The characteristics of the webpage itself, including the capacity of the host server also affects performance.

A large distance between the DSL exchange or cabinet and the location of the ISP's key network equipment is another factor than can affect performance. In New Zealand, the distance between Auckland and Dunedin is a significant influence on browsing speed. International distances are always an important influence for New Zealand. A fuller explanation of the impact of distance is included in Appendix 2.

Speeds experienced by end-users are improved by some ISP's using various data management techniques such as caching.

National Browsing Speeds

National web browsing performance has a major impact on internet user experience as much of the web browsing traffic in New Zealand is to local websites.

Browsing speed is affected by factors other than the ISP's network capability. The website being browsed may have a data transfer speed limit which is lower than the ISP download speed capability, the type of content may delay the data transfer process, or the local website may be connected via an international link if the ISP does not have a local peering arrangement. To eliminate these variables, the Commission has used a reliable New Zealand reference website with ample capacity, connected locally via a peering network.

The reference website for this reporting period was changed as the site used previously was beginning to show unacceptable performance variability. It was also considered possible that some ISPs had modified their networks to give preference to the reference website in order to improve performance test results.

As the reference website has been changed and is slower than the previous reference website, the Commission cannot use the web browsing performance benchmark used in previous reporting periods[6]. At this time no new benchmark is proposed.

Although the performance tests are intended to demonstrate the performance an end-user could expect, it should be noted that users:

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[5] Where the copper cable distance is sufficiently large to cause low DSL modem synchronisation line speeds.

[6] Web browsing speed was previously expected to be at least 60per cent of the minimum DSL line synchronisation speed for that city.

- will be located at a variety of copper line distances from the DSL exchange (and these will be different to the copper line distances of the Epitiro test sites);
- will be served from a variety of DSL exchanges which may have dissimilar DSL equipment and backhaul arrangements; and
- will have premises wiring of variable quality that will affect DSL performance.

For these reasons, end-users may experience web browsing performance levels that differ from the test results in this report. The Epitiro tests are designed to compare ISP's tested at the same site, and can indicate the differences between the urban centres in New Zealand.

National Web Browsing Performance by Test Site

Web browsing speed is always slower than the speed of downloading a large file because it is more complex operation requiring traffic going back and forth. The upper limit for the speed of DSL broadband connection is given by the line synchronisation speed. The lowest DSL line synchronisation observed at each test site is therefore noted as a benchmark for comparative purposes only.

Auckland Browsing Performance

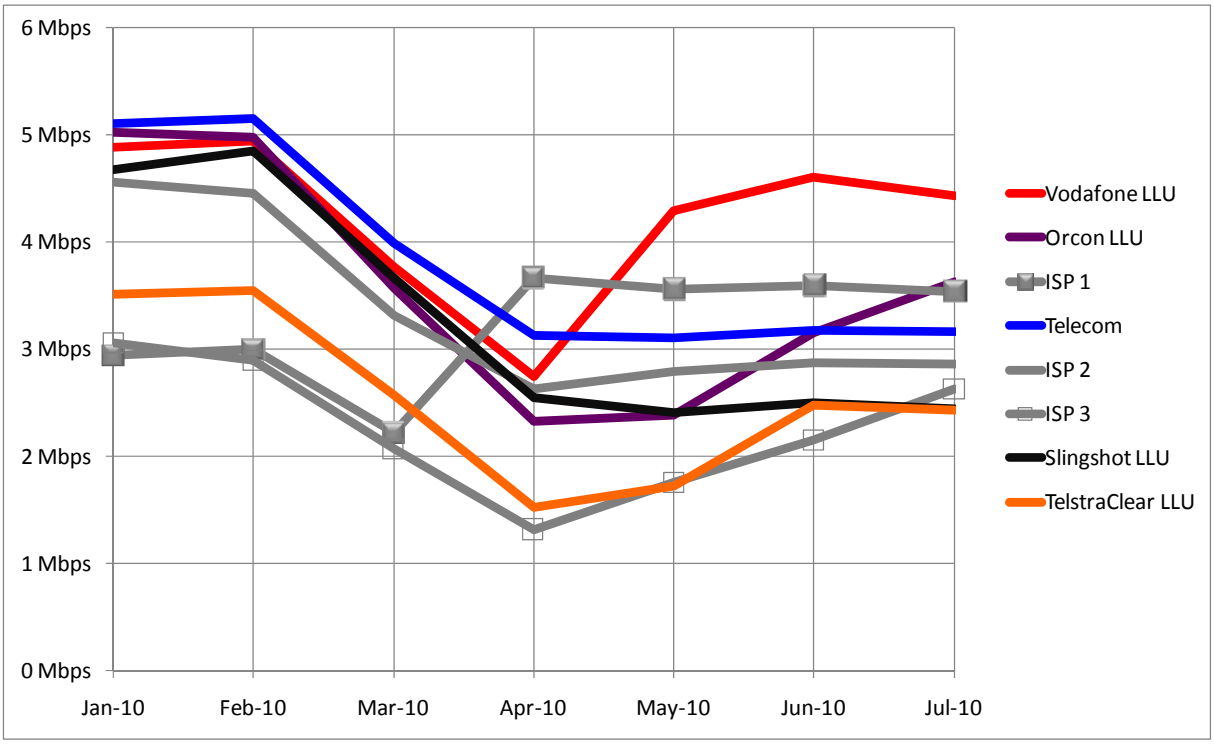
Auckland Web Browsing Performance to a nationally based reference website is presented from the three test sites located in Auckland. The test site locations enable comparisons between city and suburban exchanges.

Vodafone's performance at all the Auckland sites improved noticeably over the period to make it the best performing ISP at those sites.

Albany

The benchmark DSL line synchronisation speed from the Albany site was 6.7Mbps. Although this is a relatively low line speed, the web browsing speeds achieved were generally good by comparison.

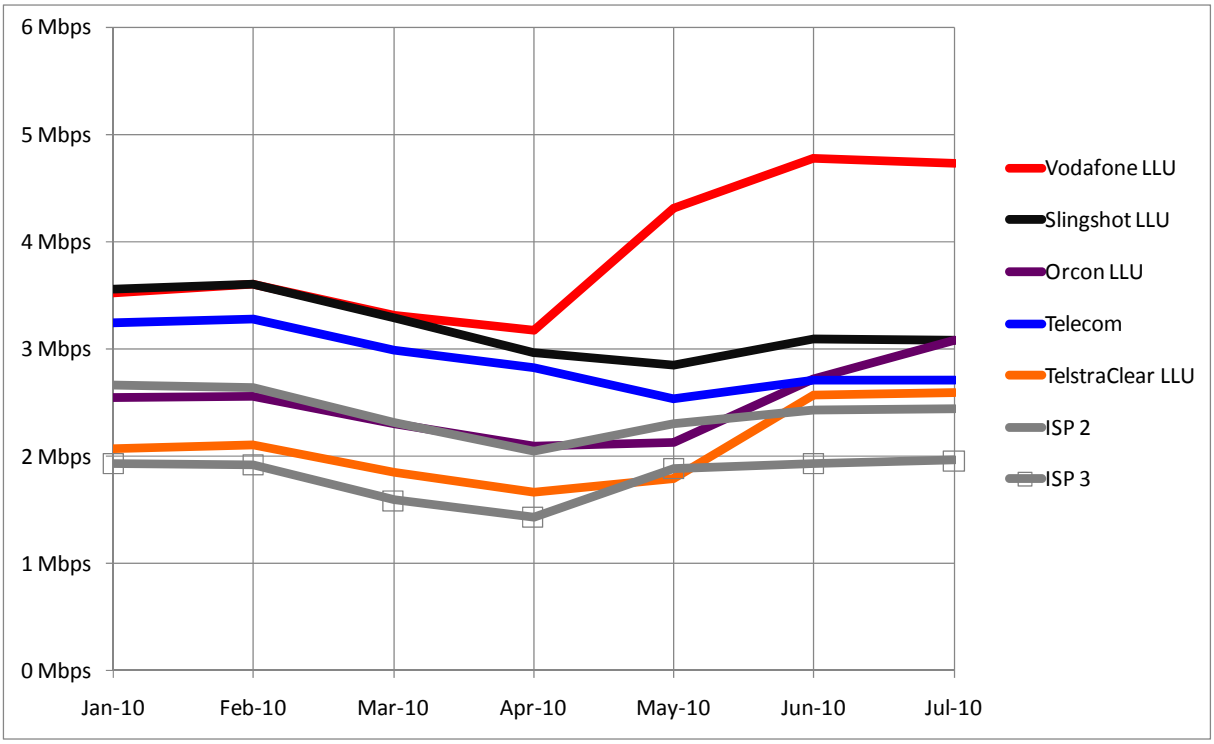
Figure 1; Albany Web Browsing



Auckland Central

The benchmark DSL line synchronisation speed from the Central City site was relatively high at 8.1Mbps. In comparison, the web browsing speeds achieved by most ISPs were relatively low.

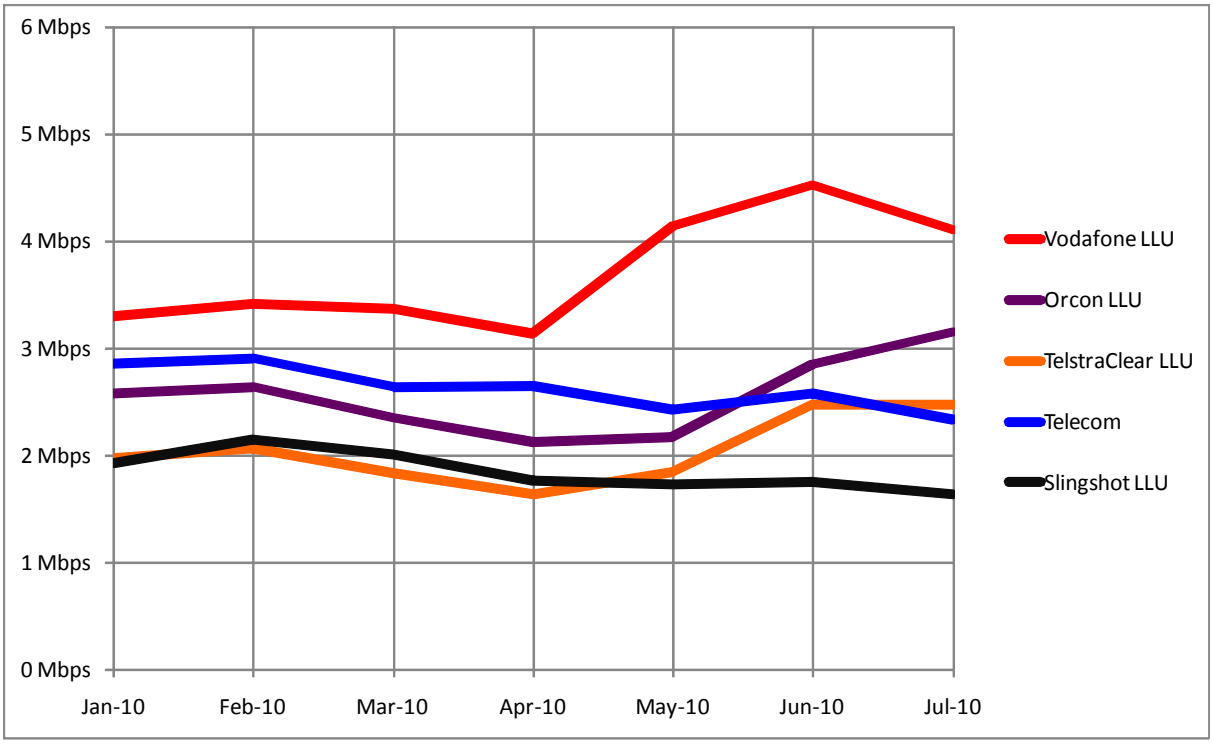
Figure 2; Auckland Central Web Browsing



Mt Albert

The benchmark DSL line synchronisation speed from the Mt Albert site was 6.4Mbps. The web browsing speeds achieved were generally relatively low in comparision.

