

**REPORT FOR THE COMMERCE COMMISSION
ON NEW ZEALAND BROADBAND QUALITY**

Q4 DECEMBER 2008

BY



EXECUTIVE SUMMARY

The New Zealand Broadband Index shows a significant increase in broadband performance across most measures by the end of 2008. This is partly the direct result of a change in measurement technology to the use of high-speed broadband ADSL2+ modems for the first time.

With ADSL2+ now a generally available technology in the New Zealand market, and with many users now having upgraded their routers or modems to ADSL2+ capable, it was decided this important technology trend should be reflected in the test footprint used to generate the data for this report.

Asymmetric Digital Subscriber Line (ADSL1) is a data communications technology that allows broadband to be delivered over a copper line. ADSL1 is an early standard, offering slower speeds up to a maximum of 8Mbps. ADSL2+ is a newer, faster upgrade that can deliver up to three times that speed under optimum conditions.

Telecom advises that 58% of their ADSL capable lines have now been upgraded to ADSL2+. However the higher speed benefits can only be accessed by users with ADSL2+ modems who are on appropriate broadband plans and reside relatively close to a Telecom exchange. Telecom Retail says it has now distributed 220,000 ADSL2+ modems in NZ households, up from 170,000 in July. This means ADSL2+ has a growing mass market subscriber base. Epitiro's upgrade to ADSL2+ modems has been timed to represent the improved performance experienced by a larger proportion of broadband users.

This report represents the fourth quarter of NZ Broadband Index (NZBBI) results, commissioned by the Commerce Commission as part of its telecommunications monitoring and reporting objectives under the Telecommunications Act. The Epitiro 'ISP-I' data in the index is captured from the twelve ISPs every fifteen minutes on a 24-hour basis across eleven sites in Auckland, Hamilton, Wellington, Christchurch and Dunedin. Broadband quality is evaluated on eight parameters that collectively affect the user's experience of popular services, such as email, browsing, gaming and viewing video. The upgrade of ISP-I testing sites to ADSL2+ took place at the end of September.

Key findings this quarter:

- Telecom, TelstraClear DSL, Vodafone, Orcon and Slingshot have boosted their broadband scores between 99% and 166% over 2008, most of this due to investment in their network, although some improvement will be due to the inclusion of ADSL2+. TelstraClear, which uses an entirely different coaxial cable technology, also saw a 60% improvement from an already higher base.
- In 2008, the 'other' group of second tier ISPs have improved their aggregated score by 53%, although there is wide variation of performance within this.
- As a result of the migration to ADSL2+ measurement, the key metrics affecting broadband speed, browsing, email and gaming all show a 20% to 36% improvement in the December quarter. Retrieval of local or international web content (cached and non-cached HTTP) saw a 32% to

36% improvement in performance score, while synchronization speed performance rose 20%. The email round trip index rose by 29%.

- The step-change impact of the use of new ADSL2+ modems is perhaps most apparent in the service variability charts for Q4. ADSL2+ modems enable the Epitiro sites to have up to download speeds of up to 24Mbps, compared to the previous ADSL1 limit of 8Mbps, resulting in higher speeds on average. However, not only has the download speed increased, there is also considerably less variability in service provider performance,
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INTRODUCTION

The New Zealand Broadband Index (NZBBI) is founded on Epitiro's ISP-I technology, which tests broadband Internet services from the residential end user perspective. The data provides a robust and independent perspective of broadband performance in New Zealand as seen from the Epitiro measurement platform ("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 their premium consumer broadband package on eight key performance variables (KPVs) that impact the user's experience when browsing content, exchanging email, gaming online or streaming video. This quarter the performance higher-speed ADSL2+ technology has been included, providing a significant boost to outcomes seen from the Platform.

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. Epitiro's ISP clients currently include Telecom and Slingshot.

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

Changes in the December report methodology

Reporting of unbundling and ADSL2+

This quarter Epitiro has completed the upgrade of all its test sites to measure the performance of higher-speed ADSL2+ services delivered from the exchange and also new wholesale packages, such as Enhanced Unbundled Bitstream Access (E-UBA).

ADSL2+ (Asynchronous Digital Subscriber Line) technology is an upgrade to standard ADSL1, which was measured in previous quarters. ADSL2+ offers theoretical speeds of up to 24Mbps, and typical speeds of 8Mbps to 15Mbps. ADSL1 has a theoretical speed of 8 to 10 Mbps, but typical speeds of less than 5Mbps.

In February 2009, Telecom Wholesale reports 58% of users were capable of receiving ADSL2+ as a result of exchange upgrades. While it is hard to quantify actual numbers of ADSL2+ users, Telecom says a recent check on connections from roadside cabinets showed 53% of lines had ADSL2+ modems; eighteen months ago, this would have been 33%, an indication of penetration growth. The industry has heavily driven take-up of ADSL2+ modems and compatible plans throughout 2008, which means much of the recent switching and subscriber growth has been to the higher speed technology.

ADSL2+ therefore now has a growing mass market subscriber base, making it a critical feature of New Zealand's broadband evolution. Epitiro captured two weeks of ADSL2+ data in the September quarter, with the December result representing a full three months ADSL2+ data.

However, Epitiro is not yet measuring the performance of ‘unbundled’ lines through ISP-I. ‘Unbundling the local loop’ (UCLL) occurs when competitive carriers install their own equipment in the Telecom Exchange and deliver and provision their own broadband services to users, rather than wholesaling the service from Telecom. Epitiro plans to introduce measurement of unbundled services in the future.

Methodology in reporting TelstraClear (TCL) results

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 exclusion of TCL’s On-Net results had an estimated 2% impact on the New Zealand national average in the September quarter.

The NZBBI is consequently reporting on two TCL broadband services in the December quarter:

- **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. This quarter we no longer make the ‘Off-Net’ distinction, reporting it simply as TCL DSL.

Time to Connect

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.

Email Roundtrip Test Issues in Q4

Email data in Q4 does not cover the whole quarter. A hardware failure on Christmas day affected one week of email data, which has been excluded.

NEW ZEALAND INDUSTRY PERFORMANCE

Broadband Overview

New Zealand’s rate of broadband growth slowed in the December quarter, impacted by both the economic slowdown and increased broadband penetration. While migration from dial-up to broadband continued as new price plans, services and acquisition/retention strategies came into play, the number of subscribers upgrading was less.

