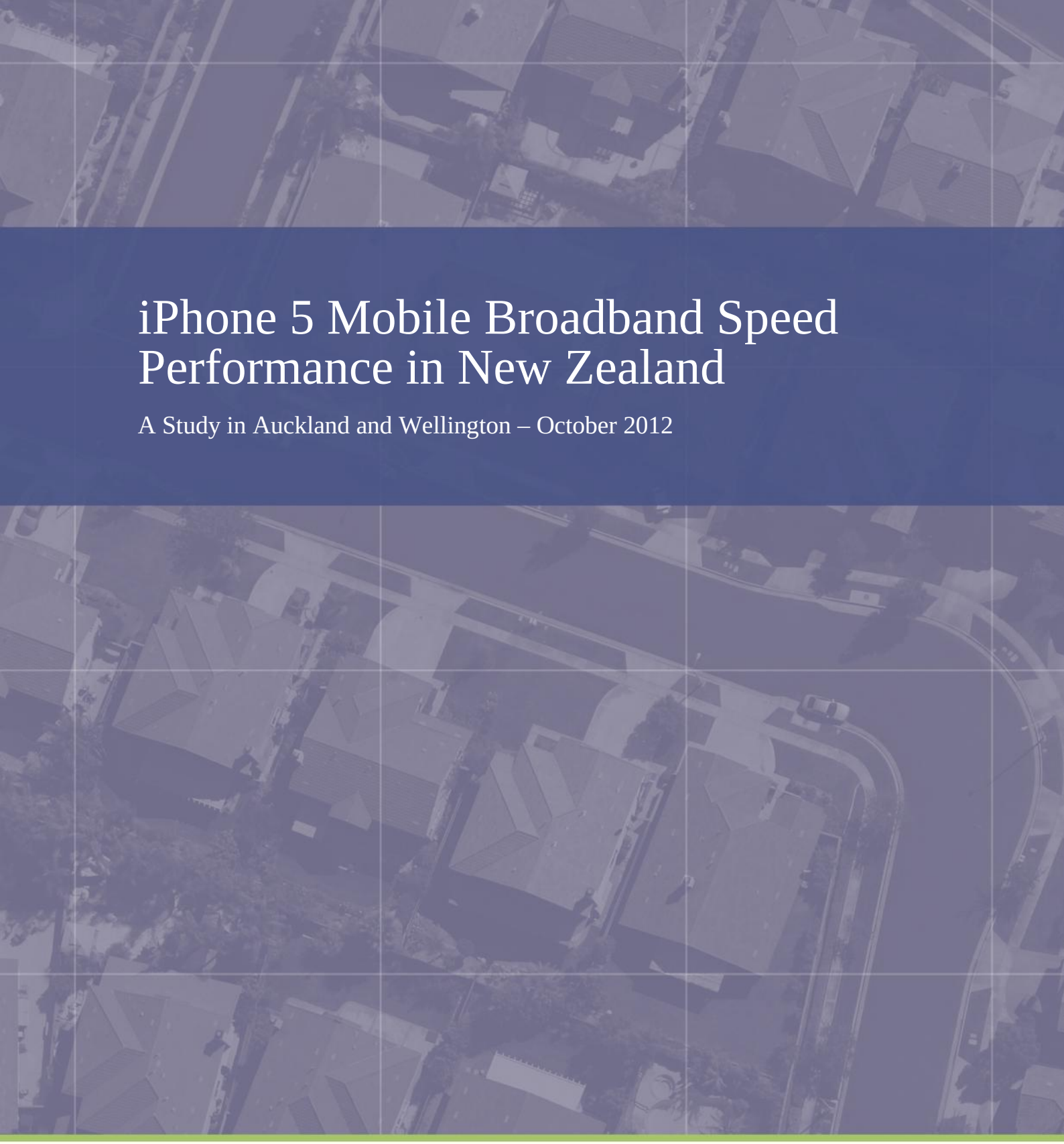

iPhone 5 Mobile Broadband Speed Performance in New Zealand

A Study in Auckland and Wellington – October 2012

epitiro

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EXECUTIVE SUMMARY

In October 2012 Epitiro carried out a study measuring the performance of mobile broadband in New Zealand.

