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

Telecommunications Usage in New Zealand: 1993-2003

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February 2003

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ISCR Working Paper BH03/02. The authors would like to thank the management of CityLink, Telecom New Zealand Limited and Xtra, who made data available for this analysis. In particular, they acknowledge the support of Roderick Deane, Neil de Wit, Mark Jenkins, Mike Lott and Chris Thompson for this project. They also would like to thank Lewis Evans for helpful comments on an earlier draft of this article, and Matthew Morrison for editorial assistance.

Executive Summary

This report suggests that the telecommunications market in New Zealand is surprisingly mature. We infer that the potential for growth is limited. There has been negligible growth in any of the number of fixed lines, either business or residential, since 2000. The number of residential lines is growing only in proportion to the number of households, indicating that household penetration is now saturated. Business line connections have been constant since approximately August 1999, although there is evidence of substitution away from Public Switched Telephone Network (PSTN) connections towards Independently Switched Digital Network (ISDN) connections in this market. ISDN is predominantly used for voice access by New Zealand businesses, with less than 0.1% of connections being used for data communications in January 2002.

While the number of mobile connections has been increasing, the total volume of voice-based telephony traffic (local and long distance fixed line and mobile) has settled at a constant level. Diffusion of mobile telephony sits at approximately 75% of the population over 10 years of age and, while still growing, the rate of growth appears to be slowing, implying that this technology is close to saturation as well. Average usage per mobile account is declining, indicating that the connection growth that is being recorded is related to users with lower than average demand for the service.

The data offer significant evidence of substitution between technologies (fixed line to mobile) for voice traffic. Thus, the presumption that mobile and fixed line telephony are separate markets must be questioned. This is particularly evident in the residential market; as the evidence supporting substitution coincides with the introduction of prepay accounts, which have been targeted at residential consumers.

The only telephony volume to show significant growth is that of dial-up Internet traffic. However, even this traffic is showing signs of slowing, both on measures of volume per fixed line and volume per Internet Service Provider (ISP) account. Diffusion of this technology is also widespread, with nearly 60% of households having connections. Thus, this technology may also be approaching maturity in the New Zealand market, as, with mobile technology, new connections represent users with lower than average demand. Whilst there is some evidence of substitution of dial-up Internet access technology with DSL in the business market, in the residential market substitution still appears to be dominated by learning effects associated with the applications that consumers use, and the individual valuation of time.

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Introduction

The telecommunications market operating in New Zealand over the past ten years has been distinctive. As the first telecommunications market in the OECD to adopt 'light-handed' regulation[1], its behaviour has been closely monitored[2] in order to assess the effectiveness of these regulatory policies. It is not the intention of this paper to revisit the 'light-handed' regulatory policy however it has enabled a market environment to develop in New Zealand that is relatively free of the demand and supply distortions induced by regulatory intervention that are evidenced in other markets.[3] Industry analyses[4] concur that at the end of 2002, New Zealand had high levels of telecommunications service coverage and uptake and low levels of infrastructure over-investment relative to other countries: "We continue to see a rational competitive environment … and a market that has escaped the consequences of significant capacity overbuild"[5]. It is noted, however, that since 2001, with the establishment of a Telecommunications Commissioner with a specific agenda to mediate and settle industry disputes, including setting prices, there has been a change to industry-specific regulation.

Simultaneously in this ten-year period, the telecommunications industry has undergone vast, technologically induced change, such as digitalisation of networks, commoditisation of mobile telephony and commercialisation of the Internet[6]. In particular, lower costs of data transmission, and the emergence of new computer-based applications requiring transfer of data between locations, have created significant new opportunities for telecommunications companies[7]. Yet the demand for telecommunications services is a derived demand[8] determined by the application-based demand for information transfer, be it voice-based or data-based,

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[1] Boles de Boer, David; and Lewis Evans. 1996. The Economic Efficiency of Telecommunications in a Deregulated Market: the Case of New Zealand. *Economic Record* 72(216): 24-39.
[2] E.g. MED, 2000; OECD, 2001
[3] Ferguson, Charles. 2002. *The US Broadband Problem*. The Brookings Institution Policy Brief # 105, July 2002 and Howell, Bronwyn. 2002. *A New Zealand Response to The United States 'Broadband Problem'*. NZ ISCR Working Paper BH02/07, http://www.iscr.org.nz/workinprocess/
[4] Morgan Stanley. 2002. *New Zealand Telecommunications Overview.* Hong Kong: Morgan Stanley Equity Research Asia Pacific and Merrill Lynch. 2002. *Telecom Sector Review 20 November 2002.* Merrill Lynch Asia Pacific Telecommunications and Salomon Smith Barney. 2002. *Weekly Wire* 14 October 2002.
[5] E.g. Morgan Stanley, 2002 ***ibid pg2***

[6] Taylor, Lester. 1999. Telecommunications Demand in Transition. Chapter 1 in Loomis, David G., and Lester D. Taylor, eds. *The Future of the Telecommunications Industry: Forecasting and Demand Analysis.* Norwell, Massachusetts: Kluwer Academic Publishers.
[7] Dineen, Chris; and Mohammed Abrar. 1999. Demand Modeling at Bell Canada. Chapter 6 in Loomis, David G., and Lester D. Taylor, eds. *The Future of the Telecommunications Industry: Forecasting and Demand Analysis.* Norwell, Massachusetts: Kluwer Academic Publishers and Kridel, Donald J.; Paul N. Rappoport; and Lester D. Taylor. 1999. An Econometric Study of the Demand for Access to the Internet. Chapter 2 in Loomis, David G., and Lester D. Taylor, eds. *The Future of the Telecommunications Industry: Forecasting and Demand Analysis.* Norwell, Massachusetts: Kluwer Academic Publishers
[8] Howell, Bronwyn; and Lisa Marriott. 2002a. *The State of e-New Zealand: 12 Months On*. NZ ISCR Research Paper http://www.iscr.org.nz/research/

between discrete locations, moderated by the technological options available to undertake these transfers and the prices at which they are offered[9].