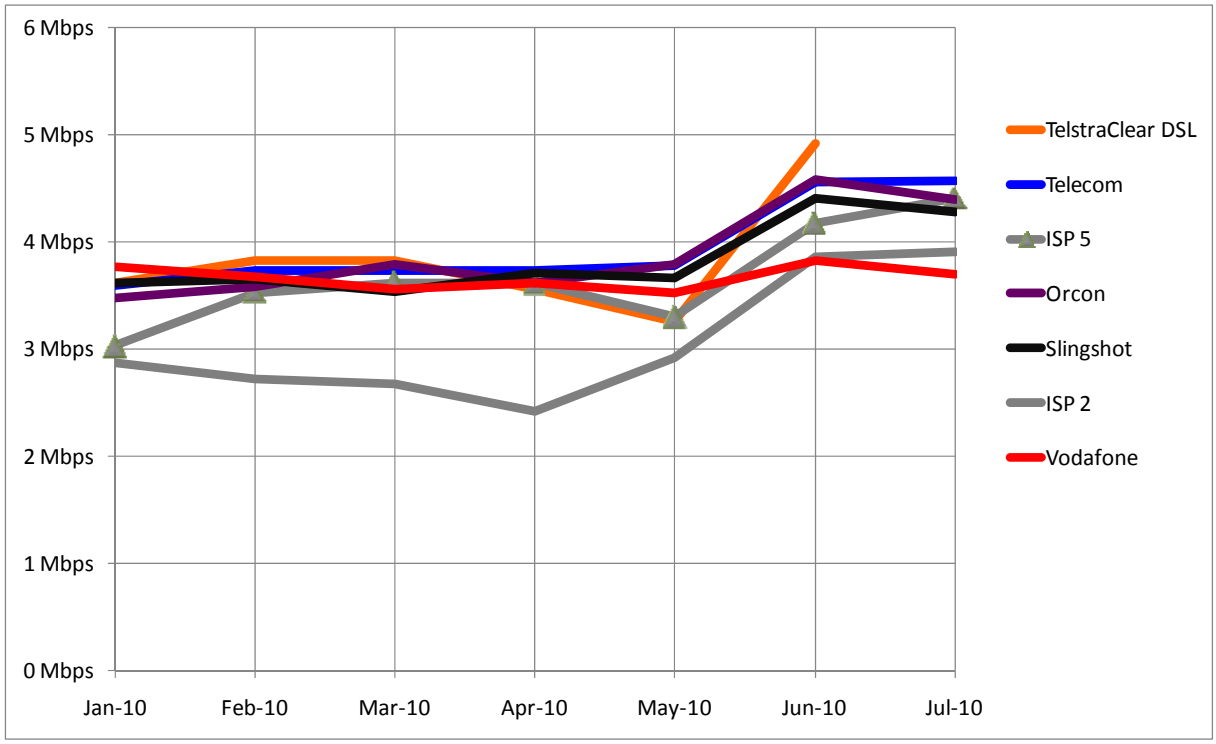
Figure 3; Mt Albert Web Browsing



Hamilton Browsing Performance

The benchmark DSL line synchronisation speed for the Hamilton Epitiro site was high at 13.4Mbps. In this context, the web browsing speeds achieved were all relatively low. The Hamilton test site is one of the closest to the local exchange which explains why the line synchronisation speeds are higher than elsewhere.

Figure 4; Hamilton Web Browsing



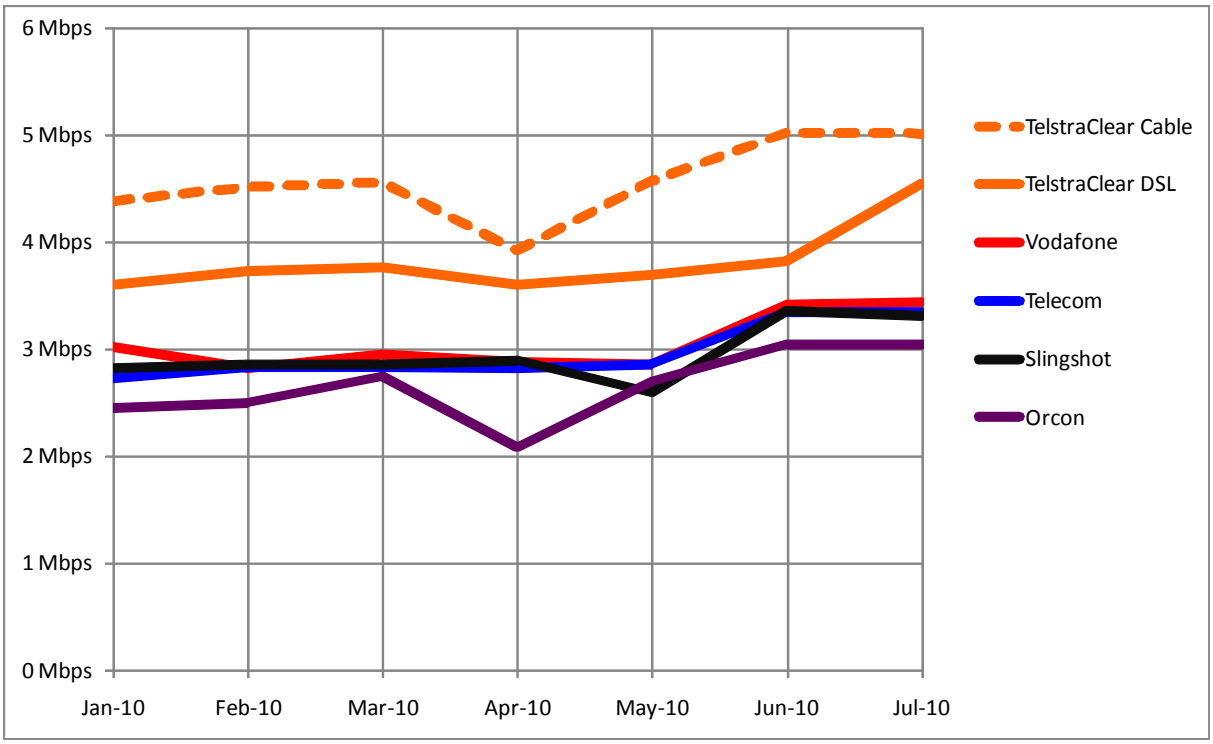
Wellington National Web Browsing Performance

The three sites for testing in Wellington are Johnsonville, Wellington Central and Newtown. Cable broadband services are tested at Johnsonville and Newtown.

Johnsonville

The benchmark DSL line synchronisation speed for this site was 10.1 Mbps which happened to be very close to the 10 Mbps theoretical maximum speed for the TelstraClear cable plan being tested at the same site. It was therefore especially appropriate to compare cable and DSL plans at this site. The cable plan achieved reasonable browsing speeds while most of the DSL plans had significantly lower browsing speeds.

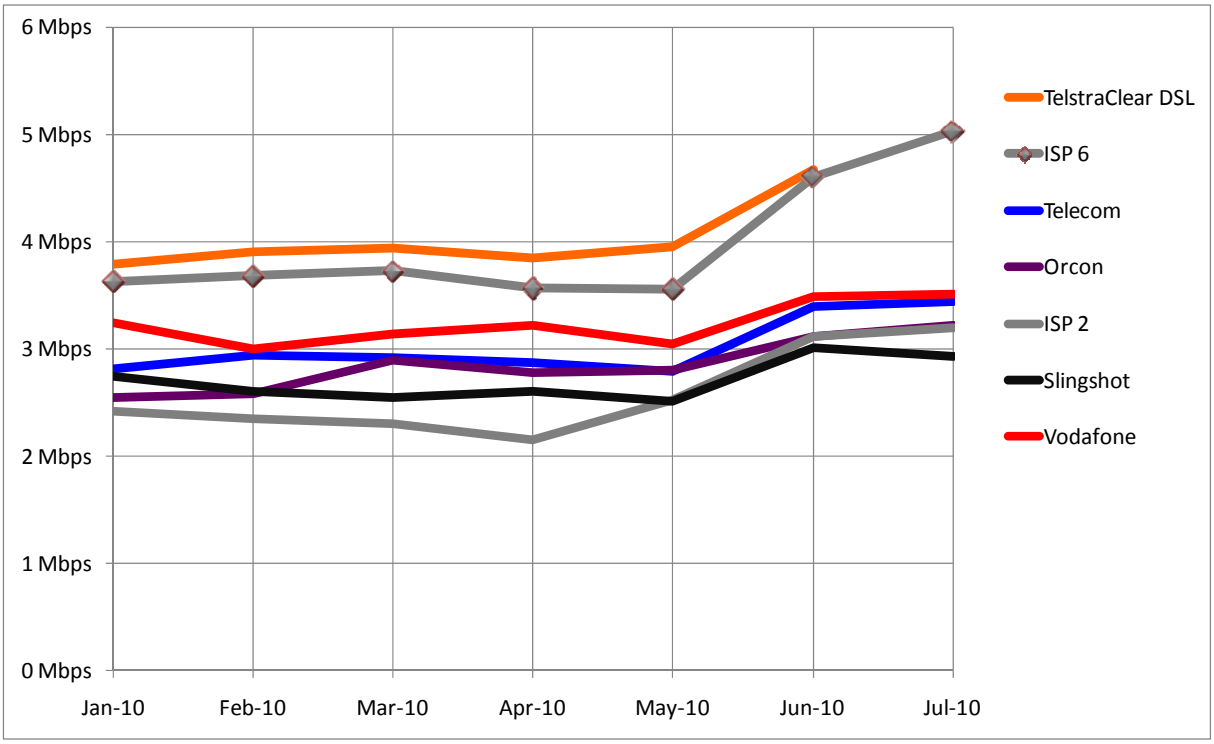
Figure 5; Johnsonville Web Browsing



Wellington Central

The Wellington Central test site is close to the exchange which gave it a minimum DSL line synchronisation speed of 12.1 Mbps. In comparison, all web browsing speeds were relatively low.