Mobile broadband networks have been subject to rapid advances in the technologies deployed. The recent releases of Apple's new iPad and iPhone 5 have seen the commercial availability of the first tablet and smartphone devices capable of taking advantage of Dual-carrier HSPA technology. This will be a standard that will be adopted by other mobile device manufacturers in their future releases.

Dual-carrier HSPA (High Speed Data Packet Access) is an evolution of the HSPA family of 3G mobile telephony protocols. This technology offers higher performance connections. The introduction of DC-HSPA capable cell towers is underway by the New Zealand mobile network operators, notably Vodafone NZ who are extending deployments already running in parts of major cities.

Epitiro first reported on the quality of experience of mobile broadband services in September 2011. The aim of this study was to explore how improvements in performance may be experienced by users of DC-HSPA capable devices like the iPhone 5. As such the study focussed on the throughput speeds experienced for file downloads and uploads.

This report describes the performance of mobile broadband networks in New Zealand based on data collected during four days of drive testing in Auckland and Wellington between 3rd and 10th October 2012. The performance of mobile broadband services from Vodafone NZ, Telecom NZ and 2degrees were tested and analysed with over 9,500 throughput speed measurements collected.

The following key points were determined;

- The average download speed recorded in Auckland and Wellington was 9.4 Mbps, and the fastest speed measured was 26.9 Mbps on Vodafone NZ in Auckland.
- The majority (84%) of download speeds were measured as being over 5 Mbps, and 37% recorded at faster than 10 Mbps.
- Mobile broadband performance varies significantly between operators and across the geography tested in Auckland and Wellington.

A summary of the average throughput speed performance observed for each operator is presented in Table 1 below.

- The fastest average download performance observed during this study was on Vodafone NZ where a speed of 13.6 Mbps was measured.
- The fastest average upload performance of 2.2 Mbps was also measured on Vodafone NZ.

Epitiro will continue its research into mobile broadband performance and recommends that further study is required in New Zealand as HSPA+ and LTE services emerge, and to assess the user experience of these services across a wider geography.

Table 1 Summary of average throughput performance by operator

	Download Speed	Upload Speed
Vodafone NZ	13.6 Mbps	2.2 Mbps
Telecom NZ	7.8 Mbps	1.2 Mbps
2degrees	6.9 Mbps	1.4 Mbps

INTRODUCTION

Since 2000 Epitiro has measured broadband performance and regularly published studies examining numerous key performance indicators (KPIs) that affect the quality of experience of those services. Epitiro provides services and broadband performance data to ISPs, industry bodies and telecommunication regulators for benchmarking, service assurance and customer experience management purposes.

Founded on Epitiro's ipQ™ technology that enables measurements of broadband services from the customer experience perspective, this report details the performance of throughput speeds for mobile broadband services in the central parts of Auckland and Wellington in New Zealand. Specifically, the performance of cellular 3G and HSPA services, based on data collected in October 2012. To enable this study Epitiro conducted a period of drive testing to measure the performance of leading mobile operators from locations around central Auckland and Wellington. The analysis of that data forms the basis of this report.

RATIONALE FOR THE REPORT

Mobile broadband is an increasingly important element in the provision and delivery of consumer broadband services, with user adoption of smart phones and tablets being a key driver in the growing demand for mobile broadband services.

A recent study of Mobile Broadband in New Zealand by IDC[1] predicted an 18% growth in use of mobile broadband services from handsets, from 1.4 million connections in 2010 to 1.6 million in 2011. Access to mobile broadband using USB dongles also continues to grow, with a predicted increase of 32% from 252,000 dongle connections in 2010 to 333,000 in 2011. Spending on mobile broadband services in 2011 is expected to exceed $300m, growing from $236m in 2010.

OBJECTIVES OF THE STUDY

Epitiro's first report on mobile broadband performance in New Zealand was in September 2011[2]. Epitiro's objectives for this further study were as follows:

- Explore subsequent improvements in consumer experience of mobile broadband services in New Zealand for emerging new technologies.
- Compare the performance of the services currently delivered by the three operators in Auckland and Wellington New Zealand.

DEFINING MOBILE BROADBAND

Mobile broadband is an undefined term with respect to speed and technology used. GPRS, 3G, HSDPA, HSPA+, LTE and WiFi technologies may be considered by service providers as mobile broadband thus there is a variance in what is promoted to the public.