'Light-handed' regulation has theoretically offered the New Zealand market greater opportunities to respond more quickly to the challenges of rapid technological change than more heavily regulated markets[10]. Absence of overt regulatory intervention should have enabled infrastructure and service providers to respond solely to the demands of consumers of services in meeting the challenges of a changing technological base. Thus, we would expect to see in New Zealand telecommunications technology uptake and usage statistics a reflection of actual end-user application-based consumer demand for specific information exchange technologies as they become available in the market, and the extent of substitution between existing and new technologies based upon their utility to the user at the prices at which they have been offered.

As New Zealand was the first to adopt light regulation, and was arguably the least regulated market in the world between 1988 and 2001, New Zealand telecommunications data offer a potentially rich source of information about the ways in which consumers have adjusted their information exchange and usage patterns in response to changing technological options, and the ways in which infrastructure and service providers have anticipated and reacted to these changing demand patterns. This information promises to offer significant new insights into the ways in which information producers and consumers create, transfer, store and utilise information to create value in an information-based economy, which will be relevant in all information exchange markets.

This paper forms part of a portfolio of ISCR research papers investigating the changing uses of information in an information-based economy. The papers in this portfolio are based upon the presumption that telecommunications services are fundamentally information exchange (that is, information transportation) services. The purpose of this paper is to present the most recent data collected on telecommunications in New Zealand. Section One provides a brief overview of the New Zealand market, derived from publicly available data. Section two outlines our methodology and introduces the ISCR dataset used to explore the New Zealand telecommunications market. Section three and four presents our findings and offers some preliminary analysis based upon our methodology, while section five poses some preliminary conclusions and questions for future research.

[9] Howell, Bronwyn; and Mark Obren. 2002. *Broadband Diffusion Lags:Testing for Vintage Capital, Learning by Doing, Information Barriers and Network Effects.* NZ ISCR Working Paper BH02/10, http://www.iscr.org.nz/research/

[10] Boles de Boer, D. & Evans, L. (1996) *op cit. pg 24-39*

1. The New Zealand Telecommunications Environment

Following a series of fundamental economic reforms beginning in 1984[11], the government-owned telecommunications network was separated out from postal, banking, policy-making and regulation services into a separate, state-owned enterprise in 1987. The monopoly company Telecom New Zealand Ltd (hereinafter Telecom) was privatised in 1990, subject only to a regulation that residential free local calling be made available at a line rental no more than the Consumer Price Index-adjusted price prevailing at privatisation and the competition law provisions of the Commerce Act 1986.

1.1 Fixed Line Infrastructure

Three years before privatisation, industry deregulation removed entry barriers, enabling competing fixed line infrastructure providers to enter the market[12]. Clear Communications became the first new entrant in the market in 1990, when it took over ownership of fibre-optic trunk previously owned by railway operator the New Zealand Railways Corporation. This infrastructure bypassed the Telecom network and enabled Clear to offer long-distance services. Saturn Communications (later merged with Telstra to form TelstraSaturn, and subsequently with Clear Communications to form TelstraClear) began installing cable-based telephony, television and Internet infrastructure in a few selected urban and suburban locations in 1998. Both of these new entrants have been required to negotiate interconnection agreements with the incumbent lines operator Telecom in order to offer their fixed line customers access to Telecom's customer base and vice-versa[13].

A small number of other operators have registered as network operators under the Telecommunications Act 1987, mostly providing specific corporate services (e.g. Trans Power New Zealand Ltd) or data transfer services in specific geographic locations (e.g. CityLink Ltd.). At August 2001, a total of twelve network operators had registered[14], but in 2002, following the merger of Telstra Saturn and Clear, only two significant providers offered PSTN services. However, Telecom remains the major provider of network lines, with over 96% market share in April 2002 (Figure 1). Thus, practically all fixed line telephone traffic originating in New Zealand travels on Telecom lines via Telecom switches. Fixed line penetration in households is

[11] Evans, Lewis; Arthur Grimes, and Bryce Wilkinson. 1996. Economic Reform in New Zealand 1984-95: The Pursuit of Efficiency. *Journal of Economic Literature* v34 (4):1856-1902

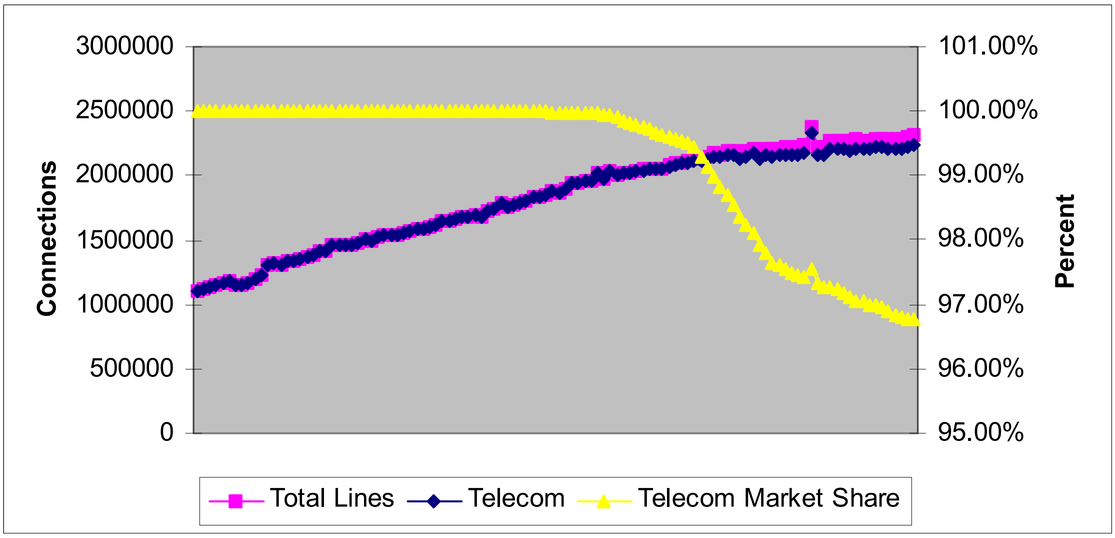
[12] Boles de Boer, D. & Evans, L. (1996) *op cit. pg 24-39*

[13] Evans, Lewis T.; and Neil C. Quigley. 2000. Contracting, Incentives for Breach, and the Impact of Competition Law. *Journal of World Competition* 23(2):79-94.