This is impacting the market in a number of ways. Some ISPs say a greater proportion of new broadband users are opting for entry-level or lower value plans, which is impacting the average revenue per user (ARPU). There is also a trend towards customers better managing their existing packages by preventing overage on data caps and reducing calling volumes and costs. This is particularly strong in the business market, but is also a consumer trend. There are, as yet, no

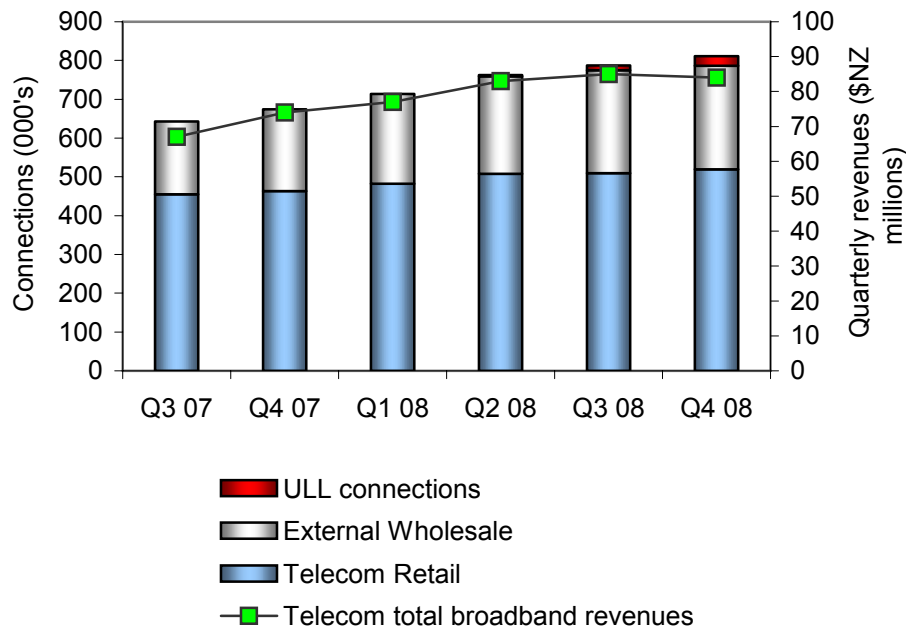
signs that current broadband users are reverting from broadband back to a dial-up connection, but some ISPs report continued demand for lower-cost dial-up service.

Telecom estimates the economic crunch has had a \$10 million impact on earnings before income tax, depreciation and amortisation (EBITDA) in the December quarter, although this is a relatively minor 1% of total EBITDA. This is being felt both in moderating take-up overall and a slowdown in subdivision development which impacts new fibre deployment.

Telecom is the only carrier to have reported financial data this quarter. Based on Telecom's published results, as shown in *Figure 1* below, total retail, wholesale and unbundled connections increased 3% in the December quarter to 811,000 (primarily DSL-based). While positive growth, it nevertheless represents a slowdown on the 6% and 7% connections take-up reported in the first two quarters of 2008. Wholesale numbers, which represent the broadband services wholesaled by Telecom to other service providers, were flat quarter on quarter. This reflects the shift from wholesale to unbundled connections which grew by up to 13,000 in the period to 25,000.

FIGURE 1

Telecom Broadband connections growth – calendar quarter



Note:

- Telecom retail figures include Telecom Retail and Gen-I figures.
- Unbundled connections include estimates for June and September quarter based on Commerce Commission data
- Total Telecom broadband revenues include Telecom Retail, Wholesale and Chorus (ULL) financials

Source: Telecom Financial Report, Q2 09

Telecom's results show it captured 11,000 new retail connections in the December quarter (excluding gen-i), giving the incumbent an estimated 43% of total net additions this quarter.

While connection numbers grew, however, Telecom's total broadband revenues saw a slight 1% decline in December over the September quarter.

Whilst these figures exclude cable and fixed wireless numbers, DSL remains the majority broadband technology, 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 was 4868 in the December quarter, based on the inclusion of high-speed ADSL2+ data for the first time.

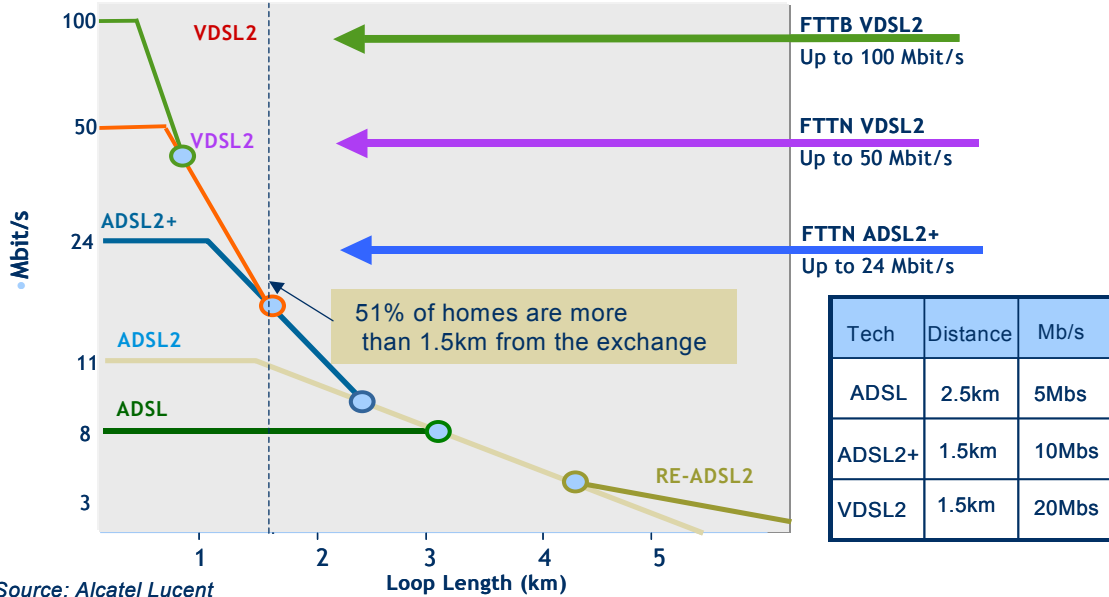
Telecom exchanges have been upgraded to ADSL2+ technology over 15 months as part of a \$1.5 billion investment programme. Telecom estimates 58% of their lines are now ADSL2+ capable. All unbundled lines from competitive carriers (Vodafone and Orcon) are ADSL2+ capable - representing 2% of all lines - and are VDSL capable on request. However users must have the correct modem and plan to benefit from these technologies. This is the first report in which a full quarter of ADSL2+ data has been captured.

Digital Subscriber Line (DSL) is a data communications technology that allows broadband to be delivered over a copper line. ADSL1 is an early standard, with maximum download speeds capped at 8Mbps and typical rates below 5Mbps. As Figure 2 below shows, ADSL2+ is a newer, and faster standard that can deliver a theoretical top download speed of up to 24Mbps, with users typically experiencing between 8Mbps and 15Mbps. However ADSL2+ performance is highly dependent on how far the signal has to travel over the copper connection to the home – the greater the distance, the slower the speed. Other factors like the nature of the broadband plan, the modem, the quality of computer and home wiring also affect the user's experience.

(Note: Epitiro's ISP-I sites measure the full speed download and full speed uplink consumer service of each ISP at the same distance from the exchange for consistent benchmarking.)

