NEW ZEALAND INSTITUTE FOR THE STUDY OF COMPETITION AND REGULATION INC.

Building Best Practice Broadband in New Zealand:
Bringing Infrastructure Supply and Demand Together

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June 2003

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ISCR Working Paper BH03/06. The data for this paper come from the ISCR Telecommunications Database. The author gratefully acknowledges the support of CityLink, Telecom NZ and Xtra in compiling this database. The author also acknowledges the editorial assistance of Veena Mishra, data management and analysis assistance of Mark Obren, and the helpful comments of Lewis Evans, Mark Obren and Neil Quigley, in the preparation of this paper.

Executive Summary

New Zealand has historically enjoyed early and significant adoption of Information and Communications Technologies (ICTs). If, as has been espoused by organizations such as the OECD, increased economic and social benefits were to accrue from the use of these technologies, New Zealand would appear to be well placed relative to its OECD counterparts to enjoy these benefits.

However, despite OECD-leading levels of Internet uptake and usage generally, New Zealand lies well to the bottom half of the OECD in respect of uptake of broadband technologies per capita. This has been interpreted as a 'problem' for New Zealand, as it has been widely presumed that if basic Internet access technologies are beneficial, then widespread use of faster and more capable Internet technologies such as broadband should accelerate the accrual of these gains.

New Zealand's failure to record significant broadband penetration levels has resulted in an examination of the underlying information transportation mechanisms, in particular the telecommunications infrastructures, in order to determine whether the poor performance is a symptom of market imperfections. This examination has been especially interesting given that New Zealand has been one of only four OECD countries (the others being Switzerland, Mexico and Turkey) to neither allow for, nor impose, the industry-specific regulatory intervention of compulsory Local Loop Unbundling (LLU). This intervention has been widely promoted within the OECD as a means of opening up monopoly networks to competition, and by this mechanism, encouraging the growth of broadband penetration.

This paper adopts a productivity-based approach to assess the state of the New Zealand broadband market. This approach presumes that broadband penetration is a proxy for the ultimate objective of increased economic and social benefit, which can be measured as increases in productivity. The state of the market is examined from the technology-agnostic perspective of competition for the provision of broadband services, in terms of availability and price. This is then juxtaposed with a detailed analysis of New Zealand broadband purchase and utilization behaviors. Broadband purchase is seen in this analysis as merely another technology that may enable increased productivity from the use of information exchange over the Internet.

The paper finds that there is substantial evidence of New Zealand's ability to access the benefits of an Information Economy from the already extensive use of the Internet. Furthermore, far from

failing to capitalise upon the benefits of broadband, New Zealand exhibits no sign of any evidence of failures of the market to provide multiple technology platform competition (six infrastructures) widespread coverage (two technologies – mobile and satellite – claim near nationwide coverage, while the third – DSL – has 85% coverage) low prices relative to comparative benchmark countries and one of the highest levels of business uptake of the technology in the OECD. As New Zealand's businesses are typically small relative to other countries, this business result is impressive.

Moreover, business penetration of the technology is amongst the highest in the OECD, with a conservative calculation revealing over 8% of New Zealand's significant business units using DSL alone, compared to 3.5% in the UK and 3% in Australia. In addition, regional business penetration shows no sign of a significant rural-urban divide, with second and third highest penetration levels per significant geographic unit (i.e. sites where business is conducted) being recorded in provincial areas Otago and Gisborne respectively.

If New Zealand has a 'broadband problem' at all, it relates to low levels of residential uptake of the technology. However, the available evidence is not consistent with this being a result of a supply-side 'problem'. Rather, both lower residential connection purchase and higher levels of business connection purchase appear to be almost solely due to pricing arbitrage in respect of the costs of accessing information transport via the Internet. Despite low prices, levels of business data exchange are very low, suggesting that the capabilities of the technology (speed and capacity) are not the primary reason for purchase. As the price of broadband is, for some business users, less than the price of dial-up given that dial-up access incurs per-minute charging for telephony access, DSL merely offers a more cost-effective way to access the Internet. Substitution is occurring principally because of the productivity effects of conducting low levels of information exchange using the cheaper technology. It is noted, though, that the wide variety of volume plans offered in New Zealand, as opposed to flat rate plans used elsewhere, enable small users to economically access the technology by not forcing them to subsidise heavier users via the flat-rate plans. This is a significant additional factor in encouraging New Zealand's small businesses to use broadband, relative to the countries where flat-rate business plans prevail.

Residential purchase, however, is relatively more expensive than dial-up, as these customers do not face a per-call or per-minute charge to access the Internet. Broadband purchase is being delayed not because the technology is too expensive, but because access to the extremely high quality New Zealand dial-up product is so cheap. As average information exchange usage is low, the point has not yet been reached for the majority of users whereby the amount of information transferred, or the portfolio of applications used, require the capabilities of broadband technologies. The benefits of faster exchange are not as yet sufficient to justify the additional costs, so the efficiency-maximising technology selection remains dial-up. This does not mean that these customers are not benefiting from Internet exchange – far from it, as New Zealanders are amongst the heaviest Internet-using populations in the OECD. Rather, the most efficient access technology choice with current levels of usage and applications remains dial-up. Indeed, encouraging use of broadband merely because it exists, in isolation from these productivity considerations will actually lower productivity if the benefits are not valued in excess of the additional costs.

However, the very low levels of both business and residential information transfer revealed in this study are a factor of significant concern. The median monthly information exchange for residential users is less than 1000Mb, and even the average amount of transfer by customers of the package with a 5000Mb monthly allowance is less than 1500Mb. This implies that overall; there is a shortage of applications from which New Zealand users derive productivity or utility benefits. This is quite clearly a demand-side problem that infrastructure regulation is impotent to address. Furthermore, it may not be a New Zealand specific factor. It is a problem that has been identified already in the United States market. For example, Ferguson identifies low United States broadband uptake as 'The United States Broadband Problem'[1], and Haring *et al.* observe "we would put our chips on demand rather than supply constraints, and on the relative paucity of applications as being the main 'culprits' restraining take-up"[2].

The New Zealand data, without a significant cable product, have enabled analysis of broadband uptake independent of the distortions that bundled content and infrastructure packages such as cable TV content and cable Internet access introduce in other jurisdictions. This analysis therefore adds insight to wider broadband uptake 'problems' identified in other jurisdictions. Combined with the comparative absence of overt regulatory intervention that has prevailed New Zealand country throughout the development of the Internet and broadband access technologies[3], this unique

[1] Ferguson, Charles. *The United States Broadband Problem: Analysis and Policy Recommendations.* Brookings Working Paper May 31, 2002.

[2] Haring, John; Jeffrey H. Rohlfs and Harry M. Shooshan. 2002. *Propelling the Broadband Bandwagon*. Bethesda, Maryland: Strategic Policy Research. http://www.oftel.gov.uk *op. cit*. p 76.

[3] Boles de Boer, David; and Lewis Evans. The Economic Efficiency of Telecommunications in a Deregulated Market: the Case of New Zealand. *Economic Record* 72(216), 1996, 24-39; extended in Howell and Obren. (2002). *Broadband Diffusion: Testing for Vintage Capital, Learning by Doing, Information Barriers and Network Effects.* ISCR Research Paper. http://www.sicr.org.nz.

infrastructure, applications and regulatory environment provides an interesting counterfactual from which other OECD countries may learn[4].

From a policy perspective, as the 'problem' of low broadband uptake appears to be a demand-side rather than a supply-side problem in New Zealand, the real challenge lies in identifying ways of stimulating demand in a productivity-enhancing manner. Whilst creating awareness of the benefits of existing applications may overcome information barriers and enable latent productivity gains from existing applications, the real benefits lie in stimulating the creation of new productive uses for Internet information exchange. It is far from clear that infrastructure-focused thrusts such as LLU can address this problem satisfactorily, and may indeed be damaging if the objective becomes meeting a predefined a technology penetration statistic rather than focusing on productivity improvements. Furthermore, there needs to be clarity whether the greatest productivity gains from ICTs will arise from Internet-based solutions, which focus on productive information transfers between discrete entities or locations, or the productive use of information within these entities, which does not require information transmission via the Internet.

The New Zealand broadband market has, within the existing frameworks, delivered a competitive environment with resources focused upon encouraging productive use of the technology. It is debatable that there is any 'supply-side' problem that needs fixing, and supply-side intervention in a single broadband technology (telephony) at this point may jeopardise the competitive balance and significant benefits that this market has already delivered by threatening the financial viability of alternative technology platforms that are more capable of servicing topographically challenging areas than the telephony-based product.

The conclusions of this paper strongly advocates that the more significant productivity gains from the use of the Internet stand to be derived from demand-side application development and use rather than supply-side infrastructure supply development, especially in a market where it is far from clear that there are any significant supply-side problems.

4 Howell and Obren (2002) *ibid.*

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Introduction

Broadband Internet access technologies are widely acknowledged as the frontier digital communications access technology[5] of the 'Information Economy' due to the faster transmission speeds and greater information transfer capacities that they offer. Thus, development of broadband access infrastructures has been given increasing prominence in the communications policies of the majority of OECD countries[6], based upon the presumption that advanced communications technologies are of critical importance in boosting productivity growth and thus increasing welfare[7]. The widely-accepted premise has been that "the current bottleneck to growth in the communications sector, and beyond for areas such as electronic commerce, is the limitations of local access networks" as "there is usually one, or at best two, networks passing most homes and businesses in OECD countries"[8]. This presumption has spawned a host of policy and regulatory interventions across the OECD focused upon freeing up the perceived bottlenecks and laying the foundations for expansion and uptake of the broadband technology platforms that are perceived as "a significant harbinger and bellwether of future economic prospects"[9].

The OECD acknowledges that infrastructure availability and access alone is insufficient to ensure that the promised economic and social benefits ensue. "Having the equipment and networks alone is not enough to derive economic benefits. Other factors, such as the regulatory environment, the climate for trust and security in a digital economy, the availability of appropriate skills, the ability to change organizational set-up, as well as the strength of accompanying innovations in ICT applications, also affect the ability of firms to seize the benefits of ICT"[10]. Nonetheless, whilst there is no simple metric via which to measure a country's potential to reap the economic and social benefits of the Internet generally, and broadband networks in particular[11], a general consensus has emerged that the rollout of broadband access in OECD countries provides a 'litmus test' of the potential to reap the promised economic and social benefits in the future. Underpinning this

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[5]The Internet is presumed to be a General Purpose Technology (as defined by Helpman, Elhanan and Manuel Trajtenberg. 1996. *Diffusion of General Purpose Technologies.* National Bureau of Economic Research Working Paper 5773. http://www.nber.org/papers/w5773) and broadband technologies the current frontier in Howell, Bronwyn and Mark Obren. 2002 *op. cit*.;
See, for example, OECD. Working Party on Telecommunication and Information Services Policies. 2001. *The Development of Broadband Access in OECD Countries*. Paris: OECD paper DSTI/ICCP/TISP(2001)2/FINAL p 4; and NOIE. 2000. *E-Commerce Beyond 2000. Final Report.* Canberra: DOCITA pp 1-12.
[7] OECD Working Party on Telecommunication and Information Services Policies. 2002. *Broadband Access for Business.* Paris: OECD paper DSTI/ICCP/TISP(2003)3/FINAL pp 4-5.
[8] OECD (2001) *ibid* p 4.
[9] Haring, et al. (2002) *op. cit*. Executive Summary.
[10] OECD Meeting of the OECD Council at Ministerial Level. 2003. *Seizing the Benefits of ICT in a Digital Economy*. Paris: OECD. p 11.

consensus is the presumption that infrastructure availability stands as the necessary component enabling access to the promised benefits[12]. Without infrastructures, the benefits of Information and Communication Technologies (ICTs) cannot ensue, and impediments to making infrastructure widely and cheaply available are presumed to be the underlying cause of the perceived bottlenecks delaying benefit accrual in some economies.

To this end, the OECD continues to emphasize the relative importance of access to broadband infrastructures, and to stress that "the most fundamental policy available to OECD governments to boost broadband access is infrastructure competition"[13]. The OECD's ideal environment for boosting broadband access is one of multiple competing broadband infrastructures, owned by legally separate entities, as "the countries with alternative infrastructure available to business users are developing broadband access much faster than in those markets where there is only one, or at best two, platforms available to provide broadband access"[14] and there is evidence that common ownership of competing platforms is strongly correlated with slower rollout of broadband platforms[15]. Regulatory intervention such as unbundling local loops and mandatory line sharing are seen as tools that will "open up the networks of players in dominant positions to competitive forces"[16] as a stepping-stone on the path towards full facilities-based competition[17]. The corollary of this is that if full facilities-based competition already exists as espoused in the OECD's 'ideal' environment, then intervention for the purpose of 'unplugging the bottleneck' is unnecessary, as access bottlenecks should not exist in such competitive environments. If the business case for purchase and use of the technology exists, then there will be no longer any impediments to accessing it for these productive purposes.

Thus it is apposite, in advance of the New Zealand Commerce Commission's pending decision upon whether to recommend mandatory Local Loop Unbundling (LLU) as allowed under section 64 of the Telecommunications Act 2001, to examine the state of New Zealand's broadband infrastructure market. Despite the fact that the OECD identifies New Zealand as one of the leading nations in the uptake of ICTs ("some countries lead in the uptake of ICT on almost every indicator, notably the

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[11] See Appendix 1.
[12] OECD. 1997. *Measuring Electronic Commerce*. Paris: OECD.
[13] OECD (2001) *op. cit.* p 4.
[14] OECD (2002) *op. cit.* p 4.
[15] OECD (2001) *op. cit.* p 19.
[16] OECD (2001) *op. cit.* p 4.
[17] Shelanski, Howard A. Competition and Regulation in Broadband Services. Chapter 8 in Crandall, Robert W.; and James H. Alleman (eds). 2002. *Broadband: Should We Regulate High-Speed Internet Access?* Washington, D.C.: AIE-Brookings Joint Center for Regulatory Studies. p 175

United States, Canada, New Zealand, Australia, the Nordic countries and the Netherlands")[18], a widespread perception persists that New Zealand is failing in its ability to capitalise upon the promises and benefits of ICTs[19]. This perception arises as, despite its high level of uptake of other ICTs, New Zealand's penetration of broadband connections as a proportion of the population is low by OECD standards[20].

This paper examines the nature of the Internet market generally in New Zealand, and the specific availability and use of broadband Internet access, in relation to infrastructure availability and pricing. New Zealand's position is compared to other OECD countries in order to assess the country's relative performance, and hence its relative ability to capitalise upon the promises of an "Information Economy".

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[18] OECD (2003) *op. cit.* p 10.
[19] For example, Chris Barton's article in the New Zealand Herald 16 Apr 2003
[20] New Zealand Commerce Commission. April 2003. *Telecommunications Act 2001: Section 64 Reviews Into Unbundling The Local Loop Network and the Fixed Public Data Network: Issues Paper.* Wellington: Commerce Commission. http://www.comcom.govt.nz p 101.

Methodology

For the purposes of this analysis, it is presumed that the Internet is a General Purpose Technology (GPT), and broadband technologies, as the most capable, represent the current frontier of Internet access technologies[21]. This is consistent with the OECD framework for measuring the benefits of Electronic Commerce, which is neutral in respect of the access technology used[22].

The subsequent analysis presumes that the Internet GPT provides transportation of digitised data between points, much as a trucking firm transports physical goods. The digitised data is constructed and consumed at the end points, independent of the trucking mechanism. Digitised data will be moved only if there is a demand for transport, determined by the construction and consumption processes. Thus, 'available' infrastructure will be utilised only if there is a product to be moved. Whilst it is acknowledged that in some instances, if transportation does not exist, a product will not be constructed, even if consumption demand exists at the other end, if transportation capability exists and it is not utilised, then it is presumed that products requiring transport do not exist, as there is not a demand for them that makes production economically viable.

In the transportation analogy, narrowband and broadband technologies represent trucks of two differing speeds and capacities within the Internet GPT. One (broadband) is merely faster and more capacious than the other (narrowband). The decision of which transportation mechanism to use is influenced by availability in the first instance, but in the presence of choice the infrastructure that yields the most efficient outcome is the one selected. If speed and volume are necessary, then the faster technology is purchased, but where either will suffice, the faster technology will be purchased only if the benefits it offers outweigh the additional costs associated with the faster speed and greater volume.

Thus, the market for all Internet access technologies represents an interaction of supply of information transportation infrastructures of various types that enable access to occur, and demand for that access underpinned by the demand for applications that require the capabilities of the access

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[21] Helpman E. and Trajtenberg M. (1996) *Diffusion of General Purpose Technologies*. National Bureau of Economic Research Working Paper 5773.
http://www.nber.org/papers/w5773

[22] OECD (1997), (2003) *op. cit*.; Colecchia, Alessandra. *Defining and Measuring Electronic Commerce: Towards the development of an OECD methodology*. Conference on the Measurement of Electronic Commerce, Singapore 6-8 December 1999.

technologies[23]. Purchase and use of Internet access infrastructures is a combination of infrastructure supply and user demand. User demand is a derived demand determined by the applications that Internet access users employ. In turn, demand for these applications is determined by the benefit users derive from the application[24]. Business users will employ an application and purchase the required Internet access if use of the application increases business profit. Residential consumers will employ an application and purchase the required Internet access if use of that application raises the consumer's utility within the consumer's budget constraint.

Whilst absence of infrastructure availability stands as a barrier to gaining potential profits and increasing individual utility, if infrastructure availability is not a constraint, then the decision to purchase Internet access becomes purely one of the ability to increase either profits or individual utility. Failure to purchase access where there is no availability constraint implies that there is no productivity or utility gain available. This may be because either applications exist but the benefits available at the current prices are insufficient, or that applications which offer productivity or utility gains are not available[25]. Moreover, users will substitute the frontier technology (i.e. broadband) for the existing technology (i.e. narrowband) when the productivity benefits of the frontier technology exceed those of the current technology[26].

In addressing these issues, the analysis examines all facets of the New Zealand broadband market that influence the ability for supply of, and demand for, the technology to interact. The analysis embraces the extent to which New Zealanders use the Internet generally and the applications that characterise Internet use, as this determines whether there is a base level of demand for digital data transport (i.e. is there a cargo to transport?). It then examines the supply-side availability of broadband infrastructures, the speeds of these technologies and the prices at which these technologies are made available to users (i.e. are there enough trucks of the appropriate size and price available?). Next, it examines the extent of purchase and use of broadband Internet access as a reflection of the interaction of supply and demand factors (i.e. how well are the existing trucks actually being used?). This analysis exposes a dilemma: despite very high levels of Internet use generally, desirable market conditions including wide availability of, and comparatively low prices for, broadband Internet access, New Zealand penetration of this technology is poor compared to the

[23] Crawford, David W. 1997. Internet Services: A Market for Bandwidth or Communication? Chapter in McKnight, Lee W.; and Joseph P. Bailey (eds). *Internet Economics*. Cambridge, Massachusetts: Massachusetts Institute of Technology. p 380.

[24] Howell and Obren (2002) *op. cit.*

[25] For a full discussion of this analogy, see Howell, Bronwyn. 2003. *'Solving' the Broadband 'Problem': a Challenge for Regulators or Producers?* Wellington:ISCR Research Paper http://www.iscr.org.nz

rest of the OECD. On first blush, this anomaly appears quite counter-intuitive, given New Zealand's reputation as an early adopter and extensive user of the Internet. The paper proceeds to explore this dilemma using a detailed analysis of the demand-side substitution decision that underpins progression to more capable technologies within the GPT framework. Finally, the analysis uses these findings to draw some conclusions about the ability and desirability of policy interventions to 'redress' this 'problem'.

The Primary Data

The primary New Zealand data used in this analysis come from the ISCR Telecommunications Database. This database contains connection and utilisation information from New Zealand's incumbent telecommunications company (Telecom New Zealand Ltd.) that provides in excess of 96% of local telephony connections, the largest Internet Service Provider (Xtra), which has in excess of 50% market share, and the longest-serving broadband provider (CityLink), which has been providing broadband Internet access since 1996.

The Telecom data provide connection and utilisation information on all Digital Subscriber Line (DSL) broadband connections by business and residential categories, and by geographic region. DSL has in excess of 90% market share of the broadband market in New Zealand[27]. The data also contain usage figures of the dial-up Internet traffic network IPNet, which manages all dial-up Internet traffic originating and terminating on the 96% of local access lines that Telecom manages. This is presumed to be a close approximation of the entire national consumption for dial-up Internet use, given the very large market share. Telecom DSL usage data are thus presumed to be population usage totals for both dial-up and DSL.

The Xtra data provide counts of the number of dial-up and DSL ISP accounts of the country's largest ISP. As Xtra has over 50% market share in both the business and residential markets, it is presumed that Xtra's customer base is indicative of the wider New Zealand ISP market. National dial-up ISP account numbers are estimated by applying Phoenix Research market share estimates to the Xtra account base. The Xtra data also provide sample months of residential DSL user application bases, which are presumed to be indicative of all residential DSL usage.

[26] Howell and Obren (2002) *op. cit.*
[27] Extrapolating between reported penetration figures provided by each of the broadband providers, and Phoenix Research.

The CityLink data provide usage and survey data from longstanding and experienced (‘mature’) business broadband users of an Ethernet LAN network. These data provide a point of comparison between the observed patterns from the DSL market, and information of actual and projected application usage by some of the world’s most experienced broadband users.

The population-based nature of the data in the ISCR database enables comprehensive analysis of technology uptake and utilisation based upon Statistics New Zealand’s counts of population, households, significant business enterprises and significant geographic business units. The ensuing numbers are hence actual penetration and usage rates based upon total customer and account numbers, rather than the survey data that is commonly provided to measure the extent of uptake and usage of specific technologies.

The numbers contained in this analysis (with the exception of the CityLink survey) are presented with the confidence that they are an accurate portrayal of the real situation in New Zealand, as they are not subject to sampling bias or the uncertainties associated with self-selection of respondents to voluntary surveys. Where there is any doubt about the extent of a statistic, the analysis takes a conservative approach. Specifically, the classification of business and residential customers of Telecom is based upon Telecom’s database of businesses, which records some 100,000 fewer businesses than Statistics New Zealand’s 280,000 significant business enterprises. The 100,000 discrepancy implies that a significant number of small businesses by Statistics New Zealand’s definition may be purchasing dial-up and broadband services as residential Telecom customers. Thus, business penetration levels, measured using Telecom’s classification, but calculated using Statistics New Zealand’s business classification, represent a ‘least possible penetration level’, as the real penetration levels will be greater, but to an unknown extent.

International comparisons in this analysis wherever possible use data sourced from official reporting sources, such as the OECD, the Office of Telecommunications (Oftel) in the United Kingdom, the Federal Communications Commission (FCC) in the United States and the National Office for the Information Economy (NOIE) in Australia. This approach is taken to ensure the authenticity and consistency of the figures for comparative purposes. However, it is noted that in some instance even these data rely upon sampling processes. Whilst this makes absolute comparison difficult given the population-based approach of the ISCR analysis, as survey data is more prone to error, the very positive comparison yielded by the New Zealand data even on this conservative basis serves to further reinforce the extent of New Zealand’s strong comparative position with other countries as displayed in the following analysis.