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

high, at around 96.3% (Statistics New Zealand 2001 Census)[15]. The Telecom network was, in 1997, one of the first in the OECD to be fully digitalised[16].

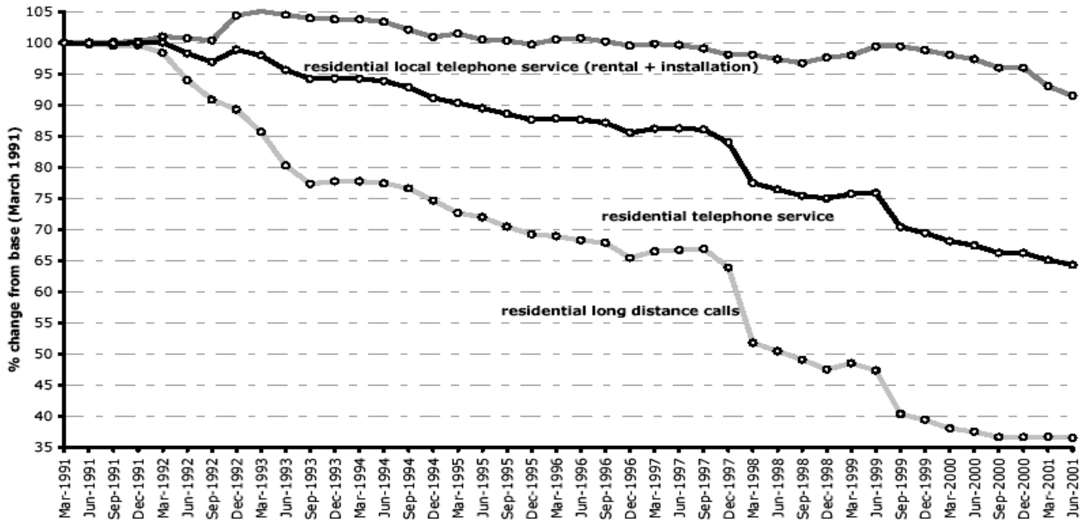
Figure 1. Fixed Line Market: New Zealand Jan 1993-Apr 2002



The 'Kiwi Share' regulation has provided a cap on residential line rentals and requires that all residential consumers have free local call access. Residential line rental charges have varied little in nominal terms over this period, with the only significant change being in August 1997, when Telecom's line rental was adjusted downward to reflect a change in charging policy for directory assistance[17]. In real terms, using the Statistics New Zealand basket of residential telephone services constructed for the Consumer Price Index, the price of residential local telephone services (including both local line rental and installation, and long distance) has declined on average by about 4% per annum since 1991[18], as shown in Figure 2.

[15] http://www.stats.govt.nz/domino/external/pasfull/pasfull.nsf/0/4c2567ef00247c6acc256c86006eaaf9/
[16] MED. 2001. *op cit*
[17] MED. 2001. *op cit*
[18] MED. 2001. *op cit*

Figure 2. NZ Real Residential Telephone Service Price Index: 1991-2001



Source: MED (2001):23

Assuming that the Statistics New Zealand residential basket is comparable with the OECD basket for residential telephone charges, we can compare these figures with the OECD time series (Figure 3). If this is valid, then New Zealand's combined fixed and usage price decline of 35% over this period between 1991 and 2001 appears to be nearly twice that of the OECD average of 17% between 1990 and 2000. Further, New Zealand data reveals a decline in the fixed component (which includes all local call charges as per the Kiwi Share) of around 8% between 1991 and 2001, whilst overall the OECD has registered a 24% increase in this component between 1990 and 2000. The total New Zealand percentage price decline is similar to that evidenced in the United Kingdom over the period 1996-2001[19], presuming once again that the baskets are comparable.

Figure 3. OECD Time Series for Telephone Charges

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Residential											
Fixed	100.0	109.18	112.66	112.76	112.82	122.39	125.91	112.97	115.50	119.27	124.08
Usage	100.0	104.17	98.45	96.77	94.05	98.56	90.09	81.29	78.69	70.54	57.80
Total	100.0	106.17	104.13	103.16	101.56	106.09	104.42	93.97	93.42	90.03	83.31
Business											
Fixed	100.0	104.30	107.45	107.59	107.99	108.07	106.37	113.07	118.68	123.37	118.55
Usage	100.0	103.50	96.88	94.18	91.29	92.52	83.26	86.46	84.31	75.18	55.50
Total	100.0	103.66	98.99	96.86	94.63	95.63	87.88	91.78	91.18	84.82	68.11
Source: OECD, Tellgen											

[19] Oftel. 2001. The UK Telecommunications Industry: Market Information 2000/01. http://www.oftel.gov.uk

In the limited number of localities where Telecom faces competition from other infrastructure providers, price variation exists[20]. However, the vast majority of residential customers pay identical prices for access. Posted prices for business line access have also been relatively stable over the period, and business consumers pay per minute charges for local calls in addition to line rentals. Whilst Telecom has faced competition in central business districts from new infrastructure providers, notably Clear Communications, and prices paid by large businesses in particular are often subject to volume discounts, even here, anecdotal evidence suggests that prices have been relatively stable.

1.2 Mobile Infrastructure

Telecom first installed mobile telephony infrastructure in 1987, using the AMPS analogue standard. BellSouth entered the market in 1992 with a GSM digital network, and was sold to Vodafone in November 1998. By June 2001, Vodafone had achieved a market share of over 40%[21], whilst a market share of 51% was announced in May 2003[22].