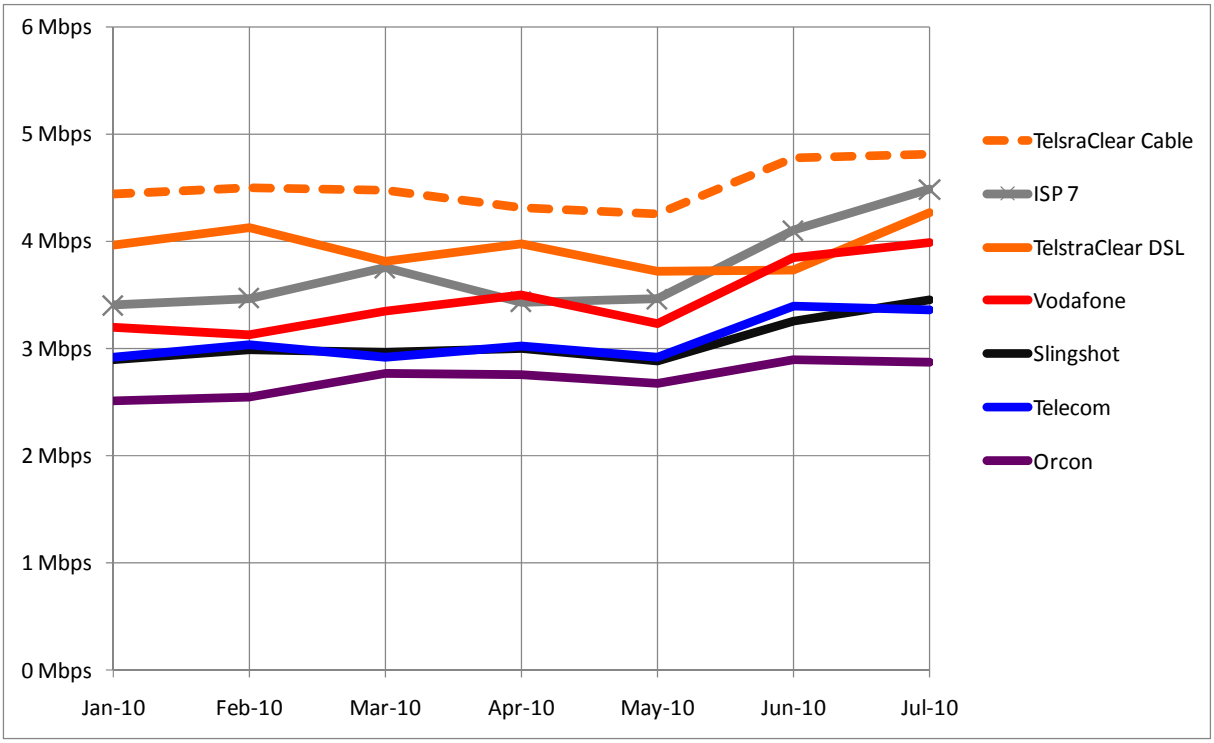
Figure 6; Wellington Central Web Browsing



Newtown

The Newtown test site is also close to the exchange which enabled high connection speeds. The benchmark DSL line synchronisation speed was 11.5 Mbps but browsing speeds were all relatively low with cable consistently exhibiting the best performance.

Figure 7; Newtown Web Browsing



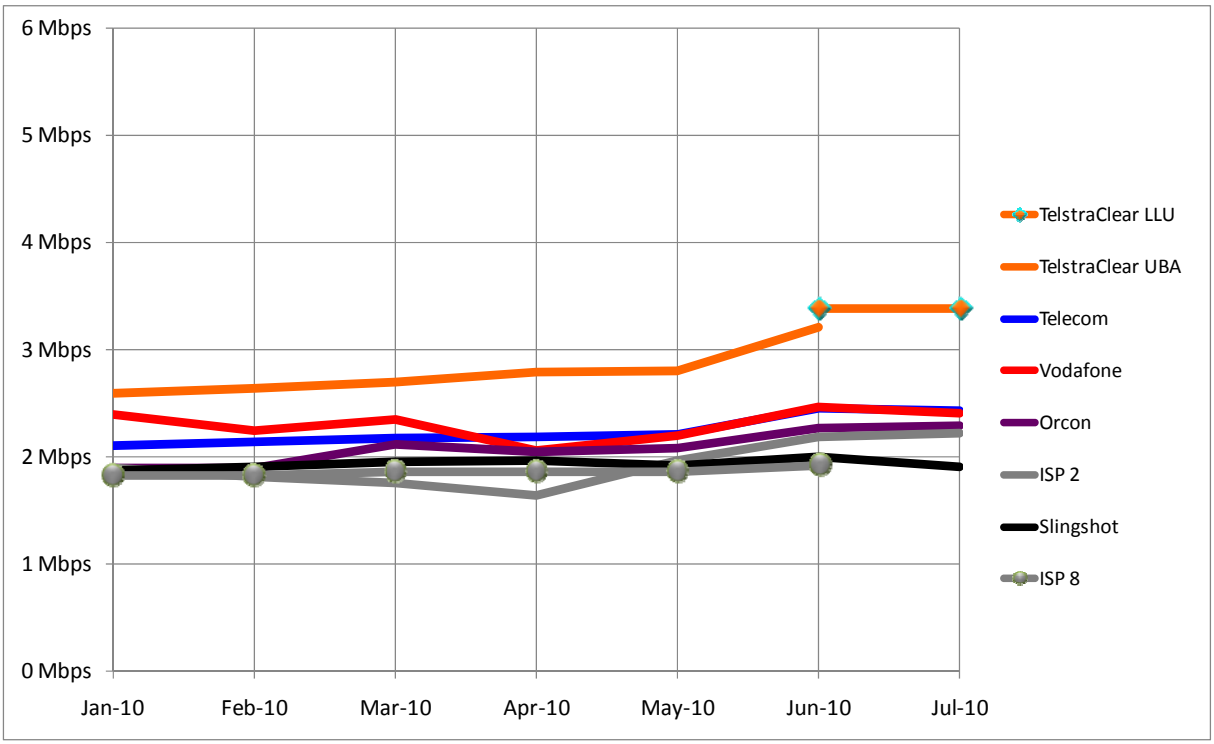
Christchurch National Web Browsing Performance

There are three sites in Christchurch; Central City, Linwood and Riccarton.

Central City

The distance to the test site from the exchange is around 2km resulting in a benchmark DSL line synchronisation speed of 6.2 Mbps. TelstraClear changed from DSL via Telecom's Wholesale service to their own DSL over UCLL during June. The two results for TelstraClear as at 1 June are for the first and second parts of May.

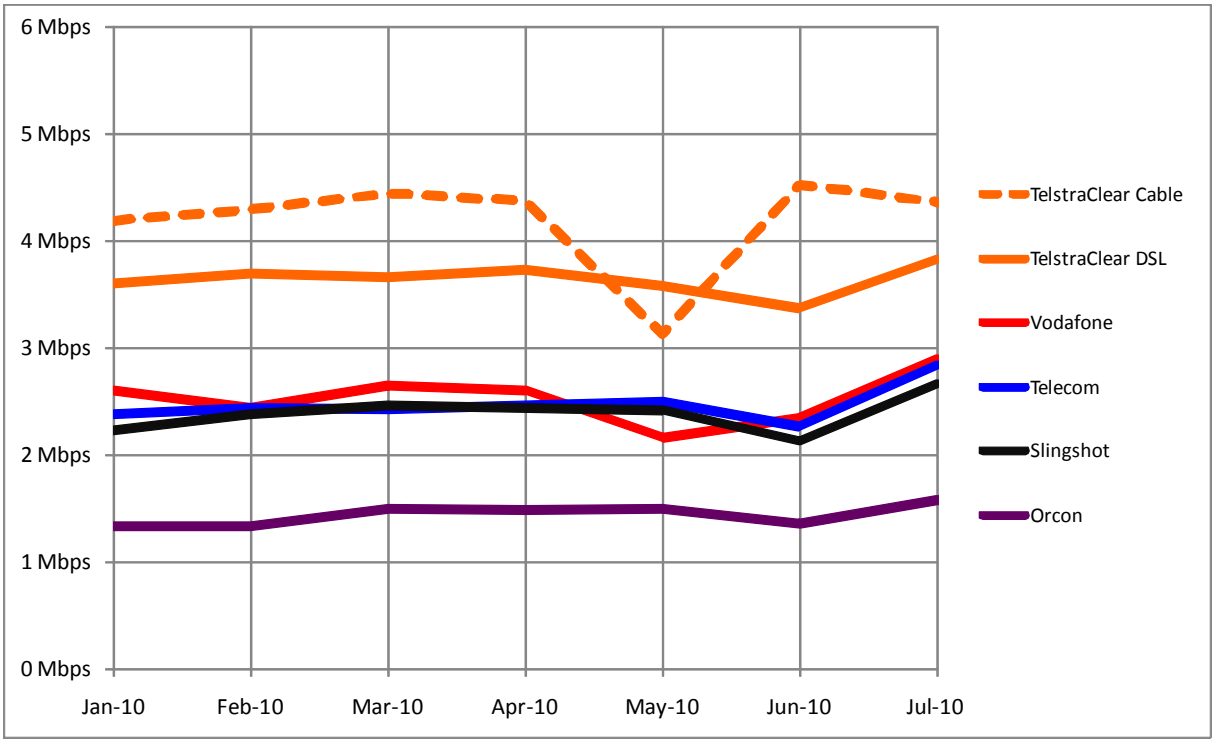
Figure 8; Christchurch Central Web Browsing



Linwood

The distance from the Linwood test site to the exchange is 1.6km, resulting in a benchmark DSL line synchronisation speed of 8.2 Mbps. The Linwood test site has a TelstraClear cable testing unit to enable a direct comparison between DSL and cable. The cable plan and one other ISP had relatively good browsing speeds for most of the six month period.