FIGURE 2

DSL technology performance over distance



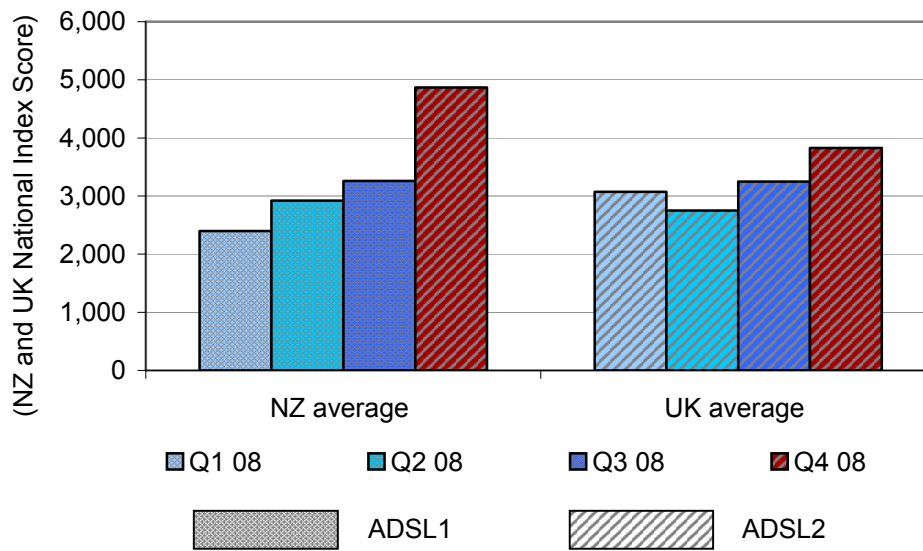
Source: Alcatel Lucent

This means care must be taken when interpreting the national result. While Q4 shows a significant improvement over the Q3 quarter, as shown in *Figure 3*, the quarterly results are not strictly comparable. The ADSL2+ services measured this quarter represent a technology evolution with higher speed capability. By contrast ADSL1, which was measured in the September quarter, has a large installed base but is an increasingly legacy technology.

The changes from ADSL1 to ADSL2+ are real changes happening in the market, causing improvements in capability of all lines. Epitiro has waited until now before changing the ADSL2+ to provide a closer representation to the performance that NZ households can expect on their lines.

FIGURE 3

New Zealand and UK quarterly average performance



Source: Epitiro, December 2008

This step-change in measured capability this quarter has also put New Zealand 27% ahead of the UK, after being on a par in the September result.

This reflects the differences in the two markets. The UK primarily measures cable and ADSL2+, but over 19 sites with a total of ten service providers. In New Zealand there are 11 sites nationally.

The relative size of the UK market, the more mature stage of ADSL2+ adoption and issues of contention as many more users compete for bandwidth, all have an impact on the UK Epitiro outcomes.

The average speed delivered in the UK is 3.6Mbps. However the main service providers, BT And Virgin Media (Cable) are both beginning an extensive network upgrade. BT has started to rollout its 21CN services to its exchanges, and this will continue through 2009. Virgin Media is upgrading its cable services to a peak 50Mbps. There is also increasing take-up of mobile broadband as competition brings prices down, and 3G upgrades make it an increasingly viable alternative to fixed line DSL.

National Key Performance Variables

As a result of the migration to ADSL2+ measurement in December, the key metrics affecting broadband speed, browsing, email and gaming all received a 20% to 36% boost in Q4 08.

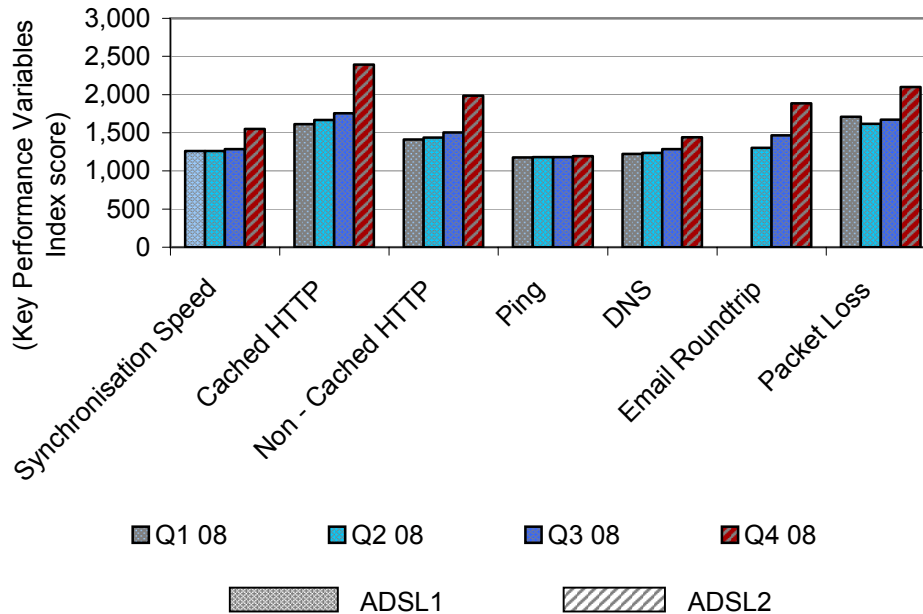
The NZBBI measures ISPs on eight metrics known as 'key performance variables' (KPVs). The tests are run every 15 minutes on a 24/7 basis over the quarter. The KPVs, individually and in combination, provide insight into the customer's broadband browsing, gaming, email and overall experience.

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.

While the use of ADSL2+ modems at each Epitiro site is potentially the major influence on the changes in Figure 4, this nevertheless provides an excellent indication of the advantages of upgrading to an ADSL2+ modem.

FIGURE 4

Key Performance Variables – National Index Score



Source: Epitiro, December 2008

Cached HTTP and non-cached HTTP scores are 36% and 32% higher respectively in Q4. ‘Caching’ is the storage of popular content on NZ-based servers, which improves retrieval speed, and reduces the amount and cost of international traffic. This in turn improves the performance of accessing content from overseas (non-cached HTTP). Both of these measures contribute to browsing speed and performance particularly over ADSL2+.

The improvement in Q4 is likely to be due to a combination of factors, including service provider investment in local caching solutions, purchase of additional international capacity, in addition to the higher speeds available through the upgrade to ADSL2+ technology.

Synchronisation speed rose at a more moderate 20%. Epitiro data shows that initially synchronization speeds improved dramatically after site upgrades had been completed, but then moderated over the rest of the quarter.

Only the ‘ping’ metric, which measures how quickly the ISP’s network can respond to a request, has remained static with a 1% improvement. Given the number of factors that influence this result, including physical distance, number of hops and contention in the network, this is not surprising. Ping times are dependent on international links and as such are unlikely to change unless they decrease due to congestion on those links.

Email round trip times improved 29%. The score for DNS, which measure the time it takes for a web address to be resolved, rose 12%, driven by a mix of improved last mile access, domestic backhaul of data and investment in DNS servers.

These improvements are likely to be more attributable to investment upgrades than the ADSL2+ effect.

Industry Raw Data

The table below is a quarterly snapshot of the actual raw data generated from Epitiro's testing infrastructure. This highlights the different measurements and orders of magnitude, which need to be aggregated and weighted for comparative purposes.

TABLE 1

Q4 Key Performance Variables - Raw Data

	Synchronisation speed	Cached HTTP	Non-Cached HTTP	Ping	DNS	Email	Packet Loss
	<i>kbps</i>	<i>kBps</i>	<i>kBps</i>	<i>ms</i>	<i>ms</i>	<i>minutes</i>	<i>%</i>
TCL DSL	12220.8	104.4	78.6	184.4	51.9	0.9	0.03
Telecom	11709.2	120.3	106.8	175.8	29.1	1.1	0.12
TCL Cable	na	153.1	121.0	152.4	28.6	0.9	0.05
Orcon	12517.8	132.1	115.5	184.8	26.0	1.5	0.11
Vodafone	12002.0	86.1	74.2	189.6	49.6	1.0	0.12
Slingshot	11849.8	181.1	125.1	170.7	26.8	1.1	0.09
Other	11509.9	74.5	65.7	192.2	60.1	4.6	0.1

Source: Epitiro, December 2008

ISP PERFORMANCE BY CITY

Overview

The data presented in the following graphs should be viewed as a guide to service provider changes in each quarter, rather than regional performance. In order to test the investment in network links or 'backhaul', service providers are tested at one or three sites in each city centre. This is not representative of overall city access performance. The Epitiro Isposeure measurement tool currently under evaluation captures a more comprehensive data set across a wider range of parameters, making it more indicative of regional performance.