Evidence from the New Zealand Internet Access Market

As the Internet is a GPT, and broadband technologies merely one form of access to the GPT from which benefit is generated, then broadband and narrowband Internet access are substitutes for each other in the market for digital information transfer. Hence, an understanding of the market for broadband services requires an understanding also of the market for all Internet access technologies, including broadband's forerunner narrowband access.

Empirical evidence in the New Zealand market supports the contention that the broadband Internet access purchase decision is a productivity-based substitution determined by a combination[28] of the relative prices of the two technologies (both fixed and variable)[29], the user's valuation of time[30], and the number of productivity-enhancing information exchanges that the user undertakes (generated by either access to multiple applications, or multiple uses of a single application)[31]. This decision is conditioned by the availability of infrastructure, but is nonetheless the result of the intersection of supply and demand.

Howell and Obren find that at the prices of each technology in New Zealand, where low-risk flat-rate dial-up pricing structures are the preferred method of initial access to the Internet (80% of ISP accounts are effectively 'flat-rate' plans – greater than 150 hours per month), learning-by doing is the most significant determinant of the point at which a user will substitute broadband for dial-up. Upon gaining access to the Internet, the user accumulates learning about the applications that offer productivity enhancements, and uses them increasingly to the point that it becomes more productive to substitute to broadband, determined either by the user's value of time, or by the data exchange requirements becoming too great to be serviced by a dial-up connection. Given the predominant user choice of flat-rate plans, broadband infrastructure providers are limited in their ability to influence the point of substitution to either varying their access prices relative to dial-up, or by inducing the user to adopt more applications that either increase the demand for information transfer, or require the greater information transfer capacity of broadband (e.g. video streaming).

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[28] Howell and Obren (2002) *op. cit.*

[29] Hausman, Jerry. 2002. Internet-Related Services: The Results of Asymmetric Regulation. Chapter 7 in Crandall, Robert W.; and James H. Alleman (eds). 2002. *Broadband: Should We Regulate High-Speed Internet Access?* Washington, D.C.: AIE-Brookings Joint Center for Regulatory Studies.

[30] Varian, Hal. 2002. The Demand for Bandwidth. Chapter 4 in Crandall, Robert W.; and James H. Alleman (eds). 2002. *Broadband: Should We Regulate High-Speed Internet Access?* Washington, D.C.: AIE-Brookings Joint Center for Regulatory Studies.

[31] Bailey, Joseph P. 1997. The Economics of Internet Interconnection Agreements. Chapter in McKnight, Lee W.; and Joseph P. Bailey (eds). *Internet Economics.* Cambridge, Massachusetts: Massachusetts Institute of Technology.

The point at which a user substitutes broadband for dial-up, and hence the characteristics of the broadband market in New Zealand, are thus determined in large part by the usage characteristics of the dial-up Internet market. Consequently, it is necessary to gain a detailed understanding of the Internet access market in general, and the dial-up Internet access in particular, to gain a detailed understanding of the broadband Internet access market in New Zealand, as the two are interdependent.

Whilst much policy emphasis has been placed upon encouraging growth of broadband penetration, if the benefits of digitised information exchange are already being accrued from dial-up infrastructures, then the substitution to broadband will occur as soon as the productivity trade-off determines that it is more efficient to substitute to that method of access. If substitution to broadband is not occurring, imperfections in the broadband market are not the only possible explanation for observations of low broadband pennetration. It is equally possible that substitution delays are occurring because there are underlying imperfections in the dial-up market that are delaying the substitution decision, insufficient applications-based learning has occurred to date or that there are insufficient productivity-enhancing application usages as yet to justify the substitution, at the prevailing prices, for the vast majority of Internet users. Whilst manipulating prices may bring forward the point at which the substitution occurs, ongoing sustainable productivity gains will occur only as a result of increasing productivity-raising usage.

The justification for any regulatory intervention in the market for broadband services (such as LLU) requires an understanding of which of the causes is responsible for low levels of broadband purchase. Regulatory intervention in the market for access (trucks and roads) will solve the problem only if there is in fact a bottleneck arising from a shortage of infrastructure (trucks and overly small roads). Moreover, it is not economically reasonable to expect all users of the road to be driving Mack trucks and Ferraris if loads are small and the most frequent trip is to the local store for a newspaper and milk. Pursuing a penetration-based measure in isolation of the productivity-based justifications for purchasing the technology runs the risk of investing too soon, thereby decreasing overall productivity. As with any investment strategy, optimal accrual of the benefits of broadband requires the timing of investment in all necessary components (infrastructure, applications, user learning, etc.) to be co-ordinated. Investing too soon in an expensive technology in advance of the additional requirements being available may result in costly assets lying underutilised while capability in the complements is acquired, with associated declines in productivity[32]. These outcomes are very real possibilities when pursuit of one metric (biggest, fastest, newest) is pursued in isolation from the other contextual elements.

1. New Zealand Exhibits OECD-leading Internet Penetration, Utilisation

This section examines evidence from the New Zealand market to determine whether there is any evidence of a market failure in either of the markets for Internet access or broadband access. In the event of no such evidence being found, then the remaining conclusion is that there is an absence of productivity-raising demand for the technology that cannot be addressed by intervention in the markets for infrastructure.

The ability of a country to generate economic benefit from the use of information transport lies in the technology-agnostic ability of individuals and businesses to access and productively employ information exchange. Information exchange may occur over a variety of mechanisms (e.g. person-to-person, computer-to-computer, person-to-computer) and media (e.g. smoke signals, voice, paper, digital). The principal mechanism of widespread and flexible digital information exchange is the Internet. Compelling evidence exists that New Zealanders are amongst the earliest adopters and most prolific users of both computer and Internet applications in the OECD. This indicates that to date there is little evidence of widespread failures of investment in the underlying infrastructures to enable information exchange and consequent economic benefit creation via the Internet.

1.1 Dial-Up Internet Infrastructures

New Zealand has a record of being one of the heaviest-investing countries in Information and Communications technologies (ICTs) in the OECD. New Zealand has recorded the highest percentage of GDP spent on ICTs in the OECD consistently over the period from 1996[33]. This is reflected in very high levels of investment in all technologies, from the underlying telephony infrastructures through to computer ownership and usage to Internet access.

Telecommunications infrastructures provide the basis for the earliest means of Internet access – dial-up access based upon modems. However, data transport requires digital telephony infrastructures[34].

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[32] Jovanovic, Boyan and Dmitriy Stolyarov. 2000. Optimal Adoption of Complementary Technologies. *The American Economic Review.* 15-29.
[33] SourceOECD Science and Technology database.
[34] Economides, Nicholas. 2003. *US Telecommunications Today*. Forthcoming in Brown, Carol V., and Heikki Topi (eds) *IS Management Handbook.* Baton Rouge, Florida: Auerbach Publications.

Much of New Zealand's high levels of ICT investment have been applied to improving and developing the telecommunications infrastructure, as evident in the current state of this infrastructure relative to that of other OECD countries. In 1993, New Zealand with 95% led the OECD in digitisation. This compares to Australia with 40%, the UK 75% and the US 85% at the same date. New Zealand became the fourth country in the OECD to have a fully digital network (after France, Luxembourg and Iceland) in 1997. Australia did not reach this milestone until 1999, at which stage the US level had reached only 94%[35]. By 2001, the United States had achieved only 97% of digital access lines, whilst only 88% of Korea's telephone lines were digital and the OECD average stood at 97%[36]. The current high quality levels and wide availability of both dial-up and broadband telecommunications networks in New Zealand are a reflection of the levels of historic investment that have occurred. Whilst it is acknowledged that service quality and availability are in some instances restricted by geographical factors, given the challenging topography of the country and the low population density relative to many other OECD countries[37], New Zealanders on average enjoy access to state-of-the-art telecommunications infrastructure not offered universally in other larger countries with much higher populations and more conducive topography. Furthermore, New Zealanders have been enjoying these higher-quality services for much longer than their foreign counterparts due to early implementation.

New Zealand was also one of the first OECD countries to have widespread commercial access to the Internet. Academic access to NZGate began in 1989, and was extended to full commercial availability in 1992[38]. A highly competitive Internet Service Provider (ISP) market emerged and early adoption of dial-up access by both commercial and residential users ensued[39]. At February 2003, using Statistics NZ household and population numbers[40] (as opposed to survey figures) and dial-up account numbers from Xtra[41] extrapolated using Phoenix Research market share numbers[42], New Zealand exhibits a dial-up penetration of 60 accounts per 100 households, or 21.4 per 100 population at March 2003 (Figure 1).

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[35] OECD (2001a) *op. cit*. p. 89.
[36] OECD. 2003a. Communications Outlook 2003. Paris: OECD. p 109
[37] Alger, Dan, and Joanne Leung. 1999. *The Relative Costs of Local Telephony Across Five Countries*. ISCR Research Paper. http://www.iscr.org.nz/research/
[38] Brownlee, Nevil. 1997. Internet Pricing in Practice. Chapter in McKnight, Lee W.; and Joseph P. Bailey (eds). *Internet Economics*. Cambridge, Massachusetts: Massachusetts Institute of Technology.
[39] Enright, Christina. 2000. *Strategic Behaviour of Internet Service Providers in New Zealand*. Wellington: ISCR http://www.iscr.org.nz/research/
[40] Statistics New Zealand population and household tables, http://www.statistics.govt.nz
[41] Source: Xtra
[42] Phoenix Research. 2003.

Figure 1. Dial-Up Market

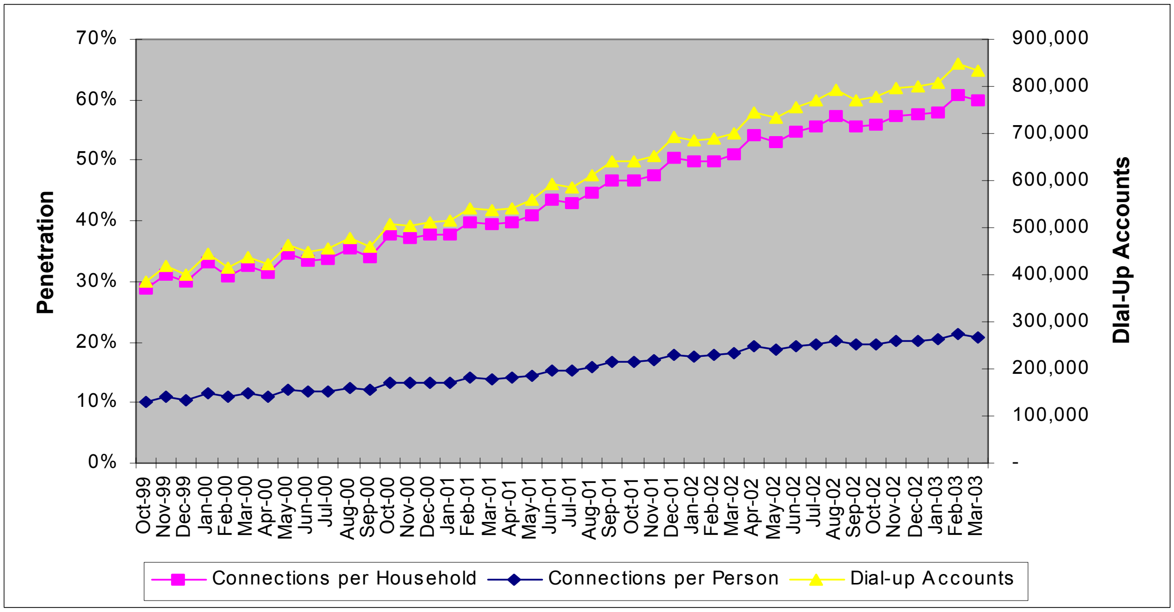
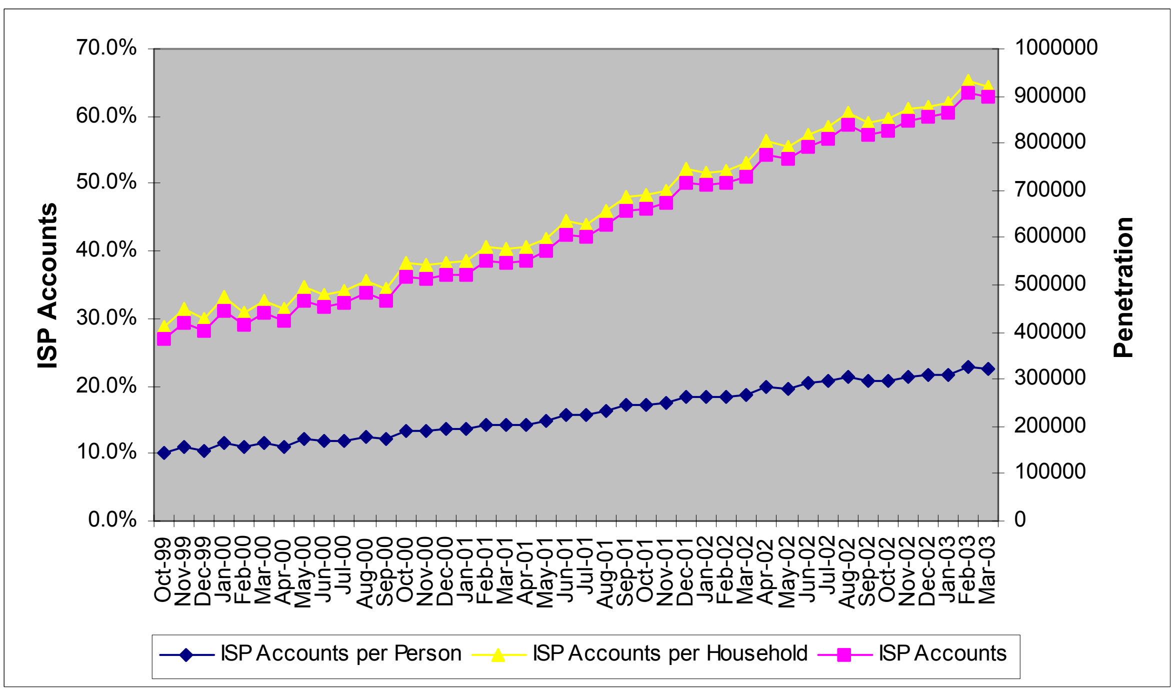


Figure 2. ISP Accounts



Moreover, when DSL accounts are added to dial-up accounts, New Zealand exhibits a low-end estimate of total ISP account penetration of 65 accounts per 100 households and 23 accounts per 100 at March 2003 (Figure 2). This compares with the latest OECD figures at December 2001, which shows Australia with 21.9 per 100, the United Kingdom at 22.7, the United States at 27.2 and South

Korea at 48.8[43]. New Zealand's comparable statistic at this date was 18.5 per 100, or 14th in the OECD.

The New Zealand dial-up access product is of very high quality compared to United States offerings, with an average speed of 46.3kbps compared to IBM (45.7), MCI (44.7), TDSNet (35.2) and WebUSA (32.8)[44]. It is likely that this high quality is a consequence of New Zealand's early telecommunications digitalisation programme. This high-speed capability, combined with generous allocations of nodes per customer at the ISP level, ensures that the average dial-up customer receives a service that averages around 10kbps at peak times[45].

The highly competitive ISP market has ensured that New Zealand has enjoyed early innovation and low prices for Internet access products and services. Rapid price reductions are catalogued in Enright (2000), along with New Zealand being one of the first countries (after the United States) to introduce unmetered ISP access packages. Currently approximately 80% of New Zealand dial-up customers[46] use unmetered[47] packages, compared to 48% in the UK[48], and the prices for these packages compare extremely favourably with the international benchmarks in Figure 3. Fierce ISP price competition has also been fuelled by the competitive behaviours of the two telecommunications companies Telecom and TelstraClear, principally with the emergence and subsequent demise of 'free' ISPs[49].

Wide availability and low prices of New Zealand dial-up services have been sustained over an extended period[50]. Recent developments in the market for dial-up type narrowband Internet access services include the introduction of SkyMail by Sky Television.

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[43] OECD (2003a) *op. cit*. p 137.
[44] Boardwatch Top 10 Dialup Internet Service Providers, April 2003.
[45] Based upon Xtra provisions (50% market share) - interview with Chris Thompson, May 8 2003.
[46] Based upon Xtra customers (50% of the market) as at March 2003.
[47] This paper follows the Oftel convention of pricing all packages that offer 150 hours or more per month Internet access for a fixed fee as 'unmetered'.
[48] Oftel. 2003. *Internet and Broadband Brief – January 2003*. http://www.oftel.gov.uk p 4
[49] Karel, Annemieke. 2003. *Free ISPs in New Zealand.* NZ ISCR Working Paper.
[50] Howell, Bronwyn and Lisa Marriott. 2002. The State of e-New Zealand: Implications for Economic Development. Chapter 14 in Gomez, Edmund Terence; and Robert Stephens (eds). 2003. *The State, Economic Development and Ethnic Co-Existence in Malaysia and New Zealand.* Kuala Lumpur: CEDER.

Figure 3. Comparison of Residential Dial-Up Internet Access Prices – Peak

Annual Prices in GBP, PPP as at August 2002

Country	ISP	Package	Connect-ion	Annual subscrip-tion	usage for 150 hours	total ISP	Annual fixed	usage for 150 hours	total PSTN	ISP+ PSTN charges
NZ	**Paradise**	**Paradise 150**	**0**	**134**	**0**	**134**	**0**	**0**	**0**	**134**
NZ	**Xtra**	**Xtra Daytime**	**0**	**164**	**0**	**164**	**0**	**0**	**0**	**164**
NZ	**Paradise**	**Paradise 250**	**0**	**178**	**0**	**178**	**0**	**0**	**0**	**178**
UK	Tiscali - UK	Tiscali Daytime	0	72	0	72	119	0	119	191
UK	NTL	128k Package	17	180	0	197	0	0	0	197
France	Noos	Noosnet Forfait Primo	47	161	0	208	0	0	0	208
US-CA	Speak Easy	56K Dial Up	0	128	0	128	100	0	100	228
NZ	**Xtra**	**Xtra ValuePack**	**0**	**230**	**0**	**134**	**0**	**0**	**0**	**230**
US-CA	Pacbell SBC	Yahoo! Dial Bundled Plan with SBC	0	137	0	164	100	0	100	236
US-CA	AT&T	Worldnet Service Plus	0	145	0	145	100	0	100	245
Sweden	Tele2	Tele2Internet Kabel	47	303	0	251	0	0	0	251
US-CA	XO	Consumer Dial - Unlimited Access Plan	0	154	0	154	100	0	100	253
Sweden	UPC	Chello	11	244	0	255	0	0	0	255
Germany	Tiscali - de	Tiscali DSL 500	40	215	0	256	0	0	0	256
UK	NTL	NTL:home internet service unlimited	0	120	0	120	137	0	137	257
US-Ohio	Speak Easy	56K Dial Up	0	129	0	129	129	0	129	258
US-CA	Qwest	Qwest DSL 256	71	188	0	259	0	0	0	259
US-Ohio	Qwest	Qwest DSL 256	72	190	0	262	0	0	0	262
US-Ohio	Ameritech	SBC Yahoo! Dial Bundled Plan	0	138	0	138	129	0	129	267
UK	Telewest	Blueyonder Surfunlimited	0	144	0	144	124	0	124	268
Germany	Prima	Com _easy	19	250	0	268	0	0	0	268
US - CA	AOL	Prepaid subscription	0	171	0	171	100	0	100	271
US - CA	EarthLink	EarthLink Unlimited Prepaid Deal	0	171	0	171	100	0	100	271
US - CA	XO	Consumer Dial - Unlimited Access Plan	0	171	0	171	100	0	100	271
Sweden	Telia	(Comhem) High speed internet IC 500	31	241	0	271	0	0	0	271
Sweden	Telia	Telia Gruppenanslutning Broadband	29	245	0	274	0	0	0	274
UK	Onetel	Unlimited hours plan	0	156	0	156	119	0	119	275
US-Ohio	AT&T	Worldnet Service Plus	0	147	0	147	129	0	129	275
UK	Virgin	Virgin.Net- 24seven	0	162	0	162	119	0	119	281
Sweden	Spray	ADSL Broadband	38	244	0	282	0	0	0	282
US-Ohio	XO	Consumer Dial - Unlimited Access Plan	0	155	0	155	129	0	129	284
UK	Freeserve	Freeserve AnyTime	0	168	0	168	119	0	119	287
US-CA	AT&T	WorldNet Service Unlimited	0	188	0	188	100	0	100	288
US-CA	MSN	Dial-up Access	0	188	0	188	100	0	100	288
US-CA	Pacbell	SBC Yahoo! Dial Service Plan	0	188	0	188	100	0	100	288
Sweden	UPC	Chello Plus	8	285	0	293	0	0	0	293
US-CA	EarthLink	EarthLink Unlimited	6	188	0	194	100	0	100	294
Germany	Arcor	Arcor ISDN Flat Rate 64	0	212	0	212	84	0	84	296
Sweden	Tiscali - se	Tiscali ADSL Bredband	32	265	0	297	0	0	0	297
Germany	Tiscali - de	Tiscali DSL time1000	40	258	0	298	0	0	0	298
UK	Tiscali - UK	Tiscali Anytime	0	180	0	180	119	0	119	299
US-Ohio	AOL	Prepaid subscription	0	173	0	173	129	0	129	301
US-Ohio	EarthLink	EarthLink Unlimited Prepaid Deal	0	173	0	173	129	0	129	301
US-Ohio	XO	Consumer Dial - Unlimited Access Plan	0	173	0	173	129	0	129	301
US-CA	AOL	Standard Plan	0	205	0	205	100	0	100	304
UK	BT	BT openworld Anytime	0	192	0	192	119	0	119	311
Sweden	Telia	(Comhem) High speed internet IC 1000	31	286	0	316	0	0	0	316
UK	NTL	512 Package	17	300	0	317	0	0	0	317
UK	Telewest	Blueyonder Broadband Internet	17	300	0	317	0	0	0	317
US - Ohio	Ameritech	SBC Yahoo! Dial Service Plan	0	190	0	190	129	0	129	319
US - Ohio	AT&T	WorldNet Service Unlimited	0	190	0	190	129	0	129	319
US - Ohio	MSN	Dial-up Access	0	190	0	190	129	0	129	319
France	Noos	Noosnet Forfait Presto	73	246	0	319	0	0	0	319
Germany	Arcor	Arcor DSL - Flatrate 128	6	316	0	322	0	0	0	322
France	Wanadoo	CableWanadoo	60	263	0	322	0	0	0	322
US - Ohio	EarthLink	EarthLink Unlimited	6	190	0	196	129	0	129	325
Sweden	Tele2	Tele2 ADSL	33	293	0	326	0	0	0	326
France	AOL.fr	Unmetered Service	0	212	0	212	114	0	114	326
US-CA	EarthLink	EarthLink The Works	0	231	0	231	100	0	100	331
US-Ohio	AOL	Standard Plan	0	207	0	207	129	0	129	335
Sweden	Telenordia	Telenordia ADSL Bredband	36	301	0	337	0	0	0	337
Sweden	Telia	Telia ADSL Broadband	33	306	0	340	0	0	0	340
UK	Pipex	Pipex Xtreme Solo	59	281	0	340	0	0	0	340
Germany	Tiscali - de	Tiscali DSL time2000	40	300	0	341	0	0	0	341
US-CA	Qwest	DSL Deluxe	71	274	0	345	0	0	0	345
UK	Demon	Express Solo	46	300	0	346	0	0	0	346
US-Ohio	Qwest	DSL Deluxe	72	277	0	348	0	0	0	348
US-CA	EarthLink	EarthLink High Speed Internet	0	360	0	360	0	0	0	360
US - Ohio	EarthLink	EarthLink The Works	0	233	0	233	129	0	129	362
US-Ohio	EarthLink	EarthLink High Speed Internet	0	363	0	363	0	0	0	363
Germany	Arcor	Arcor DSL - Flatrate 768	6	360	0	365	0	0	0	365
US-CA	Covad	TeleSurfer Link	47	325	0	373	0	0	0	373
US-CA	AT&T	Broadband Internet Value Package	12	361	0	373	0	0	0	373
US-Ohio	Covad	TeleSurfer Link	48	329	0	376	0	0	0	376

New Zealand residential consumers have also benefited from unmetered access to local telephony services via the Kiwi Share (latterly the Telecommunications Service Obligation). Combined with unmetered ISP access, this offers New Zealand residential consumers unlimited access to the Internet while accruing no additional usage charges once fixed access prices have been paid, and is considered to be instrumental in engendering very high levels of utilisation of the Internet[51].