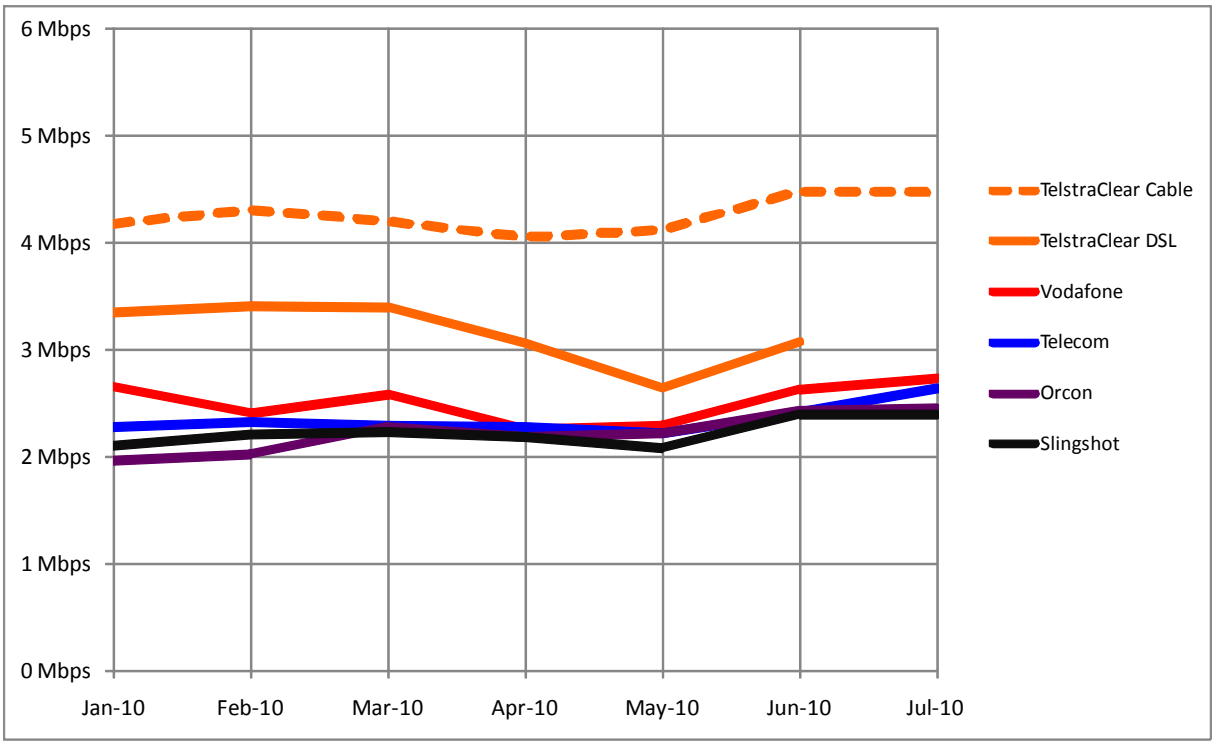
Figure 9; Linwood Web Browsing



Riccarton

The Riccarton test site is located at a distance of 1.8km from the exchange. The benchmark line synchronisation speed was 8.4 Mbps. The cable plan exhibited relatively good browsing speeds.

Figure 10; Riccarton Web Browsing

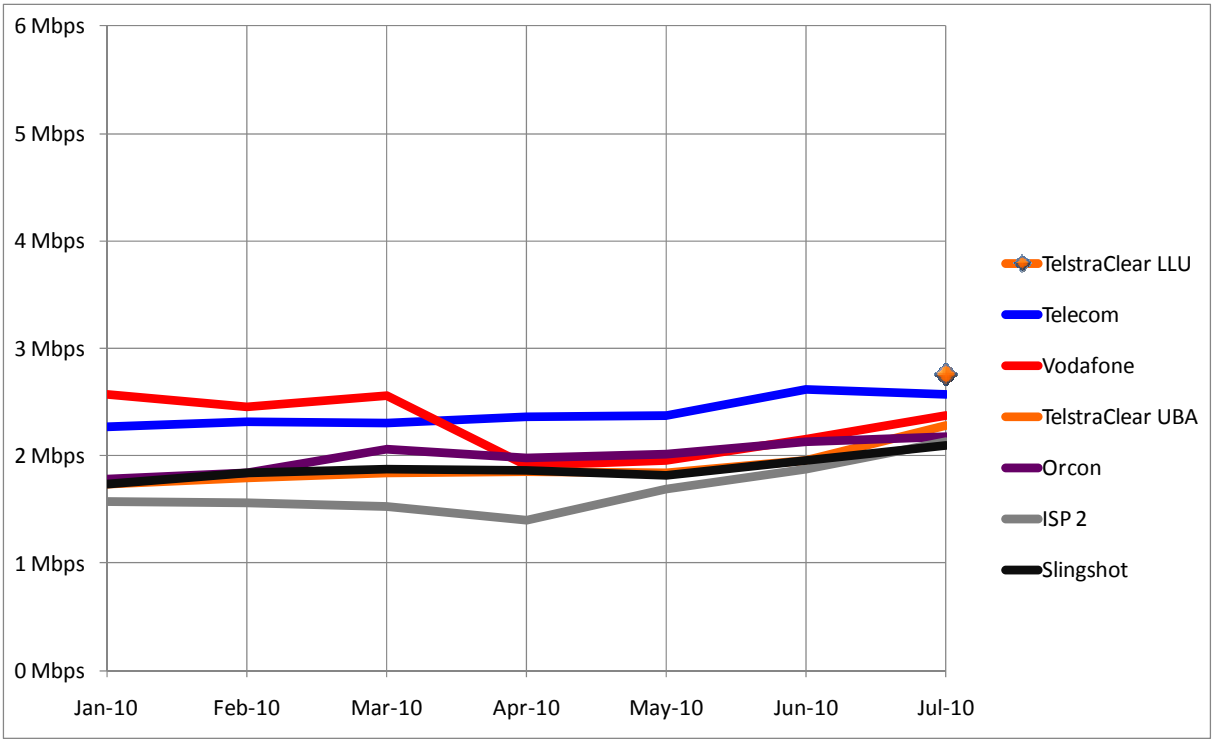


Dunedin National Web Browsing Performance

The benchmark line synchronisation speed for the Dunedin Epitiro test site was 10.9Mbps. While the test site is close to the Dunedin central exchange (700m) so has a reasonable DSL line synchronisation speed, it is the furthest away from Auckland. Data travelling from Auckland has to go through various aggregation points along the way, slowing it down. In comparison, Christchurch has some more direct data links to Auckland enabling at least TelstraClear to achieve some reasonable web browsing speeds.

Browsing speeds were relatively low for all ISPs with the best performance being only 2.7Mbps.

Figure 11; Dunedin Web Browsing



Central City Web Browsing Performance

In addition to the trend for national web browsing speeds to decline the further test sites are from Auckland, there also appears to be a tendency for web browsing speeds to be relatively slower for central city sites compared to suburban sites. For example, in Auckland central where the site is relatively close to the exchange nearly all the ISPs were struggling to achieve a web browsing speed of 3Mbps at the end of the period while this speed was exceeded by several ISPs in suburban test sites even as far south as Christchurch.

It is possible that the age of copper lines and/or interference with other data services in the copper plant have contributed to slower browsing speeds for central city sites. If so, this could potentially be alleviated with various interference management solutions. However, the focus is now moving to the replacement of copper with fibre broadband access, which does not suffer from these electromagnetic interference problems.

Unbundled Local Loop Performance vs Telecom Wholesale Connections

Where ISPs purchase an unbundled local loop from Chorus to supply DSL broadband rather than a bitstream connection from Telecom Wholesale they are using their own equipment and have more control over the quality of service. In Auckland some ISPs are supplying both a broadband plan supplied by a bitstream connection and the equivalent plan supplied by an unbundled local loop. This enables a comparison to be made between the two types of broadband service.

The average performance of the unbundled local loop plans improved towards the end of the reporting period, and for last two months of the period the average national web browsing speed was these plans was approximately 20 per cent better than for the bitstream plans. The Commission will continue to monitor this to determine whether the improvement is sustained over future measurement periods.

International Web Browsing

Many websites viewed by users are situated overseas so the speed of data transfer from these websites is important to the user experience. Even websites with names ending in '.nz' may be based overseas.

International web browsing speed is limited by the significant distance the traffic has to travel and also by any restraint on international capacity. However, caching of international content may offset some of these limitations and most ISP's are now caching to improve performance.

Figure 12; International Web Browsing

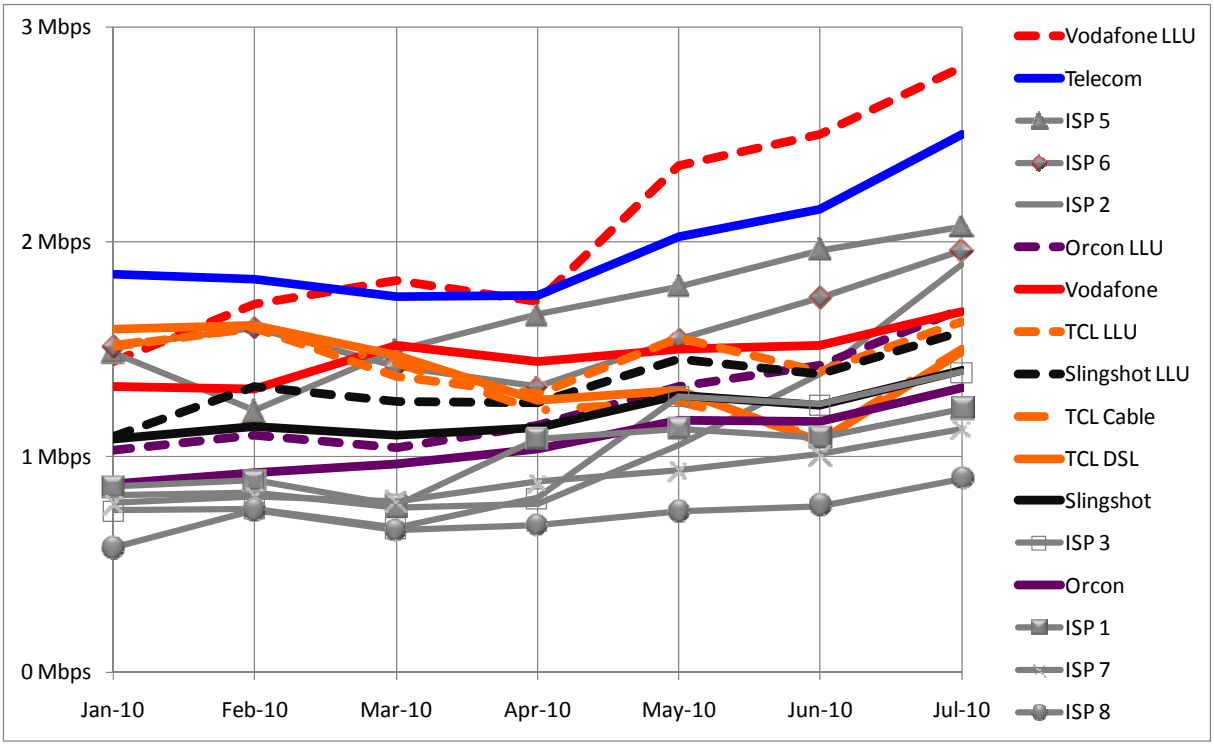


Figure 12 shows the range of international web browsing speeds achieved in the 6 month reporting period[7]. The Commission has set a benchmark of 1.5Mbps as a reasonable speed to achieve for international web browsing. Nine ISP services achieved benchmark performance at some time during the six months, but only two met the benchmark for the entire period. This international performance benchmark can be reviewed upwards if necessary to take account of changing circumstances such as improved broadband technology, better caching, etc.

