REPORT FOR THE COMMERCE COMMISSION ON NEW ZEALAND BROADBAND QUALITY

Q1 MARCH 2009

BY

EXECUTIVE SUMMARY

New Zealand's broadband performance shows a moderate improvement in the March 2009 quarter, but congestion in key portions of the network continue to impact broadband download speeds. This is particularly affecting cities remote from Auckland, which is the aggregation point for international web traffic.

These are the core findings of the New Zealand Broadband Index report this quarter, which includes new analysis and graphs on national and international download speeds, broadband reliability and variability in performance over the day.

The new analysis shows peak download speed for national web content is typically around 5Mbps, based on an average of all ISPs to a single test website. This is more than double the top average speed of 2Mbps for international traffic.

This report does not capture the performance of new broadband services delivered from unbundled exchanges in Auckland and Wellington. It is expected that this information will be captured commencing with the Q3 report.

The NZ Broadband Index is published by the Commerce Commission as part of its telecommunications monitoring and reporting objectives under the Telecommunications Act. This is the second quarter in which the higher-speed broadband technology, ADSL2+ is used between the local exchanges and the labs, driving a step-change in broadband performance in the December period.

The Epitiro data is generated at a laboratory site located 800m to 1.5km from a Telecom exchange, and should therefore not be regarded as representative of a user's broadband experience in the home. It does not capture all the variables that influence individual performance such as a home's distance from the Telecom exchange (which impacts speeds), the quality of computer equipment, or home wiring. However it provides a valuable comparative view of changes in broadband service performance over time, as it compares ISP performance under controlled laboratory-type conditions.

Key findings this quarter:

- New Zealand's overall broadband performance demonstrated further incremental 4% improvement this quarter. However the gap in performance between the best and worst performing ISPs continued to widen, driven by relatively significant investment in network performance.
- New availability measures show the level of broadband uptime and reliability is very good, averaging 99.97% in March. This means an average network downtime of approximately 14 minutes per month.
- New caching solutions, which store popular international and national content locally, can deliver a two to threefold improvement in international download speeds, but have a marginal impact on national content.
- Over the course of the day, the peak pressure periods for broadband services are after 3pm in the afternoon and again at 9pm, with some service providers in particular struggling to meet demand during these times.
- Changes in data management settings are providing a performance boost to some ISPs. 'Interleaving' settings provide greater stability to

broadband performance over distance, but increase latency. Some ISPs are now turning interleaving off as a default setting in their network to increase performance.

INTRODUCTION

The New Zealand Broadband Index (NZBBI) is founded on Epitiro's ISP-I technology platform, which tests broadband Internet services from the residential end user perspective.

The ISP-I data is gathered from twelve Service Providers ('ISPs') measured across five cities at eleven sites located relatively close to various Telecom exchanges. ISPs are measured on their premium consumer broadband package on seven key performance variables (KPVs) that impact broadband performance.

The Epitiro data provides a useful comparison of changes in broadband Internet Service Provider performance over time under controlled laboratory-type conditions. However it should not be seen as representing a user's broadband experience in the home: it does not capture all the variables that influence residential performance, such as a home's distance from the Telecom exchange (which impacts speeds), the quality of computer equipment, or home wiring. Internet users will also experience large variations in performance from the websites they visit, some of which may be very slow.

This is the second quarter in which the performance of the higher-speed ADSL2+ technology has been included. ADSL2+ offers theoretical speeds of up to 24Mbps, although typical sync speeds are up to 15Mbps. This compares to standard speeds of less than 5Mbps provided by the earlier ADSL1 technology. ADSL2+ can only be received by broadband users with an ADSL2+ modem. Over 60% of broadband lines are now capable of delivering ADSL2+ and it has a growing mass market subscriber base.

All data in this report is gathered, processed and indexed by Epitiro. IDC New Zealand has been commissioned by Epitiro and the Commerce Commission to review the methodology and provide independent analysis of the presented data and findings.

Full details of Epitiro-IDC's reporting methodology are included in the Appendix at the end of this report.

Changes in the March report methodology

The NZBBI was first introduced in March 2008, representing a new reporting programme and index methodology. Over the last year the report has been refined and a number of changes have been made this quarter:

1. Discontinuation of the international comparison

The Commission has decided to discontinue reporting changes in NZ in comparison to the UK. An accurate indexed comparison is becoming increasingly difficult due to the nature of technology deployed, scale of data measurements and other competitive and environmental factors. We hope to include international data again in the future when we are able to provide more direct comparisons.

2. Change in service variability indicators

The service variability charts demonstrate the variation in broadband performance throughout a day due to congestion. These charts are produced in a format that shows the range of ISP performance at key points during the day, over the period of a week.

3. Introduction of a new availability measure

Availability is a measure typically associated with the communications industry, and represents the total time a service is available. This is often measured in the number of “nines”, representing the percentage of uptime over a set period. The internet is more flexible than the telephony service which is expected to perform to 99.999% (5 nines) availability, because web browsing users are not noticeably affected if the service is momentarily interrupted. However this is changing quickly and users are beginning to expect the internet to be available at all times, especially if they use an internet telephone service or other similar service in which any interruption or delay, no matter how brief, may be noticeable. Performance is currently averaging 99.97% for all ISP’s, with the top ISP achieving 99.987%.

4. New national and international download speed measures

This quarter, a new dataset has been introduced comparing national and international download speeds by city. The data comes from two carefully selected test sites that have almost unlimited capacity up to the internet, which means the website's own capacity constraints won't distort results. As a result, ISPs national and international download speeds can be compared, with the outcomes shown as a maximum and minimum speed with a weighted average in each city.

NEW ZEALAND INDUSTRY PERFORMANCE

Broadband Overview

Recession and ongoing economic uncertainty appeared to impact broadband growth in the first quarter of 2009, although there were mixed signals across different sectors.

A number of ISPs cited a pick-up in consumer broadband adoption in the New Year, attributing this to new service bundles and improved broadband caps for the same price. Businesses and consumers seem to be seeking to control costs by migrating to lower value plans or reducing toll and mobile calls and data overage.

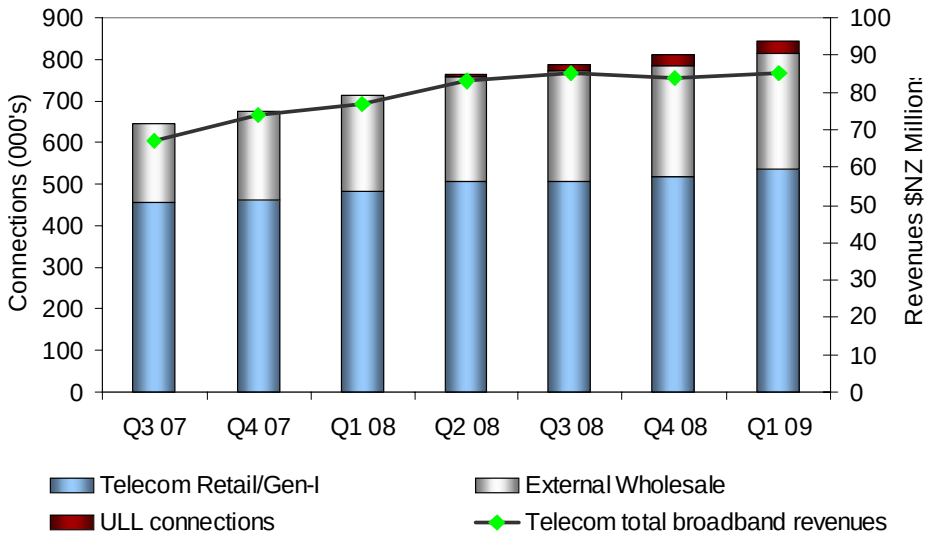
Nevertheless Telecom has estimated for the third successive quarter that the economic downturn has had a relatively modest $10 million dollar impact on earnings before income tax, depreciation and amortisation (EBITDA) in the three months to March across its entire telecommunications business, or around 2%.

Based on Telecom's published results, as shown in Figure 1 below, total retail, Gen-i, wholesale and unbundled connections increased 4% in the March quarter to 845,000, slightly ahead of connections growth the previous quarter (up 2.9%)

FIGURE 1

Telecom Broadband connections growth

(Calendar quarter)



Note:

- *Telecom retail figures include Telecom Retail and Gen-I figures.*
- *Unbundled connections are reported by Chorus*
- *Total Telecom broadband revenues include Telecom Retail, Wholesale and Chorus (ULL) financials*

Source: Telecom Financial Report, March 09

Telecom's retail broadband subscriber connections grew 4% to 519,000 (excluding Gen-i), matched by 4% growth in the number of wholesale broadband connections to other service providers to a total of 277,000.

However the very strong growth rate in unbundled connections slowed this quarter. 'Unbundling' occurs when a service provider installs their own equipment into a Telecom exchange in order to offer its own services to users, rather than services wholesaled from Telecom. In September, 12,000 new unbundled connections were reported as Vodafone, Slingshot and Orcon shifted many of their wholesale customers onto their own network in areas served by exchanges where unbundling was available. In the March quarter, 4,000 new unbundled lines were reported, taking the total to 30,000.

Whilst these figures exclude cable and fixed wireless numbers, DSL remains the primary broadband technology in New Zealand, comprising 89% of all broadband connections as at June 2008 (cable 5.9% and fixed wireless 4.6%). *(Telecommunication key statistics, June quarter 2008, Commerce Commission)*

New Zealand's National Broadband Outcomes

New Zealand's national broadband score showed an incremental increase of 4% in this quarter under the new ADSL2+ broadband measurement platform.