Mobile telephony prices have been quite variable over this period, both in respect of fixed access and call costs. The market has been characterised by a large number of call plans designed for differing usage patterns. The very first mobile handsets were sold at cost plus a margin, targeting early adopters who were prepared to outlay the large initial cost. Between 1993 and 1994, mobile connections began to be sold on call plans with low handset prices and higher monthly connection and per call charges. Monthly connection charges also varied, depending upon the number of un-metered minutes included before per call charges became effective, and whether the un-metered minutes were used in peak or off-peak hours. Anecdotal evidence suggests that these plans were initially more appealing to business users, and that most initial purchasers of the technology came from this sector. Prepay accounts with no monthly connection fee, but per minute call charges paid in advance of consumption, were introduced by BellSouth in 1997 and Telecom in 1998.

[20] MED. 2001. *op cit*
[21] MED, 2001 *op. cit.* p 18.
[22] Steeman, Marta. Mobile Vodafone Passes Telecom. *The Dominion Post*, May 29, 2003 p C1.

Figure 4. Mobile Tariffs - Residential

Date	Provider	Plan	Monthly Access Fee	Free Minutes	Peak Usage Charge per minute	Off-peak Usage Charge per minute
Dec 1998	Telecom	Basic	$15	-	$1.79	$0.20 - $0.40
	Vodafone	Basic	$29.95	200 off-peak	$1.79	$0.20
Feb 2000	Telecom	Go Prepaid	None	-	$0.99	$0.49
		Go Easy	$15	-	$1.80	$0.20-$0.40
		Go Everyday	$25	200 off-peak	$0.99	$0.49
	Vodafone	Prepay	None	-	$1.39	$0.49
		Basic	$29.95	200 off-peak	$1.29	$0.20
Aug 2001	Telecom	Go Prepaid	None	-	$1.29	$0.49
		Go Mobile	$14.95	15 Anytime	$1.29	$0.49
		Go Free 100	$24.95	100 off-peak	$0.99	$0.49
	Vodafone	Prepay (1)	None	-	$1.29	$0.49
		Prepay (2)	None	-	$0.89	$0.89
		Basic	$20	70 off-peak	$1.39	$0.49
Dec 2002	Telecom	Prepaid - Max	None	-	$0.69*-$1.39	$0.24*-$0.49
		Prepaid	None	-	$0.44*-$0.89	$0.44*-$0.89
		Mytime 50	$19.95	50 off-peak	$0.69*-$1.39	$0.24*-$0.49
		Mytime 200	$34.95	200 off-peak	$0.64*-$1.29	$0.24*-$0.49
	Vodafone	Prepay (1)	None	-	$1.39	$1.39
		Prepay (2)	None	-	$0.89	$0.89
		Get 70	None	70 off-peak	$1.39	$0.49
		Get 200	$30.00	200 off-peak	$0.99	$0.49

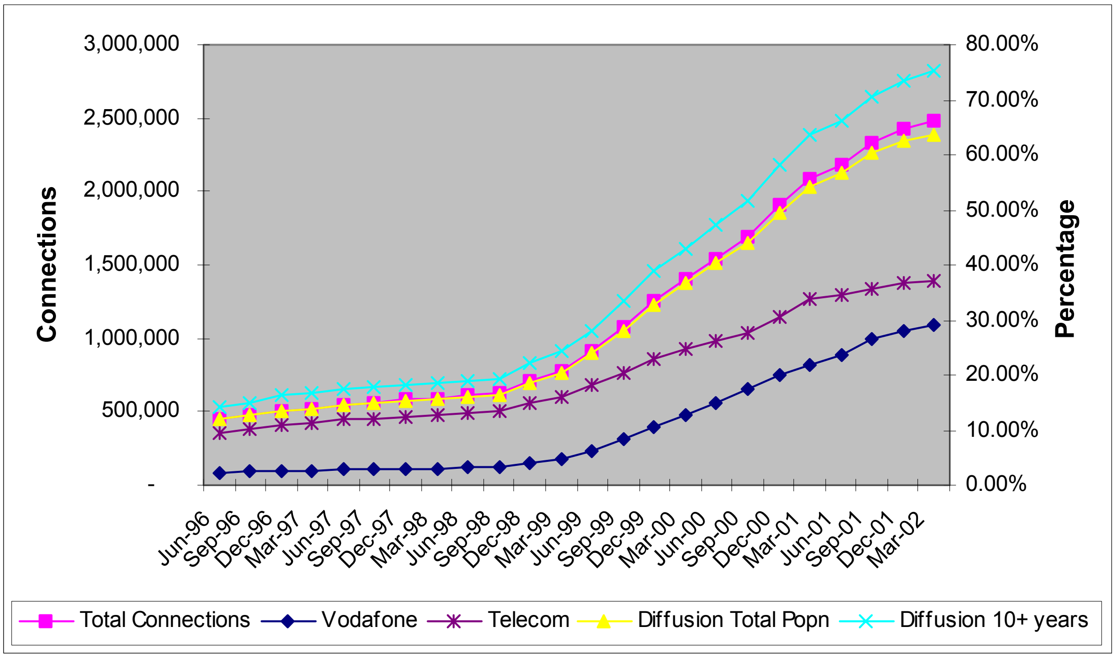
* These prices reflect the charge for calls to another telephone on the Telecom Network

Figure 4 details a range of residential call charges that have applied since 1998. For comparable services there have been gradual increases in the monthly access fees, gradual reductions in peak usage charges, but little change in the off-peak usage charges, beyond Telecom's adjustments to prices for calls over the Telecom network. However, given the wide range of call plans available, there has been considerable ability for consumers to switch between plans based upon the trade-off between fixed and variable charges at given levels of usage in order to minimise the impact of any changes in posted prices. If consumers follow this pattern, then despite some increases in posted prices, we would expect to see overall a decrease in the cost of mobile telephony in real terms as consumers adjust their plans in order not to increase the fees they pay in nominal terms.