Oftel benchmarking for unmetered dial-up packages is based upon prices for 150 hours of dial-up access a month. Figure 3 shows that three New Zealand packages offering 150 hours or more a month (Paradise 150 – 150 hours per month, Xtra Daytime (unlimited access except for 5pm-11pm) and Paradise 250 – 250 hours per month) are the cheapest in the Oftel survey. Xtra's unlimited package Xtra ValuePack price is bettered by only four products. Indeed, the cheapest New Zealand product, Paradise 150, is only 70% of the price of the cheapest Oftel-benchmarked product.

New Zealand's very low dial-up prices have led to extensive use of the Internet. New Zealand customers of Xtra are second after those of AOL in the United States in the number of hours per month spent 'on-line'[52]. Based upon total volumes of Internet traffic, as at February 2003, New Zealand's 850,000 active ISP account holders consumed an average of 34.5 hours each month on-line physically connected via the telephone network to the Internet[53]. It is noted that this figure is actual connection time. Perceived elapsed session times (as reported in market research surveys such as those of Gartner, Red Sheriff and NielsenNet) will be longer than this, as they include the time taken to connect and reconnect due to timing out, and processing time by the individual while the Internet session is timed out.

As a measure of the amount of information exchanged, this shows that New Zealanders are large consumers of information exchange via the Internet using dial-up access. Considerable application-based learning has been undertaken as a result of this extensive use of dial-up connections[54], and the maturity of the average New Zealand Internet user is confirmed by market research analysis showing that 69% of New Zealand users have more than 2 years Internet experience, 21% have between one and two years experience, and only 5% have less than 6 months experience[55]. It is noted, however, that consistent with Howell and Obren (2002), as consumers with more marginal information transfer needs join the Internet, the growth in average number of hours per month per ISP account is

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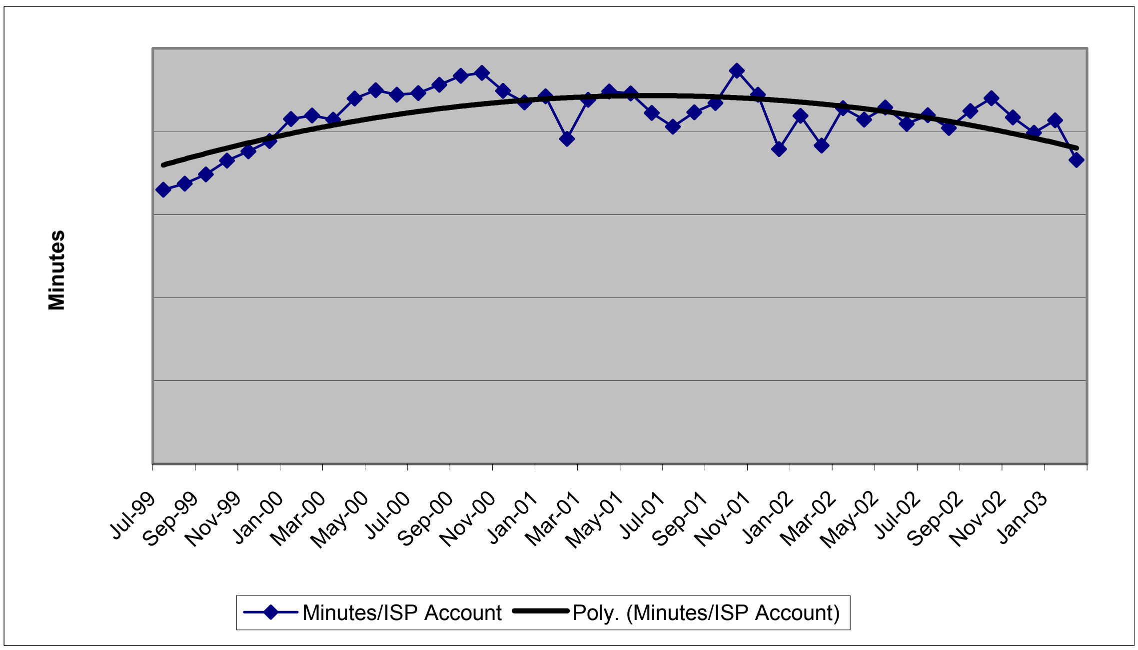
[51] OECD (2000) *op. cit.* p 8.
[52] OECD (2001) *op. cit*.
[53] Derived from Telecom and Xtra data – ISCR Telecommunications database.
[54] As per Howell and Obren (2002) *op. cit.*

levelling off, and is beginning to fall, as per Figure 4. This suggests a market that is approaching maturity, as the effect of mature dial-up users migrating to DSL and taking their large usage with them is currently small compared to the number of new dial-up users connecting (see Section 1.2 below).

Hence, there is substantial evidence reinforcing New Zealanders' extensive use of the Internet *per se,* and hence existence of the economic and social benefits that ensue from actual usage of digital information exchange.

Figure 4. Average New Zealand Dial-Up Internet Usage



[55] Phoenix Research. (2003) *op. cit*. Slide 15.

1.2 Broadband Infrastructures

Early provision and uptake of new technologies has also been evidenced in broadband services.

New Zealand became one of the first countries in the OECD to offer commercial broadband services when CityLink began Ethernet LAN services in 1996. Currently, six distinct broadband platforms exist:

- DSL - offered commercially by Telecom since January 1999; currently 85% of Telecom customers can access DSL services.
- Ethernet LAN – introduced by CityLink in the Wellington CBD; currently servicing in excess of 550 connections, including nearly all of New Zealand's Government departments, trading banks and insurance companies, several ISPs, schools, State-owned Enterprises, medical practices, a hospital, the local University and City Council, all of which are information transfer-intensive activities. This network was described by US commentator David Isenberg as one of the most impressive networks of its type in the world on his recent visit to Wellington[56].
- Fixed Wireless – first offered by Walker Wireless in the Auckland CBD in 2001, subsequently extended to include several suburban areas of Auckland, and the CBDs of Wellington and provincial centres Whangarei, Tauranga, Hamilton, Napier, Wanganui, Palmerston North, Christchurch and Dunedin, with future coverage planned in Rotorua, Taupo, Gisborne, New Plymouth, Hastings, Blenheim, Timaru, Queenstown and Invercargill; customer numbers are unknown, but the extent of current and planned regional coverage indicates significant investment to date and into the future (http://www.walkerwireless.com).
- Cable modems – first offered by Saturn Communications (now TelstraClear) in Wellington in 1999[57], subsequently extended to some areas of Christchurch in 2001 but with investment suspended in 2002[58]; predominantly a residential technology with 4500 customers in June 2002[59].

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[56] November, 2002, cited in Howell and O'Connell, 2003

[57] MED. 2001. *New Zealand Telecommunications 1987-2001: New Zealand Telecommunications Information Publication No. 8*. Wellington: Ministry of Economic Development Resources and Networks Branch. p 11

[58] presumably in anticipation of an unbundling adjudication by the Telecommunications Commissioner (Rosemary Howard, November 29, 2002; "We believe it's more industry efficient for TelstraClear to buy from Telecom rather than build duplicate networks to reach consumers who are widely spread throughout New Zealand." http://www.telstraclear.co.nz/companyinfo/media_release_detail.cfm?newsid=81&news_type=tclArchive);

[59] OECD (2002) *op. cit.* p 14.

- Interactive Satellite – provided by iHug since 1998; available nationwide; satellite download with dial-up upstream connection with 5000 customers in New Zealand in October 2002[60], representing approximately 8% of Telecom's DSL customer base at the same date, and more than the 4500 cable modem subscribers.
- Mobile broadband - offered by Telecom on the CDMA cellular phone network since 2002, with coverage over the entire Telecom Mobile network – approximately 95% of the country.

New Zealand thus exhibits active facilities-based broadband platform competition, with widespread availability. The best current estimate of market shares shows DSL technologies have approximately 90% market share and the competitors 10%. DSL's advantage appears to be derived from a combination of widespread availability, high quality service and low prices.

1.2.1 Broadband Availability

DSL is currently available to 85% of the country's telecommunications customers. This compares to 2002 availabilities of 65% in the United States, 67% in the United Kingdom and 85% in Australia[61]. Satellite and mobile services are available nationwide, and wireless services in the areas identified above. Cable is available in Wellington and some areas of Christchurch, whilst Ethernet LAN services are available in the Central Business Districts of Wellington and Auckland.

It is noted that due to technical restrictions, DSL is unfeasible for service provision at locations further than between 5 and 7 kilometres from the local exchange. Hence, it is currently an unsuitable option for many rural locations in New Zealand. Satellite, wireless and mobile telephony technologies provide alternatives in these locations for much of New Zealand. ihug claims national availability of its Ultra Satellite product, making it the broadband product with the most widespread coverage although it does require access to a fixed wire telephone service for the back-feed. Mobile telephony-based broadband services also have very wide coverage. Local initiatives (e.g. Southland, Wairarapa, Northland) are currently proceeding with wireless provision using a consortium of Vodafone, Walker Wireless and BCL as a viable rural broadband access solution.

Hence, there are very few areas of New Zealand where there is no broadband provision currently. Moreover, there is a choice of at least two platforms for most potential customers. Mobile telephony and satellite services provide a choice of platforms in areas where DSL coverage is not possible.

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[60] http://www.ihug.co.nz/news/articles/151002.html

Satellite and DSL are available to 85% of telephony customers[62]. Customers in the Wellington CBD have a choice of six platforms, in Auckland and Christchurch five, and in most provincial centres in New Zealand a choice of four platforms. Customers in suburban Wellington and Christchurch have a choice of four platforms. Such a level of platform choice is typically available only in large urban areas of the United States, as exhibited by the statistic that 35% of the US population cannot even access DSL. Extensive coverage with a variety of platforms given the low population density and difficult topography of the country reinforces that the high levels of spending on ICTs registered in New Zealand over the 1990s have translated into infrastructure investment and consequent widespread availability of a range of the most advanced broadband technologies available.

Thus, it is difficult to conclude that there is a widespread infrastructure investment and technology availability problem in New Zealand that requires 'fixing'. This is not to minimise the fact that there may be some very local provision problems in certain geographical areas in respect of some technologies, but this challenge is not unique to New Zealand, and is generally due to the limitations of technology and topography making investment in specific networks in some circumstances uneconomic.

1.2.2 Broadband Speeds

The standard ADSL service offered to both residential and business users is a guaranteed minimum of 2Mbps downstream and 250kbps upstream, with a slower symmetrical package offering 128kbps also available for residential consumers only[63]. Cable modem services offer two speeds: 256kbps downstream / 128kbps upstream and 2Mbps downstream/256kbps upstream[64], whilst Ethernet LAN services are available at speeds of 10, 100 and 1000 mbps. Mobile-based broadband services using CDMA technology achieve maximum speeds of 153kbps[65], whilst wireless services promise speeds up to 3Mbps downstream and 1Mbps upstream[66]. Satellite speeds are variable, with speeds over 1Mbps readily achievable from top sites, but as "a rule of thumb, you can expect to download data from popular sites at around 6 - 10 times faster than a standard modem"[67] – that is, around 256kbps to 400kbps based on New Zealand average modem service speeds.

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[61] OECD (2002) *op. cit.* p 32.
[62] Although it is noted that the technology currently used by iHug requires connection to a PC, and is therefore unavailable to users with Macintosh computers.
[63] http://www.telecom.co.nz/content/0,3900,200359-200546,00.html#20020481
[64] http://www.telstraclear.co.nz/products/internet/broadband
[65] http://www.telecom.co.nz/content/0,3900,202142-1487,00.html#20019589
[66] http://www.walkerwireless.co.nz/static/aboutthetrial.asp
[67] http://www.getultra.co.nz/sales/speed.html

In international terms, the New Zealand broadband services offer comparatively very high-speed services for residential consumers. Oftel benchmarking of European Union and United States broadband products classifies residential services as offering a minimum speed of 128kbps, but shows only one provider (Bostream, Sweden; 2.5Mbps upstream/750kbps downstream) as offering a faster residential broadband product than the standard New Zealand ADSL offering. The majority of residential services offer between 512 and 1500 kbps downstream speeds[68]. In respect of business offerings, Oftel categorises service speeds into low (minimum bandwidth 128kbps), medium (minimum 500kbps) and high (minimum 1000 kbps). Clearly, most of the New Zealand services targeted at business users (DSL, Ethernet LAN and wireless) sit within the high-speed Oftel classification. Only the mobile telephony product sits in the 'low' category. Only 14 of the 50 business products benchmarked by Oftel as "high" exceed the speed of the basic New Zealand DSL business offering[69].

Thus, New Zealand enjoys wide availability of very high-speed DSL broadband products compared to the European Union and the United States.

1.2.3 Broadband Prices and Usage

Benchmarking of broadband products where there is a wide variety of product quality is problematic. Comparisons are also difficult when flat-rate priced products are juxtaposed with products charging per megabyte of traffic. Furthermore, the United States-centric nature of the international Internet charging processes mean that New Zealand users must pay the costs of transportation both of traffic requested by New Zealanders from the United States and New Zealand sourced content requested from the United States. As over 85% of all Internet traffic consumed in New Zealand incurs this premium, benchmarking the price of transporting a specific piece of information worldwide is fraught with difficulty.

Nonetheless, some reliable benchmarking exercises have been undertaken. The OECD process weights the number of kbps per month that can be downloaded per US dollar. By this method, New Zealand's residential Jetstream packages ranked 2nd and 3rd in the OECD in 2001, within the caps applicable then of 400Mb and 600Mb respectively[70]. The unmetered and uncapped Telecom/Xtra

[68] Oftel (2002) *op. cit.* p 130
[69] *Ibid* p 133.
[70] OECD 2001 *op. cit.*

Jetstart product (no longer available – replaced with Jetstream Starter 5000 with a 5Gb cap) had the 3rd lowest monthly charge in this benchmarking.

The Oftel benchmarking process compares prices using a basket approach based upon market segment (business or residential) and product quality to rank the best-priced broadband products in the Sweden, Germany, France, the United Kingdom and the United States. Residential baskets are priced presuming a monthly traffic volume of 1.2Gb and a minimum bandwidth speed of 129kbps. Oftel's 'Business – Low' presumes 6Gb monthly at minimum bandwidth 129kbps,'Business – Medium' 9Gb at minimum 500kbps and 'Business – High' 16Gb at 1000kbps[71]. Oftel benchmarking prices the best 70 products in each category. Only in the 'Business-High' category are there fewer than 70 products available. Fifty products were priced in this category in August 2002.

1.2.3.1 Residential Broadband Prices

Inserting indicative New Zealand prices into the Oftel baskets as at August 2003 Telecom/Xtra's Jetstream Starter 5000, at 18th, is among the cheaper residential products offered (Figure 5), although it is the slowest. Nonetheless, it is priced significantly below the average Oftel-benchmarked price of £33.60, as are Telstra-Clear's Cable 500 product and Telecom/Xtra Jetstream Home 500, both of which impose a monthly cap of 500Mb. Telecom/Xtra Jetstream Home 1000 (1000Mb cap) is slightly above the average price, but when adjusted for the additional 200Mb of traffic used for the Oftel benchmarking, this product is comparatively expensive. Sweden appears to offer the overall cheapest residential broadband packages, with 10 of the 20 cheapest products being Swedish. Four in the cheapest ten are UK products, three German, two United States. Jetstream Starter 5000 is cheaper than the cheapest French residential package. It is noted that the majority of United States and UK DSL products, including those offered by incumbent telecommunications companies such as BT, AT&T, Verizon, Pacbell, Southwestern and Ameritech, are significantly (10%-55%) more expensive than the cheapest New Zealand products, with the Pacbell, Southwestern and Ameritech products all being more expensive than Jestream Home 1000.

71 Oftel (2002) *op. cit.* p 51

Figure 5. Modified Oftel Benchmarking: Broadband Residential

Rank	Country	ISP	Package	DSL/Cable Modem	Total Monthly Charges	Downstream capacity
1.	Sweden	Tele2	Tele2Internet Kabel	CM	21	512
2.	Sweden	UPC	Chello	CM	21	512
3.	US	Qwest	Qwest DSL 256	DSL	22	256
4.	Sweden	Telia	(Comhem) High speed internet IC 500	CM	22	512
5.	Germany	PrimaCom	_easy	CM	22	256
6.	Sweden	Spray	ADSL Broadband	DSL	23	512
7.	Sweden	UPC	Chello Plus	CM	24	768
8.	Sweden	Tiscali	Tiscali ADSL Bredband	DSL	24	512
9.	Sweden	Telia	(Comhem) High speed internet IC 1000	CM	26	1000
10.	UK	NTL	512 Package	CM	26	512
11.	UK	Telewest	Blueyonder Broadband Internet	CM	26	512
12.	Sweden	Tele2	Tele2 ADSL	DSL	27	512
13.	Sweden	Telenordia	Telenordia ADSL Bredband	DSL	28	512
14.	Sweden	Telia	Telia ADSL Broadband	DSL	28	512
15.	UK	Pipex	Pipex Xtreme Solo	DSL	28	512
16.	Germany	Tiscali	- de Tiscali DSL time2000	DSL	28	768
17.	Germany	Tiscali	- de Tiscali DSL time1000	DSL	28	768
18.	**NZ**	**Telecom-Xtra**	**Jetstream Starter 5000 (5000Mb per month)**	**DSL**	**29**	**128**
19.	UK	Demon Express	Solo	DSL	29	512
20.	US	Qwest	DSL Deluxe	DSL	29	640
21.	France	Wanadoo	CableWanadoo	CM	30	512
22.	Germany	Arcor	Arcor DSL - Flatrate 768	DSL	30	768
23.	**NZ**	**TelstraClear**	**Cable 500 (500 Mb per month)**	**DSL**	**30**	**256**
24.	**NZ**	**Telecom-Xtra**	**Jetstream Home 500 (500Mb per month)**	**DSL**	**31**	**2000**
25.	US	EarthLink	EarthLink High Speed Internet	CM	31	1500 *
26.	Germany	Arcor	Arcor-DSL flatrate 768	DSL	31	768
27.	France	Noos	Noosnet Forfait Rapido	CM	31	512
28.	US	Covad	TeleSurfer Link	DSL	32	200
29.	US	AT&T	Broadband Internet Value Package	CM	32	1440
30.	Germany	AOL	.de AOL High Speed DSL Flat (12months)	DSL	32	768
31.	UK	BT	Home 500 Plug & Go	DSL	32	500
32.	Germany	PrimaCom	_pro	CM	33	1024
33.	US	Comcast	High Speed Internet Service	CM	33	1500 *
34.	UK	Onetel	Unplugged 500	DSL	34	512
35.	Germany	Tiscali	- de Tiscali DSL 500	DSL	34	768
36.	UK	Freeserve	Connection-only pack	DSL	34	512
37.	UK	Freeserve	Freeserve Broadband	DSL	34	512
38.	**OFTEL**		**OFTEL Average**		**34.60**	
39.	UK	Pipex	Pipex Xtreme Home Office Std - Self	DSL	35	512
40.	US	AT&T	Broadband Cable Internet Service	CM	35	1440
41.	France	Club Internet	Pack Modem Haut Debit	DSL	35	512
42.	France	9 Telecom	9Online ADSL 512	DSL	35	512
43.	UK	Zen Internet	ZenADSL Home	DSL	35	512
44.	UK	Tiscali	- UK Tiscali ADSL USB 500	DSL	35	500
45.	US	Road Runner	Residential Service	CM	35	1500 *
46.	France	Wanadoo	Wanadoo ADSL (Xtense500)	DSL	35	512
47.	US	MSN	DSL	DSL	35	768
48.	US	Qwest	MSN Broadband Powered by Qwest 256	DSL	35	256
49.	Germany	AOL	.de AOL High Speed DSL Flat	DSL	35	1500 *
50.	Germany	T-Online	T-Online DSL Flat	DSL	35	768
51.	France	AOL	.fr AOL ADSL	DSL	36	512
52.	France	Tiscali	.fr Pack ADSL Tiscali Liberty Surf	DSL	36	512
53.	Sweden	Bostream	ADSL Private	DSL	36	2500 *
54.	UK	Onetel	Hard wired 500U	DSL	36	512
55.	US	Verizon	Online DSL Package 1 (Was Online DSL	DSL	37	768
56.	UK	BT	Home 500 Engineer assisted	DSL	37	768
57.	UK	Demon	Express	DSL	37	512
58.	Germany	Tiscali	- de Tiscali DSL time100	DSL	38	768
59.	**NZ**	**Telecom-Xtra**	**Jetstream Home 1000 (1000Mb per month)**	**DSL**	**39**	**2000**
60.	US	Southwestern	Basic DSL Internet Service up to 1500	DSL	40	1500 *
61.	US	Pacbell	Basic DSL Internet Service up to 1500	DSL	40	1500 *
62.	US	Ameritech	- SpeedPath 768	DSL	40	768
63.	US	AOL	.us High Speed DSL	DSL	40	1472
64.	US	Covad	TeleSurfer	DSL	41	608
65.	France	Nerim	Nerim Base	DSL	41	512
66.	France	Club Internet	Forfait Haut Debit (Net 1)	DSL	41	512
67.	Germany	NGI	NGI DSL Student	DSL	42	1024
68.	France	Wanadoo	Wanadoo ADSL 1	DSL	42	500
69.	US	Qwest	MSN Broadband Powered by Qwest	DSL	43	640
70.	US	EarthLink	EarthLink DSL	DSL	43	1500 *
71.	UK	Telewest	1MB Internet	DSL	43	1024
72.	US	Verizon	Online DSL Package 2 (Was Online DSL	DSL	44	1500 *
73.	Germany	NGI	NGI DSL Flat	DSL	44	1024
74.	US	AT&T	Single User ADSL - 608/128	DSL	45	608
75.	Germany	QSC	Q-DSL Home	DSL	45	1024
76.	**NZ**	**Telecom-Xtra**	**Jetstream1000 adjusted to 1200Mb**	**DSL**	**57**	**2000**

*All prices are calculated at PPP in UK£ based on tariffs valid at August 2002 * Denotes product of comparable quality to Jetstream*

When comparing residential Jetstream packages in the Oftel tables, it is stressed that ***the Jetstream product is the second best quality product ranked.*** Of the seventy cheapest residential products benchmarked, only Sweden's Bostream ADSL Private 2500kbps service is of higher quality. The next fastest residential products benchmarked are 1500kbps. This does not mean very high speed residential products are not offered in the markets considered – rather, it identifies that only one product of equal or higher quality than the Telecom product is among the cheapest 70 residential products in the five markets considered. At a monthly exchange volume of 1.2Gb, the combined fixed 1000Mb charge plus the additional usage of 200 Mb for Jetstream Home 1000 is priced at £57, nearly 60% more expensive than the 52nd-ranked Swedish Bostream product. However, for customers who remain within the 1000Mb cap, Jetstream Home 1000 is only marginally (8%) dearer than the unmetered Swedish product.