Over 2008, New Zealand's five main centres have all seen a 66% to 103% improvement in their broadband index score, which reflects the significant investment and infrastructure upgrades taking place last year. Much of this is in the last quarter, and is thus influenced by the change to ADSL2+. However disparate changes by city are likely to demonstrate the increasing investment in backhaul networks which link local city sites back to the core network.

Telecom, TelstraClear DSL, Vodafone, Orcon and Slingshot have boosted their broadband scores between 99% and 166% over 2008, after receiving an average 52% boost in the December result from the inclusion in ADSL2+ data. TelstraClear, which uses an entirely different coaxial cable technology for some of the services measured, also saw a 30% quarterly improvement from an already higher base.

In 2008, the 'other' group of second tier ISPs have improved their aggregated score by 53%, although there is wide variation of performance within this. In the December quarter, there was an average 47% boost for the 'other' group.

ISP initiatives this quarter

- Chorus reports 50 cabinets have been installed in December to a total of 214, serving broadband to approximately 24,000 customers. Chorus plans to increase deployment to 100 cabinets per quarter. Telecom says the attainable speed from the cabinet improved this quarter from 12Mbps to 13.3Mbps, whilst the average actual speed is 10Mbps.
- ADSL2+ broadband technology is now available on 58% of lines, although subscribers require an ADSL2+ modem and a broadband plan that offers maximum download and upload speeds. Results from EpiTiro's new Ispore measurement platform suggest unconstrained users on these plans will get an average speed of 5.0Mbps, with up to 6.8Mbps for ISPs with significant UCLL presence.
- Unbundled connections totalled 25,000 by the end of December, representing 108% growth on the 12,000 unbundled connections reported in the September quarter. EpiTiro is not yet measuring unbundled services in the NZBBI.
- Chorus reports that the Wellington ISP, Actrix, has become its third unbundling client this quarter.
- Telecom Wholesale is installing a new technology upgrade 'Very High-Speed Digital Subscriber Line 2' (VDSL2) equipment in exchanges and roadside cabinets in 2009. The new service will be introduced in some parts of Auckland by June and to 'all major towns and cities' by September. VDSL2 is expected to offer customers who live one kilometre or less from an exchange or roadside cabinet download speeds of up to 50Mbps and upload speeds of up to 20Mbps. However speed rapidly declines thereafter. TelstraClear has also launched premium VDSL2 services for business customers in some areas.
- Orcon says it is also launching unbundled services in Wellington, focusing initially on Courtenay Place and Wellington Central.
- In October, Vodafone announced that it has unbundled 40 exchanges in Auckland, ahead of its year-end schedule. The company also announced a deal with pay TV provider Sky to resell Sky content in the first DSL-based 'triple-play' package of homephone, internet and Pay TV services. TelstraClear already offers Sky services over its cable network in Wellington and Christchurch.
- Slingshot says it has migrated a 'significant portion' of its Auckland subscriber base to unbundled broadband services via its new wholesale arrangement with Vodafone, announced in September 2008.

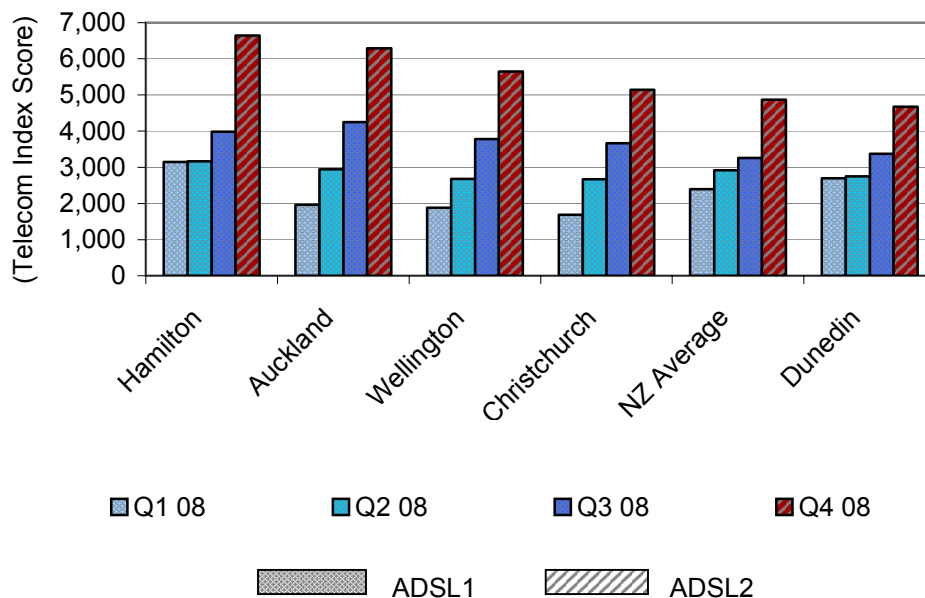
- In December, TelstraClear partnered with HP to offer a six-month free broadband package with every HP or Compaq computer sold to January 2009. TelstraClear says it has experienced 46% growth in its number of broadband customers, with a 20% increase in customers upgrading from dial-up to broadband in six months.

Telecom's Quarterly Performance

Telecom's index score rose on average 49% this quarter (Q3 35%), in line with the national average. While the migration to ADSL2+ measurement provided the primary boost, Telecom has been driving an upgrade programme at both a retail and wholesale level throughout 2008, including the rollout of new caching solutions for local content, which continued into 2004.

FIGURE 5

Telecom's Performance



Source: Epiro, December 2008

Recent upgrade initiatives include new DNS retrieval services which were launched in February 2008, allowing quicker page look-up times. The service provider's new caching solution was trialled in September and rolled out in the December quarter. Akamai content caching has been upgraded, while adjustments made on Telecom's international transit links to ensure traffic takes the most direct path to its destination is affecting service performance. Telecom Retail also says its new Thomson modems allow for better connection speeds and performance stability for customer and it has now sent out more than 220,000 ADSL2+ modems in NZ households.

In the December quarter, Telecom Wholesale began to increase the bandwidth available on its local backhaul or 'local aggregation path' from the exchange DSLAM or cabinet back to the next aggregation point. Previously a specific amount of bandwidth had been allocated, but this had led to congestion at peak periods, leading to slower speeds and latency for users. This has progressively increased by up 400% at exchanges across NZ with the upgrade completed in

January. However the impact of this is likely to be more evident in the Q1 08 results.

TelstraClear's Quarterly Performance

TelstraClear's DSL results

TelstraClear DSL posted a rise of 39% to 93% in its city index scores this quarter, following the shift to ADSL2+ measures.