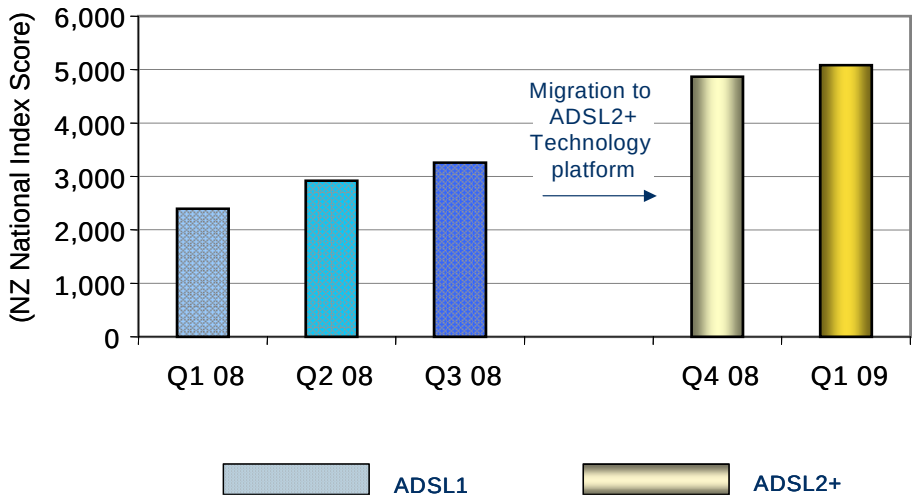
Last quarter, the Epitiro ISP-I modems were upgraded from ADSL1 to the higher-speed ADSL2+ broadband technology, which led to a step-change in performance over the December period as shown in Figure 2 below. This means this quarter's results are also being measured from a new base.

ADSL2+ can deliver a theoretical top download speed of up to 24Mbps, with users experiencing up to 15Mbps. Over 60% of copper lines are now capable of delivering ADSL2+, with over 270,000 ADSL2+ modems shipped by Telecom alone, comprising more than 50% of Telecom's broadband base.

Key factors likely driving performance improvements this quarter include continuing investment in international capacity, and further investment in and fine tuning of 'caches' which store popular international and national content locally for quicker access. Also a number of service providers have changed how they manage the transmission of data. A process called 'interleaving' helps correct data transmission faults, increasing performance stability but also increasing latency which can slow broadband performance. Over the past two quarters, a number of service providers have decided to no longer make interleaving part of their default settings, providing a one-off boost to download speed and performance. The impact of this is discussed in more detail later in the report.

FIGURE 2

New Zealand Industry Average Q2 08 - Q1 09



Source: Epitiro, March 2009

Epitiro's ISP-I sites measure the premium ADSL2+ plans offered by broadband providers under replicated, laboratory conditions relatively close to Telecom's exchanges. It therefore measures optimal ADSL2+ performance, providing a useful benchmark for ISP performance trends over time.

What it cannot capture is all the factors that will impact an individual user's experience in the home, such as the distance from the Telecom exchange - which affects broadband speeds - the nature of the broadband plan, the type of modem, the quality of the user's computer equipment and home wiring.

National Key Performance Variables

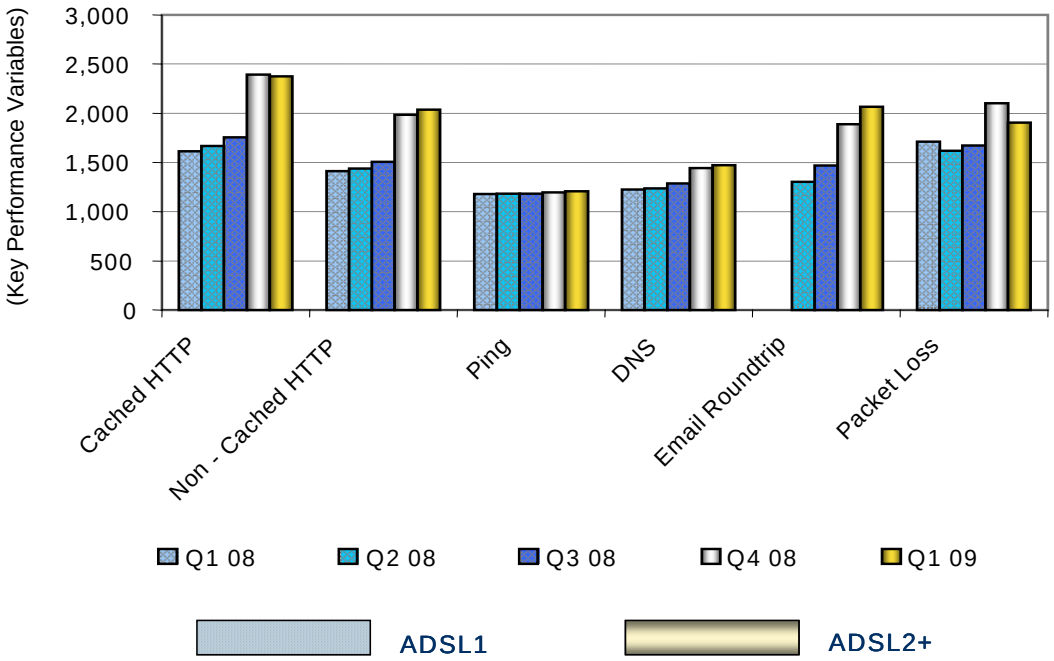
The shift to the ADSL2+ measurement platform, coupled with completion by service providers of their core network upgrades, means the key metrics affecting broadband speed, browsing, email and gaming performance were flat this quarter.

The NZBBI measures ISPs on seven metrics known as 'key performance variables' (KPVs). The tests are run every 15 minutes on a 24/7 basis over the quarter.

It is important to note that these KPV scores cannot be compared one to another – they each measure entirely different metrics. The value lies in assessing the quarterly changes within each KPV.

FIGURE 3

National Key Performance Variable Scores



Source: Epitiro, March 2009

Caching performance is almost flat this quarter. Whilst a number of ISPs showed performance gains apparently as a result of caching investment, this was offset by unrelated network changes by one of the larger ISPS early in the quarter. 'Caching' is the storage of popular content on NZ-based servers, which improves retrieval speed, and reduces the amount and cost of international traffic. Caching and the purchase of additional international capacity has been an area of significant investment for a number of service providers, with the apparent performance benefits amplified by migration to the ADSL2+ platform in the last quarter.

With few major investments this quarter, performance changes were marginal. There was a 10% improvement in email roundtrip times which has anecdotally been linked to increased investment. However packet loss average slipped 9%,

potentially due to the number of broadband users who have the data management technology known as interleaving turned off.

Domain Name Server (DNS) and 'ping' results were flat this quarter. The DNS test measures the time it takes for a web-address, such as www.stuff.co.nz, to be resolved into its IP address and retrieved. Ping measures how quickly the ISP's network can respond to a request. Ping times are more dependent on external links to an ISP and as such are unlikely to change unless the major links between networks (such as international backhaul) change.

ISP PERFORMANCE BY CITY

Overview

This section identifies changes in ISP broadband scores by city. However the data in the following graphs should not be seen as representative of overall city performance. This is because the Epitiro platform tests broadband providers at one or three sites relatively close to Telecom exchanges in each centre.

Instead these charts are a guide to changes in service provider performance over time. Millions of data points are collected from each site. This environment provides controlled insight into how service providers are managing performance through investment in backhaul, caching, peering and international transit.

In the March quarter, the majority of ISPs showed a very similar incremental single-digit improvement in comparison to the greater volatility seen throughout 2008. However there continues to be a considerable difference in ISP performance. This reflects a number of factors: the degree of investment into core network upgrades, caching, international capacity and backhaul, and also the impact of changes in approach to data management on each user's line such as 'interleaving.'

The backhaul factor

The 'backhaul' portion of a network includes the link between the Telecom exchange and the service provider's network. Backhaul can be further divided into primary or '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, which will often be a national link. A backhaul network that is not provisioned to cope with the volume of users and traffic will create a bottleneck that slows performance.

This affect can be amplified in regional centres, as all international Internet traffic must be physically routed via the Auckland exchange. If service providers are not storing popular international content locally (caching), do not have sufficient international capacity, or are using backhaul networks that are heavily congested, it will weigh heavily on regional performance.

The majority of service providers wholesale backhaul services from third parties. Telecom Wholesale is a primary backhaul provider although at least one ISP uses its own backhaul network.

The distance from the test site to the exchange

Some Epitiro test sites are closer to Telecom exchanges than others, which causes a higher synchronisation test speed from those sites. The Hamilton site, for example, is within 800m of the Hamilton Central exchange and has an average

15.1Mbps sync speed. This makes performance from this site very good, while in nearby Auckland, where the test sites are closer to 1.5 km from Telecom exchanges, the sync speed has the slowest average. (*Note: synchronization speed is 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.)