Thus, within limits of use, the New Zealand product compares very favourably with the only product of greater quality registered in the Oftel benchmarking survey. Indeed, of all the other products ranking ahead of Jetstream Home 1000, only five (Earthlink – USA, 24th; Comcast – USA, 32nd; Roadrunner – USA, 43rd); .de AOL – Germany, 47th; and Bostream) have speeds of 1500kbps or higher, and all are more expensive than Jetstream Home 500. Moreover, only .de AOL and Bostream are DSL products (both of these are more expensive than the OECD average) – the others are all cable products.

It is also noted that of the seventy residential products benchmarked by Oftel, only two (Germany's Tiscali DSL 500 and Tiscali Time 100 – both 768kbps products) are not sold as flat-rate unmetered packages. Per megabyte charging is undertaken in New Zealand due to the high costs of transporting data from its origin to New Zealand. Xtra figures[72] show that over 85% of Internet data consumed in New Zealand originates in the United States. The costs of transporting this data via the Southern Cross Cable are significantly greater than the costs experienced by United States consumers accessing the same data in the United States. Furthermore, due to Internet interconnection charging practices, New Zealand data transporters are unable to recover the cost of data transport provided by New Zealand servers to the United States or other foreign jurisdictions. New Zealand prices must include a component to cover this additional cost. Hence, the data transfer charges faced by New Zealanders are significantly greater than the prices faced by consumers in other countries who source their information predominantly from within their own country or common economic zone (European Union). The New Zealand charging practice has arisen partially

[72] Source: Xtra.

in an endeavour to ensure that consumers of international traffic pay the real costs that their information consumption incurs. Indeed, Paradise charges for additional traffic at two separate rates – 2c/Mb for national traffic, 20c/Mb for international traffic – in order to send the appropriate price signals to consumers with respect to these additional costs. This charging practice undoubtedly accounts for the higher price of the Jetstream Home 1000 package adjusted to match the 1.2Gb benchmark of the Oftel survey. Thus, ***New Zealand residential broadband prices are similar to US and European Union products of comparable quality, despite the data transfer cost disadvantage of having to pay for large volumes of data transmission from the United States via the Southern Cross Cable***.

1.2.3.2 Residential Broadband Usage

Availability, price and connection data alone tell only part of the story of intersection of supply and demand. In order to determine the real prices that New Zealand consumers are actually paying relative to their counterparts in the Oftel survey, it is necessary to consider the volumes of data actually transported. Xtra's Jetstream Starter 5000 provides the most generous Mb allowance of the New Zealand products benchmarked, at 5Gb a month. Paradise offers a similar product with a 10Gb cap. However, data from Xtra shows that even when there is a high unmetered data transfer allowance within the monthly fee, the volume of information actually transferred per Jetstream Starter account is very small. Figure 6 shows that more than 60% of the customers of this product actually consumed less than 1000Mb in the typical month examined. Eighty percent of these customers consume less than 2000Mb. Indeed, only 5% consumed more than the 5Gb allowed (0.3% consumed more than 10Gb). Average consumption per customer is 1500Mb per month, yet the median is only 700 Mb. Likewise, the average consumption per customer of Xtra's Jetstream Home 500 is 400Mb (median 200Mb) and Xtra's Jetstream Home 1000 800Mb (median 600Mb). These are the 'Extreme Users' of Figure 7, whose data exchange comprises predominantly peer-to-peer file exchange, file downloading and significant browsing such as required to support interactive gaming. The vast majority of residential usage is for low volume email and browsing[73] (Figure 8). Thus, the consumption of a few conspicuously heavy consumers masks the very low usage of the majority of broadband subscribers.

[73] Anderson, Ben; Caroline Gale; Mary Jones and Annabel McWilliam. Domesticating Broadband – what consumers really do with flat-rate, always on and fast Internet access. *BT Technology Journal* 20(1), 2002, 103-114.

Figure 6. Residential Broadband Usage – February 2003

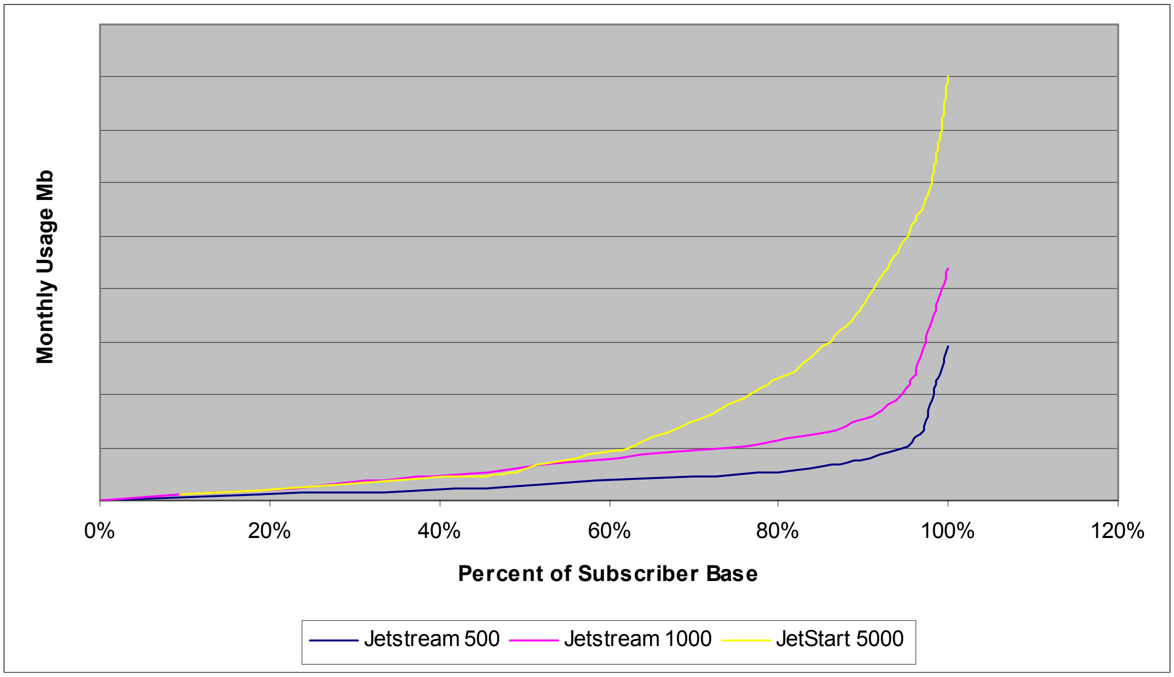
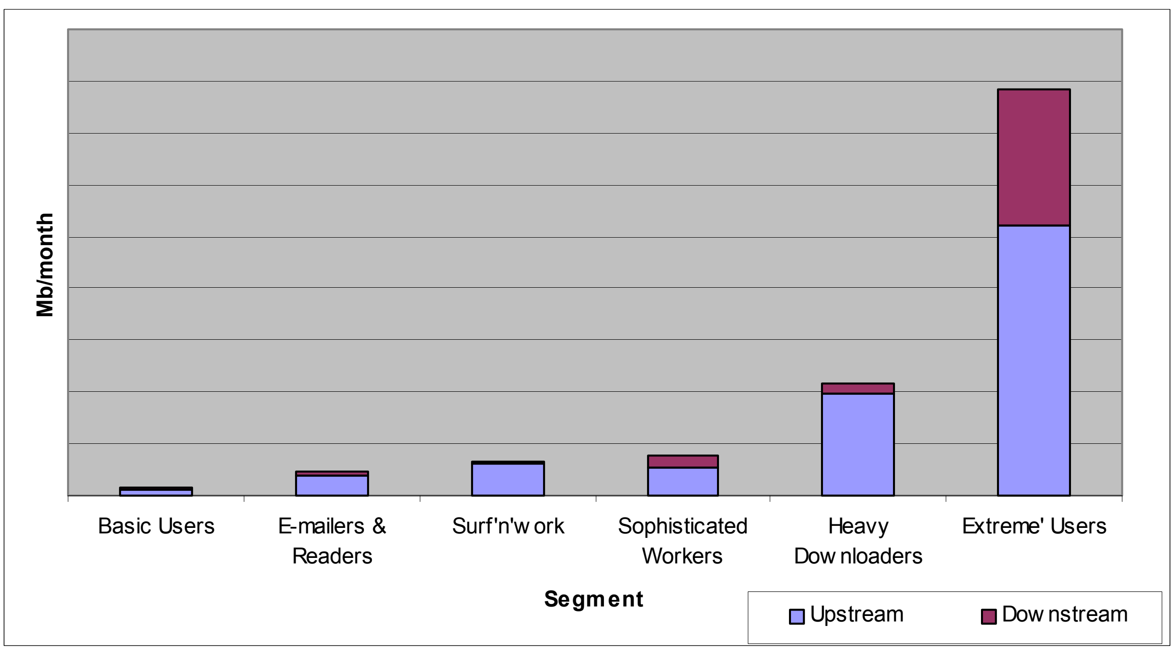
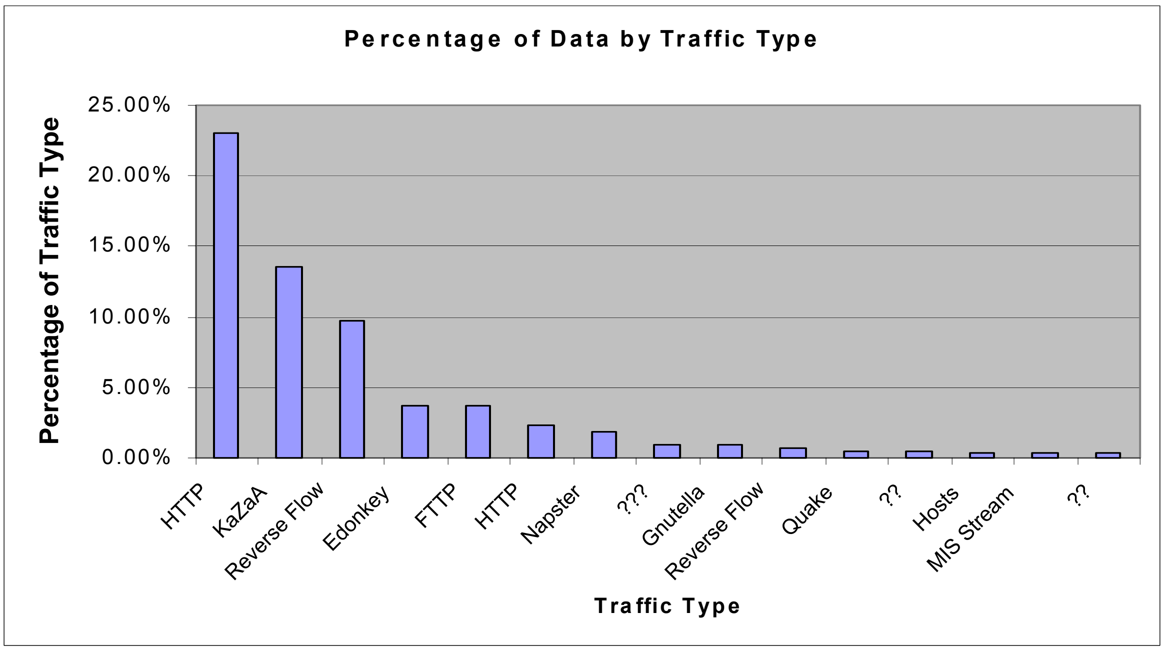


Figure 7. Current Average Usage by Segment – Feb 2003



The key inference drawn from these figures is that ***even those New Zealand residential users with access to generous downloading allowances actually consume comparatively small volumes of data***. Per megabyte charging is therefore a disincentive only to a small number of very intensive residential users, whom it can be argued should not be expecting the vast majority of much lower-using consumers to subsidise their extensive usage via flat-rate plans[74], especially when the majority of the data transfer that they consume is across the costly Southern Cross Cable. For the vast majority of residential broadband users, at the low levels of individual consumption exhibited in this analysis for both large allowance and small allowance broadband plans, ***the prices of both the slower Jetstream Starter product and the higher-speed Jetstream Home products compare very favourably with similar products in the Oftel survey.***

Figure 8. Sample Month Residential Broadband Traffic



1.2.3.3 Business Broadband Prices

The same issues of product quality and levels of usage as discussed for residential consumers also apply to the products offered to New Zealand business broadband consumers.

Given the very high quality of the New Zealand DSL product, the only relevant business product comparison that can be made using the Oftel data is in the Business – High category. To estimate the charges for the benchmarked 16Gb, two approaches can be taken:

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[74] Varian (2002) *op. cit*.

- Using the price for Xtra's Jetstream 10000 business package and adding the usage charge for the additional 6 Gb; or
- Using the price for Xtra's Jetstream 20000 and recognising that it offers a higher volume of data downloading than the benchmarked products.

The lowest price is yielded by the first option. This is displayed along with the PPP-converted prices for each of the Xtra business products (Jetstream 600, Jetstream 1200, Jetstream 1800; Jetstream 3000; Jetstream 5000; Jetstream 10000 and Jetstream 20000, with monthly caps of 0.6, 1.2, 1.8, 3, 5, 10 and 20 Gb respectively) in Figure 9.

The New Zealand product priced at 16Gb per month ranks towards the end of the Oftel list, at a price (£685) slightly higher than the Oftel average (£511). For high volume, fast broadband the United States clearly offers the best prices, with 23 out of the cheapest 24 products being offered by United States providers. It is also noted that all of the United States products, and the solitary Swedish product (3rd) in this group, are offered in unmetered packages. The next 13 positions (25th to 37th) are occupied by German products. The United States' Covad product sits at 38th, followed by another 14 German products. New Zealand's adjusted Jetstream 10000 plus 6000Mb product sits in the middle of these German products. Of the German products sitting above Jetstream, eight are metered and ten unmetered. Only Germany offers metered business broadband products at this quality level in the Oftel survey. It does not appear that any business product offered in the UK reaches the quality described as High in the Oftel definition, and only one product of this type is provided in the Swedish market.

As per the Oftel basket, New Zealand's business Jetstream product is priced on a par with those available in Germany, the European Union's strongest advocate and most active practitioner of LLU. Like New Zealand, Germany offers metered business products. Whilst United States business prices are undoubtedly cheaper per month, when service quality is factored in, only seven of the cheaper business packages (three US, four German) offer downstream speeds better than those of Jetstream. New Zealand business DSL prices are less than half those charged in France, whilst the solitary French product of comparable quality is nearly three times the price of the New Zealand product.

Figure 9. Modified Oftel Benchmarking: Broadband Business – High

Rank	Country	ISP	Package	DSL/Cable Modem	Total Monthly Charges	Downstream capacity
1.	**NZ**	**Telecom-Xtra**	**Jetstream 600**	**DSL**	**35**	**2000**
2.	**NZ**	**Telecom-Xtra**	**Jetstream 1200**	**DSL**	**61**	**2000**
3.	US	Qwest	DSL Pro, 1M	DSL	66	1000
4.	US	Speak Easy	NetCommuter ADSL 1.5/768	DSL	77	1500
5.	**NZ**	**Telecom-Xtra**	**Jetstream 1800**	**DSL**	**87**	**2000**
6.	Sweden	Telia	Telia Bredband Foretag -2.0 Mbits	DSL	116	2000
7.	US	Qwest	DSL Pro, 4M	DSL	118	4000 *
8.	**NZ**	**Telecom-Xtra**	**Jetstream 3000**	**DSL**	**139**	**2000**
9.	US	Speak Easy	NetCommuter 1100K	DSL	164	1100
10.	US	XO	Business DSL 1.1Mbps	DSL	181	1100
11.	US	Speak Easy	NetCommuter 1500K	DSL	181	1500
12.	US	Qwest	DSL Pro, 7M	DSL	193	7000 *
13.	US	Speak Easy	Multi-Office 1100K	DSL	198	1100
14.	US	Southwestern Bell	Symmetric DSL Internet 1100K	DSL	202	1100
15.	**NZ**	**Telecom-Xtra**	**Jetstream 5000**	**DSL**	**213**	**2000**
16.	US	Covad	Telespeed 1.1	DSL	215	1100
17.	US	XO	Business DSL 1.5Mbps	DSL	215	1500
18.	US	Speak Easy	Net Advantage 1100K	DSL	215	1100
19.	US	Speak Easy	Net Advantage Plus 1100K	DSL	229	1100
20.	US	AT&T	Multi User SDSL - 1100/1100	DSL	247	1100
21.	US	XO	Business DSL 2.3Mbps	DSL	249	2300 *
22.	US	Speak Easy	Multi-Office 1500K	DSL	249	1500
23.	US	EarthLink	Earthlink Biz DSL 1.1 Mbps	DSL	249	1100
24.	US	Southwestern Bell	Symmetric DSL Internet 1500K	DSL	250	1500
25.	US	Covad	Telespeed 1.5	DSL	262	1500
26.	US	AT&T	Multi User SDSL - 1500/1500	DSL	281	1500
27.	US	Speak Easy	Net Advantage 1500K	DSL	283	1500
28.	US	Speak Easy	Net Advantage Plus 1500K	DSL	283	1500
29.	US	EarthLink	Earthlink Biz DSL 1.5 Mbps	DSL	283	1500
30.	Germany	Claranet	sDSL 1024	DSL	288	1024
31.	Germany	KKF	Professional DSL Volume 1000K	DSL	356	1000
32.	Germany	KKF	Professional DSL Volume 1500K	DSL	374	1500
33.	**NZ**	**Telecom-Xtra**	**Jetstream 10000**	**DSL**	**405**	**2000**
34.	Germany	KKF	Professional DSL Volume 2000K	DSL	410	2000
35.	Germany	NGI	NGI SDSL 1000 Volume Rate	DSL	421	1000
36.	Germany	KKF	Professional DSL Flatrate 1000K	DSL	427	1000
37.	Germany	NGI	NGI SDSL 1000 Flat Rate	DSL	439	1000
38.	Germany	NGI	NGI SDSL 1500 Volume Rate	DSL	441	1500
39.	Germany	Claranet	sDSL 2300 small business	DSL	443	2300 *
40.	Germany	WorldCom	Worldcom Internet DSL Office	DSL	469	1024
41.	Germany	QSC	DSL Business 10	DSL	471	1024
42.	Germany	NGI	NGI SDSL 2000 Volume Rate	DSL	477	2000
43.	**OFTEL**		**Oftel average**		**511**	
44.	Germany	KKF	Professional DSL Flatrate 1500K	DSL	519	1500
45.	US	Covad	TeleXtend 1500	DSL	533	1500
46.	Germany	NGI	NGI SDSL 1500 Flat Rate	DSL	535	1500
47.	Germany	Claranet	sDSL2300	DSL	535	2300 *
48.	Germany	KKF	Professional DSL Flatrate 2000K	DSL	555	2000
49.	Germany	NGI	NGI SDSL 2000 Flat Rate	DSL	570	2000
50.	Germany	QSC	DSL Business 20	DSL	601	2300 *
51.	Germany	WorldCom	Worldcom Internet DSL Office2300	DSL	610	2300 *
52.	Germany	Arcor	Arcor Internet Business Flatrate2300/2300	DSL	638	2300 *
53.	**NZ**	**Telecom-Xtra**	**Jetstream (10000 + 6000Mb)**	**DSL**	**685**	**2000**
54.	**NZ**	**Telecom-Xtra**	**Jetstream 20000**	**DSL**	**724**	**2000**
55.	Germany	T-Online	T-Interconnect Basic 1.92Mbit/s	DSL	858	1920
56.	Germany	T-Online	Interconnect 3 - volume rate	DSL	867	4096 *
57.	Germany	Arcor	Arcor Internet Business Flatrate385/4000	DSL	915	4000 *
58.	Germany	T-Online	Interconnect 4 - volume rate	DSL	973	6016 *
59.	Germany	T-Online	Interconnect 3 - flat rate	DSL	1073	4096 *
60.	Germany	KKF	Professional DSL Flatrate 4000K	DSL	1078	4000 *
61.	Germany	NGI	NGI SDSL 4000 Flat Rate	DSL	1095	4000 *
62.	France	Nerim	Nerim HDSL 1024 Kbits	DSL	1314	1024
63.	France	Nerim	Nerim HDSL 1536 Kbits	DSL	1530	1536
64.	France	Nerim	Nerim HDSL 2084 Kbits	DSL	1746	2048 *
65.	Germany	T-Online	Interconnect 4 - flat rate	DSL	2063	6016 *

All prices are calculated at PPP in UK£ based on tariffs valid at August 2002   ** Denotes faster product than Jetstream*

1.2.3.4 Business Broadband Usage

When adjusting for levels of usage, however, the New Zealand business packages are very competitive. The prices for low-volume users (less than 5Gb a month) rank amongst the cheapest United States products. Indeed, even the New Zealand 10Gb product ranks in the middle of the table, at a price less than the Oftel average. The New Zealand pricing structures mean that businesses that do not require large volumes of data exchange, or consume comparatively less expensive New Zealand data rather than costly United States data, are not penalised by having to subsidise heavier users via flat-rate un metered packages.

If the distribution of New Zealand business Internet usage mirrors that of residential usage, then there is probably a very large number of very low-using businesses, and only a few very high-using ones. Moreover, business usage may not be as extensive in terms of total megabytes transferred per customer as residential usage. Anecdotal evidence from Xtra and survey data support the contention that New Zealand business broadband subscribers are on average consuming only small volumes of data exchange. Xtra reports that broadband consumption during traditional business hours (daytime) is very much less than in the evenings, which are dominated by residential usage. Furthermore, most surveys of business use of the Internet in New Zealand[75] cite email and web browsing as the predominant business Internet applications. These low-volume, unstructured applications are the ones most suited to New Zealand's small businesses, which the OECD deems are most likely to benefit from broadband access to the Internet[76]. It is presumed that larger businesses with significant data transfer requirements would be using dedicated transfer mechanisms such as leased T-1 lines or Ethernet LAN services where these are available, rather than DSL.

Thus, it can be concluded that ***New Zealand business broadband prices compare very favourably, ranking amongst the lowest of the United States prices in the Oftel survey for observed patterns of usage***. It is only when businesses require very large quantities of data from overseas that the New Zealand product becomes less competitive. In addition to accounting for the differences in cost associated with moving international traffic to New Zealand, the flexibility of the New Zealand pricing structure recognises that a 'one size suits all' pricing package is not necessarily appropriate for businesses of varying information transfer requirements. This level of pricing flexibility may be a factor contributing to New Zealand's comparatively high levels of broadband uptake noted

[75] For example, Statistics New Zealand. 2002. *Information Technology Use in New Zealand: 2001*. Wellington, New Zealand: Statistics New Zealand; Clark *et al.* (2002), *op. cit*.
[76] OECD (2002) *op. cit.* p5; Howell and Obren (2002) *op. cit.*

amongst the small business sector comparative to other countries such as the UK (Section 1.3 below).