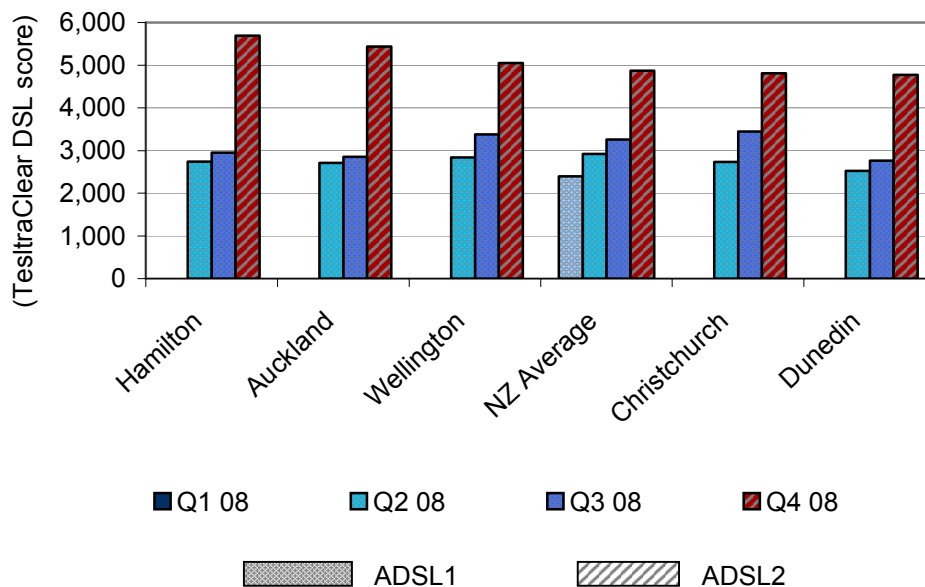
TelstraClear DSL has boosted its Hamilton, Auckland and Wellington scores to between 4% and 17% above the national average – a strong improvement on previous quarters.

TelstraClear reports that it had found what it describes as misconfiguration on some of the DSL-based interconnects between Telecom and TelstraClear. These links have now been upgraded, which has led to a rebalancing of traffic loads and improved capacity. TelstraClear says this will have improved DSL network performance for a number of its DSL customers across the country.

TCL's DSL result no longer includes its 'On-Net' DSL service which delivers broadband over TCL's limited copper network in metropolitan areas. The TCL DSL results for the past three quarters now only capture the services wholesaled from Telecom.

FIGURE 6

TelstraClear's DSL performance



Source: Epitiro, December 2008

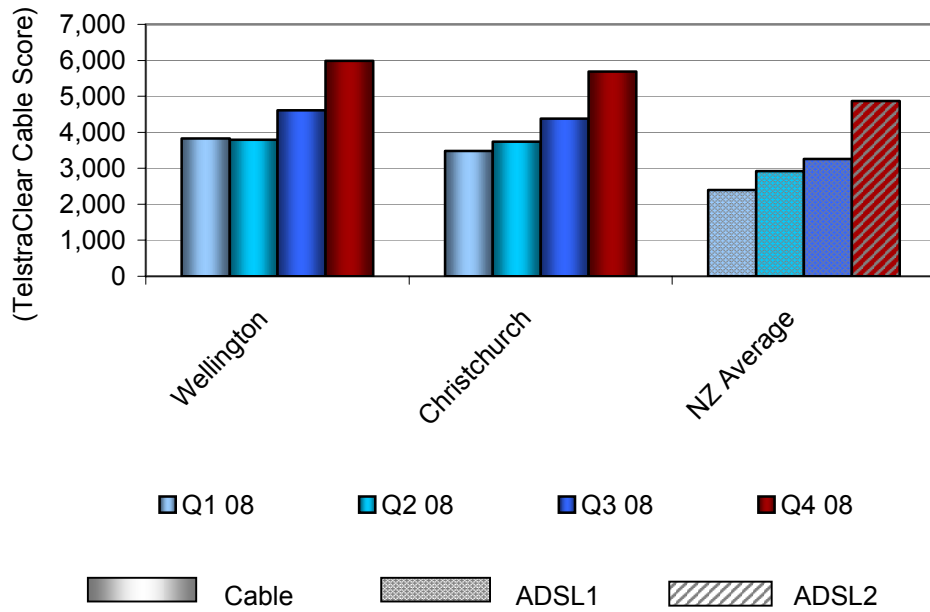
Between August and September 2008, TelstraClear also completed a major upgrade of its transparent HTTP caches located on the New Zealand side of the international transit links. This investment, coupled with the addition of new international capacity, and has contributed to a significant improvement in TelstraClear DSL's cached and non-cached metrics, and also packet loss score.

TelstraClear's Cable result

TelstraClear's Cable index score continues to show steady growth of up to 30% in Q4, even though its cable technology was unaffected by the shift to ADSL2+ measurement.

FIGURE 7

TelstraClear Cable's performance



Source: Epitiro, December 2008

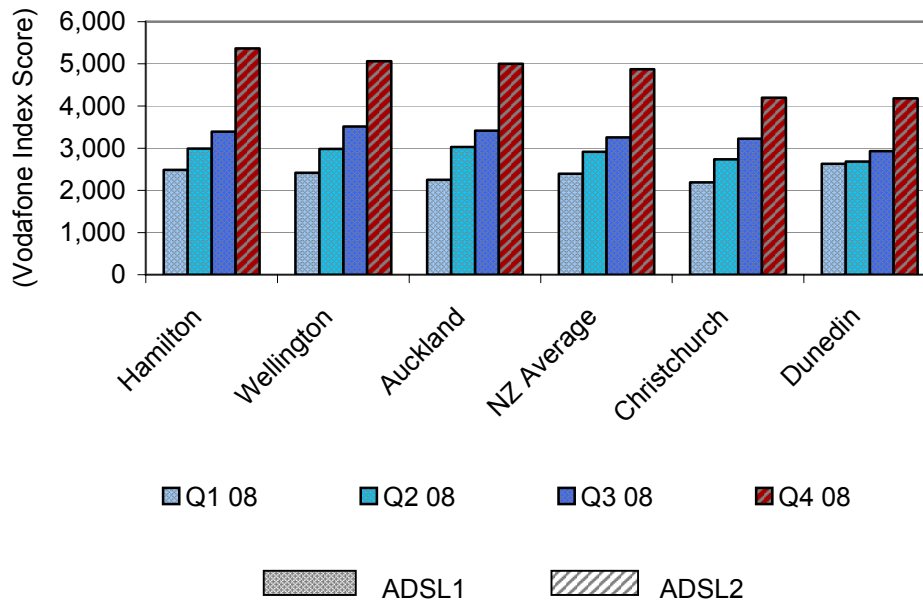
TelstraClear's cable network has a strong position in the Wellington and Christchurch markets, and the company has been upgrading the Christchurch cable network capability as part of the 'Warspeed' initiative.

Vodafone's Quarterly Performance

Epitiro does not measure the performance of unbundled lines provided by Vodafone through ISP-I. Consequently the measurements of Vodafone in Auckland only compare customers using a wholesale bitstream service provided by Telecom Wholesale. 'Unbundling' occurs when a service provider puts its own equipment into a Telecom exchange to provision its own services to customers, rather than reselling a Telecom service. These results do not, therefore, capture the full impact of Vodafone's recent unbundling investment in the Auckland region.