Site specific sync speeds are as follows:

TABLE 1

Average synchronisation speeds to Epitiro sites

City	Average Sync Speed
Auckland	9.2 Mbps
Christchurch	11.6 Mbps
Dunedin	13.5 Mbps
Hamilton	15.1 Mbps
Wellington	11.6 Mbps

Source: Epitiro, March 2009

Impact of 'interleaving'

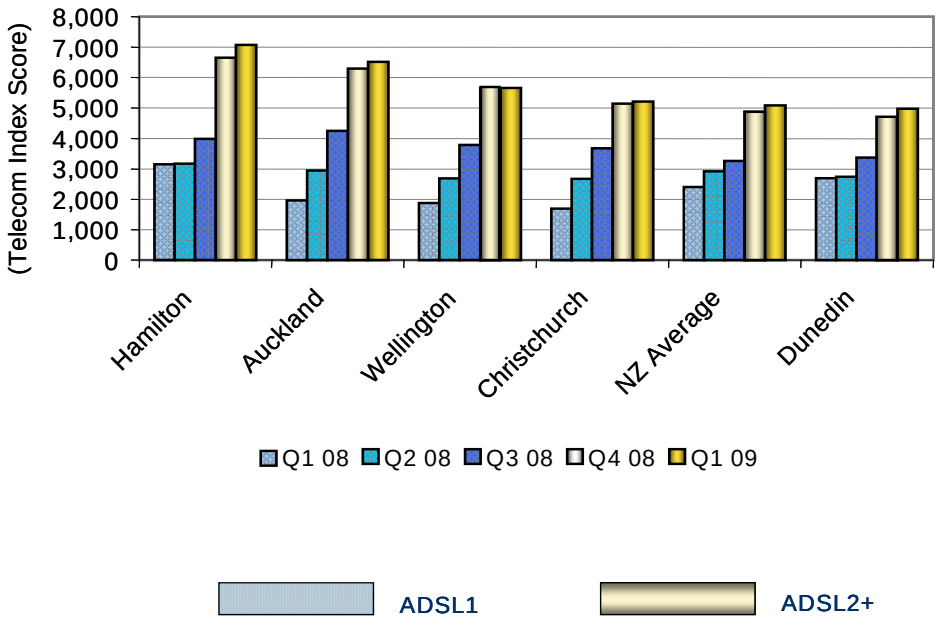
Another performance factor is the way in which service providers choose to manage data transmission through a process called 'interleaving'. Interleaving is a method of transmitting data packets in a way that corrects transmission faults and provides stability. However this process increases latency and can slow download speeds. It was designed to increase the reliability of connections a long way from an exchange, but it is of less value to users who are close to an exchange and have excellent transmission. Epitiro's data shows that by April 2009, three ISPs had their interleaving 'off' as a default. As Epitiro's platform is measuring DSL providers over short loop lengths, the removal of interleaving provides a significant one-off performance boost to response times.

Telecom's Quarterly Performance

Telecom's average index score rose 4% this quarter, in line with the national average. (The 49% boost in the December period as a result of migration to the ADSL2+ platform.)

FIGURE 4

Telecom's Index Score, Q1 2009



Source: Epitiro, March 2009

Telecom has shifted its data transmission policy to having interleaving off by default on its 40GB premium Pro Plan, which is improving latency performance Telecom plans to make this an option for Adventure and Explorer customers in July.

Telecom is now soft-launching its new caching solutions, which were tested and deployed late in 2008. The caching investment will be completed by July, which is impacting Telecom's HTTP download speeds, particularly on international traffic.

In the December quarter, Telecom Wholesale began to increase the bandwidth available on its local backhaul from the exchange DSLAM or cabinet back to the next aggregation point in the network. Previously a specific amount of bandwidth had been allocated on its wholesale service to other ISPs, leading to congestion at peak periods. Bandwidth has been progressively increased by up to 400% at exchanges across NZ with the upgrade completed in January.

TelstraClear's Quarterly Performance

This report does not include TelstraClear's cable and DSL results this quarter after it was found that the plan being measured was not what TelstraClear considered to be their premium residential plan. The plan being measured was not considered to be comparable to that being measured for the other service providers.

TelstraClear is now working with Epitiro to migrate the ADSL2+ premium broadband and cable services to new plans.

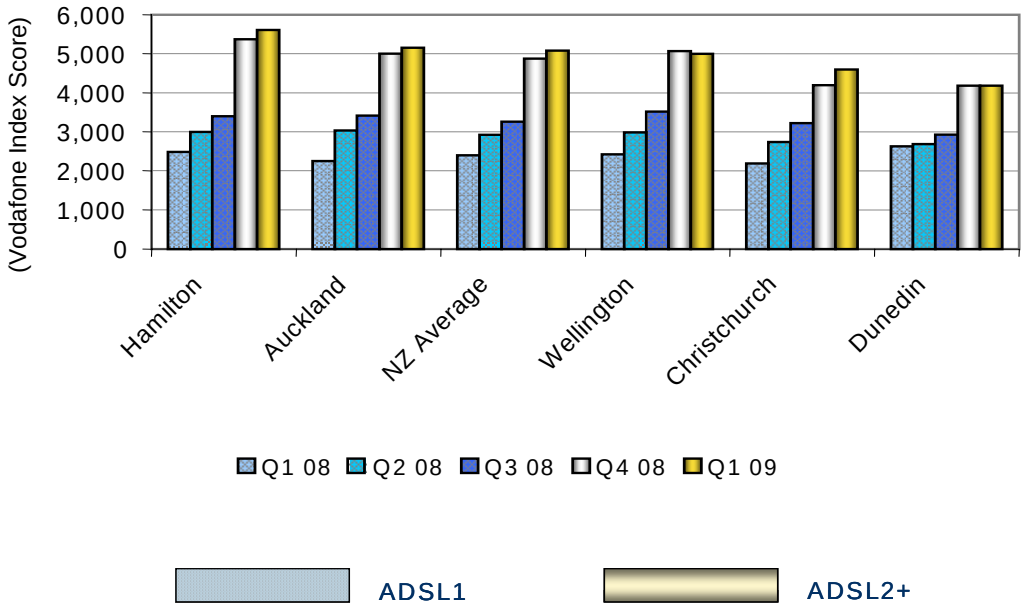
Vodafone's Quarterly Performance

Epitiro does not yet measure the performance of Vodafone's retail services provided via unbundled lines on its ISP-I platform. These results do not therefore capture the full impact of Vodafone's fixed line investment in the Auckland region where it has invested in its own broadband equipment at 40 unbundled exchanges, covering 88% of Auckland fixed lines. Instead these results only cover Vodafone's wholesale bitstream data service which is provided by Telecom Wholesale.

In the March quarter, Vodafone's index score improved by 3% to 4% in Hamilton and Auckland, rising to 9% in Christchurch, but declining marginally in Wellington.

FIGURE 5

Vodafone's Index Score, Q1 2009



Source: Epitiro, March 2009

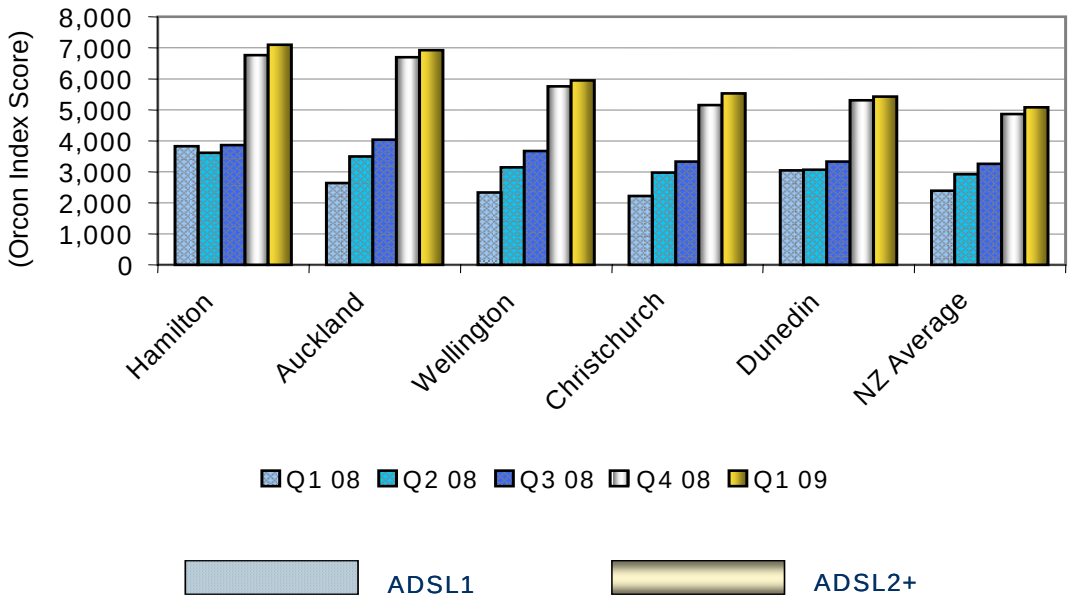
Orcon's Quarterly Performance

Orcon's results improved 2% and 7% across all city centres this quarter. (The significant improvement reported in the December period was primarily the result of Epitiro's shift to ADSL2+ measurement.)

Like Vodafone, Orcon's unbundled services in Auckland and Wellington are not measured by the Epitiro platform. Consequently these results reflect the broadband bitstream service that Orcon wholesales from Telecom Wholesale and offers to customers in less centralised areas.

FIGURE 6

Orcon's Index Score, Q1 2009



Source: Epitiro, March 2009

In the past year, Orcon has undertaken a significant network upgrade programme alongside its investment in Auckland's unbundled exchanges. The company now says that most of the upgrades have been completed: the focus now is on augmenting the existing network to meet capacity and bandwidth demand.