[7] Performance measured for browsing to a reference site in the United States.

Availability of Internet

Availability is measured as the percentage of time (over a test period) that a reference website can be successfully downloaded. This measure is intended to determine whether ISPs are providing reliable connections and whether the reliability is improving over time. The Commission benchmark of 99.9 per cent represents a network being unavailable for less than 43.2 minutes per month.

The Epitiro system runs availability tests every 15 minutes for each ISP at each site, which equates to over three million tests per month. Minor ISP results are aggregated to provide a similar number of tests to those applied to the major ISP's. The TelstraClear results include both Cable and DSL.

The results for this period are shown in Table 1 and indicate that ISP availability continues to improve and that all ISPs achieved the benchmark consistently since February 2010. TelstraClear's performance dropped below the benchmark in February, which made it the only ISP to have less than 99.90 per cent availability in any of the six months of the reporting period.

Table 1; Internet Availability by ISP

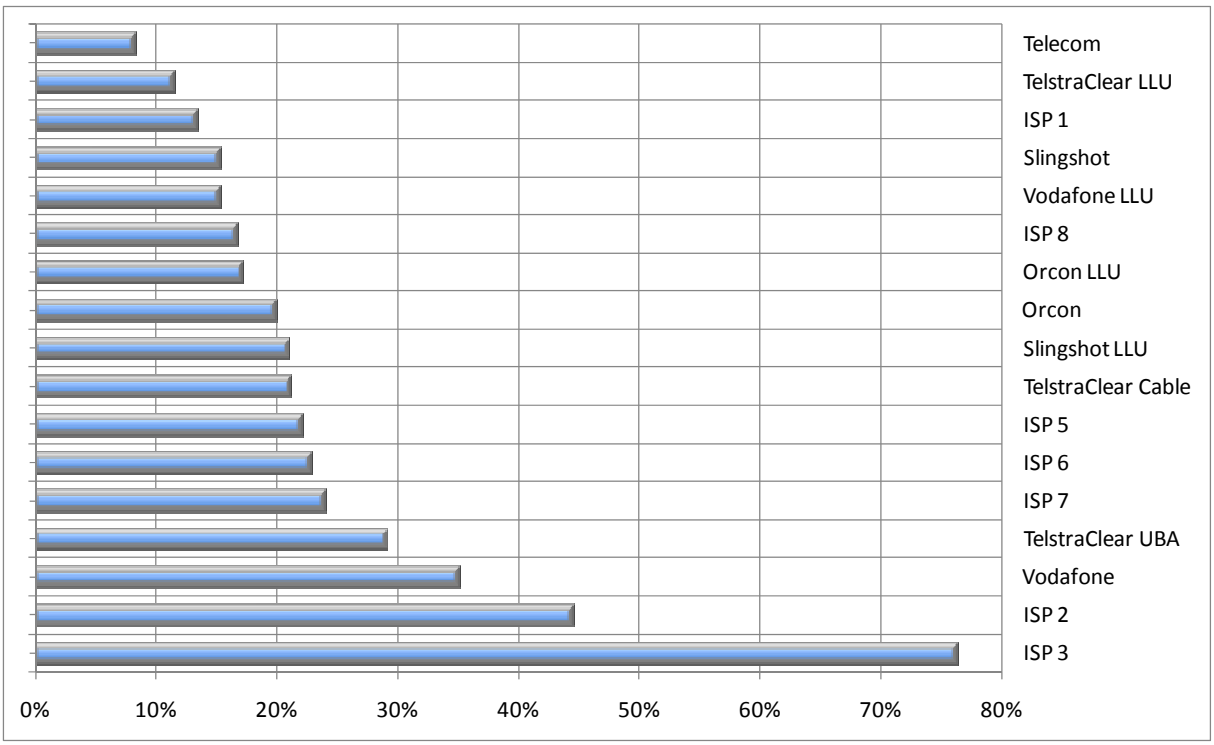
	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10
Orcon	99.98%	99.99%	99.97%	99.99%	99.98%	99.96%
Slingshot	99.98%	99.99%	99.98%	99.97%	99.98%	99.99%
TelstraClear	99.98%	99.61%	99.99%	99.93%	99.91%	99.98%
Telecom	99.98%	99.96%	99.99%	99.97%	99.99%	99.98%
Vodafone	100.00%	99.97%	99.99%	99.99%	99.92%	99.94%
Other	99.99%	99.98%	99.95%	99.97%	99.91%	99.97%

Variability of Speed by Time of Day

Consistency of service is an important feature of broadband performance. A user's broadband experience may be adversely affected if there is significantly reduced performance at certain periods of the day. The Commission's view is that a reasonable benchmark for variability of national web browsing speeds is that the differential should be no greater than 20per cent of the maximum browsing speed achieved during the 24 hour period. Typically the greatest variance occurs around the peak internet usage time of 9pm when the slowest speeds are observed.

This variability test was completed during the week of 22 June to 28 June 2010, excluding the weekend. The week chosen to analyse was one during which few interruptions to service were evident from either the ISPs or the testing methods, to help ensure a fair comparison. However, the week chosen may not reflect the variability of performance of individual ISPs for every week of the reporting period. As the week was at the very end of the reporting period it picks up the increased speeds being recorded for unbundled local loop connections.

Figure 13; Variability Over the Day

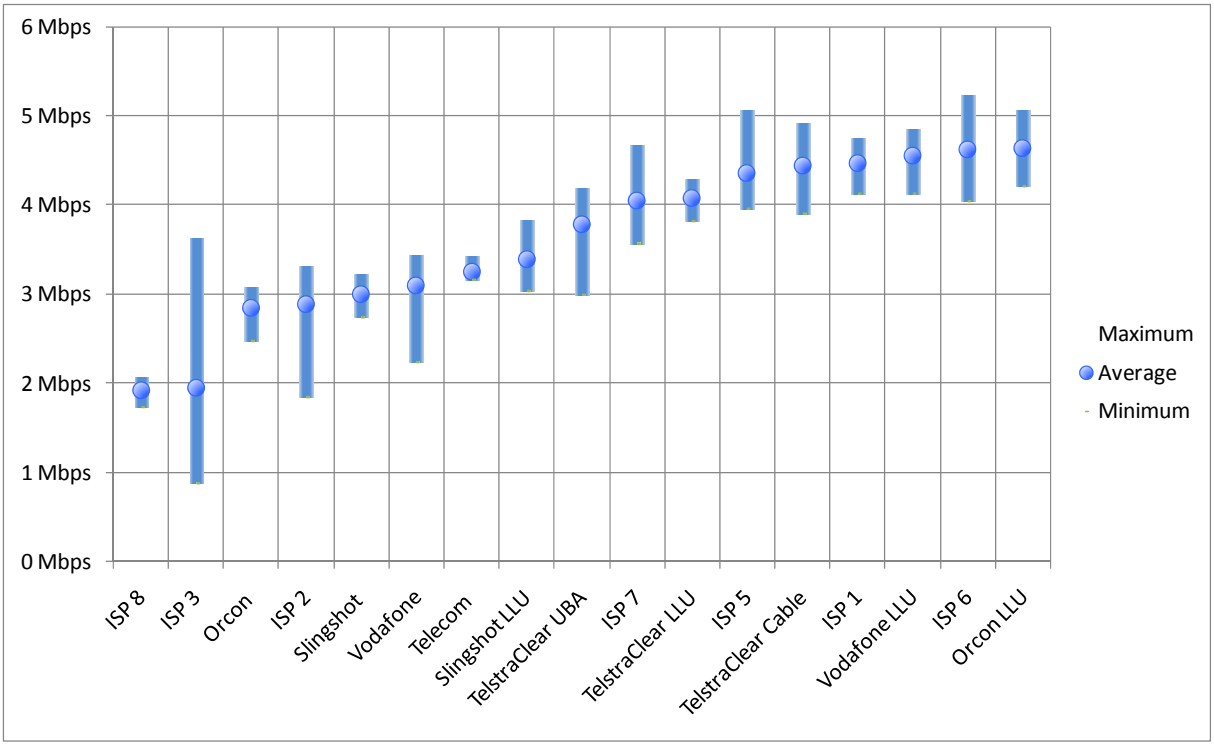


ISP's have generally improved their variability performance significantly since the previous variability test was conducted, with only two ISPs from 13 rather than the five exhibiting variability substantially above the 20 per cent benchmark. As can be seen in Figure 13, another two ISPs were materially outside the benchmark and a further five were outside the benchmark by a limited margin only. It appears that where service is provided via an unbundled local loop that variability is generally lower.

Figure 14 shows the variance from average web browsing speed for the test week in absolute terms for each ISP. The average is taken from all sites where the particular service is measured, which for the minor ISPs is generally only one site. Figure 14 should not be used to make an overall comparison of ISP speeds as some minor ISPs may be based only in

Auckland where others are only in the South Island where it is not generally possible to achieve browsing speeds which are comparable with Auckland.

Figure 14; Variance from Average

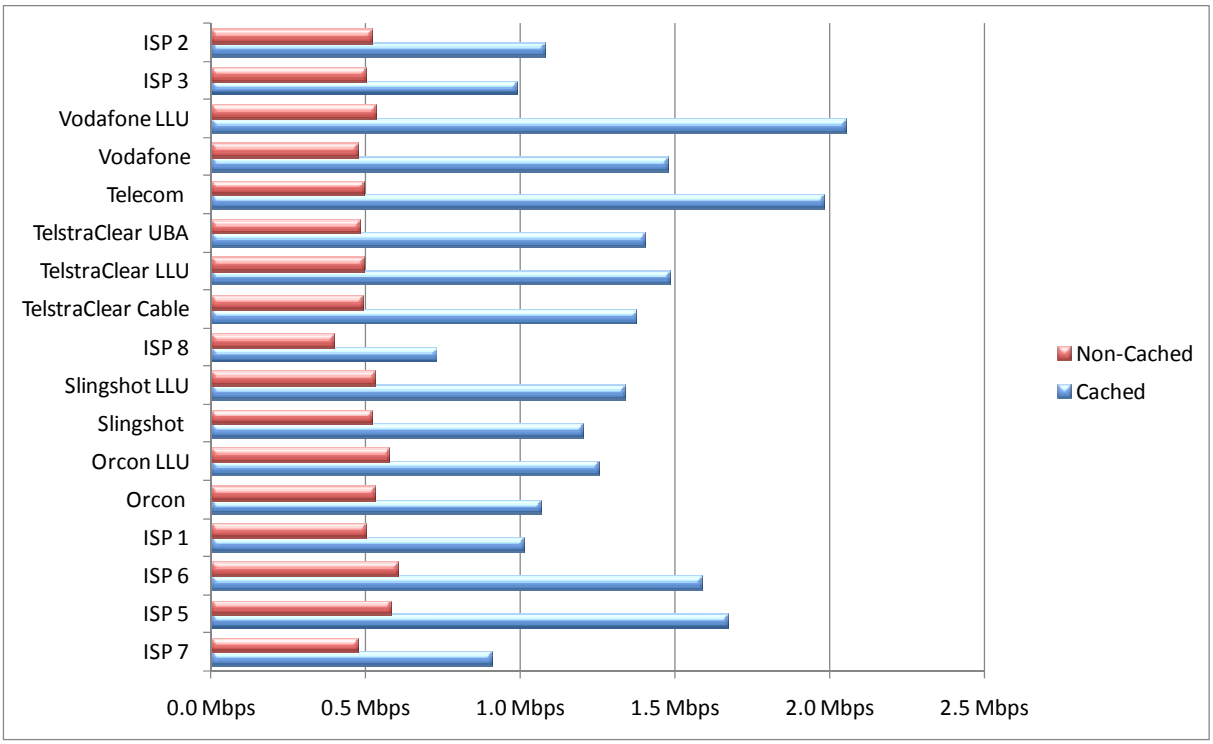


Caching

The speed and reliability of web browsing is one of most important factors affecting user internet experience. Around 40 per cent of internet traffic in the Asia Pacific region is generated by web browsing.[8]

Caching of international content is an important factor affecting international web browsing performance in New Zealand. Caching stores international (and sometimes national) content locally, enabling users of this content to download it at local or national speeds. The impact on performance from caching content can be significant.