For the purposes of this research, Epitiro focused on cellular broadband services specifically as experienced by users of the latest Apple devices.

GPRS (because of its low speed) and WiFi (as it connects via fixed line infrastructure) were excluded in favour of researching mobile broadband services delivered using available 3G, HSDPA and HSPA+ access technologies.

[1] IDC New Zealand, January 2011

[2] Mobile Broadband Performance in New Zealand. September 2011.

METHODOLOGY

SCOPE OF TESTING

This study of mobile broadband services in New Zealand focused on measuring the performance delivered by the three leading operators (Telecom NZ, Vodafone NZ and 2degrees) in the major cities of Auckland and Wellington.

The measurements captured during the testing focussed on measures of download speed and upload speed performance. During the course of the testing, in excess of 9,500 measurements were recorded.

APPROACH AND METHODOLOGY

The measurements that form the basis of this report were conducted by drive testing in Auckland and Wellington. Each city was tested over a period of two days; Auckland 3rd and 4th October, Wellington 9th and 10th October 2012.

The vehicles used were equipped with Apple iPhone 5 handsets running Epitiro's ipQ software. The Apple iPhone 5 is capable of connecting to HSPA+ based mobile broadband services and supports theoretical download speeds of up to 42 Mbps and upload speeds of up to 5.6 Mbps through support of Dual-carrier HSPA. Three handsets were deployed in each vehicle to enable the concurrent testing of the three mobile services.

Testing was carried out between 7am and 10pm, covering the working hours and early evening of each day. The adopted drive test routes covered the central business district in Auckland, as well as areas as far as Ponsonby to the west, Newmarket, Parnell to the East and Eden Terrace to the South. In Wellington the testing covered the central business district, in addition to areas as far as Thorndon to the north and Newtown to the South.

All the measurements of broadband performance were conducted while the vehicle was stationary, with tests executed on all three operators for approximately 15 to 30 minutes at each location along the routes. Locations were selected where all three operators have full coverage.

A detailed description of the testing methodology that resulted in the individual measurements is presented in the Technical Testing Methodology at the end of this report.

FINDINGS – MOBILE BROADBAND PERFORMANCE

This section examines the performance of the three mobile broadband services as observed during this study. In excess of 9,500 measurements were captured during the drive testing over two days for each test run in Auckland and Wellington.

The performance analysis in this report focuses on performance delivered while connected to 3G, HSDPA or HSPA+ bearers. Measurements recorded from a GPRS bearer are excluded.

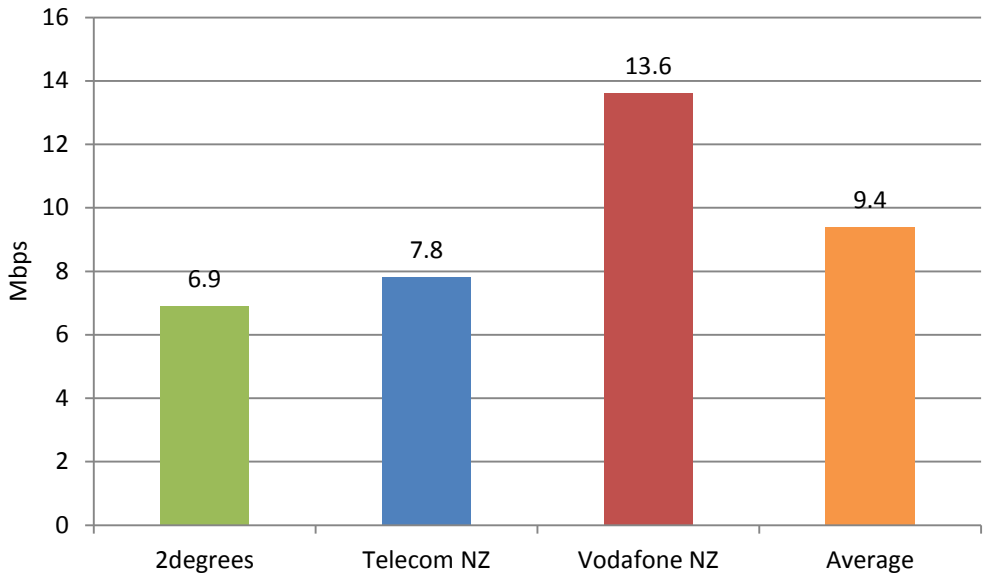
THROUGHPUT SPEED

Throughput speed is a measure of the rate at which data can be delivered by the mobile broadband service to the user's device. Higher bandwidth applications, such as video and audio applications, benefit significantly from faster throughput speeds.