The company continues to acquire both backhaul and international capacity. It is also one of the service providers to have taken interleaving off for its customers which contributes to lower latency and HTTP speed.

However Orcon is not yet caching domestic or international content. The company has made the investment and, once satisfied caching performance is reliable, will provide it to users. Like most major ISP's, it uses Akamai's content delivery networks to deliver software upgrades and other content.

One factor impacting Orcon's range of scores across city centres is its reliance on its wholesale provider's backhaul and capacity in centres like Christchurch and Dunedin in comparison to Auckland where the backhaul requirement is less.

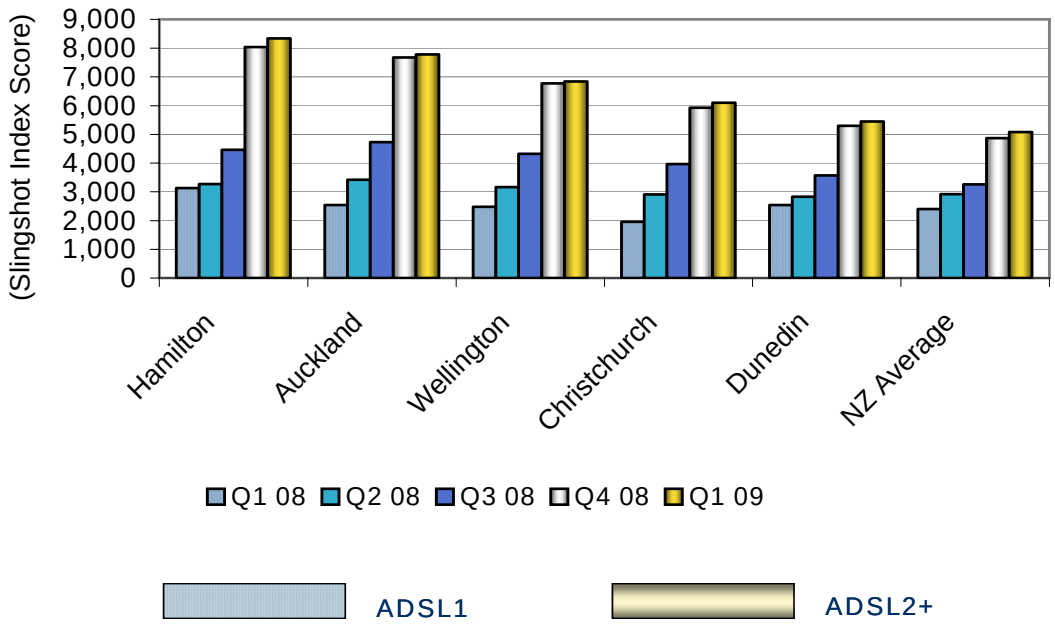
Slingshot's Quarterly Performance

Slingshots city scores grew by 3% and 4% this quarter. (The strong increase in the December quarter was due to the inclusion of ADSL2+ data.)

Slingshot is one of two ISP's delivering an index for all cities greater than the national average.

FIGURE 7

Slingshot's Index Score, Q1 2009



Source: Epitiro, March 2009

Slingshot attributes its performance to its investment in caching popular national and international content locally, and further investment in international capacity. The service provider rolled out new caching solutions last quarter, and during March focused on tuning the caches to maximize speed and performance. The service provider says it has migrated its customers to either unbundled services wholesaled from Vodafone, or higher speed plans, and that this is creating demand for more bandwidth. Further caching investment will be needed to increase capacity by about 50% in coming quarters.

Slingshot has left interleaving off as a default for over a year now. They report that reduction in latency is particularly important for gamers who find even a marginal change in response times critical.

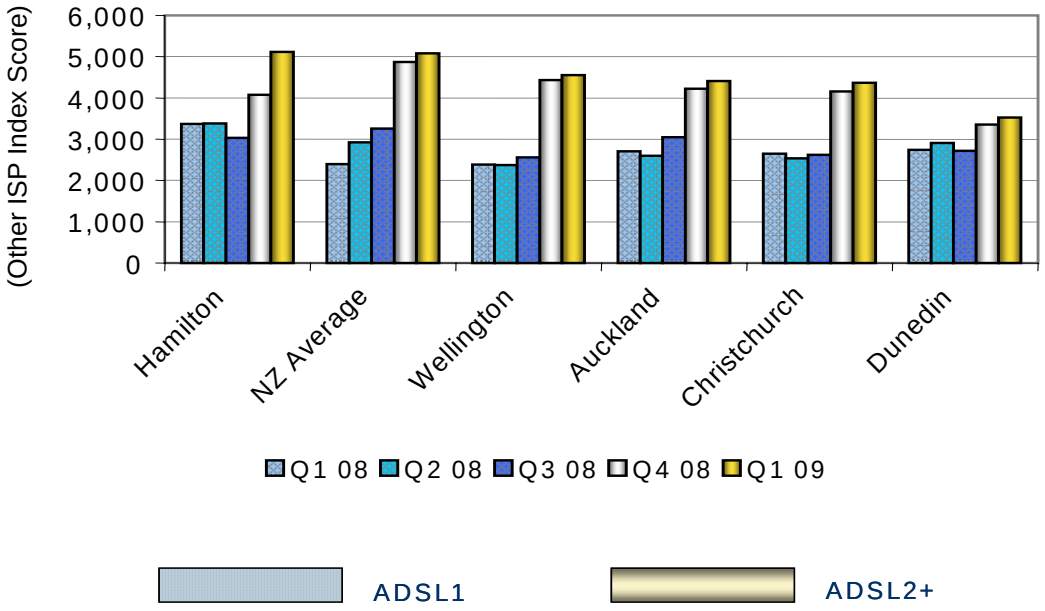
Other ISP Quarterly Performance

The aggregated 'other' group includes results from WorldxChange (11 sites); Snap (1 site), Actrix (3 sites), Compass (2 sites), MaxNet (3 sites), Inspire (3 sites) and Woosh DSL (4 Sites).

After the volatility of recent quarters, in the March period, the 'Other' group showed a steady improvement of between 3% and 5%, with the exception of Hamilton, which improved 26% from a relatively low score last quarter. This brought the 'Other' Hamilton result into line with that of other service providers.

FIGURE 8

Other ISP Index Score, Q1 2009



Source: Epitiro, March 2009

It is important to remember that because a number of these ISPs are only measured at a limited number of sites, any technical problem or enhancement can have a significant one-off impact on their results. As they are only measured on their DSL services, rather than wireless or fibre-based services, the shift to ADSL2+ methodology also provided a direct boost to performance.

SERVICE VARIABILITY AND AVAILABILITY BY TIME OF DAY

Service variability

Consistency and reliability of service is a critical feature of broadband performance: a user's broadband experience will be disrupted if there are frequent outages or reduced performance at certain periods of the day.

Consequently Epitiro has reviewed its service availability metrics and introduced new availability measures, following industry feedback.

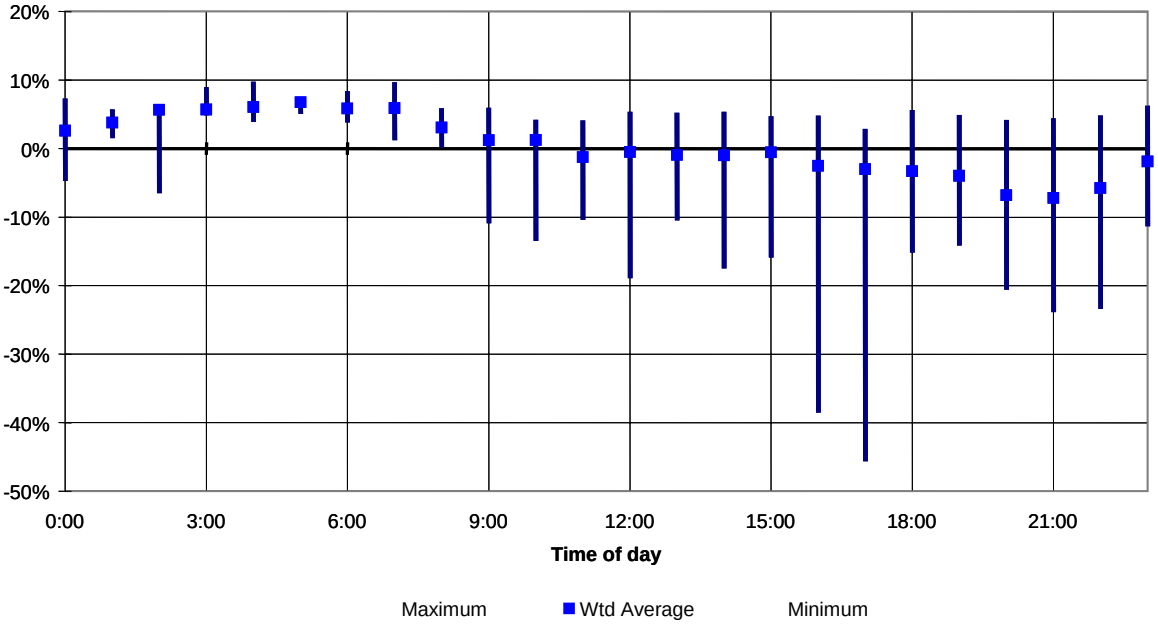
Service variability data shows how broadband performance can change over the course of the day, based on the number of users and volume of traffic on the network at any one time.