For business customers, the costs have adjusted due to changes in handset charging policies. Prior to 2001, for call plan customers, handset prices were significantly subsidised from the monthly connection fee. During 2001, firstly Vodafone, and subsequently Telecom, reduced the subsidy and raised the price for handsets, and hence the fixed connection cost. Whilst some price reductions still exist for call plan customers, the handset prices are significantly higher, and much closer to the prices for prepay account handsets, than previously.

Figure 5 shows that the diffusion of mobile technology has been rapid, with particularly strong growth following the introduction of prepay accounts. By March 2002, mobile account diffusion per New Zealand resident over 10 years of age stood at 75%.

Figure 5. Mobile Telephone Uptake and Diffusion

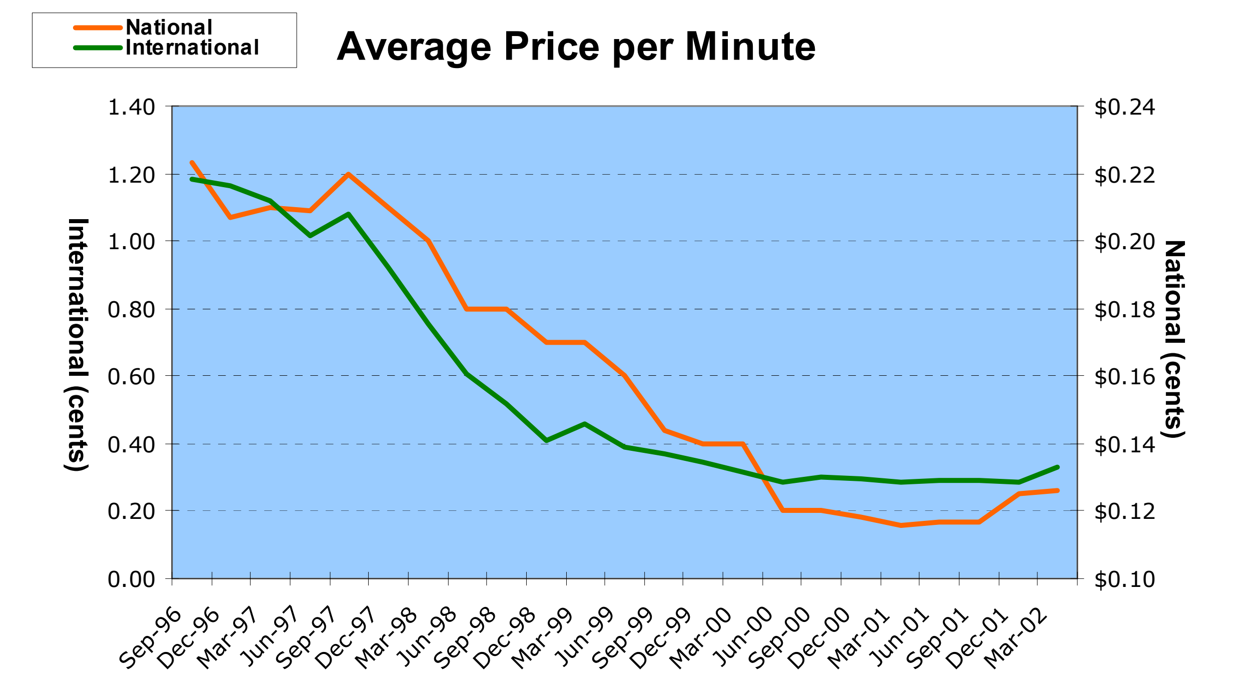


1.3 Long Distance (National and International) Calls

Competition in long distance calling has been a feature of New Zealand's telecommunications market since Clear Communications' entry into the market in 1990. At August 2001, twenty-eight providers were registered as international operators pursuant to the Telecommunications (International Services) Regulations 1994[23].

As shown in Figure 2, long distance call prices have declined significantly since deregulation, with the reduction averaging 10% per annum in real terms between March 1991 and June 2001. National and International call minute volumes have increased as prices have fallen throughout this period[24]. However, even in this market, prices have approached some relative stability since the year 2000 (Figure 6).

Figure 6. Long Distance Average Price per Minute – Telecom



Source – Telecom New Zealand Ltd

Moreover, using posted prices and its standard basket of international calls[25], the OECD[26] finds that in the period between 1998 and 2000, New Zealand's international collection charges per minute at peak rates fell 65%. Only Switzerland (71%) and Australia (68%) recorded greater

[23] MED. 2001. *op cit pg 32*
[24] MED. 2001. *op cit pg 19-22*
[25] From the base country to other OECD countries
[26] For a discussion of the methodology of the OECD system of pricing baskets, see Howell (2003).

price falls, whilst the United States prices fell 23% and the United Kingdom prices rose by 3% during this period[27].

The OECD baskets are costed at posted prices rather than actual usage. Fixed, un-metered charges for residential long distance and international calling within specific time periods (predominantly non-peak times such as weekdays after 6pm, and all weekends) have been a feature of the New Zealand market over this entire period[28]. This option has received high consumer acceptance, possibly because it replicates the total fixed cost/zero marginal cost model that has prevailed historically in residential fixed line local call access, and subsequently with dial-up Internet access, in the New Zealand market. Widespread use of these call packages is possibly resulting in an understatement of the OECD fall in posted call charges over this period. For example, Figure 6, which measures actual collection per minute by Telecom, shows that the sharp fall (around 60%) occurred between 1997 and 1999, whilst the OECD data records price falls of a similar magnitude occurring at least a year later (i.e. between 1998 and 2000).

1.4 Internet Access

New Zealand enjoyed early availability of telephony-based dial-up Internet access, with the first service for academic users, NZGate, commencing in April 1989. This service expanded to full commercial availability in 1992[29]. A highly competitive ISP market has emerged[30] and high levels of uptake of this technology have ensued[31] as shown in Figure 7. New Zealand has been consistently in the top ten OECD countries in all of the number of ISP accounts, Internet hosts, domain name registrations, and secure servers per head of population since these statistics have been collected[32]. Moreover, in 2000, using a combination of infrastructure-based metrics, it was ranked amongst the top four countries in the OECD (along with the United States, Canada and Australia) to benefit from electronic commerce[33].