During the testing conducted in this study, throughput speed was measured from the drive test probes to an Epitiro server hosted in the Auckland Peering Exchange. The server was managed and monitored by Epitiro throughout the testing and is attached to bandwidth dedicated to the purpose of throughput measurement.

The average download speeds recorded for each mobile operator are shown in Figure 1. The average download speed measured across all operators was 9.4 Mbps. Vodafone NZ delivered the fastest download speeds with an average of 13.6 Mbps, which was 74% faster than the average measured for Telecom NZ, and 97% faster than 2degrees.

Figure 1 Average download speed by operator



These throughput results compare favourably with the earlier Epitiro study of mobile broadband performance in the NZ conducted in September 2011. The average download speed of 9.4 Mbps in this report is 176% faster than the 3.4 Mbps average in the 2011 Epitiro report. It should be noted that the 2011 study utilised Android based handsets that did not feature the latest chipsets installed in the Apple iPhone 5. This comparison is however indicative of the on-going improvement of network capabilities of mobile broadband in New Zealand from continuing infrastructure investments by the operators.

Figure 2 Distribution of average download speeds by operator

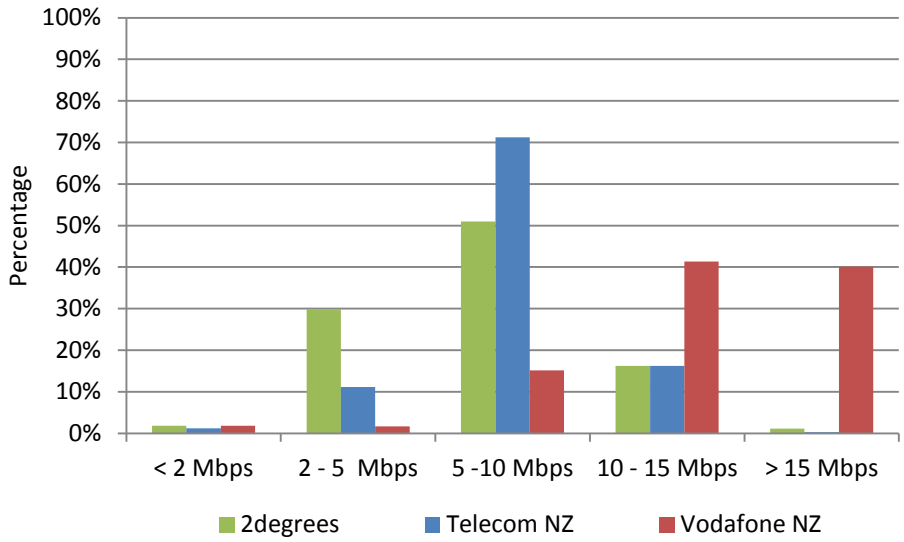
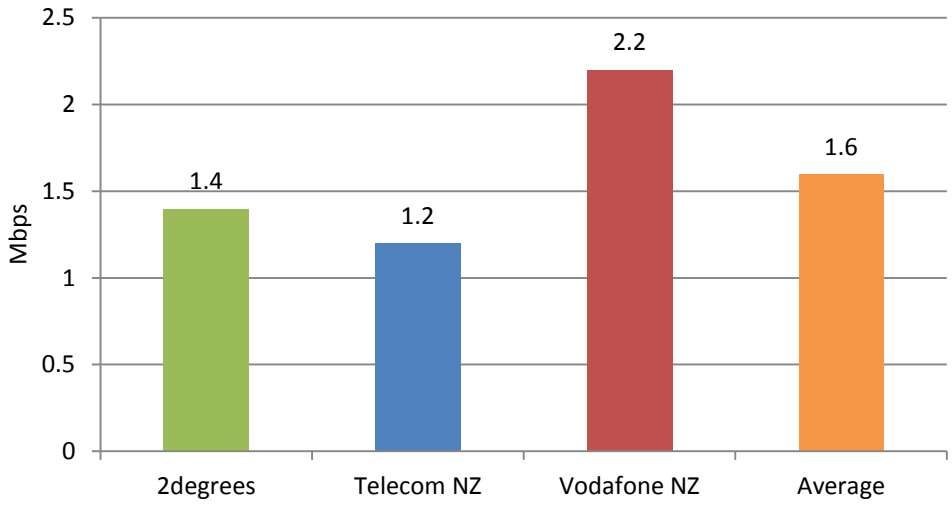