1.3 Summary: OECD-Leading Internet Connectivity, Uptake

Given the very favourable supply-side factors of wide and early availability of Internet technologies, low prices for dial-up products, low prices for low levels of broadband usage, and prices comparable with the best of the United States and the European Union for equivalent quality broadband products, high product quality of both dial-up and broadband,and many of the other policy and environmental factors deemed helpful in promoting information exchange on the Internet, it is not surprising to find that New Zealand enjoys some of the best connectivity and utilisation measures in the OECD.

Figure 10 summarises New Zealand's relative position to benchmark OECD countries in a variety of metrics[77]:

Connectivity:

- ISP accounts per 100 population, measuring the extent of penetration of the Internet generally
- Households with access to the Internet, indicating relative availability and recreational use of the Internet
- PC access to the Internet in schools, providing evidence of educational utilisation of the Internet
- Internet Hosts per 1000 inhabitants, a measure of domain name linked computers connected to the Internet, and hence a measure of specifically business connectivity to the Internet
- Web sites per 1000 inhabitants, providing an indication of the extent of (particularly business) content being created in each location
- Domain names per 1000, as a measure of both business and residential 'presence' and indicating the extend to which individuals and business are creating content for the Internet
- Secure servers per million inhabitants, measuring the extent to which Internet connectivity is being utilised for secure transactions

Broadband Statistics

[77] The metrics in figure 11 are taken from the current OECD Telecommunications Database http://www.sourceoecd.org unless otherwise indicated.

- Broadband subscribers per 1000 population
- DSL subscribers per 1000 population

Uptake

- Minutes of use per ISP account per month, as a proxy for the relative amounts of information being exchanged via dial-up Internet accounts

Figure 10 shows that New Zealand sits within the top 10 countries of the OECD for the vast majority of these connection and utilisation statistics. In particular, it lies ahead of near neighbour Australia in all except the broadband statistics. Comparisons with the United Kingdom also show New Zealand to be performing well, with the exception of content creation. Whilst the United States clearly shows higher rankings than New Zealand, this is not surprising given that most innovation with respect to Internet technologies and the applications that make use of the capabilities of the new technologies is occurring in that market. What does appear surprising is the relatively large amount of content that is being created in New Zealand, given that around 85% of Internet traffic 'consumed' in New Zealand emanates from the United States. The significance of this statistic is that it is business content creation that sits favourably against OECD benchmarks. This is a strong indication that New Zealand's extensive use of Internet connectivity is being used within the business sector for productivity gains relative to other countries.

New Zealand's DSL penetration per head of population is very close to that of the United States (Figure 10). Despite extensive LLU activity in the United States, New Zealand has achieved both a much higher level of DSL coverage and a level of DSL connectivity (Figure 10) and pricing (Figures 5, 9) that is very nearly the same. This reinforces that residentially focussed cable infrastructure is the leading determinant of the United States' overall 4th ranking in OECD broadband penetration. New Zealand's DSL penetration is also significantly in advance of that of Australia, the UK and France. In each of these cases, as with the US, higher overall broadband penetration relies upon the extent of cable subscriptions. As residential DSL pricing is not significantly different from others in the modified Oftel benchmarking (cheaper for some products), cable is predominantly a residential application, and New Zealand does not have a significant cable offering, then absence of a cable product appears to be the single factor distinguishing the New Zealand residential market from its counterparts. This implies that something associated with the cable product may be relevant in explaining the apparently poor broadband uptake statistic.

Figure 10. Relative OECD Internet Connectivity and Uptake Rankings

Internet Metric	New Zealand		Australia		USA		South Korea		UK		France	
	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank	#	Rank
Connectivity Statistics												
ISP Accounts/100	14	9th	12	10th	18	5th	23	1st =	11	12th	5	21st
Household %	48	5th	47	8th	50	3rd	-	-	38	10th	12	23rd
School Availability	22	4th	17	5th	27	2nd	5	19th	16	9th	6	18th
Internet Hosts/1000	105	8th	95	10th	272	1st	14	26th	63	13th	31	19th
Web Sites/1000	11	12th	9	13th	47	1st	6	17th	25	4th	4	20th
Domain Names/1000	22	11th	19	16th	38	5th	21	14th	51	1st	9	20th
Secure Servers/million	202	3rd	190	5th	301	2nd	11	28th	141	8th	38	21st
Broadband Statistics												
BB Subscr/1000[78]	7	19th	9	17h	47	4th	173	1st	6	20th	11	15th
DSL Subscr/1000[79]	14	15th	8	20th	15	14th	130	1st	7	21st	12	17th
DSL Coverage %	85		85			65		90		66		91
Uptake Statistics												
Hours/month/ISP account	21	2nd	18	4th	26	1st	-	-	10	7th =	10	7th =
	(Xtra)		(Telstra)		(AOL)				(All ISPs)		(All ISPs)	

The comparison between New Zealand and South Korea is especially interesting. Whilst South Korea leads the OECD in the number of individuals connecting to the Internet (ISP accounts per 1000 and broadband connections per 1000), it lies in the lower half of the OECD in respect of business utilisation and content creation statistics. Indeed, it can be argued that South Korea's strong broadband uptake is predicated almost solely on recreational residential consumption of interactive gaming and English language video content due to the absence of enforcement of copyright (see Appendix 2).

Thus, New Zealanders can be classified as world-leading users of Internet technologies, and there is considerable consistency in the extent of this leadership across sectoral divisions (business, residential, educational). This suggests that usage of the Internet and the information that its exchange enables, is widespread. This is in contrast to South Korea, which leads in individual connectivity statistics, but lies in the lower half of the OECD in respect of business usage statistics, suggesting a distinct skew in the types of Internet usage, and hence information exchange, that is occurring in that country. Whilst accrual of benefits and consequently the performance implications in New Zealand would appear to cover most sectors of the economy, the accrual of the benefits of

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[78] September 2002 http://www.oecd.org/EN/document/0,,EN-document-41-1-no-4-39262-41,00.html
[79] September 2002

information transport in South Korea appear to be largely confined to the residential sector. These benefits will not necessarily translate into measurable productivity improvements as the increases in utility gained by a consumer substituting one form of entertainment consumption spending for another within household entertainment budgets go largely unmeasured in aggregate national statistics, as the same amount of consumption spending is recorded as long as the budget stays constant. The spending is merely transferred between sectors[80]. High broadband connectivity *per se* in South Korea is thus not necessarily an indicator of increasing measurable productivity enhancements.

2. The Dilemma: NZ Exhibits Dismal Broad Band Penetration by OECD Standards

It is only when broadband connectivity statistics are added to the table that New Zealand shows evidence of slipping to the rear of the OECD tables. In terms of the consistency argument advanced in Appendix 1, ***only one statistic in respect of New Zealand's overall electronic information transportation and utilisation environment stands out as being inconsistent.*** But does this really matter, if it is actually ***information exchange via the Internet*** that generates productivity gains?

The single inconsistency in broadband penetration poses an interesting dilemma: New Zealanders show very high levels of Internet usage relative to the rest of the OECD, yet have very poor broadband connectivity. Why, despite the multiple advantages of:

- early entry into the broadband market;
- early provision of telephony-based DSL services;
- multiple competitive broadband technology platforms;
- low prices by world standards (despite the double disadvantage of price penalties due to an overwhelming percentage of content consumed emanating from the United States);
- high levels of broadband availability and coverage;
- a history of significant use of information content exchanged over the Internet; and
- multi-sectoral use of the technology;

have the majority of New Zealand Internet users eschewed the opportunities to purchase broadband connections? As there appears to be no significant supply-side bottleneck, then the remaining solution is that there are impediments to uptake on the demand side.

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[80] Triplett, Jack E.; and Barry P. Bosworth. 2000. *Productivity in the Services Sector*. Washington: Brookings Institution.

Explaining the Dilemma

Howell and Obren's [81] substitution-based model uses the application base, the value of user time and information transfer technology costs to analyse the point at which a given user will substitute broadband technologies for dial-up. They conclude that in the presence of flat-rate pricing for both dial-up and broadband technologies, the only factors that induce earlier substitution are:

- high fixed costs of dial-up relative to broadband;
- broadband that is significantly faster than dial-up;
- a high user valuation of time; and
- the number of information exchanges that the user undertakes.

When there is a usage charge for both dial-up and broadband, in addition to the other factors, substitution is less likely to occur if the per-megabyte charge for broadband is high relative to the per-minute charge for dial-up.

As there is no evidence of either a significant supply side bottleneck or a low number of Internet information exchanges occurring in the New Zealand Internet market, then it is most likely that the explanation for the observed dilemma will be found in analysing factors such as the relative prices of the technologies influencing the point at which the substitution from dial-up to broadband is made, including pricing, any significant market segment differences, and the application base that underlies demand for Internet information exchange.

1. Pricing Arbitrage

It is widely acknowledged that the relative pricing of broadband compared to dial-up is a key factor influencing the point at which substitution will occur[82]. If the broadband infrastructure is offered at prices that are very low compared to dial-up, then substitution will be induced not because of any of the intrinsic technical capabilities and qualities of broadband (e.g. transmission speed, capacity), but simply because pricing mechanisms render it comparatively less costly. If the real costs of providing broadband are less than those of providing the existing platform, then this is efficiency-raising and will lead to genuine productivity gains. However, these gains are transitory. Given a standard application set, total usage of the technology will increase only to the extent of that induced by the lower prices, and eventually settle at a new level. Pricing arbitrage merely brings forward the

[81] Howell and Obren (2002) *op. cit*

[82] Howell and Obren (2002) *op. cit*; Oftel (2002) *op. cit.*

point at which the technology substitution will occur[83]. Whilst short-term productivity benefits accrue from productivity improvements associated with existing applications, these are capped. ***Additional productivity enhancements still depend upon the development of additional usage over and above that induced simply by lower prices***.

Figure 11 shows the comparative prices based upon Oftel benchmarking[84]. Despite New Zealand's internationally low prices for both dial-up and broadband within the currently observed levels, there is still a significant price disadvantage for broadband compared to other countries. Residential consumers face ratios greater than those of the US and the UK. ***However, this is not because New Zealand broadband is expensive, but because residential dial-up is so very cheap, given low ISP costs and no charging for local call access***.

However, when comparing the costs facing businesses, the New Zealand ratios are significantly lower, due to the per-minute charging for local calls. For larger volume users, the difference is considerable, with Jetstream5000 being 20% less expensive than a 200 hour dial-up package. It is noted that the New Zealand business ratios are also less than the comparable ones for the UK and the US.

Figure 11. Modified Oftel Comparison: Broadband and Dial-up Costs.

	Residential			**Business**		
	Broadband	**Dial-Up (150 hours)**	**Ratio**	**Broadband**	**Dial-Up (150 hours)**	**Ratio**
France	367	793	0.46	850	1460	0.58
Germany	305	537	0.57	510	1110	0.46
Sweden	250	805	0.31	430	1281	0.34
UK	317	224	1.42	370	332	1.12
US	317	247	1.28	442	328	1.35
NZ (1)[85]	348	134	**2.59**	420	353	**1.19**
NZ (2)[86]	348	230	**1.51**	213	263	**0.81**

Prices in UK£, PPP at August 2002

Hence, purely as a consequence of access pricing arbitrage, Figure 11 implies we would expect to see a much earlier substitution to broadband by businesses than residential consumers.

[83] Howell and Obren (2002) *op cit.*
[84] Oftel (2002) *op. cit.* p 69-70
[85] Jetstream Starter 5000 and Paradise 150; Jetstream 600 and Xtra Prepay20
[86] Jetstream Starter 5000 and Xtra ValuePack; Jetstream 5000 and Xtra Prepay200

2. *Usage Levels and User Value of Time*

It is noted, however, that whilst Figure 11 incorporates trade-offs between minutes of dial-up use and megabytes of broadband traffic, these are not the sole price factors influencing the substitution decision. Usage levels and the user value of time must also be considered.

Marketing of both residential and business broadband has emphasised the superior speed of the broadband product in order to induce purchase. This factor is especially relevant given the very high speed offering of the standard New Zealand DSL product. Depending upon the users' value of time, then in addition to any incentives offered by pricing arbitrage, if time savings from faster transmission exceed additional costs, substitution will occur. Substitution in New Zealand may therefore be delayed relative to other countries if user valuations of time are comparatively low.

Whilst low user time valuations may be depressing residential substitution in respect of unmetered products, usage charges are considered to be a significant factor in the business market and the metered residential market.

The credibility of usage charges as an inhibitor in the business market is weak, however, given the variety of usage packages (0.5, 1.2, 1.8, 3, 5,10, and 20 Gb per month) offering choices from which customers can select. Careful selection of the appropriate package from within these bands results in low users facing substantially lower charges than their US and European counterparts. Furthermore, usage charges are not sufficient to explain the purchase behaviours of the vast majority of residential users whose monthly data transfer requirement does not exceed 1Gb. Moreover, neither does it account for the extremely low usage levels of the low-cost low-speed residential product that has a 5Gb monthly allowance. Rather, using the Howell and Obren equation, the low levels of purchase of this product are more likely attributable to a combination of low user valuations of time and the very small speed difference between dial-up and DSL, given that very high quality average speeds are achieved via dial-up (46kbps) relative to the speed of the broadband connection (128kbps) making the benefits of substitution based upon speed at the low levels of usage evidenced by residential consumers effectively negligible.

Thus, only residential users with high-volume and high-speed requirements face penalties from usage charges in the New Zealand market. As the average usage volume per month in the residential market is less than 1000Mb and only 5% of residential consumers using the 5Gb product exceed the cap, only a small proportion of the market will have the substitution question substantially influenced by the per megabyte charging policy.

3. *Market Segment Differences*

If usage charges are insufficient to explain behaviours, then pricing arbitrage appears to be a significant factor underpinning New Zealand uptake. As Figure 11 shows very different arbitrage equations for business and residential consumers, it is apposite to analyse these market sector differences. Business users, with packages offering effectively unmetered access up to a variety of customised caps, and with much more favourable broadband:dial-up price ratios, might be expected to be more likely to purchase the fast product than residential users. Residential users, though, would be expected to prefer the lower-speed unmetered product.

Figure 12 shows the pattern of sales of DSL accounts to business and residential users based upon Telecom business designation. Figure 13 shows the customer breakdown between high speed Jetstream and low speed Jetstream Starter within Xtra's customer base. Figure 14 shows the diffusion of sales of DSL accounts to customers that Telecom bills as business customers, measured as a penetration amongst Statistics New Zealand's database of significant business enterprises (280,000 as at February 2002). These penetration statistics represent a low-side estimate of business penetration, as small businesses recorded on the Statistics database may be purchasing DSL connections as part of the residential base, whilst not being recorded as businesses in the Telecom database. Moreover, two levels of business enterprise growth are postulated beyond the data from 2002 – high levels of business growth based upon the high levels of 2001-2002, and slow growth, based upon the average growth for the past eight years.

The predicted pattern was in fact the one observed until about a year ago. At March 2002, slightly under 50% of all New Zealand DSL connections were sold to business customers[87] compared to 30% in the United Kingdom, 20% in the United States (BellSouth) and fewer than 5% in France[88]. However, from March 2002 onwards, whist business connection growth has continued steadily, residential uptake has surged, so that by April 2003, total residential DSL connections outnumbered business ones by a factor of around 1.9:1, yielding proportions similar to those of the UK in 2002 (Figure 12).

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[87] Howell and Obren (2002) *op. cit*
[88] OECD (2002) *op. cit* p 29.

Figure 12. Telecom NZ DSL Connections

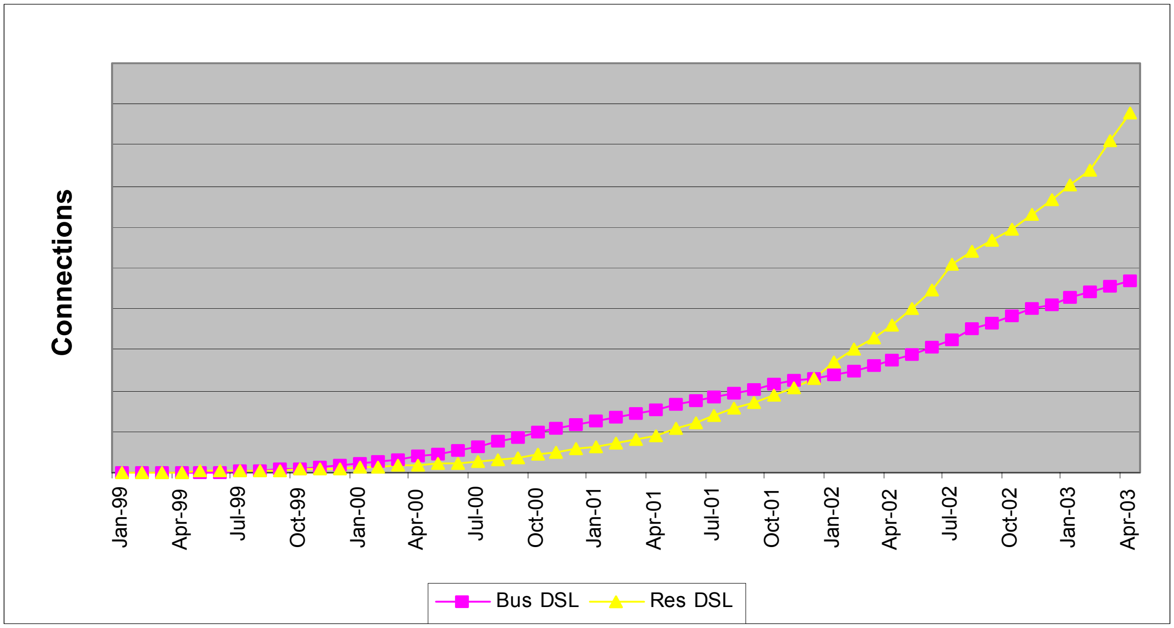
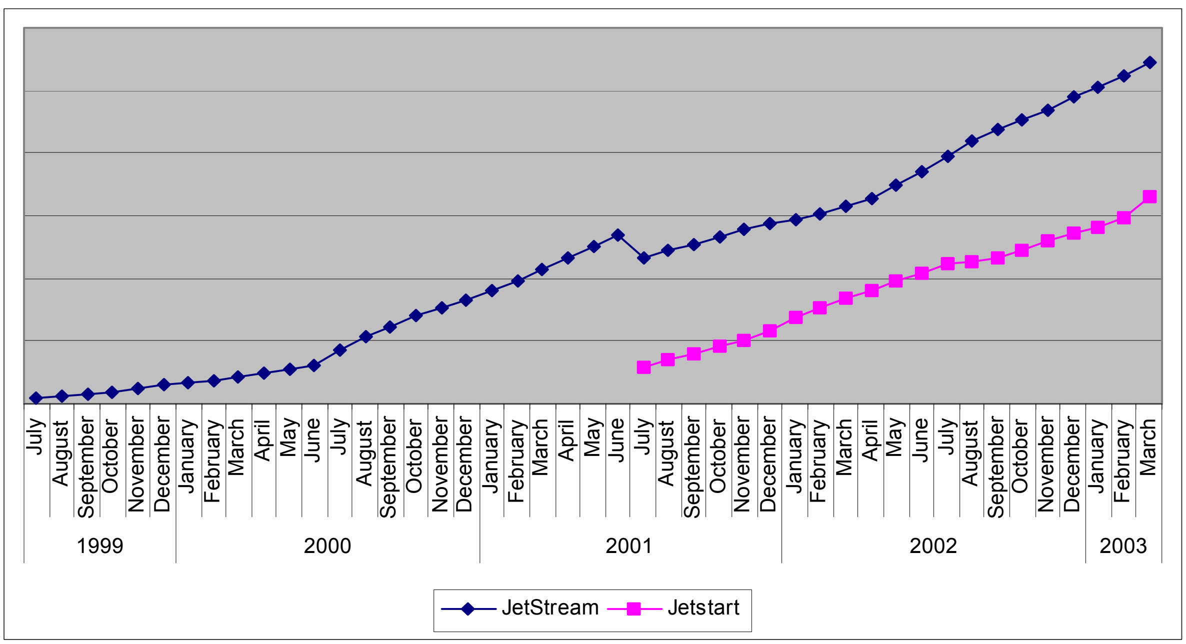
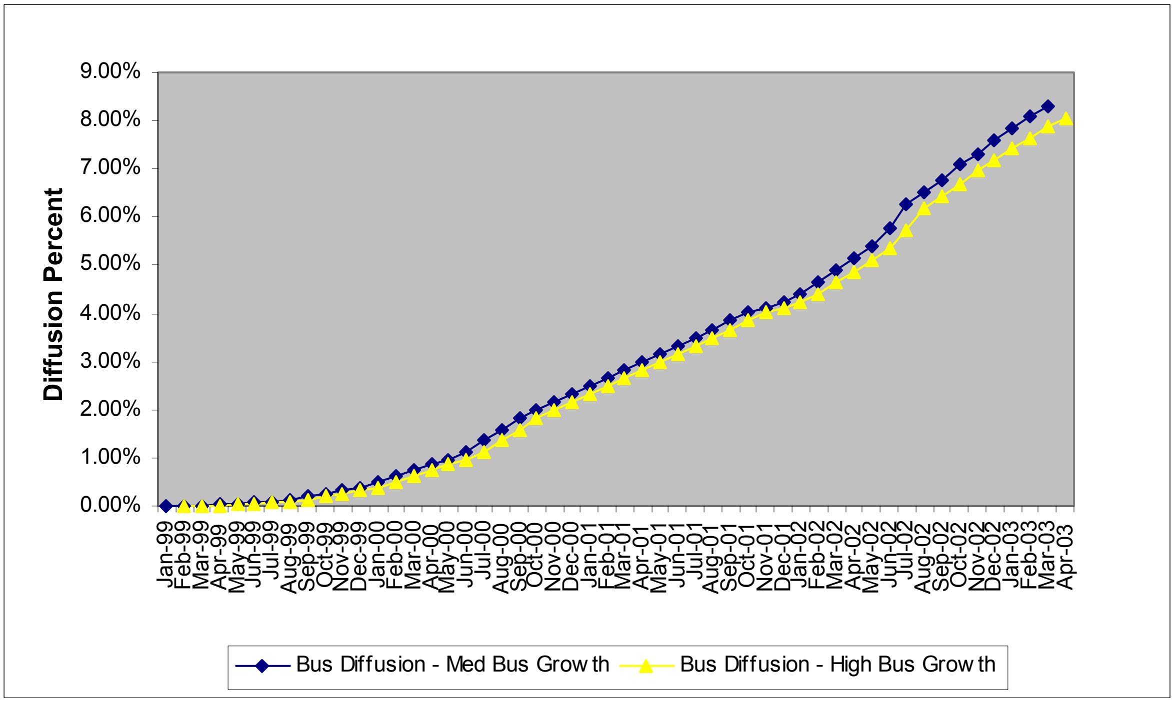


Figure 13. DSL Product Customer Connections



Note that Xtra began separating Jetstream and Jetstream Starter (Jetstart) customers in July 2001

Figure 14. Business DSL Diffusion per Significant Enterprise



Business growth Feb 2002 onwards based on projections – medium and high – due to lack of Statistics NZ data

Furthermore, the Xtra data show steady growth of both the residentially-targeted Jetstart and the business-targeted Jetstream products. Clearly, there is significant residential purchase of the faster, capped product (approximately 7000 customers purchased Jetstream Home 500 and Jetstream Home 1000 compared to the 12,900 Jetstart customers in November 2002)[89]. Either this is a measure of the extent of 'quasi-business' use of DSL occurring via residential plans, or there are residential consumers whose valuation of time is sufficient to accrue benefits from the speed of Jetstream and are prepared to either limit usage or pay the usage premium, or have such low usage that they fall beneath the caps.