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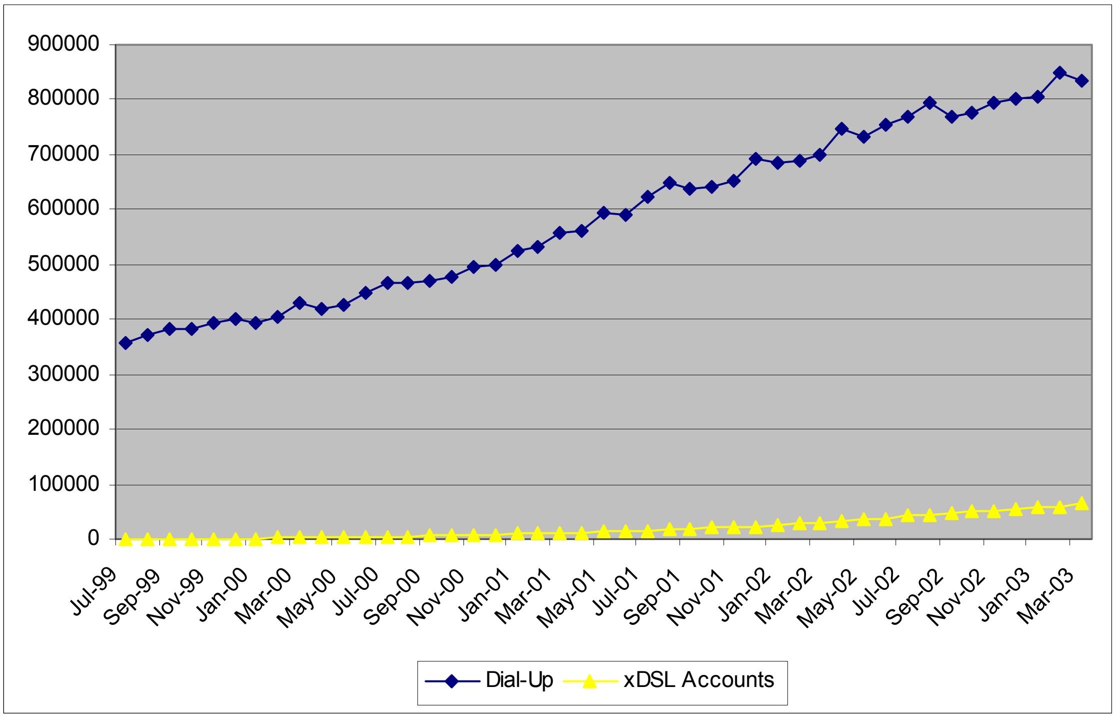
[27] MED. 2001. *op cit. pg 201*
[28] MED. 2001. *op cit. pg 10*
[29] Brownlee, Nevil. 1997. Internet Pricing in Practice. Chapter in McKnight, Lee W.; and Joseph P. Bailey (eds). *Internet Economics*. Cambridge, Massachusetts: Massachusetts Institute of Technology
[30] Enright, Christina. 2000. Strategic Behaviour of Internet Service Providers in New Zealand. Wellington: ISCR http://www.iscr.org.nz/research/
Boles de Boer, David; Christina Enright and Lewis Evans. 2000. The Performance of Internet Service Provider (ISP) Markets of Australia and New Zealand: implications for regulatory policy. *Info,* 2(5).
[31] Howell, Bronwyn; and Lisa Marriott. 2002. The State of e-commerce in New Zealand. Chapter 14 in Poot, Jacques (ed.) 2002. *Off the Map in the Global Economy*. London: Edward Elgar (forthcoming) and Howell, B. and Marriott, L.(2002a) *op cit*. and *OECD 2001 op.cit*
[32] Howell and Marriott, 2002 *op cit*; Howell and Marriott, 2002a *op cit*; OECD, 2001 *op cit*; Boles de Boer, Evans and Howell, 2000 *op cit.*
[33] OECD, 2000. *op cit*

Prices for dial-up Internet access have been consistently amongst the lower half of the OECD[34]. Flat-rate pricing for Internet services has been the predominant form of pricing since 1997[35] and combined with a zero usage charge for local telephony, has led to high levels of uptake compared to other countries practicing metered local calling[36]. Dial-up ISP access prices have been stable at around NZ$20 to NZ$28 per month since late 2000[37], despite a significant consolidation in the number of providers and the emergence and subsequent demise of 'free' ISPs[38].

Figure 7. New Zealand ISP Accounts



Ease of entry into the infrastructure market and a competitive ISP market has resulted in very early introduction of alternative technology broadband services in the New Zealand market. Competition between technology platforms is identified by the OECD as the most desirable for encouraging early and widespread adoption of broadband services[39]. New entrant CityLink first offered fibre-optic LAN-based broadband services commercially in 1996[40] and ISP iHug began a nation-wide satellite-based service in 1998[41] with 5000 subscribers recorded in October

[34] Boles de Boer, David; Lewis Evans and Bronwyn Howell. 2000. *The State of e-New Zealand.* NZ ISCR Research Paper http://www.iscr.org.nz/research/ and Howell and Marriott, 2002 op cit.
[35] Enright, Christina. 2000. Strategic Behaviour of Internet Service Providers in New Zealand. Wellington: ISCR http://www.iscr.org.nz/research/ and MED 2001 op. cit.
[36] OECD, 2000 *op cit.*
[37] Howell and Obren, 2002 *op cit*
[38] Karel, Annemieke. 2003. *Free ISPs in New Zealand.* NZ ISCR Working Paper
[39] OECD. 2002a. *Broadband Access for Business.* Paris: OECD
[40] Howell, Bronwyn; and Chris O'Connell. 2003. *Broadband Deployment and Productivity: An Exploratory Study of Mature Broadband Users*. Wellington: ISCR. http://www.iscr.org.nz/research
[41] Howell and Obren, 2002 *op cit*

2002[42]. Walker Wireless, allied with Vodafone, has also offered a wireless broadband service in Auckland since 2001, with coverage in 2003 provided in 10 central business districts (Auckland, Wellington, Whangarei, Tauranga, Hamilton, Napier, Wanganui, Palmerston North, Christchurch and Dunedin) with coverage in an additional 9 planned for the near future (Rotorua, Taupo, Gisborne, New Plymouth, Hastings, Blenheim, Timaru, Queenstown and Invercargill)[43].