Figure 2 shows the distribution of average download speeds observed during the drive testing when connected on 3G or HSPA bearers. Overall, across all three mobile operators, the majority (84%) were faster than 5 Mbps, over a third (37%) of the recorded download speeds were faster than 10 Mbps, and fewer than 2% of the measurements were lower than 2 Mbps.

When considering the distribution of speeds for individual operators, 81% of speeds measured on Vodafone NZ's mobile broadband service exceeded 10 Mbps, while Telecom NZ and 2degrees services delivered faster than 10 Mbps, 16% and 17% of the time respectively. Both 2degrees and Telecom NZ had more than 50% of results between 5 and 10 Mbps. 51% of speeds on 2degrees and 71% of speeds on Telecom NZ were within this range whereas this only represented 15% of Vodafone NZ results. Download speeds of more than 10 Mbps were measured on all three operators

The fastest download speed recorded during the drive tests was 26.9 Mbps on the Vodafone NZ service in Auckland.

Figure 3 Average upload speed by operator

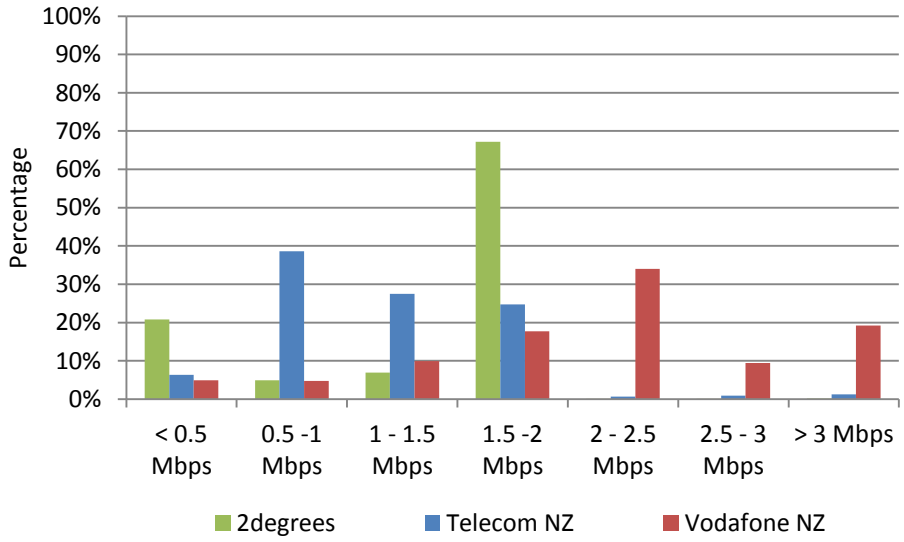


As shown in Figure 3, the average upload speed measured across all three operators was 1.6 Mbps. The average upstream performance on Vodafone's service was over 50% faster than the services from Telecom and 2degrees, with an average upload speed of 2.2 Mbps.

The upload performance recorded for this study shows in Figure 4 that Vodafone NZ delivered upload speeds faster than 2 Mbps, with over 60% of Vodafone NZ's average upload speeds in this range. 99% of 2degrees and 97% of Telecom NZ upstream measurements were slower than 2 Mbps.

The fastest upload speed recorded during this research was 5.3 Mbps on Vodafone NZ's mobile broadband service in Auckland.