This quarter, the new service variability graph shows maximum, weighted average and minimum HTTP download speeds for the industry at multiple time points during an average weekday. The maximum points represent the peak performance for any ISP in that hour, Monday to Friday, of the sample week. Minimum points show the worst performance at that time on a day.

FIGURE 9

Variability of ISP HTTP download speeds by time of day

(Weekday average for week ending February 27)



Source: Epitiro, March 2009

This new approach reveals a number of clear trends. As might be expected, maximum broadband speeds are achieved during early morning hours for all ISPs, but reduce during the day as demand increases. Over the course of the day, the greatest congestion is after school at 4 pm, and then again at 9 pm in the evening. However as some ISPs are more focused on the business market, we

notice that their greatest dip in performance is during working hours, with maximum speeds achieved after 6pm.

A small number of ISPs consistently experience a major drop in speed during busy periods, which suggests insufficient capacity. Speed reductions of more than 30% are likely to be due to demand exceeding capacity for those ISP's.

However some ISP's have little or no changes in speed over the course of the day, which may be attributable to either having additional capacity to cope with extra demand or the use of demand management practices.

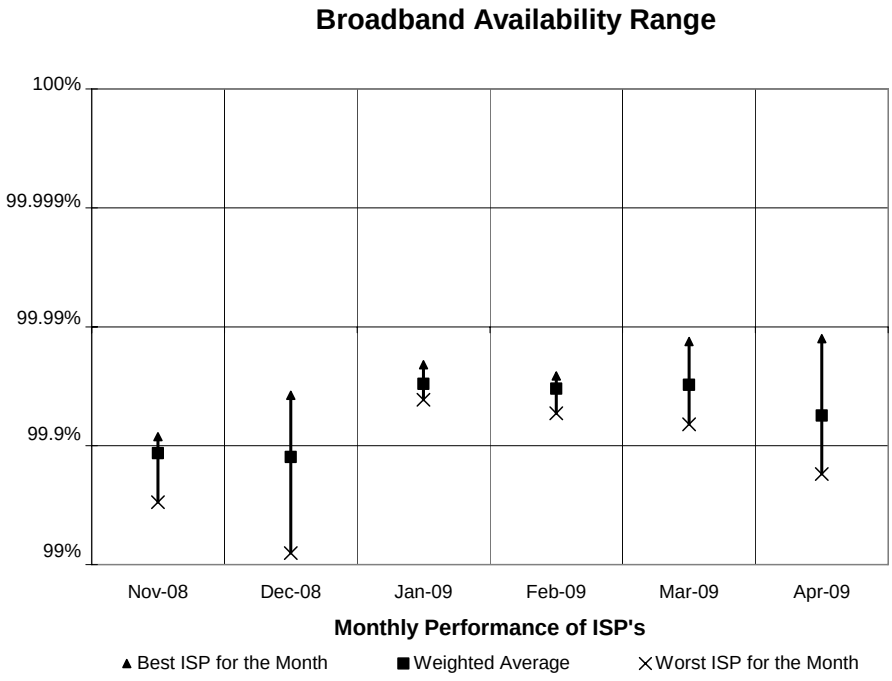
Service availability or 'uptime' measure

Service availability is a difficult metric to capture accurately. The nature of broadband service and delivery makes it difficult to match the very high 99.999% uptime standards of the traditional telephony world. Failure of an internet request is often outside service provider's control.

One parameter within the service provider's control is that of connection uptime. This quarter Epitiro is introducing a new industry availability metric, based on connection uptime across the industry (*See Figure 10)*. This is represented as a maximum, minimum and weighted average percentage of broadband availability on a monthly basis.

FIGURE 10

ISP average availability - November 08 to April 09



Source: Epitiro, April 2009

It is important to note that the scale is logarithmic and covers the one percentage between 99% and the maximum 100% uptime. This allows small shifts to be portrayed, but also emphasizes a relatively small percentage change. In order to

establish a trend, the graph covers the six months from November 2008 to April 2009.

The results are positive for the industry. Most service providers show very good availability. Performance is currently averaging 99.97% for all ISP's, with the top ISP achieving 99.987%. In user terms, the average downtime represents a rate of just fourteen minutes per month.

There is however a higher degree of volatility by a minority of ISPs. One service provider failure caused the dip in December to 99.2%, whilst a number of ISPs showed increased variability in the March to April period.

Two potential reasons could be downtime due to network upgrades or volatility from rapid growth. A number of ISPs have had regular outages for specific periods of time between midnight and 6am, which were later identified as scheduled maintenance. This is currently an industry norm, but is not compatible with a phone service intended to supply emergency services.

THE IMPACT OF NATIONAL AND INTERNATIONAL CACHING

Overview

NZ internet usage today is primarily concerned with the downloading of web-based content, with an increasing percentage of traffic traveling internationally. This means the speed and reliability of HTTP content downloads shapes the user's internet experience.

The NZBBI this quarter includes data on industry download speeds for national and international traffic for the first time. No individual ISPs have been identified: instead the emphasis is on defining trends with the reporting of industry maximum, minimum and weighted average outcomes.

Two test sites – AirNZ.co.nz and Rakuten.co.jp - have been carefully selected to provide a fair representation of typical download performance. The front page of the Air New Zealand website, and the price-comparison Japanese website both provide almost unlimited capacity up to the Internet, which means the website's own processes won't slow performance. Historically these sites have been the fastest and most consistent of the websites measured by Epitiro. The results were aggregated from a daily average and include results from cached content. It also covers a slightly longer time series from January through to April.

The strength of this data is that it provides insight into actual local and international download speeds from within a controlled test environment (although it doesn't capture all the factors impacting the home user experience). It also highlights how caching and investment in international bandwidth impacts performance.

The impact of international and national caching

National and International comparison of caching impact

Caching can have significant impact on the download speed of international content but introduces only marginal benefits on national content, according to new caching data published for the first time this quarter.

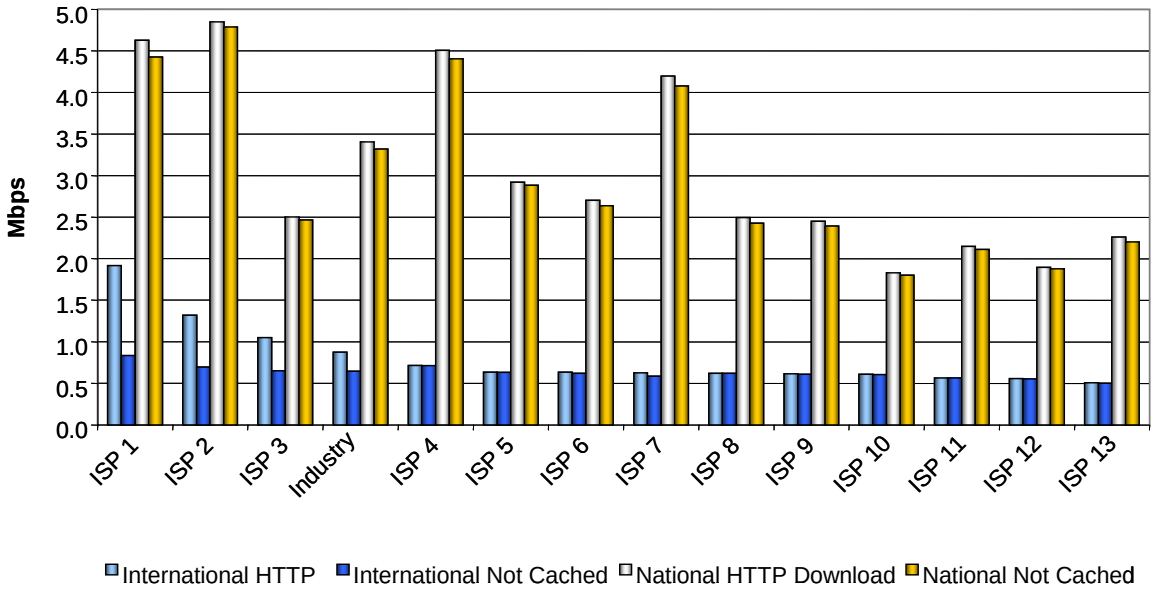
Caching allows popular content and applications to be stored locally for more rapid retrieval. However it is costly to implement and can carry with it security challenges. A comparison of HTTP download speeds across cached and non-cached content shows only three of the 13 service providers were caching international content successfully in the quarter, but by the end of the quarter a fourth ISP had begun caching. International caching can more than double the perceived download speed, bringing improvements of between 61% and 130% (0.4 to 1.1 Mbps) on non-cached results.

However the data shows changes of 5% at best between non-cached and cached local content. It is unclear at present whether national caching may have an impact for cities like Dunedin that are remote from Auckland. This will be explored in the next quarterly report.

FIGURE 11

Cached vs non cahced performance

(Average Q1 09)



Source: Epitiro, March 2009

This data also shows the stark contrast between local and international download speeds and between cached and non cached international download speeds for those three ISPs employing caching.

Average international cached speeds range from 0.5Mbps to 1.9Mbps, while average international non cached speeds are just 0.6 to 0.9Mbps. Caching is usually installed to enable cost savings and speed increases for International traffic, and it is clear from this chart how much speed gain is achieved by some ISPs.