Figure 15; Comparing Cached to Non-Cached International Web Browsing



The Epitiro test measures both cached content and non-cached content from the same offshore website. Figure 15 demonstrates the difference between these measures with cached vs non-cached performance varying widely.

The reference website used to test caching has been changed for this reporting period. The change was necessary to remove the impact of 'special' caching undertaken by some ISPs for the otherwise rarely used website previously used as a reference. To avoid similar issues in the future, the new reference website will not be named.

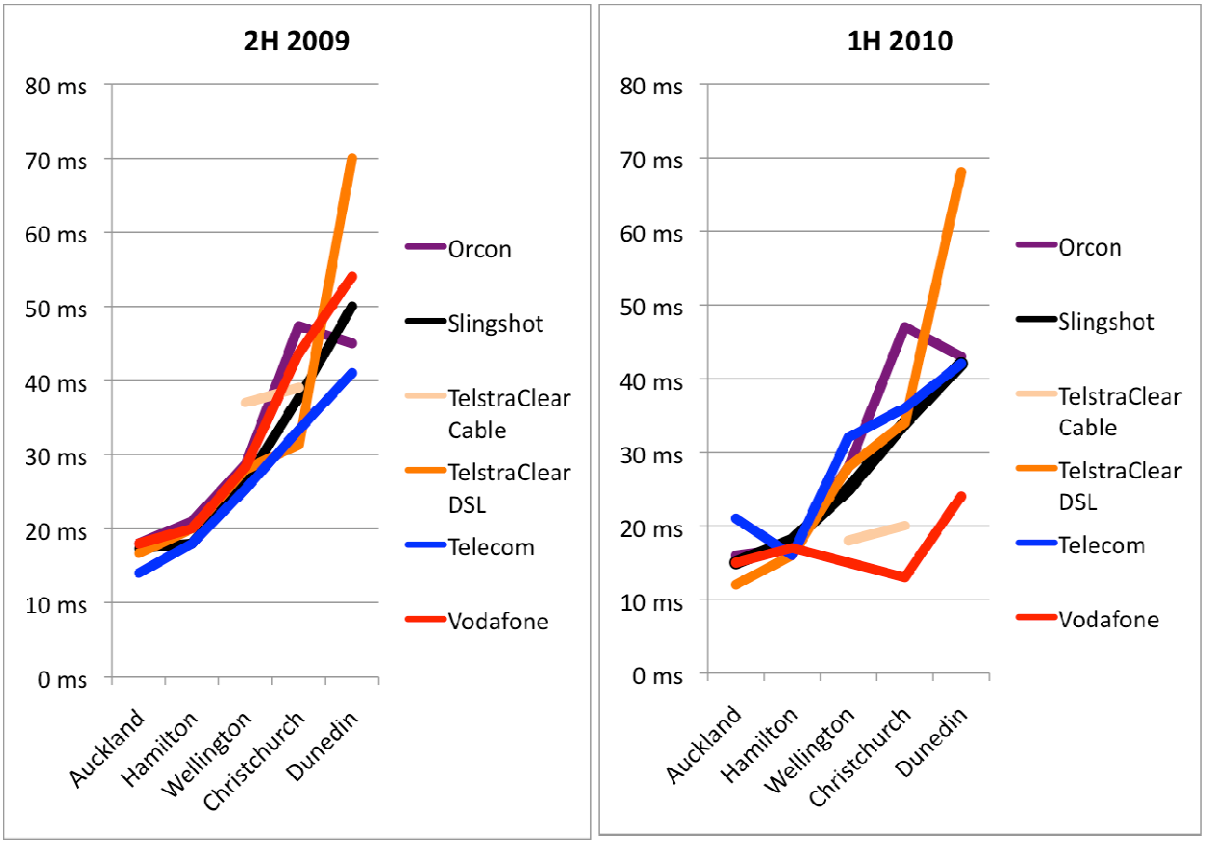
[8] Sandvine 2009, http://www.sandvine.com/news/global_broadband_trends.asp

DNS Performance

The Epitiro tests include some other detailed measures of performance that the Commission has previously reported. These include tests known as Ping and DNS. The DNS test is a Domain Name Server test and records the time taken (in milliseconds) to resolve a domain name to a corresponding IP address. This is the second time DNS test results have been reported.

A benchmark is yet to be set for DNS performance, although if 20ms can be achieved in Auckland by most ISP's based in Auckland, this would appear to be a suitable benchmark for all cities.

Figure 16; DNS Changes from 2009 to 2010



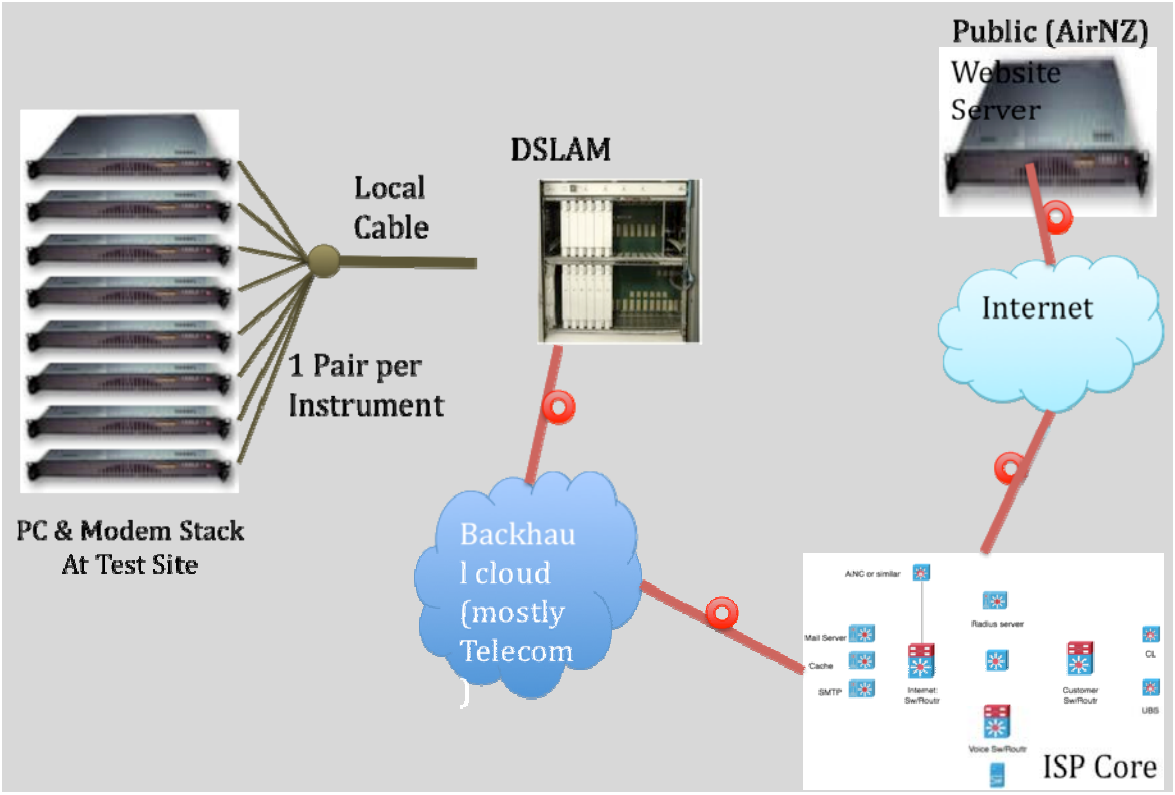
In the previous report, the DNS scores ranged from 15 to 17ms in Auckland and 40 to 70ms in Dunedin as per the left hand graph in Figure 16. Some ISP's appear to have responded by improving DNS performance considerably as can be seen from the right hand graph in Figure 16, most likely by installing equipment in the cities affected.

APPENDIX 1 - THE TEST PLATFORM

The ISP-I platform gathers data from twelve Internet Service Providers (ISPs) in five cities from eleven test sites located relatively close to various Telecom exchanges. The ISP's premium residential broadband DSL plans (or equivalent) are measured on seven key performance variables (KPVs) that impact broadband performance.

The ISP-I test platform and network setup is illustrated in Figure 16.

Figure 17: Test Network Setup



The strengths of this setup are:

- each ISP is measured with known and consistent computers and modems;
- there is no interference from users on the same connection;
- the distance from the exchange is the same for each tester at a site, ensuring that distance is less of an issue for ISP to ISP comparisons at that site; and
- the live website testing is exactly the same as a user would experience.

The weaknesses of this setup are:

- the interference from cross-talk is more than expected, probably due to the co-location of modems at the test site; and
- the use of a live website makes testing subject to the risk of changes to the website.

The test plan is normally the premium residential full speed (both upstream and downstream) DSL plan (or equivalent) that each ISP being tested offers, but in some instances Epitiro had to purchase an equivalent business DSL plan. This should not affect results.

The Epitiro data provides a useful comparison of changes in broadband ISP performance over time under controlled conditions as well as a fair comparison between ISPs located at the same site. However, it does not represent what individual users may expect from their broadband service. This is because it does not capture all the variables that influence residential performance. These include:

- a home's distance from the Telecom exchange;
- the quality of computer equipment and home wiring;
- the number of users on the same broadband connection; and
- the large variations in performance of the websites users visit.

Further details of Epitiro's methodologies are included in the Appendix 4.