FIGURE 8

Vodafone's performance



Source: Epitiro, December 2008

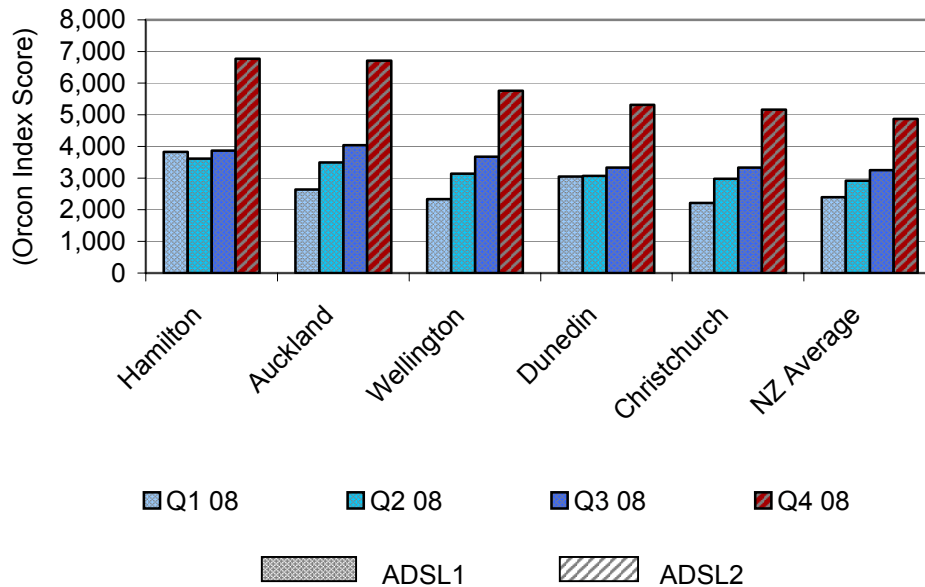
In November, Vodafone completed the unbundling of 40 exchanges, covering 88% of Auckland fixed lines and has begun actively wholesaling its unbundled connections to Slingshot, although these connections are not present in the December quarter. It has also announced a deal to resell Sky services over broadband, representing the first DSL-based triple-play service in NZ.

Orcon's Quarterly Performance

Orcon's continues to deliver above-average results in all five centres. Orcon has been a top four leader in the NZBBI in 2008. It has delivered a 111% gain in its index score over 2008, driven in part by the Q4 ADSL2+ results.

FIGURE 9

Orcon's performance



Source: Epitiro, December 2008

Epitiro does not measure the Orcon services offered over unbundled lines in Auckland. Consequently, the Auckland measures only compare Orcon customers using a wholesale 'bitstream' service, which is likely to now be limited to more remote users.

In Q4, Orcon continued to upgrade its international capacity, purchasing another 400MB which it described as "over-provisioning" to meet growth in customer traffic. It is now the third largest importer of bandwidth, which it says is providing some economies of scale and contributing to stronger browsing (non-cached HTTP) results.

Orcon is one of two ISPs delivering an index for all cities greater than the national average. However Orcon is not yet investing in the local caching solutions, such as those being rolled out by Telecom and Slingshot, as it is still evaluating security challenges.

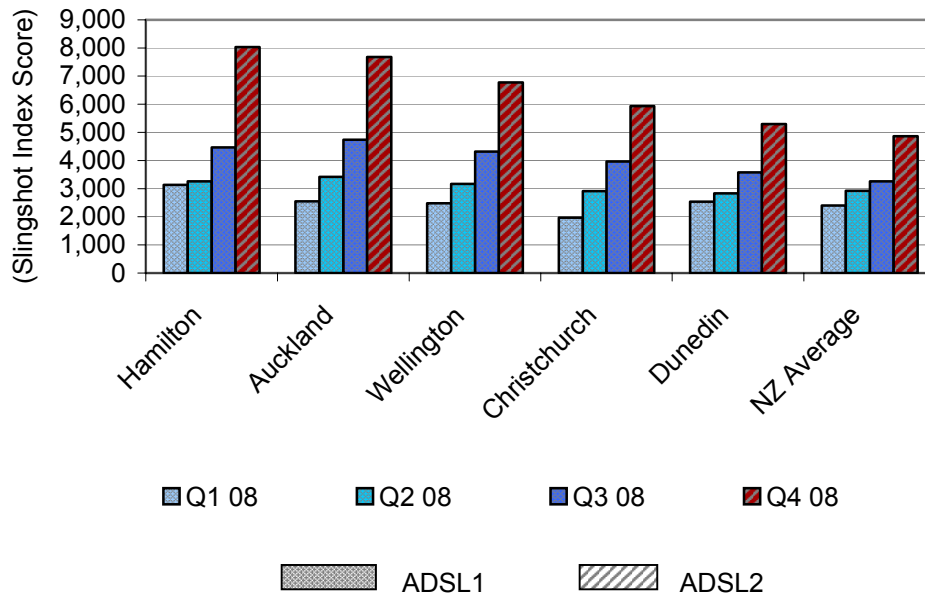
Slingshot's quarterly performance

December was another strong quarter for Slingshot, delivering city scores up 48% to 80%. Overall, Slingshot's individual broadband result for 2008 is up by over 150%.

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

FIGURE 10

Slingshot's performance



Source: Epitiro, December 2008

Whilst this result reflects the December ADSL2+ data capture, the service provider also attributes these improvements to its network investment strategy.

Unlike Orcon and Vodafone, Slingshot has not directly invested in providing unbundled services from the exchange (the results of which are not yet measured in this index). Instead Slingshot will be wholesaling unbundled services from Vodafone from the beginning of 2009, and concentrating on overhauling its core network architecture over 2008, including investing in new data centre facilities and upgrading its remote broadband remote access servers (B-RAS), which route traffic to and from the exchange.

From June, the service provider rolled out new caching services, storing popular content locally leading to faster access of that content. This in turn, freed up international traffic. In the December quarter, the company upgraded these caches to include the local storing of additional types of content. The company says this resulted in faster delivery of cached content and more bandwidth becoming available for international content. The company anticipates this will be the last major change to its caching platforms.

Slingshot has also purchased additional international bandwidth capacity, which it says has improved customer experience.

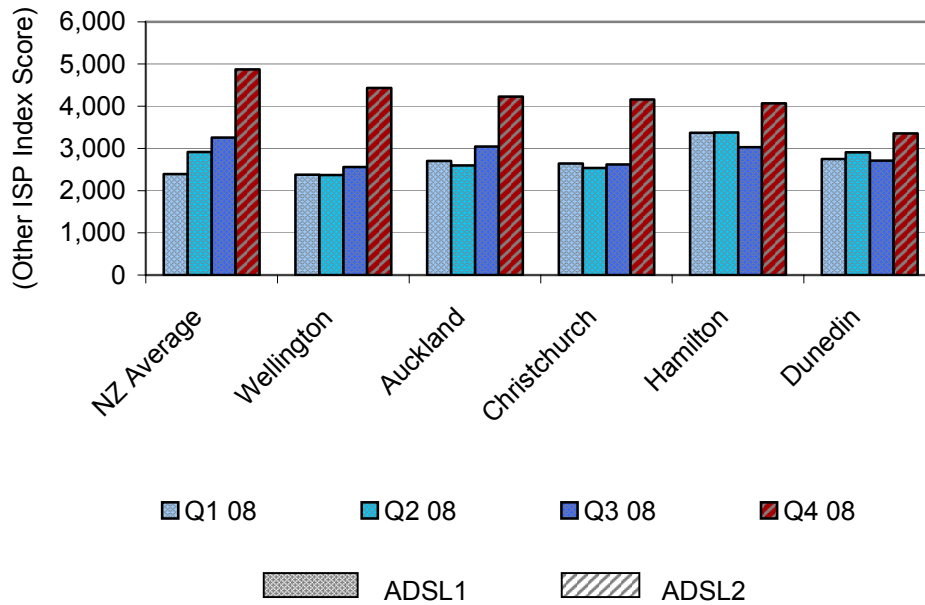
Other ISP quarterly performance

There was considerable volatility across second tier carriers' city results this quarter, which led to the aggregated scores rising between 24% and 73% across the five main centres but from a lower base.