3.1 Very High per Business Unit Penetration

Nonetheless, Figure 12 shows very different purchasing patterns between business and residential customers. Furthermore, business penetration by business size and geographic location show very high levels compared to other countries, consistent with the comparatively robust performance of New Zealand business connectivity and utilisation of the Internet in Figure 10. Figure 14 shows that, even using the very conservative methods of estimating business penetration outlined above, a DSL penetration rate of between 8 and 8.5 per 100 of New Zealand's approximately 285,000 statistically significant business enterprises at March 2003. This does not include connections to any of the other broadband platforms, and as identified above, is an acknowledged under-representation of the true level of business penetration. This business penetration level is particularly impressive in the face of international comparison. Australia, for example, has a target of 3% of all businesses using broadband in 2003[90]. New Zealand passed this level in DSL penetration alone in April 2001.

Furthermore, New Zealand's high levels of business DSL connectivity are not just confined to metropolitan locations. Figure 15 shows the regional diffusion of the technology. It is noted that the base used in this analysis is geographic units, so it captures each regional branch of each of the significant enterprises represented in Figure 14. Hence the two sets of figures are not directly comparable.

Figure 15. Regional Business DSL Penetration per Significant Geographic Unit

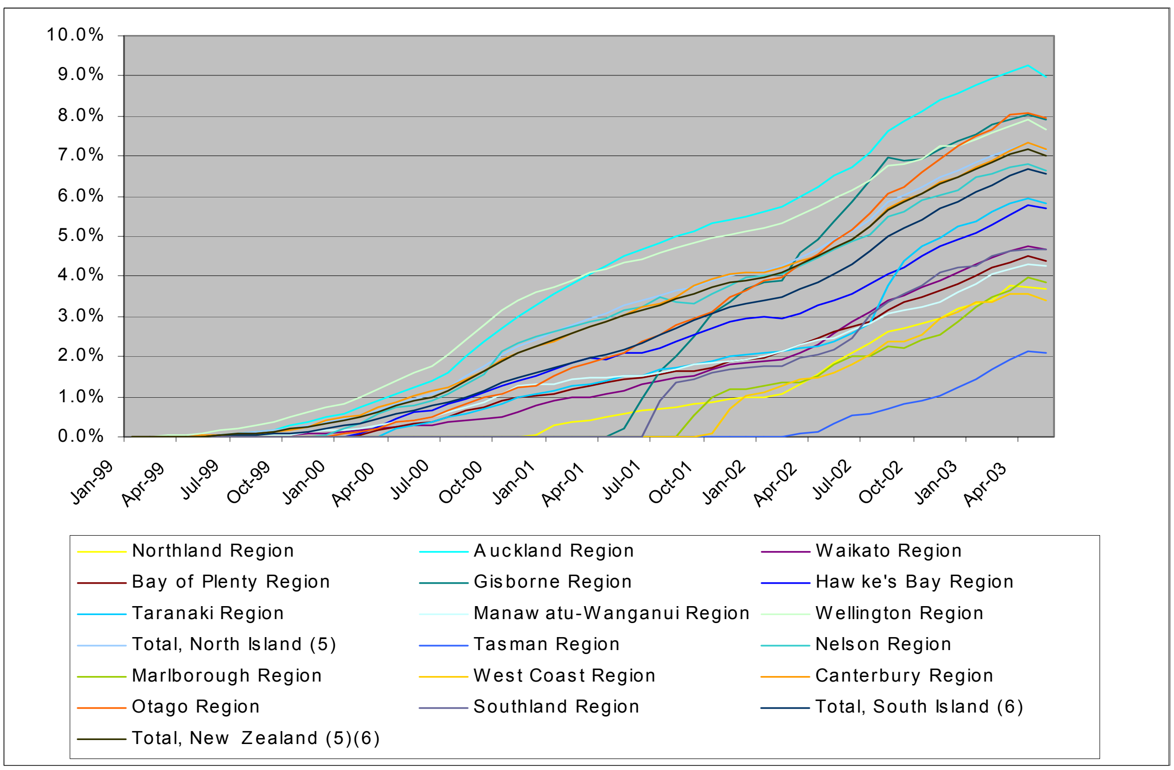


Figure 15 shows that at April 2003, New Zealand had a minimum business DSL penetration rate alone of 7.2 per 100 sites where business is transacted. This ranges from 9.2 per 100 in Auckland to

[90] NOIE (2002) *op. cit.*

2.1 per 100 in Tasman. Significantly, apart from Auckland's strong showing, there does not appear to be a strong metropolitan-provincial divide in this data, as Otago, with a large rural hinterland is second with 8.0 per 100, and provincial Gisborne third with 7.9 per 100[91]. Wellington (7.9) and Canterbury (7.4) come next, followed by Nelson (6.8), Taranaki (5.9), Hawkes Bay (5.8), Waikato (4.8), Southland (4.7), Bay of Plenty (4.5), Manawatu-Wanganui (4.3), Marlborough (4.0), Northland (3.7) and West Coast (3.6). Thus, even New Zealand's worst-performing region, Tasman, when measured on DSL penetration per significant business location, is close to the target set for all methods of broadband penetration per significant Australian enterprise in 2003.

It is important in comparing business connectivity to the Internet that businesses of like size and dimension are compared. New Zealand businesses are very small by world standards. The United Kingdom reports[92] that in November 2002, 5% of its Small and Medium (SME) businesses connecting to the Internet use broadband (equates to 3.5% of businesses in total). The comparable figure for all significant New Zealand enterprises at that point was 7.0% (geographic units 6.3%). Fewer than 0.5% of New Zealand's 285,000 significant businesses have more than 100 employees. Thus, New Zealand's total business uptake ostensibly falls within the UK's SME category, with New Zealand business DSL penetration appearing to be twice the business broadband penetration of the UK.

Using the Telecom business database, it is reported that over 50% of business enterprises with 10 or more employees in this register subscribe to DSL. Even allowing for the difference in size between the Telecom and Statistics New Zealand databases, this statistic compares very favourably to Norway, which reports only 20% of businesses using all broadband methods in this category[93]. This is especially interesting, given that Norway (12th) lies significantly ahead of New Zealand in the number of broadband connections per 100 population.

Noting that the cited figures are a deliberate low level estimate based upon population data, and given that they relate only to one technology platform, DSL, there is significant evidence that the high levels of business Internet connectivity and use exhibited in Figure 10 translate into equally impressive OECD-leading levels of business connectivity to broadband technologies. ***There is no evidence of business sector lags in broadband connectivity. Indeed, New Zealand leads***

[91] It is noted that this is a similar pattern found in website and email addresses by geography in New Zealand – see Howell, Bronwyn. 2001. The Rural-Urban "Digital Divide" in New Zealand: Fact or Fable? *Prometheus* 19(3): 231-252
[92] Oftel (2002) *op. cit.*
[93] http://www.norwaypost.no/content.asp?cluster_id=19123&folder_id=9

comparative benchmark countries by significant amounts in respect of the SME and micro business segments. These are the very business segments that broadband technologies are designed to serve[94], as larger businesses generally use leased T-1 connections (NZ has penetrations of around 50 per 100 in this technology per business with over 100 employees).

High broadband penetration levels for businesses give double reasons for celebration. Firstly, if there are measurable productivity gains to be made from the use of broadband information exchange, then these are most likely to originate from the business sector[95]. Secondly, as small and medium businesses are deemed the most likely to benefit from broadband, as opposed to other methods of information exchange such as leased T-1 connections[96], then the fact that so many of New Zealand's small and medium (10 plus employees) and micro (fewer than 10) businesses are already using the technology, relative to other countries, is very reassuring. If there are benefits to be gained, then New Zealand businesses are well placed relative to their overseas counterparts to gain these benefits. Indeed, these benefits are presumably already being reaped.

3.2 Residential Broadband Penetration is the Laggard

If New Zealand has a 'broadband problem' at all, it would appear to be confined to penetration of residential connections, which appears to be the one metric that is contributing to pulling New Zealand's otherwise OECD-leading Internet statistics back into the also-rans. As all of pricing arbitrage between broadband and dial-up, per megabyte charging and the individual valuations of leisure time may all be implicated in this low level, it is apposite to consider the relative effects of each of these to the residential purchase decision.

It is well recognised that worldwide, user valuation of leisure time tends to be low. Varian identifies in his INDEX studies that the valuation of users' leisure time at Berkeley University was around 0.5c per minute in respect of the willingness to pay extra for faster Internet connections. Hence, even if New Zealanders' value is low, so is that in other countries that rank higher in residential broadband uptake. Given that the value of user time is so low, the relative speed of technologies assumes less importance in the Howell and Obren substitution equation, as the value of time savings is small when only low volumes are transferred. This is further diminished given that the time taken to exchange information is extremely small compared to the time taken by the user (either manually

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[94] OECD (2002) *op. cit.* pp 9-10
[95] OECD (2002) *op. cit.*
[96] *ibid pp9-10*

or using computer applications) to process that information once it is received. ***The differences in transfer speeds between dial-up and DSL at prevailing New Zealand speeds and qualities would, for the very low average levels of megabytes exchanged by DSL users in the Xtra database, amount to less that a few minutes each day. Thus, in the substitution decision between dial-up and broadband, at the low user valuations of time exhibited, the effect of the savings from broadband speed to the average residential consumer is negligible.***

Indeed, given the speeds at which information is transferred over the Internet, constraints in user time are more likely to occur from constraints in distribution and processing at either end of the Internet chain (servers, etc.) than from the transmission itself. For example, server speeds of many public newsgroups are extremely slow – users must pay additional fees to access information off servers with faster speeds. No matter how capable the user's connection to the Internet is, if the servers from which information is regularly obtained are slow, then faster transmission speeds will have negligible effect on the total time taken to receive data. Using the transport analogy, no matter how fast the truck is, if the loading process is slow, overall speed of transport from ordering to receipt will appear slow to the recipient.

3.3 Pricing Arbitrage and Residential Purchasing Decisions

Thus, holding applications constant, in the absence of any real evidence of considerable savings in time for the small volumes of information actually moved, fixed access pricing arbitrage appears to be the solitary explanation for New Zealand's low residential broadband penetration rates. Not that the broadband products are expensive – Figure 9 shows they rank very competitively with the offerings of the rest of the OECD. Rather, it is the extremely favourable dial-up prices that are depressing residential uptake. But that is not 'bad' in the sense that it is not constraining use of the Internet – Figure 10 shows this is the case. Welfare benefits are being accrued, just using dial-up rather than broadband technologies. Manipulating dial-up prices may raise broadband purchase in lieu of dial-up – Figures 10 and 11 show that this is certainly what is occurring in France. However, Figure 10 shows that merely because more people are connecting to the Internet using broadband in France, it does not necessarily follow that they are actually using that connectivity more productively. In all of the access technology-agnostic statistics in Figure 10, France shows far less evidence of Internet use for productive return, in both the business and residential sectors.

The conclusion that this analysis appears to invite is that, worldwide, it is not the superior speed capabilities of broadband that are inducing residential purchase for the majority of users with identical information exchange needs. Rather it is pricing arbitrage between the two technologies for basic connectivity to the Internet that appears to be the key determining factor at the current point in time. New Zealand is not alone in this being a significant factor depressing broadband uptake – Hausman has identified that factor is significant in the United States' comparatively poor performance in the broadband penetration metric[97].

4. Applications

Having accounted for all other influences upon the substitution decision, application availability remains the only other potential explanation of New Zealand's low level of residential broadband uptake the applications. Specifically, are there applications which require the high information volume and speed capabilities of broadband that are being used in other countries but not in New Zealand? If there are, then this could explain the difference in broadband penetration rates. If there are not, then the conclusion must be that there are just not the applications available worldwide that require broad band's capabilities, and that offer sufficient benefits in increased productivity or utility that users are prepared to pay the current broadband prices in order to use them. If this is the case, then international broadband penetration statistics are solely a reflection of pricing arbitrage between different technology platforms in different countries (including bundling of broadband Internet access with other applications such as basic telephony and cable television).

If application shortage is demonstrated, then policy interventions inducing substitution by encouraging pricing arbitrage may influence the choice of method via which individuals connect to the Internet, but such policies may have very little impact upon the extent of productive benefits gained beyond initial switching to the 'cheaper' technology. Such policy interventions are also largely impotent in encouraging the development of new applications, and can do little of themselves to encourage increasing application usage rates and accrual of user learning, which have been shown to be the predominant determinants of increasing bandwidth consumption[98].

4.1 Electronic Applications

Most empirical and survey evidence in New Zealand and overseas confirms that only a limited number of applications are routinely used by businesses, and that the most valuable of these are

[97] Hausman (2002) *op cit.*

assessed by the businesses to be email and web browsing[99]. Whilst these applications are deemed productivity-raising by their users, they do not require large quantities of information to be exchanged[100]. It is only when large, customised information exchange applications such as B2B exchanges and supply chain management systems are employed that large quantities of data are routinely exchanged. However, these applications are not necessarily those most likely to be used productively by New Zealand's large number of small businesses, given that these businesses generally have only a handful of suppliers and customers, and relatively few reasons to exchange information with any of them. Furthermore, the low usage of relatively mature, high-volume applications such as video-conferencing by these businesses, despite the prices faced, tends to indicate that the productive benefits of these applications are low relative to their costs, and useful only in specific circumstances, rather than being used routinely as are email and web browsing[101].

Indeed, unstructured applications such as email are probably far more suited to these businesses than structured, specific applications. The low transfer needs of these typically used applications provide the most logical explanation for Xtra's observation that the greatest pressure on transfer capacity occurs in the evening, when businesses are not typically consuming. ***Despite high levels of broadband penetration in businesses, average data transfer per business is low, due to the types of applications typically used. By extension, bandwidth consumed is not necessarily proportional to increases in productivity for New Zealand's micro, small and medium businesses***.

Similar limited application bases for residential users emerge in surveys worldwide[102]. It is only in a handful of specific geographic locations that significant applications differences emerge.

The appendix on South Korea identifies a handful of applications that are routinely available in that country but not in New Zealand, including Voice-over-IP and un-policed streaming of audio and video content in a legal environment that does not enforce copyright. Voice-over-IP is popular in South Korea as a result of relative pricing of fixed line and Internet telephony prices. However, New Zealand residential telephony prices are in the lower half of the OECD already[103], meaning that this application is unlikely to be as popular in New Zealand unless it is associated with substantial price reductions. Currently prevailing un-metered local call access would further discourage the use

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98 Howell and Obren (2002) *op cit.*

99 Clark et al., (2002) *op. cit.;* Howell and O'Connell (2003) *op. cit.*; Statistics New Zealand. 2002. *Information Technology Use in New Zealand: 2001*. Wellington, New Zealand: Statistics New Zealand.

100 Howell and Obren (2002) *op. cit.*

101 Howell and O'Connell (2003) *op. cit*.

102 Anderson *et al.* (2001) *op. cit*. - UK; NOIE (2002) *op. cit*. - Australia;

of Voice-over-IP in the New Zealand market. Furthermore, New Zealand copyright laws do not tolerate unrestricted copying, distribution and streaming of copyright material, thereby reducing the relative application potential of the two countries.

Additionally, in the market for entertainment products, Internet entertainment applications compete with all other entertainment applications. The range of entertainment substitutes in South Korea is much more limited than that in New Zealand, making entertainment options such as video and audio streaming and interactive games more popular than in New Zealand, where a variety of entertainment options, including participating in and viewing sport, sailing, skiing, and other outdoor activities, along with many broadcast entertainment options (free and pay-to-air television, radio etc.) compete with Internet-based entertainment options (e.g. interactive gaming, video on demand). Policy interventions aimed at infrastructure supply are unable of themselves to address this fundamental demand-side application choice and availability issue. Indeed, reducing the price of access to Internet-based entertainment applications relative to other entertainment applications may induce price-based substitution away from sport and other physical recreation activities, with a consequent reduction in the performance indicators of the health sector.

Furthermore, if entertainment applications are the dominant driver of demand for broadband in other jurisdictions, there are caps to the amount of entertainment consumption that an individual can undertake within available budgets of time and cash. Saether (in the Scandinavian countries) and Galbi (US) both show that entertainment spending has not increased over the twentieth century by any more than the available leisure hours – merely the form of entertainment spending has been substituted[104].

4.2 Cable, Content and Creation Incentives

Another valid application justification arises from comparing New Zealand application usage with that of the United States, which exhibits four times the broadband penetration of New Zealand, but approximately similar levels of DSL penetration. The most significant applications difference between the United States and New Zealand is that cable television packages incorporating cable broadband Internet access are widely available in the United States, whereas cable packages in New

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[103] Howell and Obren (2003) *op cit.*

[104] Saether, Jan-Petter. 1999. Limits to Growth in Telecom Markets? Chapter 12 in Loomis, David G., and Lester D. Taylor, eds. *The Future of the Telecommunications Industry: Forecasting and Demand Analysis.* Norwell, Massachusetts: Kluwer Academic Publishers; Galbi, Douglas. 2001. *Some Economics of Personal Activity and Implications for the*

Zealand are restricted to a narrow population base (Wellington and some parts of Christchurch). Cable broadband purchase outweighs DSL purchase in the United States by a factor of approximately 2.5:1[105]. Despite the argument that cable and DSL are competitors in a single market in the Untied States[106], it has also been argued that cable television content forms part of the product that influences the decision of US broadband purchasers[107]. Without tied content to offer in a bundle with infrastructure access (i.e. television content, the copyright to which may in fact confer market power of the bundled product), DSL is in a different market, and the products are not remotely close substitutes.

4.2.1 Cable Content and Infrastructure Access Bundles

Moreover, bundling opportunities provide pricing advantages for cable providers[108]. The large majority of cable broadband subscribers in the United States, and other jurisdictions where cable is the dominant broadband technology, offer the product as part of a bundle with television content. Bakos and Brynjolfsson have shown that bundling products with near zero marginal cost with each other in bundles increases sales, supplier profits and efficiency. As both cable content and broadband access fit this scenario once the initial cable connection is purchased, broadband Internet access can be offered in the bundle at a price near to marginal cost. This may be a significant contributor to the high levels of cable purchase relative to broadband (between 2:1 and 4:1) in most OECD countries that offer cable broadband services[109]. If bundling of this type is occurring then, high levels of broadband uptake in these countries may merely be a consequence of pricing arbitrage making the bundled cable product substantially cheaper than alternative Internet access technologies.

If it is indeed content and infrastructure bundles that provide the pricing arbitrage incentives to favour cable broadband access over any other form of broadband or narrowband access, then this solitary application difference may be the single most significant factor accounting for New Zealand's low broadband uptake. It is interesting to note that without the incentive of content bundles, DSL uptake in the US is similar to that of New Zealand. Given the similarities of residential DSL prices in the two countries, there is substantial anecdotal credibility to support this

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Digital Economy. Paper presented at the 19th Annual International Communications Forecasting Conference, Washington, DC.; June 26-29, 2001.

105 Howell (2002) *op cit.*

106 Crandall, Sidak and Singer (2001) *op. cit.*

107 Howell (2002) *op. cit.*

108 Bakos, Yannis; and Erik Brynjolfsson. 1999. Bundling Information Goods: Pricing, Profits and Efficiency. *Management Science*, 45(12), pp1613-1630.

explanation, especially given that there is no evidence of business reluctance to purchase broadband in New Zealand.

By way of a comparison, whilst New Zealand does not have a nationwide cable television product with which Internet access can be bundled, it does have a digital satellite-based pay television service with 516,731 subscribers, amounting to a penetration rate of 28.3% of households within its reach, at December 31, 2002[110]. This is in addition to the 123,360 (12.2% penetration) of subscribers to its UHF pay TV service. Since late 2002, this service has offered email services with the digital product, effectively competing with ISPs for that share of the 850,000 dial-up customer market that accesses the Internet for email applications only. The potential exists for this provider to use the digital satellite infrastructure to compete directly with ISPs for wider Internet access services. If bundling of Internet access via cable with television content is indeed prompting purchase of cable broadband subscriptions in other countries, then in order to get a true a true comparison between New Zealand broadband penetration and that of other countries, New Zealand's broadband share must be adjusted to reflect the proportion of purchases of digital satellite mail access that in other countries would be registered as broadband sales.

4.2.2 Cable, Content and Increasing Broadband Penetration

It has been argued that policy interventions such as LLU may open up opportunities for content providers to distribute their applications over the telephony network, thereby offering opportunities for both increasing residential broadband uptake in New Zealand, and incentivising the creation of new applications and content.

However, it is unclear as yet whether the linkage between cable broadband purchase and broadband penetration is merely a function of pricing arbitrage or a function of linking specific content (copyright movies) and Internet access in general. Whilst video on demand is often cited as an application requiring the capabilities of broadband, as yet there is little evidence that it is extensively used in any environment other than South Korea. For example, in the United States market, the weekly household budget for all forms of video on demand (including hiring videos) is around US$10 per week, amounting to around only three movies[111].

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[109] Howell, Bronwyn. 2002. Broadband Uptake and Infrastructure Regulation: Evidence from the OECD Countries. *Communications and Strategies*, 47:33-62.
[110] http://www.skytv.co.nz/index.cfm?pageid=75&languageid=1&siteid=237_1
[111] O'Connell, Marilyn. *What will be the Telecom Industry's Key Growth Engines?* Paper presented at the 20th Annual International Communications Forecasting Conference, San Francisco, June 28, 2002.

The New Zealand evidence tends to favour pricing arbitrage as the dominant effect, as given the low prices and wide availability of broadband in this country, if video content was driving residential purchase, it could have been reasonably expected that a product linking content and infrastructure on the DSL network would have emerged[112]. Given the very low average volumes of residential data transported, there is little evidence to suggest that video on demand via the DSL network is significant, even in the form of copyright owners entering into contracts with infrastructure providers to replicate the cable product. This tends to reinforce the argument that pricing arbitrage for access to the Internet is the dominant effect.