Telecom offers two residential full speed DSL plans with data caps of 20GB or more but the Pro plan with 40GB of data is tested because its default is to have interleaving switched off.

Epitiro has moved to testing the naked DSL variants of the broadband plans tested where these are available. These changes were completed during June 2010.

APPENDIX 2 - BROWSING TEST TECHNICAL DETAILS

Overview

There are a number of ways of measuring the speed of the broadband service provided by ISPs. These include:

- HTTP or web browsing speed which measures the size of a specific web page and divides that by the time taken to download it;
- Throughput or download speed measures the speed of a file being downloaded;
- Streaming speed measures the speed of viewing a video or listening to audio.

The Commission is currently measuring browsing speed only as this is the most common use of the internet. A global internet traffic report by Sandvine[9] found web browsing made up the largest category of internet traffic, and in the Asia-Pacific region accounted for 40 per cent of traffic.

There are a number of factors that have a material impact on ISP performance that the report continues to highlight, including:

- Investment in primary and secondary backhaul;
- Distance to the exchange;
- Line synchronisation speed of the copper local loop used for each connection – i.e. the top speed possible; and
- Investment in local infrastructure.

The Backhaul Factor

The backhaul portion of a network includes the link between the Telecom exchange and the service provider's network. A backhaul network is provisioned to cope with the volume of users and traffic at both the local and national level. Correctly provisioned backhaul will ensure that there are no capacity bottlenecks that could restrict peak performance. Backhaul can be further divided into three types:

- Interconnection link, the connection between the service provider and the network provider;
- Primary (also known as local) links, which take traffic from the Telecom exchange to the nearest data switch; and
- Secondary links, which take traffic from the data switch to the service providers network. Secondary links are often a national link and may be provided by one or more network providers on behalf of the service provider.

The majority of broadband service providers purchase wholesale backhaul services from third party network providers.

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[9] http://www.sandvine.com/downloads/documents/2009%20Global%20Broadband%20Phenomena%20-%20Executive%20Summary.pdf

The Effect of Distance on Web Browsing Speed

Line synchronisation speed is reported by a DSL modem after connection to the ISP has been initiated. Although not necessarily directly correlated with the achieved data throughput speeds, this line speed can limit the peak broadband download speeds. Web browsing speeds are necessarily slower again than download speeds. DSL synchronisation speed is significantly affected by the length of the copper local loop serving the customer.

Impact of Interleaving

Interleaving is a method of transmitting data packets in a way that corrects transmission faults and improves the reliability of a connection. However, interleaving increases latency and can slow download speeds. It is of little value to users who are close to an exchange and have good transmission. As Epitiro's platform is measuring DSL providers over relatively short loop lengths, the removal of interleaving generally provides a significant boost to performance.

The September 2009 quarter was the first measurement period in which interleaving was turned off for all the plans being tested. The plans, which still had interleaving at the beginning of the period, had it turned off in late July 2009. As a result, poorer performing ISPs in particular often showed considerable improvements compared to previous quarters.

Users are advised to check with their ISP to identify if they have their interleaving on or off if their browsing speed is below what they expect. However, interleaving may not be the cause of slow speeds – it may be distance to the exchange, house wiring, cordless phone interference or other interference.

International Web Browsing

International web browsing speed is most affected by the distance to the international server, the upload speeds at the remote server, caching, the capacity of the international connection and the capacity of the ISP backhaul network.

APPENDIX 3 – DOWNLOAD SPEED TESTING

Download Speed

Download speed or throughput is the speed at which a file, e.g. a software update, is downloaded. This is the type of speed test most commonly used by internet users when they want to test the speed of their broadband connection. Many ISPs have their own download speedtest available on their website or have a link to a speedtest for their customers to use. However, ISPs normally ensure that traffic used for such speedtest testing does not have to pass through the full extent of the ISPs network in order to give a more favourable result.

The Commission is considering measuring ISP performance by download speed. This would probably require a test for each ISP at each test site that downloads a large file every hour to identify the speed achieved during a typical download.

Akamai already produce a reliable comparison (by country) of speeds to download their cached content, from servers based within ISPs. New Zealand results are shown in Figure 18. Speedtest produce a less reliable survey from users own tests to their speedtest server, which could be biased by user selection. However, both tests demonstrate the net speed, which is the speed available from a combination of network performance, distance limitations, user choice of package and in the case of speedtest, measures of cap constrained speeds.

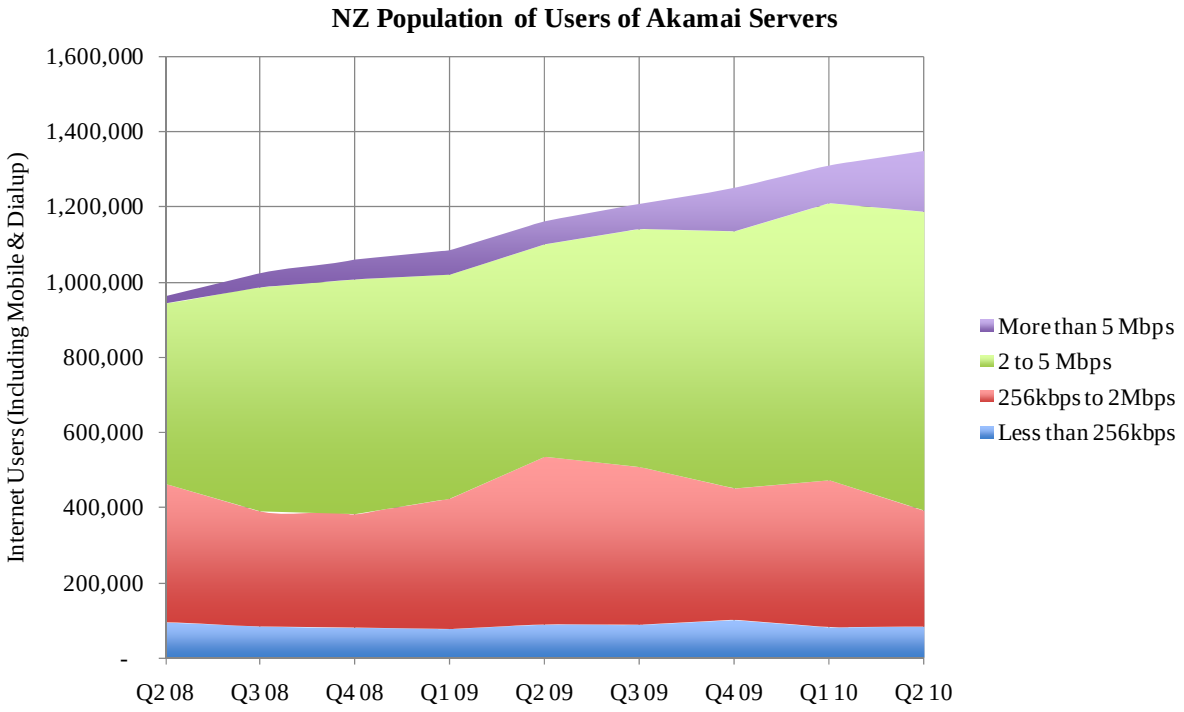
The Epitiro ISP-I testing used by the Commission to monitor ISP broadband performance tests premium broadband plans from test sites in locations that achieve good performance so it is likely the national web browsing speeds measured would be faster than the New Zealand average download speed performance reported by Akamai.

<u>New Zealand average speed performance (from Akamai)</u>

Akamai produce a study of internet speeds based on their cache servers located within many ISP’s core networks. These measure the download speed of users and effectively take into account the speed purchased as well as any limits due to distance. They will include tests from, mobile, Wifi and potentially tethered mobile, all these services tend to have lower speeds than wired Broadband. They will also include tests from very high speed Broadband including fibre at corporate, ISP and other high capacity nodes.

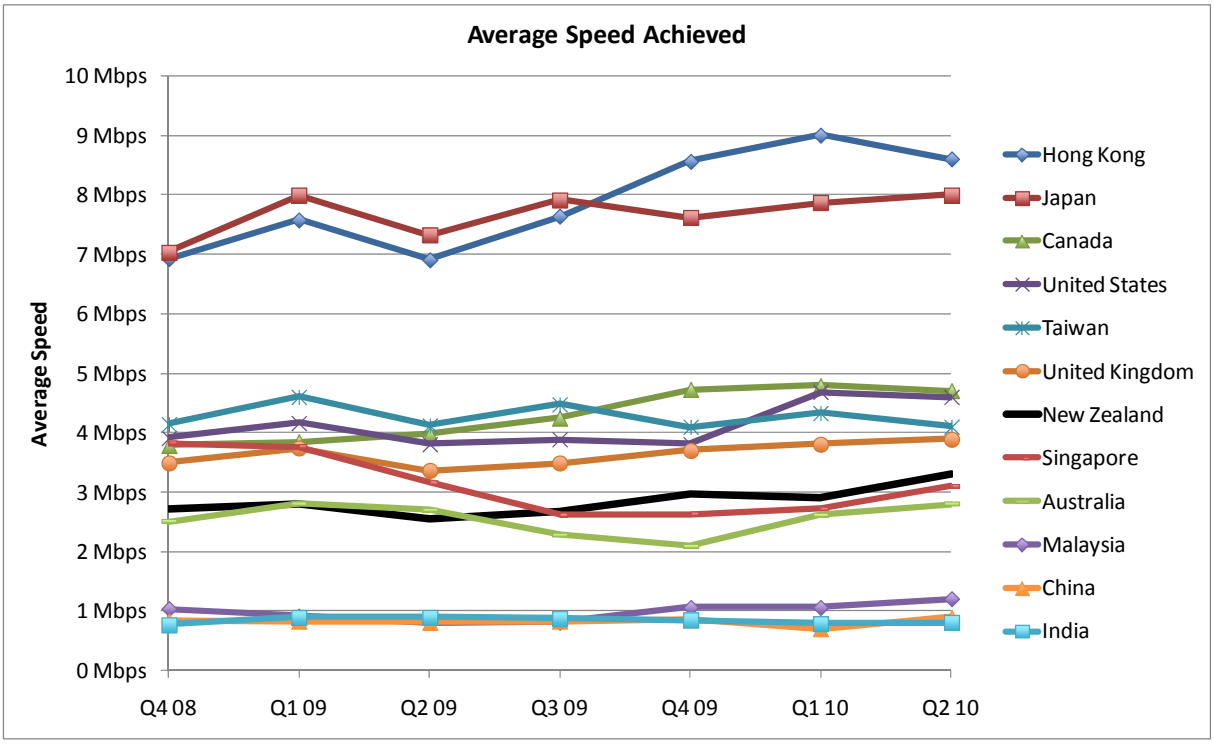
Akamai also publish download speed results from the other countries in which their cache servers are located. A selection of these results, mainly from the Asia Pacific area, including New Zealand’s is shown in Figure 19.