The '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).

FIGURE 11

Other ISP performance



Source: Epitiro, December 2008

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.

ISPs, WorldxChange, Actrix and Inspire all saw an average gains of between 39% and 51% this quarter, and Woosh's DSL services also showed significant improvement.

Actrix in particular shows strong gains in its synchronization speed and caching performance indicators. The Wellington-based service provider has just become the third client of Chorus to offer unbundled services.

These suppliers all show a lower than national average performance, indicating that economies of scale may be a major factor influencing performance.

SERVICE VARIABILITY BY TIME OF DAY

The step-change impact of the use of new ADSL2+ modems is perhaps most apparent in the service variability charts for Q4. ADSL2+ modems enable the Epitiro sites to have up to download speeds of up to 24Mbps, compared to the previous ADSL1 limit of 8Mb/s, resulting in higher speeds on average. However, not only has the download speed increased by an order of magnitude when compared with the previous quarter, there is also considerably less variability in service provider performance.

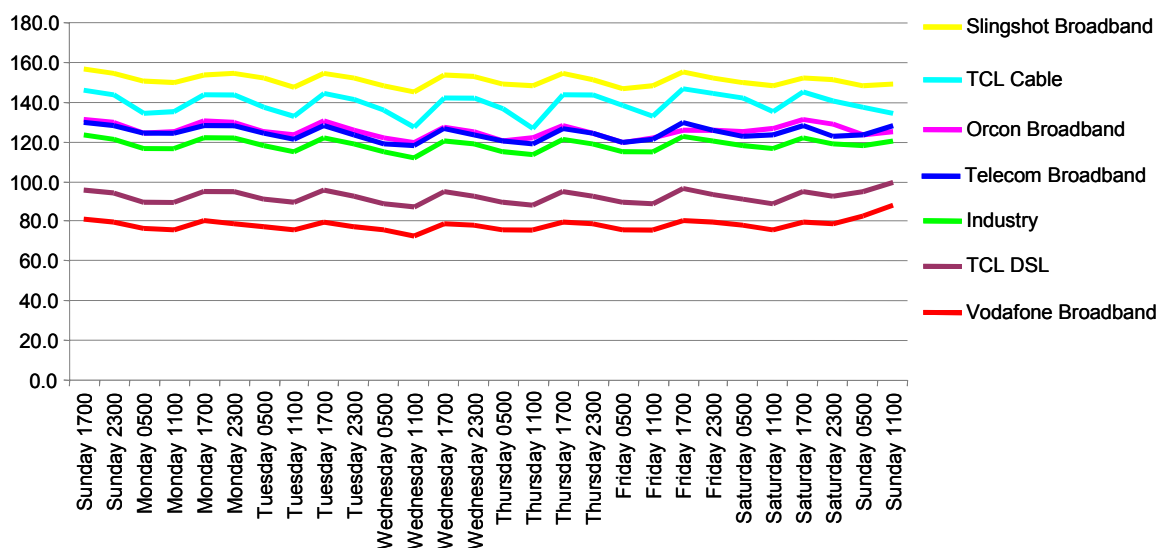
Service variability provides insight into the degree of variation that can occur in an ISP's service over a specified period of time based on peak and off-peak times in the day. It also has the potential to indicate the presence or otherwise of traffic management.

The charts below show service variability across a month in the December quarter (Figure 12) and, for comparison, the September quarter (Figure 13.) This is based on cached and non-cached HTTP data, which impacts the user's browsing experience.

Four data points each day are shown - 5am (off peak), 11am (peak), 5pm (peak) and 11pm (off peak). For each ISP, Epitiro has captured these daily data points over a month, and then averaged the result for consistency.

FIGURE 12

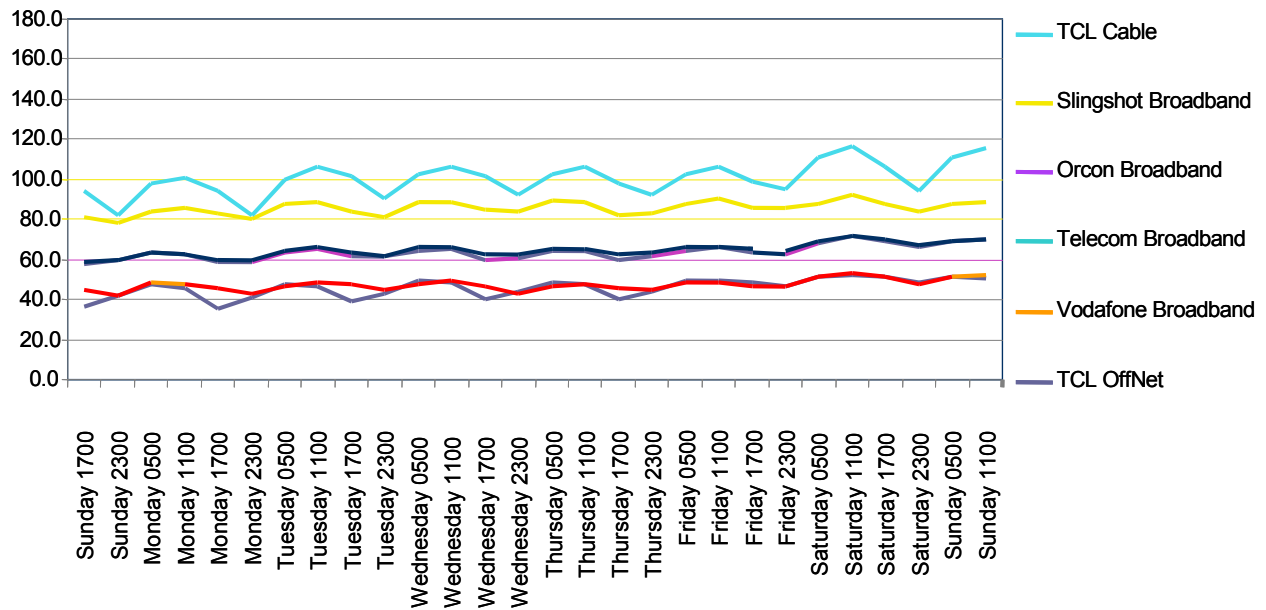
Q4 Service Variability measured by time of day
(HTTP download speeds measured in kbps)



Source: Epitiro, December 2008

FIGURE 13

Q3 Service Variability by Time of Day
(HTTP download speeds measured in kbps)



Source: Epitiro, September 2008

The two charts show the step-change in download speeds, quarter on quarter.