The average national cached speed across all ISPs is 3.4Mbps and for national non-cached traffic is 3.3Mbps, showing that caching has little impact on national speeds. Note that average individual ISP speeds for national traffic range from just 1.9Mbps to a healthy 4.8Mbps. The best ISP's average international cached speed is higher than the worst ISP's national speeds.

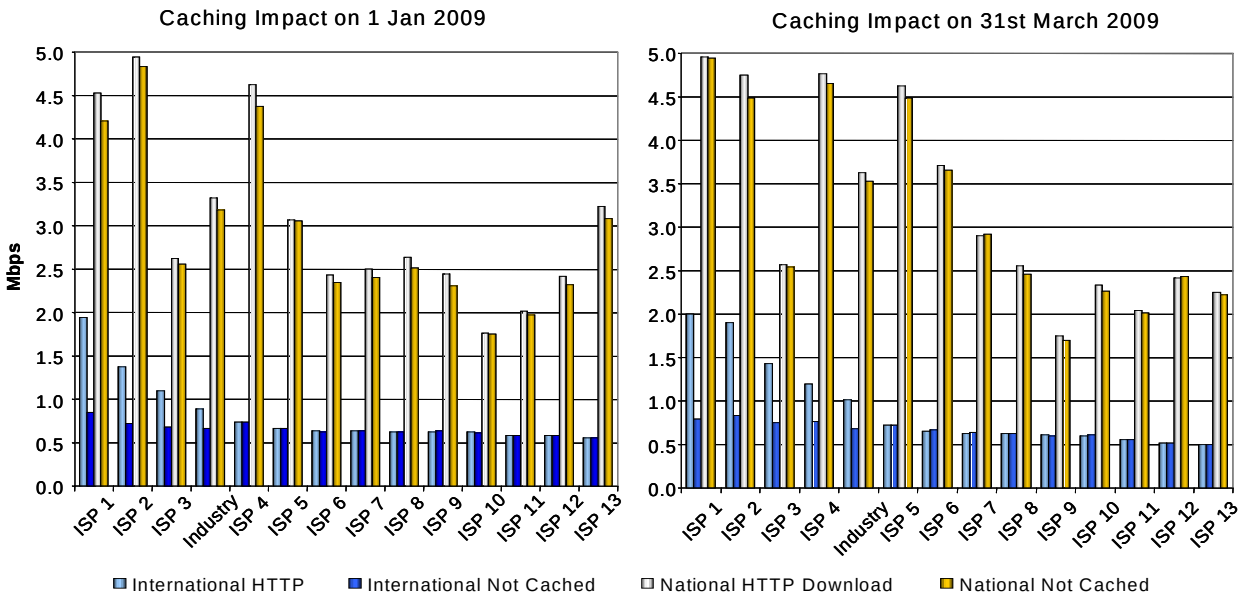
These figures do not however capture results for unbundled ADSL2+ services or the new VDSL technology results.

Quarterly caching trends

The impact of investment in caching becomes more visible if we compare results on January 1 and March 31, 2009, representing the beginning and end of quarter results.

FIGURE 12

Changes in service provider caching performance over quarter



Source: Epitiro, March 2009

These graphs show one ISP introduced caching successfully for the first time during the quarter.

INTERNET DOWNLOAD PERFORMANCE

Overview

Three factors stand out in the analysis of new ISP-I metrics on international and national HTTP download speeds:

- National Internet download speeds in New Zealand are much higher than international speeds. National traffic speeds peak at just over 8Mbps, with an average of 5Mbps. By comparison international download data speeds average 2Mbps or less.
- There continues to be a significant difference between theoretical and actual download speeds. ADSL2+ has a theoretical speed of 24Mbps: however as performance is dictated by a wide range of factors including backhaul provisioning, international capacity, a user's distance from the exchange and home environment factors, the actual broadband speed is often considerably less. New Zealand is not unique in this: the results are consistent with other international markets. *(*Note: these results do no measure high-speed unbundled ADSL2+ or VDSL2 services).*
- There is evidence of a widening performance gap between service providers, despite the fact that many use wholesale services infrastructure from Telecom. Performance appears to be closely related to investment in network facilities.

Performance is presented as maximum and minimum by day with an average weighted by market share[1]. The maximum or minimum may represent a different ISP each day, although trends are evident in the raw data.

National HTTP download performance

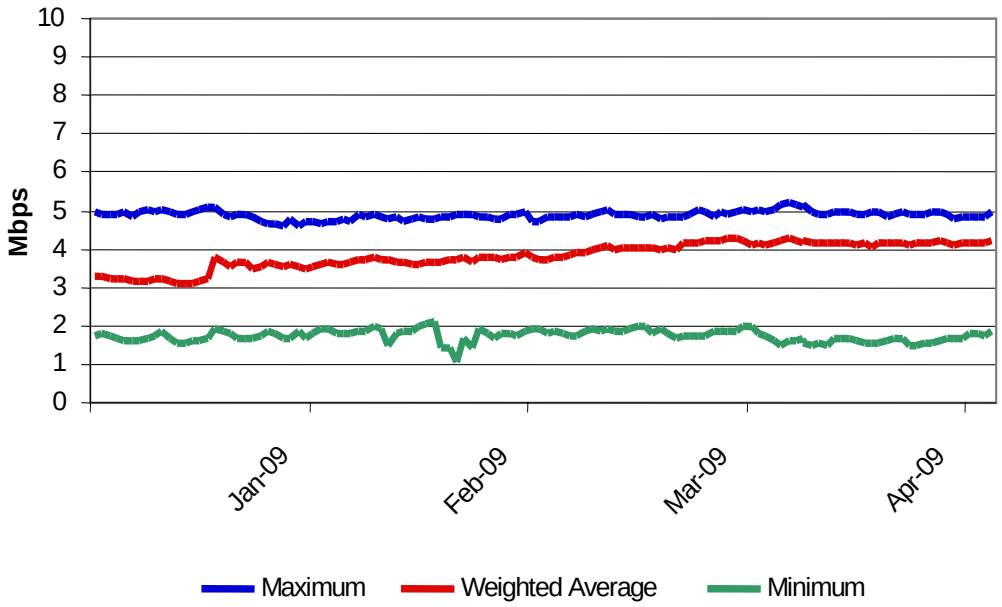
The average download speed on national NZ traffic increased by 1Mbps over the four month period to April to just over 4Mbps, whilst the average maximum speed attributable to the best ISP on any given day topped at 5.2Mbps.

However the average minimum speed attributable to the worst peforming ISP on any given day was half this rate at between 1 and 2Mbps, as shown in *Figure 13* below.

[1] Market share is taken from Consumer NZ published responses to their survey of users by ISP.

FIGURE 13

National HTTP download results - all ISPs



Source: Epitiro, April 2009

There are many factors that will lead to this gap: competitive pressures have led to significant investment by some ISPs in the caching practices, international capacity and backhaul provisioning which are improving their outcomes.

In addition, some ISPs have seen a significant increase in speed as a result of changing their data management settings on 'interleaving'. As described elsewhere, if interleaving is on, it gives a stable but slower performance, as it increases latency. By turning off 'interleaving' as a default setting, at least three to four of the top five ISPs have seen a significant boost in speed, which is more pronounced over the short distances measured by the ISP-I platform. However the removal of interleaving can also lead to less stable performance, particularly over longer access lines.

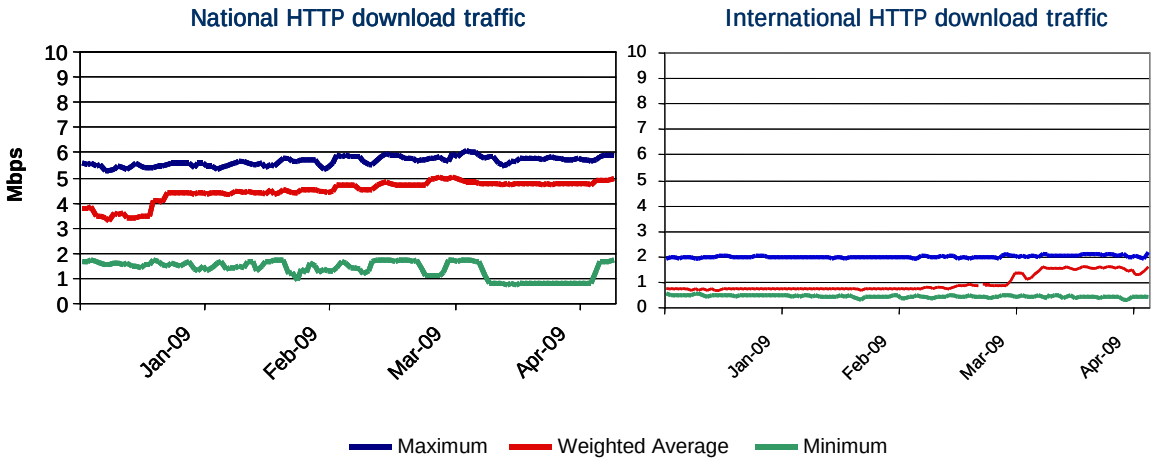
HTTP download performance by city centre

Auckland national and international outcomes

Test site data for Auckland shows international HTTP download speeds a third to a quarter those of national rates. Peak national performance is between 5Mbps and 6Mbps – by contrast international speeds don't get above 2.2Mbps.