Figure 4 Distribution of average upload speeds by operator

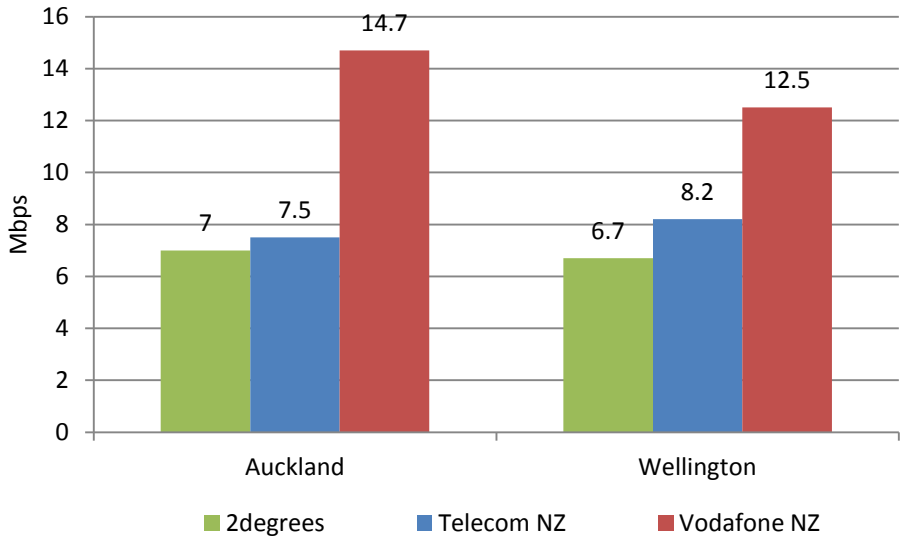


VARIATION BY GEOGRAPHY

Location is a major factor in users gaining access to the radio network and to the types of bearers necessary to deliver a desirable mobile broadband experience. The level of service available in a given area is determined by the local provision of network infrastructure by the mobile operators and also by the behaviour of the user population in accessing the mobile broadband services. This behaviour can be the cause of contention for services and bandwidth in densely populated areas at peak times.

This study is limited in its coverage of geography, but does enable a comparison of the performance observed in the cities of Auckland and Wellington covered by the drive testing. Future research should acknowledge this limitation and aim to measure performance across a wider geography in New Zealand.

Figure 5 Average download speeds by city and operator

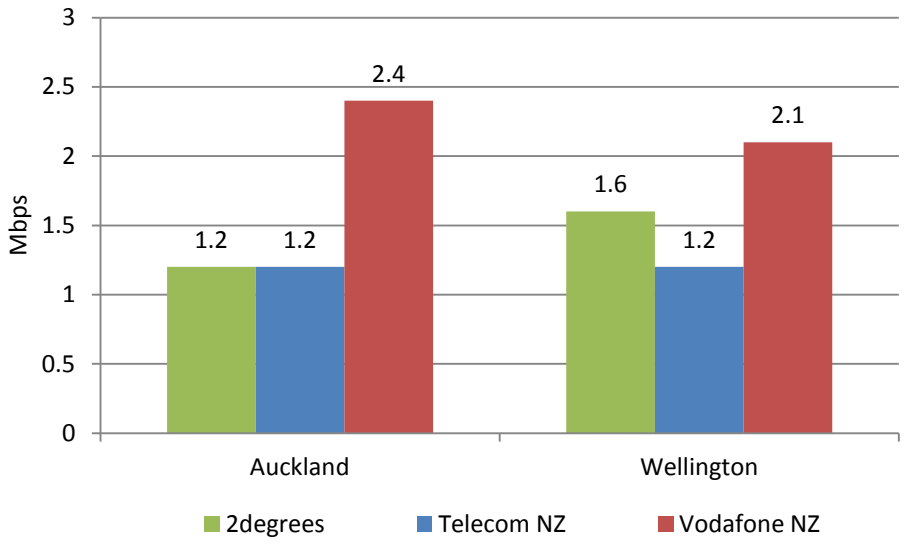


The average download speed measured for each operator in Auckland and Wellington is shown in Figure 5. Both Auckland and Wellington services delivered average download speeds over 9 Mbps.

The average performances of the individual operators were similar in each city; Vodafone NZ's service was 17.6% faster in Auckland than Wellington, Telecom NZ's was 9.3% faster in Wellington and 2degrees was 4.5% faster in Auckland.

Vodafone NZ was measured as significantly faster than the other operators in both cities. In Auckland Vodafone NZ was 96% faster than Telecom NZ and 110% faster than 2degrees with an average speed of 14.7 Mbps. In Wellington Vodafone NZ's service was 52% faster than Telecom NZ and 87% faster than 2degrees.