In the Q4 December results, the HTTP download speeds ranged from just under 80kbps to 160kbps – 60% to 100% higher than the September quarter range of 40kbps to just over 100kbps.

Slingshot's download result is ahead of TelstraClear cable for the first time at 150kbps to 160kbps, and outstretch the next competitors using DSL (Telecom & Orcon) by more than 20%.

There is also a more consistent variability profile overall, quarter on quarter. TelstraClear Cable continues to show a higher variability pattern throughout the period but this, in part, reflects the specific nature of cable as a shared medium. On a cable network, a whole street can literally share the same piece of physical wire. This makes it more challenging for the cable operator to manage contention at peak times, apart from prioritizing certain types of traffic.

CONCLUSIONS

The December Quarter NZBBI shows New Zealand's broadband scores have doubled over 2008 – a reflection of both the change in measurement technology to higher-speed ADSL2+ to reflect Telecom's investment in this technology , and also ongoing significant network investment from Telecom and other players in other areas of the network..

We believe around 60% of lines have now been upgraded to ADSL2+, with a growing number of broadband users now on the modems and plans that allow them to access this higher-speed technology.

The ISP-I data provides a useful comparison between ISPs, to show how the top performers stack up against one another, and gives an indicative performance indicator of national performance and comparison with other countries. ISP-I also provides meaningful insights into the changes in broadband performance that are occurring over time, owing to multi-billion dollar investment in the industry.

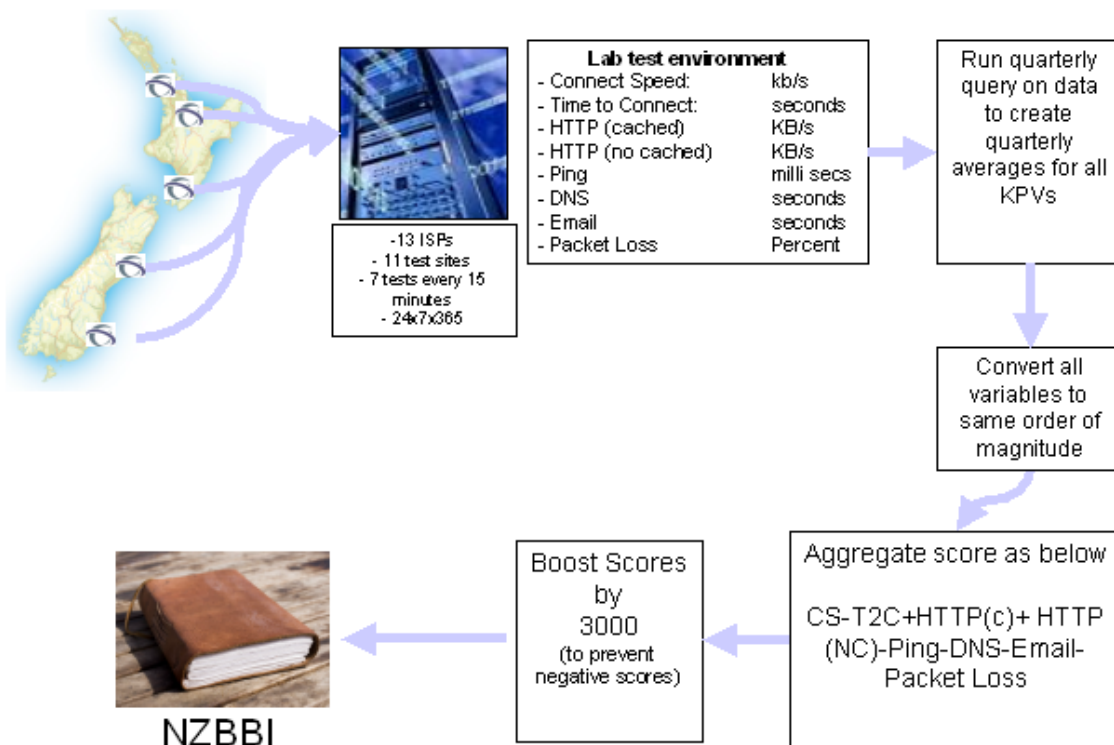
There remain challenges in 2009. While broadband performance and investment continues, the rate of broadband adoption shows further signs of slowing in a recessionary environment. There will put further pressure on revenues and capital investment programmes. Nevertheless the current committed infrastructure deployment will continue to enhance both fixed and wireless broadband capability over the next three years, driving broadband competition, penetration and services.

APPENDIX - METHODOLOGY

The methodology used in creating the New Zealand Broadband Index (NZBBI) has been tested and evaluated through a process of industry consultation and independent review.

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.

The Index Process



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, 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 the data, all of the values are converted into a score of the same order of magnitude.
 - Depending on the variable, 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 using statistical techniques. As a result, a high index score always indicates a positive performance in this report.
- **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 eight key performance variables (KPV's) analysed in this report, with two additional parameters assessing consistency of service performance and traffic management. The KPV's 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. The “non-cached” mode appends a random query parameter to the end of the URL, which will result in the request bypassing any caches present in the network. The web server specified in the URL, as opposed to any cache, will therefore service the request. 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

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 contended nature of broadband services, it is useful to try to quantify the undulating nature of these 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 this graph, cached and non-cached download speeds were taken for

the first three weeks of the month of September and averaged. This data is represented in kilobits per second (Kbps).

The service variability data measures performance at peak and off-peak times each day, represented as averages for all of those days in a month. For example, in Figure 9, Monday at 0500 represents the average of four tests taken for each Monday in September at that time. This was then repeated for each day in a seven-day week. Four tests were conducted daily, at the following times; 0500, 1100, 1700 and 2300 hours. Because of space restrictions on the page, Figure 9 labels only two of these times – 0500 and 1700 – but the other points are also present.

Isposure methodology

The Isposure agent is a small piece of software – approximately 3Mb – that can be downloaded free of charge from www.isposure.com. Registration involves providing details of the user's broadband service package, and the first 5 numbers of their telephone number. This allows the identification of the exchange, and thereby the district, sub-region and region of the user's location.

The diagnostic agent works 24-7 in the background to assess a consumer's connection speed and other meaningful parameters. Consumers can check their historical performance in addition to viewing the performance of other users in their local post-code region.

The agent tests HTTP download speeds (from the same sites as ISP-I), DNS response times and ping. In addition, the agent conducts a Transmission Control Protocol (TCP) download and upload test to endpoint servers located in the Auckland Peering Exchange. The TCP has a critical function in helping to manage data transmission, controlling among other things message size, the rate at which messages are exchange and network traffic congestion. This is therefore the most accurate test for identifying a specific line's maximum theoretical speed.

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. While Epitiro's ISP-I data only measure the premium consumer plan, Telecom Retail's broadband growth in the second quarter was driven by a limited broadband deal designed to attract customers from dial up.
- 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 is 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)

Woosh

The NZBBI does not measure Woosh's fixed wireless performance, but does include Woosh's DSL service. This is because the wireless offering is targeted at users who place a premium on mobility rather than high-speed access. Due to limitations in the technical capability of its TDD-CDMA platform it is therefore not directly attempting to compete with DSL providers with its wireless service.