Figure 18: Akamai New Zealand Speed Test Results



Source: Akamai *State of the Internet* reports

Figure 19: Akamai International Speed Test Results



APPENDIX 4 – EPITIRO METHODOLOGY

Overview

The data used in this report is collected using Epitiro's ISP-I technology. The data provides an independent perspective of broadband performance in New Zealand as seen from the Epitiro measurement platform. This platform is believed to be a good proxy of optimum customer experience.

The ISP-I data is gathered from twelve ISPs measured across five cities at eleven sites located relatively close to various Telecom exchanges. ISPs are measured on the premium consumer broadband package available at the sites where they are tested.

At each site, there are approximately 8 separate modems coupled to their own PC running the broadband quality tests. These tests are all completed on separate lines to the Telecom exchange. Interference between these lines may be higher than normally experienced in a household due to the multiple lines going to the same site, and may explain why sync speeds can vary significantly between lines. Lines are randomly allocated to ISPs.

Tests are conducted on seven key performance variables (KPVs) that impact the user's experience when browsing and downloading content, exchanging email, gaming online or streaming video. These are explained below.

The ISP-I data provides a useful comparative view of broadband service performance, with its greatest strengths being its comparisons of ISPs under controlled conditions, and the analysis of this data over time.

Data Gathering

The data is collected and managed via Epitiro’s ISP-I service. The ISP-I platform consists of a centralised database and reporting system along with geographically diverse deployment of ISP-I-configured PCs or 'satellites' that are responsible for collecting data on the performance of the monitored network services. Testing is maintained 24x7, with each ISPs service tested every 15 minutes. Tests are performed using PCs that are of a specification typical of those available for home use and which run the ISP-I software.

A consistent specification is maintained across the ISP-I network. All satellites are installed with Microsoft Windows XP Professional SP2, with the Windows Firewall enabled. In order to test each ISP’s services, Epitiro has subscribed to the premium broadband service available from each ISP at each of its physical testing sites.

Epitiro’s ISP-I Satellite software runs on Windows and employs Microsoft’s .NET framework to control the connectivity and execute tests as and when required. The ISP-I Satellite integrates very closely with the Windows Operating System, which means it uses exactly the same underlying mechanisms as an end user connecting to the internet and to the services made available via their ISP. More detail on how the ISP-I Satellite software performs its tests is given below.

The DSL modem used is a Thomson ST546 modem/router in all instances except for TelstraClear Cable, for which the modem is the standard supplied by TelstraClear.

Measurements Available from the Epitiro Test Laboratories

There are nine measurements available for this report. The commission uses these to develop the key performance variables listed in Table 1. The measurements are defined as follows:

Synchronisation Speed

Synchronisation speed is one measure of the speed of broadband service supplied to a customer. Line connect speed is the synchronisation speed reported by the modem after connection to the ISP has been initiated. It represents an upper limit on the customer experience; sustained data rates are often slower than the synchronisation speed. When connecting to a service via a modem (this includes dial-up, DSL, fixed wireless and mobile / HSDPA / GPRS broadband connections), the ISP-I Satellite software employs the Windows RAS APIs to initiate the connection. This is the same underlying mechanism that an end user would be using when they manually initiate a connection to their ISP. In the case of connections that use the Satellite's ethernet connection, such as cable or router connections, the Satellite software is able to confirm existence of an active connection, but does not capture any timings, synchronisation speeds or specific failures as the connection itself is managed by the cable modem or router.

Cached HTTP

Web pages are stored on servers that are often located in foreign countries. To improve retrieval times and reduce international transit costs, content fetched by users may be locally cached on NZ-based servers. The cached HTTP download test indicates how quickly an ISP can distribute content over the New Zealand portion of their network by testing how fast specific web pages are downloaded. The HTTP test makes a request to the specified URL and records the time taken and the amount of data downloaded, from which the speed of the download is derived. Depending on the configuration of the test, the satellite is also able to download the embedded content, such as images on a web page, in any HTML that results from the HTTP request. Any additional content downloaded is reflected in the captured timings and size of data downloaded. Epitiro has selected a basket of the websites most frequently accessed by local users.

Non-cached HTTP

The HTTP test can be configured to run in one of two modes of operation: cached and non-cached. When the test downloads from the specified URL in "cached" mode, the performance of the download can be impacted by any caching mechanisms used by the network provider/ISP connected to the PC satellite. The non-cached HTTP download test ensures that the web page request bypasses any caches present in the network, and so goes all the way back to the original website, making use of international bandwidth where necessary. This test therefore provides an estimate of the user experience in downloading web pages from foreign locations. Short times equate to a better experience. The test manages to identify cached content correctly in a large percentage of cases, but may allow cached content through as non-cached. If a failure occurs then the HTTP status code is recorded. This can be used as an indicator as to whether the error resulted from the network or from a problem with the web server hosting the URL. Epitiro has selected a basket of popular URLs located in the various regions of the world – the US, Asia and Europe particularly – to test the quality of each ISP's international connectivity.

Ping Performance

A 'ping' is the time taken for a device on the internet to send a request to a remote server and for that server to respond with an acknowledgement. The ping time test is a measure of how

quickly the ISP's network can respond to a request, so it is also known as a measure of latency. Shorter ping times are better. The Ping test measures network latency by sending an ICMP echo request to the specified server. The time recorded by the ISP-I Satellite is the total round trip time (in milliseconds) from the request to the echo response being received from the server. The ping test is conducted on the same basket of URLs used in the HTTP tests.

Domain Name Server Performance

A Domain Name Server (DNS) fulfills a function similar to a telephone directory. A DNS server takes an address readable by humans (e.g. www.comcom.govt.nz) and converts the address to an IP address, or a specific set of numbers which identifies a particular website. In technical terms, the DNS test records the time taken (in milliseconds) to resolve a domain name to a corresponding IP address. The DNS servers used for the query are those primary and secondary servers dynamically assigned by the service provider when the network connection is initiated. Alternatively a specific DNS server can be configured for use during DNS tests. The ISP-I Satellite delegates responsibility for DNS resolution to the underlying operating system, thus using the same DNS resolution mechanism employed when a user enters a URL into a web browser. More details of the specific DNS resolution algorithm used by Microsoft Windows can be found in the Windows XP Resource Kit (Configuring IP Addressing and Name Resolution). Satellites ensure that the DNS query is performed on the DNS servers, and not returned from any local cache, by disabling the Windows DNS Client Service responsible for caching the results of DNS requests.

Email Round Trip Time

The email roundtrip test measures the time that it takes for an email to be sent over the internet using the ISP's mail servers. If these servers are busy then they may take a longer time to send a message: a shorter time therefore provides a better experience. In technical terms, email testing within ISP-I consists of SMTP tests that run from the Satellite and POP3 tests that are run centrally to retrieve the emails from the POP3 mailboxes. The SMTP test executed by the Satellite can be configured to send an email using the service provider's SMTP server to one or more recipients. Each email sent can be uniquely identified by an ID transmitted in one of the email's headers. The Satellite records the time taken to send the email using the SMTP server, and also any SMTP error codes that result during the course of the conversation with the server. The POP3 component of the ISP-I platform's email testing is performed from centrally managed servers that are configured to poll the mailboxes of each POP3 account once every minute. Whenever an email is retrieved that was sent from an ISP-I Satellite, the time of retrieval is recorded. Any errors that occur while attempting to connect to a POP3 server are also recorded.

TCP Retransmits Performance

The TCP Retransmits test records the average TCP Retransmits percentage experienced during individual tests and an overall TCP Retransmits test. The TCP Retransmits test is not an individual test in the same sense as the other tests that the ISP-I Satellite is capable of executing. Instead, the Satellite records TCP Retransmits during all the individual tests executed, as well as an overall TCP Retransmits measure over the course of entire network connection during which the tests were being run. Thus, as well as measuring the TCP Retransmits in a network, ISP-I is able to indicate whether TCP Retransmits are occurring for a particular protocol or service. The ISP-I Satellite measures TCP Retransmits by utilising the Performance Counters for TCP available within Windows. TCP Retransmits are recorded as the percentage of TCP segments transmitted from the Satellite machine that contain retransmitted bytes.

ISP Service Variability

Given the potential for significant performance variability, it is useful to try to quantify the undulating nature of broadband services, specifically around performance over peak and off-peak periods, as this “natural” fluctuation can impact upon customer experience.

The best variable for measuring this variability is HTTP download speeds. For the purposes of the graph used in this report, national cached download speeds were taken for a week and averaged by the hour.

ISP Average Availability

The ISP Average Availability test measures the percentage of time that the reference website is able to be successfully downloaded from each ISP over a large number of tests (run every 15 minutes per ISP). The results provided by ISP-I are grouped into the various types of errors that were encountered while the tests were run over the specified timeframe; including HTTP status codes and errors returned by the satellite software. The results that are reported on in the ISP Average Availability graph specifically focus on those errors returned by the satellite software only to ensure that ISPs are not adversely affected if the reference site becomes inaccessible for reasons beyond their control.

Other Factors affecting Broadband Service Experience

The service an ISP delivers to a consumer is not only affected by network–related issues, as measured above; there are factors within the home or business environment that can also play a significant role in repressing broadband service performance. Epitiro’s testing has revealed these factors to include:

- The individual's choice of broadband plan, including speed and size of data cap. This is particularly critical with ADSL2+, where full benefits are only achieved on a 'maximum download, maximum upload' data plan.
- Satellite television services, when the decoder is plugged into a telephone jack without an ADSL filter;
- Faxes attached to the telephone jack, even if they are not operating and have a ADSL filter;
- PC hardware specification;
- PC operating system configuration;
- Extent of applications and malicious software or viruses that may be running in the background on a user’s PC;
- Telephone line wiring quality;
- Number of cable pairs bundled together (when serving multiple tenancies, for example blocks of flats), and the number of those running broadband services.

The ISP-I data included in this study is collected in a way to standardise the impact of these factors, to ensure like for like performance from each ISP is measured.

Reporting on Other ISPs

A total of thirteen ISPs are measured (counting Telstraclear DSL and cable as two), but a number were only measured in one site or one city. TelstraClear Cable is measured where it is available in Wellington and Christchurch.

Disclosure Statement from Epitiro

The data used in the preparation of this report is provided to the Commission under contract by Epitiro (NZ) Limited, a part of Epitiro, a technology-focused customer experience management and benchmarking company operating world-wide. Epitiro is committed to providing information that is objective, reliable, and unbiased.

Epitiro provides a range of services to other parties, including ISPs, that are or may be the subject of analysis in this report, including: Telecom, Vodafone and Slingshot. Epitiro has made commitments to the Commission to ensure that its contractual relationships with other parties do not undermine the reliability of the data used in this report.

Other parties that receive Epitiro services may publish their own conclusions or analyses based on the information provided by Epitiro, which may differ from the analyses and conclusions reached by the Commission in this report. Differences in reported results or the conclusions drawn may arise from:

- The methodology used to analyse the information;
- The source of the information; and
- The time period being analysed.