4.2.3 Shortage of Applications

Having eliminated all other possible explanations for low residential broadband uptake in New Zealand, and the low levels of data transfer overall in both the business and residential markets, the remaining explanation for both low levels of purchase reflecting delays in the substitution of dial-up with broadband is that, as yet, there are few applications for which the productivity benefits of substituting overcome the additional costs of access. If this is the case, then no amount of infrastructure (supply side) intervention is going to alter the situation. Interventions to raise productive broadband usage thus must relate to demand side factors. This can only occur by increasing the range of productivity-raising applications requiring information transport from which

[112] Whilst technically feasible, it is yet to be proven that it is economically sustainable for providers of entertainment content to distribute it satisfactorily using unbundled as opposed to owned infrastructure, due to the unique economic characteristics of information content – specifically the fact that it has high fixed costs of creation and near zero costs of reproduction [Hazlett, Thomas W.; and George Bittlingmayer. 2001. *The Political Economy of Open Access*. Brookings Joint Center for Regulatory Studies Working Paper 01-06.]. Furthermore, the total amount of content created may be less. Generally, the ability to recoup an investment on information content creation requires control of both the content and the delivery mechanism. This explains why newspaper chains, for example, generally require unique distribution for their stories within a single newspaper, rather than 'blending' stories from a variety of sources into a single infrastructure (a solitary edition, for example, containing both Fairfax and Murdoch stories). It is the returns from selling the physical paper that generate the certainty for content creators, who have made high fixed cost but low reproduction cost information products. Without certainty from the newspaper that the returns from sale of the physical paper will be collected from the end consumer, freelance content creation will not occur. If the cost of the infrastructure (the newspaper) is small compared to the value the consumer places on the information content, then multiple infrastructures will be purchased (many people purchase 2 or more daily newspapers). The information creator has incentives to integrate content production and infrastructure (even 'freelance' journalists become associated with one newspaper chain rather than multiple).
Rather, the model that appears to have emerged in practice in environments where LLU exists and content bundling is not expressly prohibited is common ownership of competing platforms by consortia of content and infrastructure providers (as occurs in Australia), with its attendant implications upon the depression of broadband uptake [OECD (2001) *op. cit.*]. It is indeed possible that an LLU environment enabling the owner of the solitary cable infrastructure in New Zealand to assume a range of property rights to an otherwise competing infrastructure (telecommunications) might effectively achieve via regulatory fiat the same penetration-limiting circumstances that common ownership of competing infrastructures has induced in Australia, Denmark and other such OECD countries [OECD (2001) *op. cit.*], in addition to any reduction in competition that may occur as a result of reduction in investment in the existing infrastructure.

users may select. These applications must embrace new ways of using information, rather than merely creating more content from which users can select within their already constrained budgets of cash and time. In the business sector, this may entail sector-driven initiatives in areas such as health and education; in the residential sector it probably requires developing information exchanges that are not constrained by human consumption bottlenecks, and which offer benefits greater than the range of benefits residential users currently enjoy.

Most importantly, however, solving the applications shortage is a challenge best addressed on the demand side. Endeavouring to encourage application development by oversupplying infrastructure will inevitably result in new applications being created. However, there is a very strong probability that the applications developed as a result may not be the most efficient use of inventive and innovative energy. Focusing all inventive effort on making 'square-shaped cargoes' merely because 'square-shaped trucks' are oversupplied may divert effort away from developing even more valuable cargoes of different shapes, the trucks for which have not yet even been invented. If the benefits foregone from these new products exceed the benefits of the 'square-shaped' cargoes, then the result is lower productivity than might have otherwise been achieved, and a welfare loss to society.

Furthermore, the applications solution need not be focused merely upon the productivity enhancements arising from Internet-based information exchange. Internet application productivity benefits arise from the exchange of information between physically separate entities. However, Internet-based information exchange comprises only a very small proportion of the total amount of information moved. In the United States, of all bandwidth available, only 2% is required for Internet transfers (external transfers) – the remaining 98% of capacity is used for dedicated point-to-point transfers within firms and directly linked entities[113]. When accounting for the shared use of the resource by Internet users, approximately 90% of information transferred is internal. New Zealand data show that 90% of CityLink's capacity is dark fibre linking facilities directly. Only 10% is used for Internet-like transmission. If the vast majority if information transfer relates to internal information, then applications offering more productive ways of using this internal information may provide greater benefit per research dollar than the small quantity of external information that apparently are used between entities. This implies research into how information is used is a necessary prerequisite to any further policy development with respect to promoting the use of ICTs.

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[113] Galbi, Douglas. 2000. *Growth in the "New Economy": U.S. Bandwidth Use and Pricing Across the 1990s.* Washington: Federation Communications Commission

Implications for Policymakers

In conclusion it appears that:

- New Zealand exhibits high Internet use;
- Internet penetration is high;
- Broadband is widely available in New Zealand;
- Choice of broadband platform exists for most New Zealanders;
- Business broadband penetration is very high by world standards;
- It is only residential broadband penetration that is low relative to OECD figures;
- Residential and business broadband prices compare favourably with overseas counterparts;
- Residential DSL consumption per customer is very low, even for low-priced products with generous downloading caps;
- Despite claims of consumer perception of the value of broad band's speed, at volumes currently exchanged, the time saving to New Zealanders from broad band's transfer speed is negligible;
- Substitution decisions are made on the basis of other factors – principally application value and pricing arbitrage in accessing the Internet;
- Low dial-up prices bias residential users to access the Internet using this technology, despite DSL prices comparable to other countries with higher broadband penetration;
- Low dial-up prices and low DSL exchange volumes together suggest a shortage of applications requiring the capabilities of broadband which the customers value sufficiently to pay the small price premium – regulatory intervention on the supply side is impotent to address this issue;
- Widespread availability of cable television content and infrastructure bundles is the single most significant differentiator between New Zealand's residential market and comparison countries (noting South Korea is not a viable counterfactual due to the differences in copyright enforcement);
- Pricing arbitrage to access the Internet, and absence of cable content bundles appear to be the main factors depressing residential broadband uptake in New Zealand;
- Ultimate accrual of benefits lies with the utilisation of existing applications and the creation of new ones. Any direct economic or social benefits from supply-side regulatory intervention will be small and transitory compared with the creation and use of applications. An apparent current worldwide shortage of such applications even in countries where extensive supply side regulatory intervention exists underlines that technology availability will not be the primary driver of application creation and consequent benefit accrual.

There is little evidence of a widespread market failure in the provision of Internet access services in New Zealand.

NZ has achieved almost every aspect of the ***environment*** that the OECD claims is required to ensure the accrual of economic and social benefits of an information economy – widespread availability of multiple competing technology platforms, widespread use of the Internet, comparatively low prices of all Internet access technologies, and wide availability of the competing broadband platforms. Alternative platforms exist in almost all areas, with the exception of perhaps a small number of rural localities.

There is only one statistic that is apparently anomalous – the number of broadband connections per 100 New Zealanders. Yet even this statistic masks the fact that New Zealand exhibits world-leading penetration of broadband in the business sector, and especially in the SME business sector that is most likely to benefit from broadband. ***The most likely explanation for the high observed levels of business uptake of the technology is pricing arbitrage due to the per minute call cost faced by dial-up users, and the variety of broadband packages enabling business customers to select and pay for a data exchange volume that meets their needs, without having to subsidise heavier users via flat-rate plans***.

If there is a problem, it relates to broadband penetration in the residential sector. ***The most likely explanation for New Zealand's low level of residential broadband uptake is a high relative price of broadband compared to dial-up access. However, this arises not because of expensive broadband, but an abundance of cheap, high quality dial-up access.***

However, it is noted that a shortage of applications is probably constraining demand growth. This is not a problem unique to New Zealand, as it has been noted in other countries[114].

[114] Ferguson (2002) *op. cit.*; Haring, John; Jeffrey H. Rohlfs and Harry M. Shooshan. *Propelling the Broadband Bandwagon*. Bethesda, Maryland: Strategic Policy Research, 2002. p 76

1. The Existing Policy Regime Has Delivered This Outcome

The New Zealand Internet access market environment described above has been achieved almost entirely under the policy regime prevailing prior to the Telecommunications Act 2001. Absence of overt regulatory intervention with the intention of influencing prices to encourage overall broadband penetration in isolation from the accrual of benefits from productive use of information exchange has delivered the environment most likely to encourage long-term productivity growth from the use of information exchange.

Faced only by the characteristics of the market, New Zealand broadband providers have responded by offering the most advantageous pricing options (multiple pricing and downloading options to cater for varying exchange demands) in the business sector. The variety of packages offered ensures that businesses of all dimensions can access services and pay prices appropriate to their level of demand. This is the most efficient way of offering services, as flat-rate plans require low users to pay more than the costs of their demand, and hence subsidise high users. Pricing arbitrage with respect to the ratio of broadband prices to dial-up has also favoured business users. Again, this is efficient in respect of generating measurable productivity enhancements, as measured productivity growth will almost certainly be generated by the business sector.

Moreover, there is no expectation in the current pricing regime that one sector or one group of users should subsidise another via universal flat rate pricing plans. If each user is encouraged to pay the full cost of information transport demanded, then the amounts of information transported will be closer to the efficient level than when large cross-subsidies via flat-rate plans encourage over-use by some users at the expense of others. This is especially relevant in the residential market, where the vast majority of users (even on flat-rate plans) have small usage demands. It is efficient that heavy users should limit their use of a scarce costly resource (the Southern Cross Cable) to that which actually generates benefit or utility in excess of its marginal cost.

Thus, if increases in productivity are indeed the objective of encouraging use of broadband, then the New Zealand market has evolved to meet this objective. This is not surprising, given that each individual decision about substitution of technology is ultimately underpinned by enhancements in productivity.

However, if this objective is overridden by a policy objective to deliver increased utilisation of a specific technology in isolation from the productivity-enhancing factors, then there is no guarantee that the end result is indeed productivity enhancing. The result of such a policy may be over-investment in infrastructure capacity that lies idle awaiting a use. Indeed, there is evidence that the financial difficulties faced by telecommunications companies in the United States may be attributed to just this type of intervention[115]. These difficulties have been largely avoided in New Zealand, as no such overt policy objectives with associated supply-side regulatory intervention have been employed to date.

2. What About LLU?

It is apposite, therefore, to consider what this finding means in advance of the Telecommunications Commissioner's recommendation on Local Loop Unbundling. One of the primary justifications given for LLU is that it is purported "to increase penetration of broadband services"[116]. Yet, if the benefits of Internet information exchange are already being gained, should it matter which technology is used?

As there is no evidence of a supply shortage throughout the country, up to six competing broadband platforms, and little evidence of a broadband pricing problem relative to other markets for services of like quality, what more can LLU offer? LLU is unable to address the fundamental application shortage problem so the only significant outcome it may induce may be to influence broadband pricing on the telephony network, a network that will never, due to its technological limitations, reach all New Zealand homes and places of business. However, eencouraging a 'price war' on the telephony network may undermine the financial viability of the competing infrastructures capable of providing a truly national service (wireless, satellite, mobile telephony), threatening their existence, with the net result that rural connectivity in the long run may be decreased rather than increased. This will inevitably result in a reduction of competition the New Zealand market (fewer infrastructures) and an increase in market power of the telephony network as Internet information transport provider if it results in a consolidation on only one infrastructure (telephony) with a limited number of operators forced to co-operate via regulatory fiat to provide products and services to consumers.

Whilst pricing intervention may increase substitution by residential consumers as a consequence of pricing arbitrage, it is debatable if there is a tangible productivity-based justification for encouraging this action at the current point in time. Given the very small number of residential users consuming

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[115] Merrill Lynch. 2002. *Telecom Sector Review 20 November 2002.* Merrill Lynch Asia Pacific Telecommunications.

large quantities of data exchange, pricing arbitrage will likely to confer a disproportionate benefit on these heavy users who are currently being encouraged to cover their additional costs. Marginal users, who consume very small information exchanges at a cost of production far less than the price they are expected to pay, must fund this benefit.

In the absence of any concrete evidence that LLU of itself is capable of increasing productive output, the overriding policy question facing the Telecommunications Commissioner must be: 'is it worth the risk of jeopardising all of the positive measurements New Zealand has already achieved in order to find out if the policy works in stimulating the one proxy in which New Zealand currently appears to be lagging, and which of itself is of dubious merit in assessing long-term productivity gains?'

3. Conclusion

The New Zealand 'light-handed' regulatory environment, with little direct regulatory intervention into the market for broadband services, has enabled perhaps the only 'live counterfactual' to the extensive intervention in other OECD countries, such as the United State, Australia and the European Union, where policies specifically targeted at promoting broadband penetration have been applied. This paper shows that, in terms of applying resources to greatest productive effect, there is little evidence of emergence of a supply-side market failure.

Rather, the relative absence of intervention, combined with the unique opportunity to observe the development of broadband information exchange markets in the absence of a distorting content-transfer product bundle such as cable offers, has provided an almost unique opportunity to observe the outcomes of the intersection of supply and demand for purely information transfer services, as offered by the Internet. The results of this study lead to the primary conclusion that worldwide, there is probably a shortage currently of productivity-enhancing applications requiring the speed and capacity characteristics of broadband, and that overall, broadband penetration statistics are almost solely a result of pricing arbitrage in order to access the Internet GPT.

Low broadband uptake is therefore, in New Zealand at least, not a supply-side problem. The 'solutions' to 'fixing' it lie on the demand side. Infrastructure regulation is impotent to solve this

[116] Issues Paper para 396 p 98.

underlying ‘problem’, as it arises from a shortage of cargoes awaiting transportation. More trucks and more roads will not fundamentally alter this scenario.

The findings from the New Zealand counterfactual pose cogent issues for policy-makers in other jurisdictions. Whilst flat-rate pricing regimes have been favoured internationally, variable pricing and usage products in New Zealand have made it economically feasible for small businesses (those deemed most likely to benefit from the use of broadband) to access the benefits of the technology without having to incur the costs of subsidising larger, heavier users. This is evidenced in New Zealand’s very high broadband penetration rates for businesses. Other countries struggling to stimulate business uptake may take note of this significant New Zealand finding.

Moreover, the New Zealand findings have drawn into sharp relief the issues of whether it is desirable to emphasise innovation, research and development to support residential uptake of the technology at the expense of business uptake, given that productivity benefits are largely provided by the business sector. Where scare resources must be allocated, prioritising business research and development offers larger productivity benefits. Yet ‘national performance’ in the ‘information economy’ race tends to be dominated by measures that reflect residential use of the technology. However, in New Zealand, absent policy interventions focused upon expanding residential consumption, broadband product innovation has occurred principally in the business sector. If incentivising innovation for the benefit of the residential sector removes resources from innovating for the business sector, penetration statistics will certainly increase, but measurable productivity gains may be scarcer. Furthermore, if the vast majority of information transferred pertains to internal business movements, the scope for productivity gains may be greater in applications that are not even Internet-based.

The challenge facing policy-makers in the light of these findings is now one of stimulating solutions not to the infrastructure supply-side problem, but to the applications demand-side problem.

Appendix 1. Performance Measurement in an Information Economy

This Appendix was written as background for a submission prepared in response to the Commerce Commission's Local Loop Unbundling issues paper. It is reproduced here for the purposes of identifying the inadequacies of using a solitary metric – broadband penetration – as the indicator of potential to benefit from the use of the Internet and Electronic Commerce.

The Issues Paper identifies the main rationale underpinning LLU adoption in most jurisdictions is "to increase penetration of broadband services"[117]. However, no substantiation is offered as to why increased broadband penetration *per se* is a desirable policy objective, given that there is considerable theoretical debate and disagreement over how, why or even if, universally available fast, cheap Internet access contributes to the accrual of economic and social benefits.

Whilst the exact relationships between infrastructure availability and the accrual of measurable economic and social benefits are as yet unclear, there is a growing body of empirical and theoretical research that casts significant doubt upon the efficacy of using any solitary metric, including broadband penetration, to proxy either actual or potential economic or social gains from the Internet. If the overarching policy objective of the Commerce Commission is to promote the long-term benefit of the end-users of the Internet, which encompasses many more networks and platforms than the telecommunications infrastructures currently governed by the Telecommunications Act, then is the Commerce Commission justified in using broadband penetration as the solitary proxy by which this benefit, either actual or prospective, is to be measured? If it cannot, then the entire basis for promoting LLU as a tool to increase economic and social benefit by promoting broadband penetration is flawed.

A.1.1 Theoretical Linkages: Broadband Penetration and Consumer Welfare

The mechanisms via which computers contribute to measured economic and social performance are far from clearly understood[118], and measured productivity improvement attributable to the

[117] Issues Paper para 396 p 98.
[118] See for example:
Abramovitz, Moses and Paul A. David. 2001. *Two Centuries of American Macroeconomic Growth From Exploitation of Resource Abundance to Knowledge-Driven Development.* Stanford Institute for Economic Policy Discussion Paper Number 01-05.
Brynjolfsson, Erik and Shinkyu Yang. 1999. *The Intangible Costs and Benefits of Computer Investments: Evidence from the Financial Markets.* Working Paper.
Greenwood, Jeremy and Boyan Jovanovic. 1998. *Accounting for Growth.* National Bureau of Economic Research Working Paper 6647.

considerable capital investment in computers over the past 30 years has fallen far short of original projections[119], giving rise to Solow's famous paradox "we see computers everywhere but in the productivity statistics"[120]. Yet the accrual of benefits from utilisation of broadband technologies is contingent almost exclusively upon the utilisation of computer-based applications[121]. To date, accurate attribution of productivity benefits to investment in Internet infrastructures and Internet-based applications has been equally as problematical as that for investment in computers[122], giving rise to the suggestion that the 'computer productivity paradox' is metamorphosing to incorporate a similar 'broadband productivity paradox'[123].

The purpose of this section is to raise theoretical debate about the validity of penetration of broadband connections per head of population as an appropriate policy target, and the ability of LLU to deliver on this metric. This debate is crucial in determining the basis for estimating the extent of public benefit and detriment as a consequence of adopting an LLU policy in New Zealand. If broadband penetration is a poor proxy for determining social benefit and detriment, how reliable is a policy that delivers only that proxy in delivering the ultimately desired gains? What are the costs and risks associated with the extent of accuracy of the proxy? And how much weight should be given to policies that deliver the broadband penetration proxy over policies that deliver other proxies that may be equally or more significant in delivering the ultimate objective?

Greenwood, Jeremy and Mehmet Yorukoglu. 1997. 1974. *Carnegie-Rochester Conference Series on Public Policy.* 46:49-95.
Howell, Bronwyn. 2001. *E-Commerce Performance Measurement for New Zealand*. Prepared for the Ministry of Economic Development, August 2001.
Quah, Danny. 2002. *Technology Dissemination and Economic Growth: Some lessons for the New Economy*. Centre for Economic Policy Research.
Triplett, Jack E. 1998. *The Solow Productivity Paradox: What do Computers do to Productivity?* Brookings Institution.
Triplett, Jack E.; and Barry P. Bosworth. 2000. *Productivity in the Services Sector*. Washington: Brookings Institution.

[119] Jorgenson, Dale W.; and Kevin J. Stiroh. 2000. *Raising the Speed Limit: U.S. Economic Growth in the Information Age*. Harvard University Working Paper; Oliner, Stephen D.; and Daniel E. Sichel. 2000. *The Resurgence of Growth in the late 1990s: Is Information Technology the Story?* Mimeo, Federal Reserve Board.

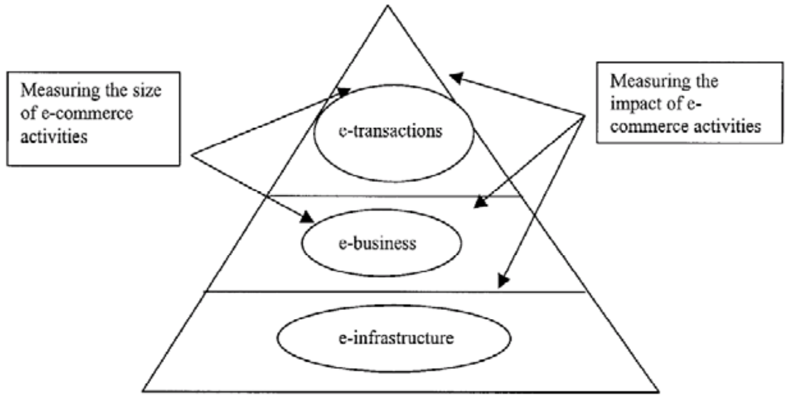
[120] Solow, Robert M. 1987. We'd better watch out. *New York Times Book Review* (July 12): 36.

[121] Howell, Bronwyn. 2002. Broadband Uptake and Infrastructure Regulation: Evidence from the OECD Countries. *Communications and Strategies*, 47:33-62.

[122] Barua, A., Whinston, A. and Yin, F. 2000. *Not all Dot Coms are Created Equal: An Exploratory Investigation of the Productivity of Internet Based Companies.* University of Texas Center for Research in Electronic Commerce working paper.

[123] Howell (2002) *op. cit.*

Figure A1. OECD Measuring e-Commerce Size and Impact



Source: OECD.

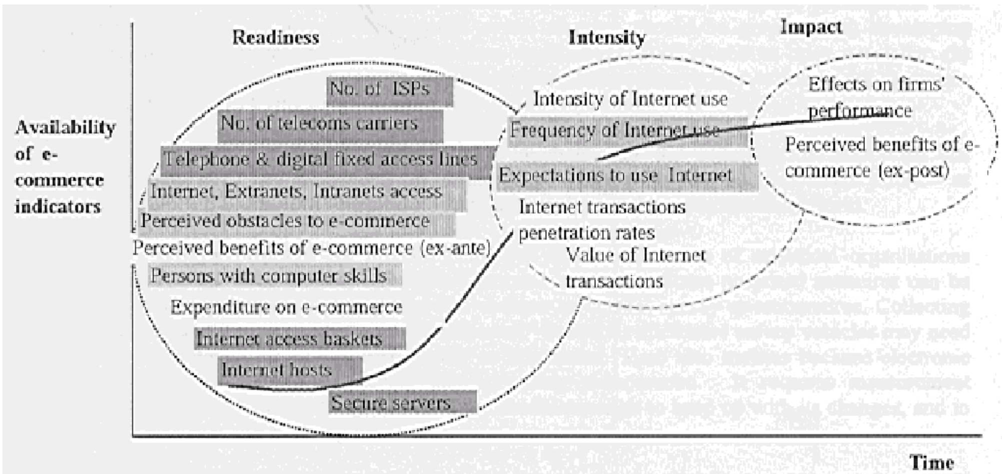
The use of broadband penetration as the principal metric for measuring delivery of the economic and social benefits of the Internet stems from the creation of the 1997 OECD document *Measuring Electronic Commerce*[124]. The OECD proposed that electronic information exchange infrastructures form the foundation for accruing the benefits of electronic commerce, as shown in Figure A1, on the basis that without the enabling infrastructures, no benefits will accrue[125]. This framework was expanded in 1999 to develop a time-bound framework whereby the national and international benefits of electronic commerce would emerge over time as countries passed through the three stages of Readiness for electronic commerce, Intensity of Internet use and reaping the Impacts of the policy[126]. These documents together propose infrastructure penetration metrics as the best available proxies for measuring performance, as per Figure A2.