Figure 6 Average upload speed by city and operator



Average upload speeds as shown in Figure 6 also reveal similar results with average speeds of 1.6 Mbps. Telecom NZ average upload speeds were identical in both locations at 1.2 Mbps. 2degrees was faster (33%) in Wellington with 1.6 Mbps compared to 1.2 Mbps in Auckland. Vodafone NZ showed best performance in Auckland with 2.4 Mbps, 14% higher than Wellington.

Vodafone NZ was measured with upload throughput speeds significantly faster than the other operators in both cities. In Auckland Vodafone NZ was twice as fast as Telecom NZ or 2degrees with an average speed of 2.4 Mbps. In Wellington Vodafone NZ's service was 75% faster than Telecom NZ and 31% faster than 2degrees.

The heat maps in the analysis below provide a view of the download speeds measured for each operator in the different areas of Auckland and Wellington covered by the drive tests. The areas where throughput speed tests were conducted are represented on the maps by a coloured tile. The colour of the tile indicates the average performance experienced in that area while connected to a mobile broadband service. The legend above the heat maps in Figure 7 and 8 shows the range of speeds represented by each colour. Where there is no coloured tile, it simply indicates that no measurements were made in that area, and does not represent lack of service or coverage.

Figure 7 Average download speed across Auckland by operator

0 to 2 Mbps 2 to 10 Mbps 10 to 20 Mbps

Tiles with no colour indicate areas where no measurement was carried out

Figure 7.1 Vodafone NZ

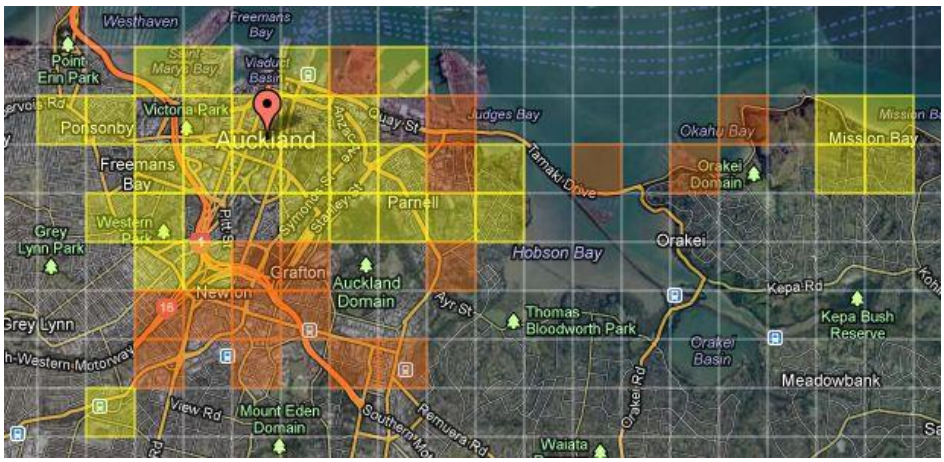


Figure 7.2 Telecom NZ

Figure 7.3 2degrees

Figure 7 provides heat maps showing the average download speeds measured for Vodafone NZ, Telecom NZ and 2degrees throughout the drive tests in Auckland. Slower speeds of up to 10 Mbps are represented by red and orange tiles. Yellow tiles indicate faster speeds in the range of 10 to 20 Mbps.

Figure 7.1 for Vodafone NZ shows availability of average download speeds over 10 Mbps across the central business district, surrounding areas and Mission Bay, over 60% of areas tested. Average download speeds in the 2 to 10 Mbps range at least were available from Telecom NZ and 2degrees in most areas tested. Higher average download speeds in the 10 to 20 Mbps range were available in 15% of areas tested for Telecom NZ.

Figure 8 Average download speed across Wellington by operator

0 to 2 Mbps 2 to 10 Mbps 10 to 20 Mbps

Tiles with no colour indicate areas where no measurement was carried out

Figure 8.1 Vodafone NZ

Figure 8.2 Telecom NZ

Figure 8.3 2degrees

The heat maps in Figure 8 represent the measured performance of each operator during the drive tests in Wellington, between Thorndon to the North and the area of Newtown to the south of central Wellington.

As observed in Auckland, Vodafone NZ shows availability of average download speeds over 10 Mbps across the central business district of Wellington and surrounding areas, over 80% of areas tested. Average download speeds in the 2 to 10 Mbps range at least were available from Telecom NZ and 2degrees in most areas tested. Higher average download speeds in the 10 to 20 Mbps range were available in 9% of areas tested for Telecom NZ and 11% for 2degrees.