FIGURE 14

Auckland's HTTP download speeds



Source: Epitiro, April 2009

The data, captured at three Auckland sites under controlled lab conditions, also shows a widening gap between service providers for national performance. Maximum and average internet download speeds to the New Zealand test website improved by up to 50% in the four months to April 09 to between 5Mbps and 6Mbps. By contrast the poorest performers experienced greater volatility and declining speeds, dropping below 1Mbps at the lowest point.

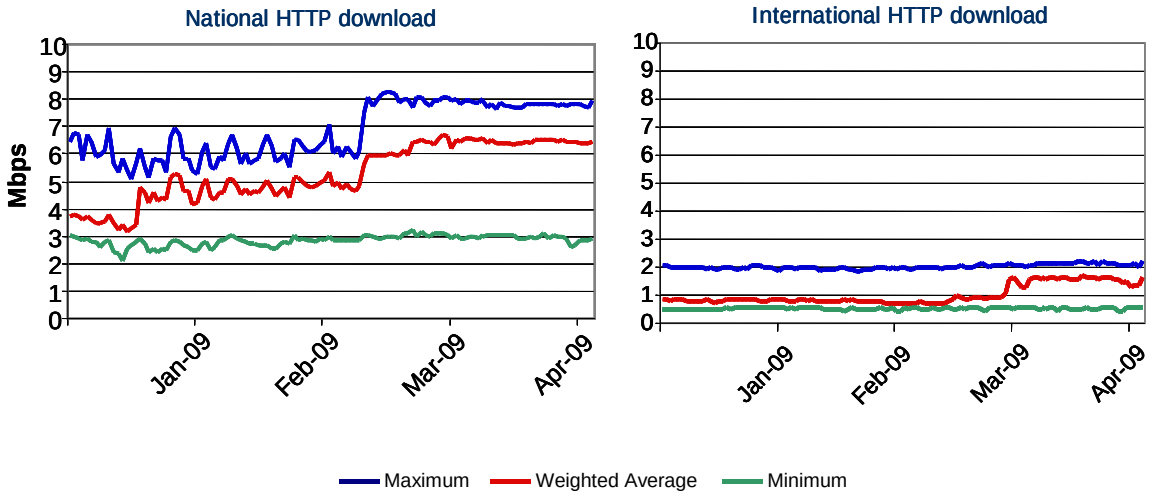
The services measured were based on Telecom wholesale services broadly known as unbundled bitstream. The data doesn't currently capture the performance of unbundled ADSL2+ services which have attracted significant investment and potentially offer higher speeds. It is expected this report will begin providing data on the performance of unbundled lines from the third quarter.

Hamilton national and international HTTP download performance

The Hamilton national download result, captured from one Epitiro site, showed significant volatility over the four months, particularly among the lead ISPs, as shown in Figure 13. The test site is close to the exchange in Hamilton, leading to a higher average speed than other sites.

FIGURE 15

Hamilton National and International HTTP download results



Source: Epitiro, April 2009

The download speed of the best performing ISP each day lifted from a low of just over 5Mbps to 8Mbps by the end of the period – and this widened the gap between best and worst performers to 5Mbps. This was, in part, driven by a one-off performance boost from one ISP which, in turn, pushed up the weighted average by 3Mbps to a 6.5Mbps.

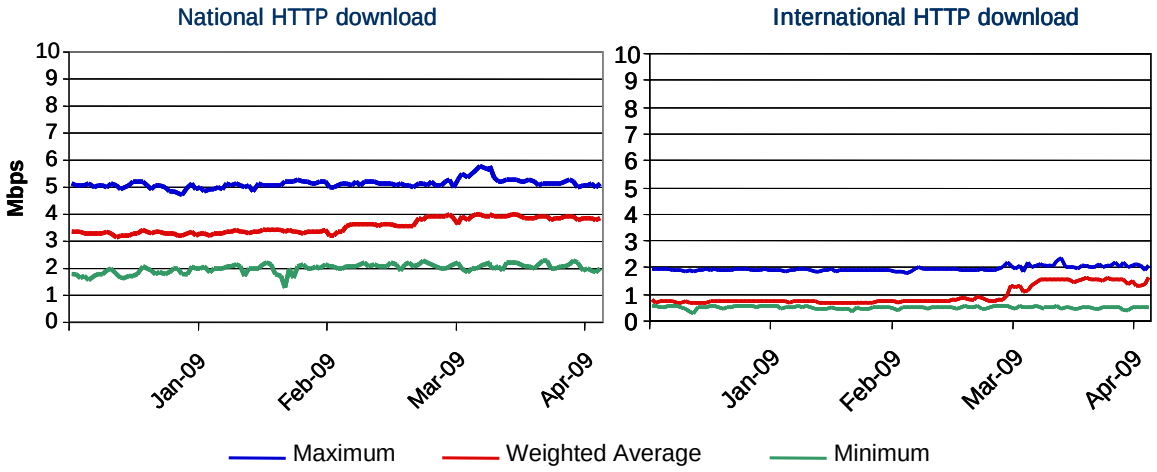
Wellington national and international HTTP download performance

The challenges of congestion in backhaul begin to emerge in Wellington. The Capital's national maximum download performance at 5Mbps was half a megabit behind Auckland's top speed, while the minimum averaged 2Mbps, despite the test sites being on average closer to exchanges than in Auckland (See Table 1).

Much of both national and international internet traffic must be routed via Auckland.

FIGURE 16

Wellington HTTP national download results



Source: Epitiro, April 2009

The international profile for Wellington was very similar to other North Island centres, ranging from 0.5Mbps to just over 2Mbps, although there was a strong increase in the weighted average towards the end of the period.

Christchurch national and international HTTP download performance

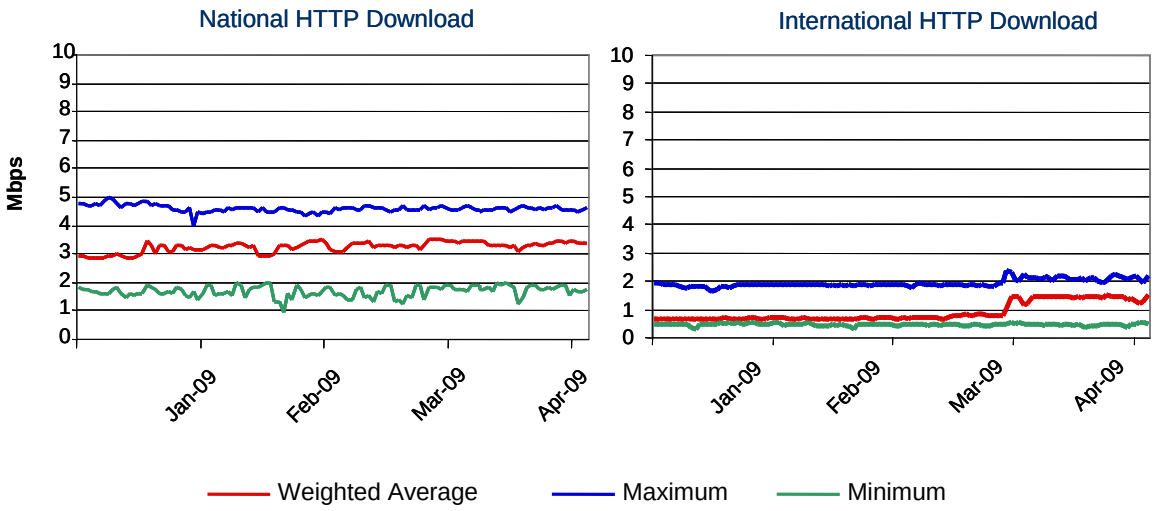
The impact of distance and network congestion is also visible in Christchurch, where download speeds for national traffic never rises above 5Mbps, putting it on average 1Mbps behind Auckland speeds.

The weighted average shows a slight increase over the quarter, but minimum speeds range on average been 1 and 2Mbps.

However international traffic has a very similar profile to Wellington, Auckland and Hamilton, ranging between 2 and 0.5Mbps. This is likely because speeds are already limited by congestion on international links and therefore the limited intercity speeds have little further impact.

FIGURE 17

Christchurch National HTTP download results



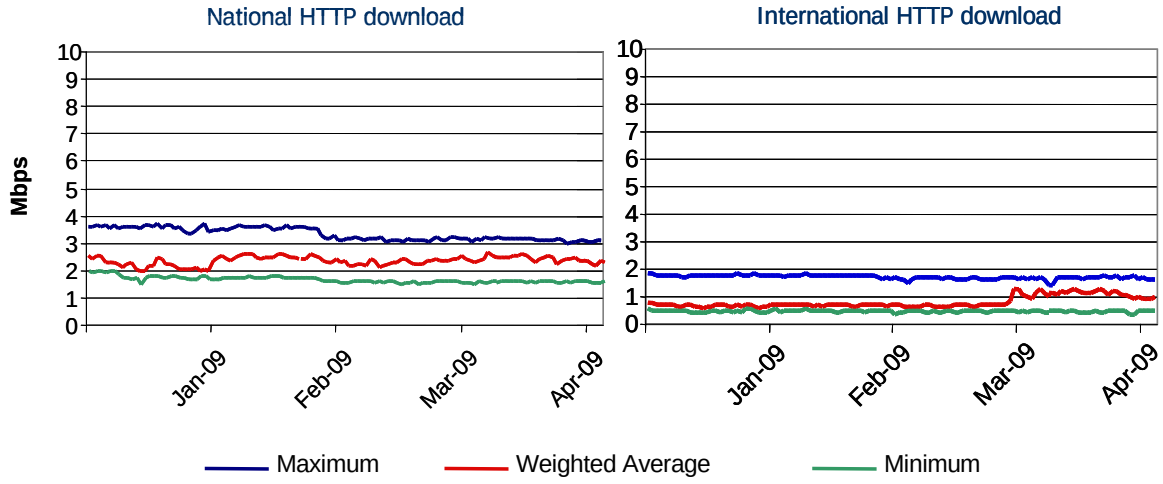
Source: Epitiro, April 2009

Dunedin national HTTP download performance

The challenges of congestion in backhaul appears to be the primary factor in the poor performance in Dunedin.