Entry by alternative technology platforms has provided competitive pressure on the telecommunications providers, with Telecom offering DSL services in January 1999[44] and TelstraSaturn cable modem services in August 1999[45]. It is noted that CityLink, a regional operator, focused its infrastructure on the central business district of the capital city, Wellington, and that Telecom and TelstraSaturn both began offering their broadband services in this location. Telecom's second location for DSL deployment was New Zealand's largest city Auckland, where the iHug and Walker Wireless networks were located. However, regional DSL deployment by Telecom has been rapid, with over 80% of the country's fixed telephone lines being connected to DSL-capable exchanges by the end of 2001[46]. This equates to around 75% of customers being able to purchase DSL services[47]. Moreover, within specified levels of data exchange, Telecom's DSL prices are amongst the cheapest in the OECD[48].

1.5 Summary

The patterns evidenced in the New Zealand telecommunications market since deregulation appear to follow the patterns evident in other countries over the decade 1993-2002[49]. The key features of the market are steadily decreasing real prices for the bundle of line rentals and local calling, dramatic reductions in the price, with consequent increases in the volume of national and international calls, the growth of mobile connections and the burgeoning of Internet-based telecommunications traffic.

New Zealand appears to have recorded a different pattern from other telecommunications markets with respect to investment in new infrastructures. Deployment of new investment in the broadband market by the incumbent appears to be spurred initially by localised competitor

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42 http://www.ihug.co.nz/news/articles/151002.html
43 http://www.walkerwireless.com
44 Howell and Obren, 2002 *op cit*.
45 MED, 2001 *op cit pg 11*
46 Howell and Obren, 2002 *op cit*.
47 It is noted that customers living outside a radius of around 5 to 7 kilometres from the exchange are unable to access DSL services, due to the technological limitations of the product. OECD, 2002a *op cit 32*
48 OECD, 2001 *op cit;* Howell, 2002a *op cit*

49 Merrill Lynch. 2002. *Telecom Sector Review 20 November 2002.* Merrill Lynch Asia Pacific Telecommunications; OECD, 2001 *op cit* and Oftel, 2001 *op cit*.

entry underpinned by specific local demand, and the threat of either competitive or regulatory discipline on the incumbent if broadband infrastructures based upon the local loop were not deployed. CityLink offered its Ethernet LAN service, and iHug its satellite services, in direct response to consumer demand for these services. Telecom initially responded to CityLink in Wellington and iHug in Auckland by offering a competing Ethernet LAN service, and its broadband offerings have grown to include the deployment of DSL. DSL was again offered first in metropolitan areas Wellington and Auckland where demand existed.

Telecom's DSL product was initially been priced low in order to compete with alternative technologies. More widespread regional deployment at the same prices as charged initially has followed, using the same universal pricing policy as prevails for telephony services, despite infrastructure costs differing between locations. Regional deployment priorities have been determined largely by localised growth in demand for the technology. Targeting the deployment of new technologies this way, based upon actual rather than anticipated demand, has both spread the risk of investment across several infrastructure providers, and has resulted in a demand-based, rather than a regulatory- or supply-driven, investment pattern. This has left the incumbent less exposed to the risks of over-investment that have been experienced in other countries[50].

However, as yet, broadband investment does not appear to have compromised growth in the number of dial-up Internet accounts. Howell and Obren (2002) suggest that this may be related to the extent of learning required to benefit from the use of Internet applications, and the 'insurance' that flat-rate dial-up pricing offers against unexpectedly large usage bills associated with learning using alternative technologies

[50] Morgan Stanley, 2002 *op cit*.

2. Analysis

2.1 Demand-driven Usage of Telecommunications in New Zealand

From an consumer perspective, telecommunications networks offer two forms of information exchange – voice and data. Derived demand for telecommunications services is driven by end-consumer decisions based upon the productivity (or utility) of the bundle of information and its transportation costs in the applications from which the end user derives benefit[51]. This demand is clearly affected by both the price of the information, and the cost of transportation. Telecommunication networks provide the information transportation service, but the information transferred is both created and consumed by entities other than the telecommunications company.

When new information-utilising applications that require information transportation become available, consumer uptake is influenced primarily by a welfare-raising question: does utilisation of the new application raise benefit above levels achieved with existing applications, within income and time constraints and alternative demands upon these resources? Business user uptake is influenced by the question: does utilisation of the new application yield higher profits for the same level of inputs as the existing application? If the answer to either question is 'yes', then the user will substitute away from the existing application to the new one. Understanding the benefits of the end application enables understanding of the extent to which this will influence the derived demand for telecommunications services. It will also affect the time at which a given user will adopt the new technology.

Howell (2001) introduces a schema[52] that endeavours to identify how measures of infrastructure connectivity and usage reflect the extent to which economic and social benefits can be gained from the use of information. This schema (Figure 8) recognises that infrastructure connectivity and uptake (usage) are proxies for measuring the amount of information that is used in applications that will ultimately create economic productivity and growth or social gain (welfare). This schema recognises that the key element is information, and that infrastructures and applications, while necessary to the process of creating welfare from information, are not sufficient for creating welfare merely because they exist. However, when taken together, measures of infrastructure connectivity and uptake (usage) along with application connectivity and uptake, may offer insights into the ways in which information is being used to improve welfare.