From 1997, the OECD began collecting infrastructure penetration statistics in accordance with these frameworks. To date, the OECD statistics and subsequent reports based upon them have been dominated by telephony-based Internet access proxies, almost certainly as a combined consequence of history and data availability rather than derivation from methodological accuracy. In 1997, almost all Internet access from the end user perspective (residential consumers and businesses) was achieved via either dial-up modem across the PSTN or T-1 data lines leased from telecommunications providers. Hence, telecommunications was the logical infrastructure for proxying value creation from connectivity in 1997. In addition, information on telecommunications

[124] Howell (2001) o*p. cit.*
[125] *Ibid*, p. 19.
[126] Colecchia, Alessandra. *Defining and Measuring Electronic Commerce: Towards the development of an OECD methodology*. Conference on the Measurement of Electronic Commerce, Singapore 6-8 December 1999.

infrastructure penetration is a tangible measure[127], readily available (usually from regulatory agencies), is approximately standardised across the OECD countries and the data collection methodology remains reasonably stable over time. This has enabled reasonably timely and reliable cross-country and time series comparisons to be undertaken.

Figure A2. Availability of e-Commerce Indicators Across OECD Countries



NOTE: The darker shade indicates availability across all OECD countries; the lighter shade indicates availability across a limited number of countries (more than three); no shade indicates a very limited availability (one to three countries). *Source*: OECD.

Inter-country analysis has subsequently been undertaken almost exclusively using as its basis infrastructure proxies that reflect the availability of data as much as they accurately capture the underlying metric being measured – economic and social benefits arising from the use of electronic commerce. However, as new technological platforms are developed via which end users can access the Internet, and as these new technologies enter production, sole reliance upon telecommunications infrastructures as proxies for benefit measurement becomes increasingly less credible and reliable.

As an alternative, Boles de Boer, Evans and Howell (2000)[128] suggest that no single infrastructure proxy alone can be used reliably, without testing its logical consistency in a form of triangulation with a variety of other proxies. Many proxies pointing together in a similar direction provide a context within which to assess both the validity of, and consequently the weight that can be given to, the result of polling any one proxy. Moreover, consistency amongst a variety of proxies makes it

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[127] It measures something physical that can be easily counted and is hard to dispute – Lev, Baruch. 2001. *Intangibles: Management, Measurement and Reporting.* Brookings Institution Press.
[128] Boles de Boer, David; Lewis Evans and Bronwyn Howell. 2000. *The State of e-New Zealand* http://www.iscr.org.nz

easier to identify anomalies and interesting deviations within the collection of proxies used, and thereby isolate possible explanations or identify useful areas of inquiry.

Crawford (1997)[129] identifies the primary functionality of the Internet as communication, mediated through digital information content transmitted via network usage of bandwidth. By combining Crawford's definition of the Internet, a consistent multi-proxy approach, a recognition of the dynamic nature of the technology adoption process and the presumption that the accrual of Impacts begins as soon as Readiness enables Intensity to occur, Howell (2001, 2003)[130] has developed a framework that links infrastructure availability (Connectivity, measured as infrastructure penetration) with human capital and application availability (Capability) to derive utilisation measures (Uptake) to deliver benefits, determined by increases in productivity (Performance) resulting from the application of transferred information – Figure A3. However, Connectivity, Uptake, and the subsequent benefits are not possible without investment having first occurred to create the infrastructure. Connectivity is itself dependent upon another metric – *Coverage.* Infrastructure coverage defines the most basic indication of the ability to generate benefits, but coverage does not automatically lead to Connectivity (measured as *Penetration*), let alone Uptake (*Utilisation)* of the technology, as utilisation requires the presence of productivity-generating information-using applications.

Whilst productivity benefits remain difficult to measure, Howell argues that all three elements (Connectivity, Capability and Uptake) are required to yield the performance benefits. Electronic commerce Uptake (proxied as information movements over electronic infrastructures) provides the best indication of benefit accrual, as end users will not adopt electronic information exchange methods and applications unless the net benefits of doing so exceed those achieved using forerunner technologies and applications (that is, a productivity improvement or increased consumer welfare ensue from substituting the new technology for an existing application).

This model also recognises the competitive process as the dynamic interaction of supply-side and demand-side factors. Whereas infrastructure connectivity statistics proxy productivity improvements from the 'bottom up' supply side perspective, consumer purchases of technologies are determined principally by assessing whether adoption of an application increases productivity in the

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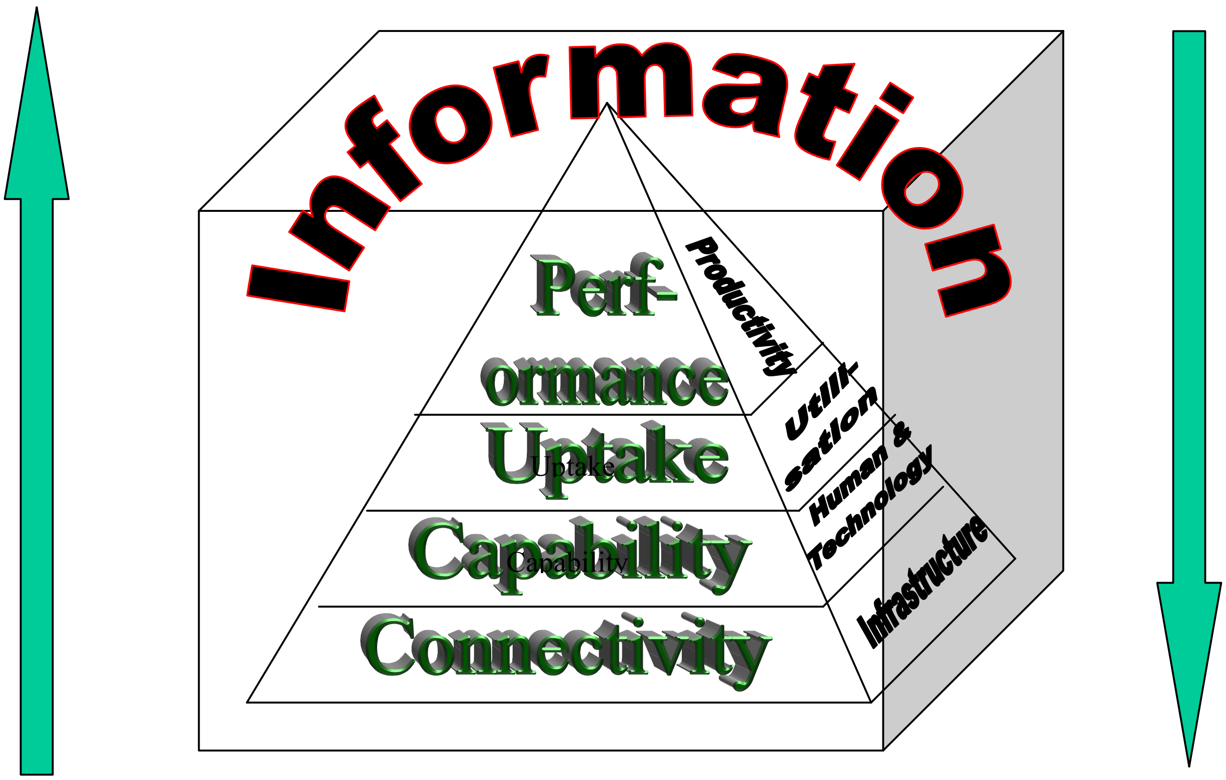
129 Crawford, David W. 1997. Internet Services: A Market for Bandwidth or Communication? Chapter in McKnight, Lee W.; and Joseph P. Bailey (eds). *Internet Economics*. Cambridge, Massachusetts: Massachusetts Institute of Technology. p 380.

first instance. Benefit is derived from use of the application, which requires use also of a technology, but availability of the technology serves as a conditioner of the ability to make the choice to utilise it. This is the demand side approach. Consistency of proxies, as per Boles de Boer, Evans and Howell (2000), requires additional consistency in this dimension.

Figure A3. Electronic Commerce Performance Measurement Framework



Supply Side Lens Demand Side Lens

As can be seen in Figure A2, telephone and digital access lines and Internet access comprise only two components of the eleven Readiness indicators identified by the OECD. Furthermore, the accrual of benefits, measured in the Impact end of the schema, presumes far more than just connectivity to a solitary technology as the determinant of let alone the measure of potential welfare gain. This is recognised in multi-factor indicators such as the Economist Intelligence Unit's E-Readiness Rankings[131], where fixed and mobile telephony services, technology-agnostic access to the Internet, and the affordability, quality and reliability of these access mechanisms, together with access to computers, are weighted at only 25% in the construction of the indicator.

[130] Howell (2001) *op. cit.*; Howell, Bronwyn; and Mark Obren. 2003. *Telecommunications Usage in New Zealand: 1993-2002.* ISCR Research Paper.

A.1.2 Market: 'Information' or 'Platform-Based Information' Transfer?

In addition to identifying the dynamic interactions of supply and demand side factors and the roles of infrastructure availability and utilisation proxies in assessing the extent of productivity benefits, the Howell measurement methodology brings into sharp relief the fact that demand for telecommunications infrastructures is a derived demand, based upon the demand for information to be transported to meet the needs of end user applications[132]. Information is created and consumed independent of the telecommunications network that transports it, analogous to the cargoes carried by trucking firms between producers and consumers, or between participants in a supply chain. Whilst trucks and the roads on which they travel are important, they comprise just one component of the value chain[133].

Thus, information is the product of central concern in this transportation market. Alternative technology platforms (of which telecommunications is but one) compete to move information, using vehicles of differing capacity depending upon customer requirements. It appears far too simplistic to expect to understand the dynamics of the marketplace for information transport merely by attempting to understand the dynamics of one mode of information transfer.

A.1.3 Telecommunications as Information Transportation

At its most basic level, digitised information is the cargo of telecommunications. Fixed and mobile voice telephony infrastructures enable information of one type – human-to-human voice communications - to be transported. Likewise, computer-to-computer information transfers over the Internet can also be handled. In this sense, voice traffic is a subset of information traffic. Specific technologies for handling interfaces – e.g. fixed line voice, mobile voice – offer alternative ways of loading and offloading the same information to different locations and applications. The local loop, T-1 leased lines, fibre, wireless and other technology platforms offer alternative networks over which computer to computer information can be transferred, either over the Internet or directly. In the trucking analogy, choosing a platform is like choosing road over rail.

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[131] Economist Intelligence Unit. 2003. *The 2003 e-Readiness Rankings*. London: EIU.
[132] Bailey, Joseph P. 1997. The Economics of Internet Interconnection Agreements. Chapter in McKnight, Lee W.; and Joseph P. Bailey (eds). *Internet Economics*. Cambridge, Massachusetts: Massachusetts Institute of Technology.
[133] Porter, Michael. *The Competitive Advantage of Nations*. London: McMillan, 1990. p 41

In this context, if road (telecommunications network) is selected, dial-up modems and DSL broadband represent merely two alternative sub technologies via which information can be transferred using the chosen platform - the local loop. One (broadband) is merely faster and capable of moving physically larger quantities of information than the other. Choosing broadband or dial-up rests upon which speed and capacity of truck is required to carry out the transportation task most efficiently (e.g. cost, timing, reliability) in relation to the other parts of the value-creating production function that the information is being transported to facilitate. This is a function of the application, not the transport mechanism, and it is highly unlikely that one combination of transportation technologies will be optimal for all applications.

LLU's ability to influence economic growth via this market definition is analogous to increasing efficiency in the transportation market by manipulating the market for Mack trucks. It will only work if there is a problem in the transport market that is suitable to be solved with Mack trucks.

A.1.4 Role of Application Base

Hence, the Internet is a subset of information transportation infrastructure, with broadband and dial-up being substitute Internet transportation mechanisms. Application use of information will dictate the quantity, quality, speed and timeliness of information exchange requirements, thereby setting the parameters for selecting the appropriate technologies. Application-based demand is the necessary condition for information transfer to occur. Absent applications, no transfer is required, irrespective of how available the transport technologies may be[134].

Applications of different types necessarily result in different transport choices. Given that alternative transport choices exist, the user will choose the information transport method that yields the greatest productivity of the application. Substitution from one to the other will occur only if the substitution is productivity-raising. Given that transportation costs are only a very small part of the productivity deriving from the use of information, the ability of transport infrastructure providers to influence the choice of technology is relatively small, and usually confined to price (e.g. bundles of voice and Internet telephony, pricing arbitrage between platforms, flat-rate pricing). Much more significant in the decision-making process in the choice between broadband and narrow-band technologies are the number of applications available to be used, the number of times each

[134] Howell, Bronwyn. 2003. *'Solving' the 'Broadband Problem': a Challenge for Regulators or Producers?* Wellington: ISCR.

application is used, the application learning levels of the user and the user's valuation of time[135]. It is noted that empirical analysis in the United States shows that Internet users place a very low value on their time, as they are prepared to spend only in the order of 0.5c a minute for faster downloading during leisure hours[136]. The transport provider will have significant ability to influence the technology choice only if the operator can influence these user factors (e.g. influencing the application base by offering cable television entertainment content in an Internet access bundle)[137]. LLU is unable, by itself, to influence the application base or any of these other user-determined characteristics.

However, there is a mounting body of evidence suggesting that the number of applications requiring the fast transfer speeds and greater transfer capacity of broadband is small, and the users who derive benefit from them not necessarily large in number. Haring *et al.*[138] (2002) observe "we would put our chips on demand rather than supply constraints, and on the relative paucity of applications as being the main 'culprits' restraining [broadband] take-up", whilst Anderson *et al.* (2001)[139] (in the UK), Howell (2003) and Howell and Obren (2002) (in New Zealand) and Varian (2002)[140] (in the US) all find the applications used by mature and experienced residential broadband users are confined to a base of email, web browsing, entertainment downloading, interactive gaming and chat, much of which is not information transfer-intensive. The business application base is even narrower, comprised of email, web browsing, limited dedicated applications such as B2B exchanges and supply chain integration[141]. Moreover, Howell and O'Connell (2003)[142] find that even in the extremely mature business broadband user market, aside from a limited number of information-intensive specialist users such as filmmakers, radiography practices and ISPs, the application base is small, with few perceived applications with great future productivity benefits being considered for use in this market.

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[135] Howell and Obren (2002) *op. cit.*
[136] Varian, Hal. 2002. The Demand for Bandwidth. Chapter 4 in Crandall, Robert W.; and James H. Alleman (eds). 2002. *Broadband: Should We Regulate High-Speed Internet Access?* Washington, D.C.: AIE-Brookings Joint Center for Regulatory Studies.
[137] Howell (2002) *op. cit.*
[138] Haring, John; Jeffrey H. Rohlfs and Harry M. Shooshan. *Propelling the Broadband Bandwagon*. Bethesda, Maryland: Strategic Policy Research, 2002. p 76
[139] Anderson, Ben; Caroline Gale; Mary Jones and Annabel McWilliam. Domesticating Broadband – what consumers really do with flat-rate, always on and fast Internet access. *BT Technology Journal* 20(1), 2002, 103-114.
[140] Varian (2002) *op. cit.*
[141] See, for example Clark, Delwyn; Stephen Bowden and Patricia Corner. *Adoption and Implementation of E-Business in New Zealand: Comparative Empirical Results for 2001 and 2002*. Hamilton, New Zealand: Waikato Management School. 2002
[142] Howell, Bronwyn; and Chris O'Connell. 2003. *Broadband Deployment and Productivity: An Exploratory Study of Mature Broadband Users*. Wellington: ISCR.

A.1.5 Connection versus Utilisation

Hence, given that application-based use of transported information determines the extent of economic value derived in an information economy, and together applications and infrastructure underpin the necessary demand supply and transportation conditions for creating that value, the question is 'which metrics offer the best proxy for potential future value creation?' Infrastructure penetration figures alone are clearly inadequate, and indeed can be potentially quite misleading if taken in isolation. A connection to an infrastructure (measured as infrastructure Penetration) does not necessarily result in Uptake (*Utilisation,* measured as application-determined quantities of information transferred per connection). The benefits of connection accrue from utilisation, not connection. Hence, utilisation measures, presumably determined by productivity-generating use of applications, reflecting the interaction of supply-side availability of infrastructures and demand-side requirements for productivity-raising information exchanges, provide a more robust proxy for Performance.

A.1.6 Is Broadband Penetration Per Se a Sound Policy Objective?

Whilst the analysis methodologies all recognise the role of electronic communication infrastructures as necessary to the accrual of information-related productivity benefits in an 'Information Economy', it is far from clear that widespread connectivity to infrastructure of a specific speed or capacity (broadband) or of a specific technological base (telecommunications, as defined in the Issues Paper) in isolation from utilisation is sufficient as a stand-alone policy metric in assessing relative national productivity performance, let alone desirable as a targeted policy objective in its own right.

Nonetheless, policymakers in most OECD jurisdictions have adopted 'increasing the penetration of broadband technologies' as the primary policy objective underpinning their 'Information Economy' initiatives[143]. This policy imperative has translated into regulatory intervention in the form of LLU as this has been perceived as a strategy that has the potential to deliver increased performance in this metric, in the short term at least.

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[143] For example,
Australia in NOIE. 2002. *The Current State of Play*. Canberra: NOIE.
New Zealand, in MED. 2000. *Ministerial Inquiry into Telecommunications.* Wellington: Ministry of Economic Development; and
The United States in FCC. 2002. Third Report In the Matter of the Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable And Timely Fashion, and Possible Steps To Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996. Washington: FCC
CC Docket 98-146

Broadband Internet access has attracted attention as the connectivity infrastructure metric of preference in the current policy debate, as broadband technologies are the fastest and most capable mass-market Internet information exchange technologies so far developed. As such, they are 'frontier technologies' which have the potential to deliver greater benefit to certain users in certain usage circumstances[144]. However, merely because a specific technology exists, it does not follow directly that universal uptake of the technology is required to generate optimum economic benefit. Does everyone need to invest in a Mack truck merely because it has the biggest cargo carrying capacity, or buy a Ferrari merely because it is fast, unless other factors indicate that this is an efficient investment strategy? A more appropriate assessment of infrastructure performance arises from asking whether it is possible for those for whom the investment makes economic sense to access and use the technology. Thus, measures of coverage and price may be better proxies than actual uptake. If a consumer actually needs the capabilities of a Mack truck or a Ferrari, can that consumer access the technologies at prices that enable appropriate use?

Individuals differ in their needs, tastes and objectives and select a portfolio of purchases within their budget constraints to maximise benefit, whilst firms will pursue a technology purchase strategy only if it increases profit (productivity). It is only if adopting a new technology increases individual welfare or firm productivity that the investment is justified[145]. Figure 3 illustrates how achieving these benefits in an Information Economy is contextually dependent upon the interaction of the availability of the technology, a need for the benefits offered by the technologies and the additional skills and resources (e.g. applications) required in addition to the technology to achieve the benefits. As with any investment strategy, optimal accrual of benefits requires the timing of investment in all necessary components to be co-ordinated. Investing too soon in an expensive technology in advance of the additional requirements being available may result in costly assets lying under-utilised while capability in the complements is acquired, with associated negative productivity consequences[146]. These outcomes are very real possibilities when pursuit of one metric (biggest, fastest, newest) is pursued in isolation from the other contextual elements.

If LLU is to be justified by achievement of such a single metric, there needs to be considerable certainty that benefit accrual is strongly contingent upon performance in that metric. Otherwise, no

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[144] Helpman, Elhanan and Manuel Trajtenberg. 1996. *Diffusion of General Purpose Technologies.* National Bureau of Economic Research Working Paper 5773.
[145] Howell and Obren (2002) *op. cit*.

matter how effective the policy is in delivering the metric, it will be impotent in delivering the ultimate objective.

[146] Jovanovic, Boyan and Dmitriy Stolyarov. 2000. Optimal Adoption of Complementary Technologies. *The American Economic Review.* 15-29.

Appendix 2. A Usage-Based Explanation for South Korea's High Broadband Penetration

This Appendix is an extract from the author's paper 'A New Zealand Response to the U.S. Broadband Problem'. It is repeated here as an illustration of the differences in applications that arise in countries that apply differing regulatory and legislative policies, which translate into significant differences in specific performance metrics. It also stands, as an example that emulation of the specific performance in a metric in which another country has excelled is not necessarily going to encourage the desired end result if the metric is a poor proxy of the desired outcome.

The most probable explanation for South Korea's high levels of broadband penetration lies in pricing arbitrage and application usage. DSL and cable broadband in South Korea are considerably cheaper than dial-up or leased line alternatives, biasing customers towards use of these technologies. For example, South Koreans face charges twice those charged by United States ISPs for 40 hours per month dial-up access, while twice the number of megabytes can be downloaded via DSL per $US1 in South Korea than in the United States[147]. Business use of DSL is also likely to be comparatively higher as leased lines prices for 2 Mbit/s lines in 2000 were the 3rd highest in the OECD. High residential (2nd highest in the OECD), and business (highest in the OECD) international telephony charges make Internet-based voice applications such as voice-over-IP attractive. Indeed, these applications enjoy high levels of use and are bundled with broadband services as part of the standard offerings by South Korean broadband providers[148].

More importantly from an applications perspective, however, is the analysis of what Koreans use their broadband connections for. Voice-over-IP aside, there is considerable evidence that South Korea's Internet and broadband uptake is attributable to residential rather than business demand. Whilst South Korea leads the OECD in broadband uptake and Internet subscribers per 100 inhabitants, it lies 25th out of 28 in the number of Internet hosts per 1000 inhabitants – a measure of domain name-linked computers connected to the Internet, and hence a measure of business uptake. Similarly, South Korea is 17th in web sites per 1000 inhabitants and 25th in secure servers (required for secure business information transfer, including secure payments)[149]. South Korean broadband purchase is almost certainly motivated by residential consumption, presumably entertainment. On the evidence of website statistics and secure server numbers, South Korean businesses do not appear to be creating and transporting significant amounts of business-related information, relative to other

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147 OECD (2001) *op. cit.* p 52.
148 *Ibid,* p 33.
149 OECD. 2001a.*Communications Outlook.* Paris: Organisation for Economic Co-Operation and Development Information Society. http://www.oecd.org/

high business-use ranking OECD countries. There is little evidence of significant quantities of web content being created in South Korea, or even that information is being consumed by businesses via secure servers. Thus, information content consumed via broadband connections must be either created and consumed entirely within the consumption sector in South Korea (e.g. interactive gaming), or created elsewhere.

Anecdotal evidence supports the contention that South Korea's broadband connection rate reflects high demand for English language video and audio content not available via the more usual broadcast channels. As South Korean law neither recognises nor enables enforcement of copyright granted in other jurisdictions in respect of video and audio material, there are few barriers to distribution of such material over the Internet. It is possible that South Korea's high broadband uptake may be in large part a consequence of this material being made freely available as a substitute for other more costly entertainment (e.g. pay video and pay cable television) in an environment where other entertainment substitutes are limited. Whilst in the short term this source of 'free' content may have had the effect of increasing South Korean broadband uptake, it adds little to measurable production for either South Korea or the country of content origin. Indeed, in the long term, it threatens to reduce the total world stock of Internet content and consequently national and international welfare[150].

In the case of South Korea, attempting to identify consistency of the proxies in light of the productivity framework results in the recognition of an anomaly that serves to put significant doubt into the credibility of broadband penetration as the sole statistic upon which to base a policy such as LLU. Rather, the triangulation serves as an added reinforcement of the presumption that the accrual of benefits in an information economy appear to be more strongly determined by demand-side application factors than supply-side infrastructure factors. Championing South Korean achievements as the model to which other countries must aspire, and utilising LLU as a means to replicate them, in isolation from considering the applications-based productivity implications may be disastrous for economic welfare in the long-term.

[150] Howell (2003) *op. cit.*