FIGURE 18

Dunedin National and International HTTP download results



Source: Epitiro, April 2009

The national peak download performance at 3.5Mbps was half of Auckland's top speed, while the minimum averaged under 2Mbps. This is despite the Epitiro test sites being on average closer to exchanges than in most other centres. (*See*

Table 1) . This means the 1.5Mbps gap between peak national and international download speeds in Dunedin is considerably less than other centres.

CONCLUSIONS

Overall ADSL2+ performance this quarter has shown moderate but steady improvement for most service providers.

Growth in broadband subscribers and ADSL2+ traffic continuing to escalate is putting pressure on service providers to invest and provision for this increase.

There are a number of positive signs. There is a good industry performance on service availability or uptime, and the recent investment by a number of ISPs in either local caching or improved backhaul appears to be significantly improving their download speeds.

However the inclusion of new caching and download speed data underscores a number of critical challenges affecting broadband performance:

- The issues of congestion in the portion of the network which backhauls traffic from a city exchange to an ISP's network and also between cities appears to be the greatest constraint on broadband download speeds.
- Congestion particularly affects cities remote from Auckland, although is also a factor in local backhaul around the cities. All international traffic has to be physically routed via Auckland Central so any congestion in backhaul networks will affect performance.
- There is an increasing gap in service provider performance. Investment in caching solutions, international capacity and backhaul provisioning appears to be boosting the performance of some service providers. Others are however showing increased volatility and little overall improvement.
- In addition some ISPs have seen a significant increase in speed as a result of changing their data management settings on 'interleaving'. Interleaving gives greater stability to broadband performance, particularly over greater distances, but increases latency and slows the connection. Turning interleaving off as a default setting has provided a significant one-off boost to at least three service providers.

The past year has been one of increased investment and competition. This quarter a number of ISPs reported that their major network upgrades are nearing completion. However the rapid growth in broadband traffic suggests that the focus now will move to optimizing the network and provisioning capacity for the quarters to come.

APPENDIX – EPITIRO METHODOLOGY

The New Zealand Broadband Index (NZBBI) is founded on Epitiro's ISP-I technology, which tests the performance of broadband Internet services. The data provides a robust and 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 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 site of each of Epitiro's 11 lab sites.

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.

All data in this report is gathered, processed and indexed by Epitiro. IDC New Zealand has been commissioned by Epitiro and the Commerce Commission to review the methodology and provide independent analysis of the presented data and findings.

Time to Connect Variable Discontinued

With the upgrade to ADSL2+ consumer premises equipment (CPE), the Time to Connect data can no longer be captured. The index has been adjusted to reflect this change.

The NZBBI does not report absolute results. Instead the raw data is aggregated and then weighted to provide a consistent indexed score for comparison, as described below. The quarterly raw data comprises literally tens of thousands of tests, which are conducted at 15-minute intervals on a continuous 24-hour cycle on all broadband services measured.

REPORT COLLATION METHODOLOGY

There are three principle steps in the formulation of this report:

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 ISP's 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.

Data Processing

This stage of the process is managed by Epitiro, and involves the indexation of the raw data. Indexation occurs for two reasons:

- To allow the data to be aggregated and manipulated. Because the tests involve a variety of measures including milliseconds, kilobits per second and percentages, the results exist in a myriad of orders of magnitude. To allow greater flexibility in analysing and viewing all of this data as one dataset, all of the raw values are converted into an index score of a consistent order of magnitude.

- Depending on the statistic being measured, a high result will, in some cases, be an indicator of good performance and in others suggest a worse performance. For example, a high synchronisation speed performance is positive, whereas high packet loss is negative. In order to make the report easier to read and to create consistency, indexed numbers have been re-weighted. As a result, a high index score always indicates a positive performance in this report.

Converting the raw values into index values is carried out as follows: :

1. An average of KPV values for a period of 3 months (prior to the first period of data used in the Index) is taken from ISP-I. This period was 1 October 2007 to 31 December 2007. This data reflects the performance of the six largest ISPs in New Zealand, or about 97% of the market by subscribers at that time.

TABLE 2

Demonstration of the multiplier impact on the index

	Sync Speed	HTTP - C	HTTP - NC	Ping	DNS	Email RTT	Packet Loss
Typical ISP raw data	6592.42	45.27	44.104	196.000	84.2	7.66	0.626
Multiplier	21.54	0.08	0.09	0.47	0.24	0.01	0.0011937

Source: Epitiro, March 2009

2. Using a multiplier, these values are converted into numbers of a similar order of magnitude as can be seen from Annex 2.
3. To ensure these factors conform to the relative weightings as agreed with the industry, the multipliers are adjusted until the new values total and average to the same amount (3,000 and 500), as depicted in Annex 2. At the request of the industry, sync speed has been weighted at half the significance of the other variables (1,500 and 250), given this is a KPV beyond the control of ISPs, and is therefore not as indicative of their performance as the other KPVs.

TABLE 3

Index Calculation

	Sync Speed	HTTP - C	HTTP - NC	Ping	DNS	EMAILRTT	Packet Loss
TOTAL POINTS AVAILABLE	1,500.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00
Typical ISP index	306.0	600.6	494.8	420.6	350.3	537.9	524.4

Source: Epitiro, March 2009

4. The resulting multipliers are then used to convert the quarterly raw data into the index values.
5. A value of 3000 is then added to the ISP scores to prevent negative values occurring, should ISP performance degrade in certain KPVs or quarters. 1500 is added to the KPV scores.
6. Each KPV score for each ISP is then cumulatively calculated, with the KPV index value being either added or subtracted, depending upon whether a high score is good (sync speed, HTTP), or bad (ping, DNS, ERTT, packet loss).This gives the final score for each ISPs' KPV performance, and each ISPs' overall performance.

Data analysis and report preparation

The period of analysis is selected in the ISP-I system and in this case represents three months of data. The system averages the results of every test conducted for every ISP across this period. Over time a database of quarterly processed and indexed results will develop for analysis and comparison in quarterly reports.

Key Performance Variables tested

There are seven key performance variables (KPV's) analysed in this report, with two additional parameters assessing consistency of service performance and traffic management. The KPVs 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, ADSL, 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 speed and reduce international transit costs, content fetched by users may be locally cached on NZ-based servers. The cached HTTP download speed 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 speed 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 speed 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 download speed test therefore provides an estimate of the user experience in downloading web pages from foreign locations. Short times equate to a better experience. 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.

Packet Loss Performance

The packet loss test records the average package loss percentage experienced during individual tests and an overall packet loss test. The packet loss 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 packet loss during all the individual tests executed, as well as an overall packet loss measure over the course of entire network connection during which the tests were being run. Thus, as well as measuring the packet loss present in a network, ISP-I is able to indicate whether packet loss is occurring for a particular protocol or service. The ISP-I Satellite measures packet loss by utilising the Performance Counters for TCP available within Windows. Packet loss is 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 in February and averaged by the hour.

Other Factors: 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 twelve ISPs are measured, but a number were only measured in one site or one city. For consistency, Epitiro-IDC's analysis of key performance variables (KPV's) only specifies the top six service providers measured across all cities and sites, while the second and third-tier ISPs have been aggregated into an 'others' category. The report does however note individual performances where appropriate in the text.

Epitiro is no longer measuring Kiwi Online following its acquisition by Orcon.

Results for all twelve ISPs have nevertheless been reported in each city they have been measured in. The second tier ISPs and sites measured include:

- WorldxChange (11 sites)
- MaxNet (3 sites)
- Inspire (3 sites)
- Compass (2 sites)
- Actrix (3 sites)
- Snap (1 site)
- Woosh DSL (4 sites)

Special Situations

TelstraClear (TCL)

Epitiro-IDC has discontinued reporting on TelstraClear's (TCL's) 'On-Net' DSL service, which is delivered over TelstraClear's own small copper network in main centers. TCL has upgraded this network to focus on the business market, which is outside the scope of this report.

The NZBBI is consequently measuring two TCL broadband services:

- Cable: TCL owns and operates a hybrid coaxial cable network in Wellington, Kapiti and Christchurch.
- TCL DSL ('Off-Net'): TCL's 'Off-Net' services are those wholesaled from Telecom, and comprise the majority of TCL's DSL services outside of Wellington, Kapiti and Christchurch where it owns and operates cable networks. We no longer make the 'Off-Net' distinction, reporting it simply as TCL DSL.

Woosh

Woosh's wireless TDD-CDMA platform emphasizes mobility over speed so is therefore not directly comparable to current high-speed broadband systems. As quantifying the difference between mobility and speed is outside the scope of this report, Woosh's wireless services are no longer measured as part of the NZBBI. Woosh's DSL service is however included in the NZBBI.

Disclosure Statement

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- The source of the information;
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