CONCLUSIONS AND FUTURE WORK

This study of mobile broadband performance in New Zealand provides a view of improvements to the user's experience of the services of the three main operators in the inner city areas of Auckland and Wellington since the earlier report conducted in September 2011.

The results show that the availability emerging HSPA+ based mobile broadband services have had direct impact on improved throughput speeds for users with devices capable of taking full advantage of them. These services offer speeds comparable to, and some instances exceeding those typically delivered by fixed line broadband services. The performance of services offered does vary between mobile operators, and reflects the differing levels of investment into the infrastructure required to support and evolve mobile broadband. Vodafone NZ in particular now has significant DC-HSPA technology deployments in the central districts of New Zealand's major cities as reflected in this report.

Throughput speed is a significant factor in the quality of experience offered by mobile broadband services to users. However, speed is not the sole indicator of user experience, with some services being influenced to a greater degree by factors such as network latency or website being accessed.

The experience of mobile broadband can vary based on geography. This study limited its focus to measuring the services in the densely populated city areas of Auckland and Wellington. Further research is required to understand the performance across the wider regions of New Zealand and the impacts of on-going investment in infrastructure improvements by network operators.

Mobile broadband access technologies are rapidly evolving. The continued rollout of HSPA+ services and the predicted emergence of LTE services in New Zealand during 2012/2013 will continue to improve the speeds and quality of experience of mobile broadband. Epitiro recommends that future research measures these next generation access technologies to assess how they are delivering in relation to expectations.

GLOSSARY

2G: 2nd generation radio and network technology.

3G: 3rd generation radio and network technology.

Contention: A slowdown in performance caused when multiple users share the same limited bandwidth.

DC-HSDPA: Dual-carrier High Speed Packet Access for 3G networks. DC-HSPA is a "dual carrier" or "dual channel" form of HSPA+ that achieves greater upload and download speeds by using two 5MHz bands of spectrum in parallel instead of relying on the normal single 5MHz band of spectrum used by HSPA+ and other HSPA network technologies.

Download speed: The rate of data transmission from a network operator's access node to a customer, typically measured in Megabits per second (Mbps).

EDGE: Enhanced Data rates for GSM Evolution – an improved data solution for GSM GPRS.

GPRS: General Packet Radio Service.

GPS: Global Positioning System.

Headline speed: The speed at which a broadband service is marketed.

HSDPA/HSUPA: High Speed Downlink/Uplink Packet Access for 3G networks.

HSPA: High Speed Packet Access for 3G networks.

kbps: Kilobits per second. 1,000kbps is the same as 1Mbps.

Latency: The time it takes a single packet of data to travel from a user's device to a third-party server and back again. Most commonly measured in milliseconds.

LTE: Long Term Evolution. A 4G access technology characterised by high throughput speeds (downlink peak rates of at least 100Mbps) and low latency.

Mbps: Megabits per second. 1Mbps is the equivalent of 1,000kbps.

MNO: Mobile Network Operator.

RSSI: Receive Signal Strength Indicator.

SIM: Subscriber Identity Module.

UMTS: Universal Mobile Telecommunications System, the 3GPP 3G system.

Upload speed: The rate of data transmission from a customer's connection to a network operator's access node, typically measured in kilobits per second (kbps).

TECHNICAL TESTING METHODOLOGY

THROUGHPUT MEASUREMENTS

Measurements of download and upload speed were conducted from the probes to a dedicated Epitiro endpoint server. The endpoint server was hosted in the Auckland Peering Exchange on bandwidth dedicated to the purpose of throughput testing for this study.

All throughput tests were conducted over TCP and were multi-threaded with 8 TCP connections in the downstream direction, 4 upstream. In order to ensure accurate results regardless of the speed being delivered by the mobile broadband service, all tests were configured as time bounded with both downstream and upstream speeds being measured for a period of 10 seconds each.

A lead-in period of 2 seconds (that did not contribute to the measured speed) was employed, to minimise the impact of TCP slow-start and any change in radio conditions or bearer that, depending on network management policies implemented by the operator, could be triggered by the flow of data.

CAPTURING LOCATION

The location of each test was recorded by employing the GPS capabilities of the Apple iPhone 5 handsets. If a GPS signal was not available, then the location was recorded using triangulation.

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