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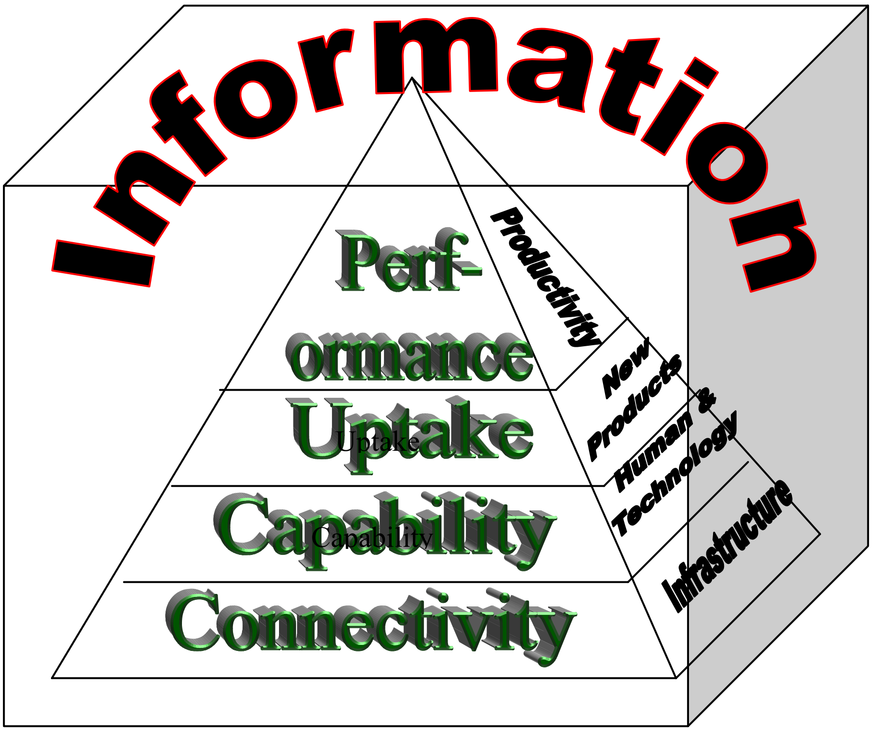
[51] Howell and Obren, 2002 *op cit*

[52] Developed from the OECD framework for measuring returns from Electronic Commerce.

Figure 8. Electronic Commerce Performance Measurement Framework



Source: Howell (2001)

The framework assists in explaining why connectivity, reflected in the number of connections and hence the *ability* to transfer information in specific forms (e.g. via voice or data) via specific infrastructures (fixed line, mobile, Internet), should be considered separately from usage. Usage reflects the actual quantities of information transferred. The choices of infrastructure and usage reflect the differing values derived by the user from the end applications in which the information transferred is applied. While some patterns observed may reflect a substitution of one voice communication technology for another simply based upon cost (e.g. ISDN primary rate for multiple PSTN lines), others reflect changes, often subtle, in the user application process. For example, when mobile substitutes for fixed line telephony, the benefit to the user may be greater timeliness from receiving the message 'on the move' which results in a welfare-raising or productivity-enhancing change in the processes associated with the message (e.g. a mobile serviceman being able to charge a premium for rearranging a job schedule in order to respond to a call received 'on the job' rather than 'in the office'). Likewise, text messages linking directly to databases may substitute for manually transcribed and keyed information received from voice calls if the savings from reduced transmission and data capture time and benefits from increased accuracy outweigh the additional costs of the application.

We recognise that changing prices will influence benefits to the consumer, and hence the use of specific telecommunications technologies. While there have been some changes in prices over the period of our analysis, we note that since about the beginning of 2000, the nominal prices of most telecommunications services in New Zealand have changed little relative to each other. Residential fixed line rentals last changed in nominal terms 1997 and flat-rate dial-up ISP charges have been around $20 to $28 per month for most suppliers since 2000. Posted posted per megabyte usage prices for DSL have changed only once since introduction, in mid 2000, when the charge reduced from 30c to 20c, although Telecom reports no noticeable alteration in traffic volumes following this price reduction. Effective installation charges have reduced as a result of periodic discounts offered to encourage connection. However, relative price constancy between these services leads us to believe that fluctuating prices are unlikely to be a significant factor in inducing substitution between Internet-based technologies.

Whilst real mobile costs per minute to the users have fallen through our period, posted mobile charges have been modified, as:

(1) handset subsidies have varied;
(2) bundled free call minutes have been introduced into call plans; and
(3) new applications have been added to the service bundles, for example call forwarding and voice messaging services.

These three mobile market changes relative to fixed telephony may be a determining factor in substitution of mobile for fixed calls.

Further, changes in monthly connection charges and applications for both mobile network operators combined with reductions in usage charges for calls within the Telecom network will spur different substitution decisions dependent upon users' levels of usage. Price changes may have increased the costs of mobile calls relative to fixed line calls for some users, but reduced it for others, thereby affecting the extent of usage of each network. As a result of changing plan options for users, there is evidence of switching between plans as both plans and user requirements vary.

Within the limitations noted above for mobile services, the relative stability of prices over the period between 2000 and 2002 enables us to explore not only patterns of substitution of telephony usage in New Zealand, but also the possible effects of changes in end user application use, in this environment.

2.2 The ISCR Data Set

Whilst the publicly available data in Section 1 enables some analysis of infrastructure connectivity in New Zealand telecommunications, it does not address the crucial issues of either the extent to which the various infrastructures are being used, or which user-based applications are determining that extent of utilisation. Greater levels of information than those contained in publicly available resources are required for this form of analysis.

ISCR has been able to bring together both connection and utilisation data, and a limited quantity of applications data from a variety of sources in order to build a more comprehensive picture of the New Zealand market, and to explore how it has developed.

As Telecom New Zealand dominates the fixed line infrastructure market in New Zealand, data from this source are imperative to a complete analysis. For this investigation, we have had access to aggregate[53] connection number and minutes of utilisation of Telecom's PSTN, ISDN and xDSL networks from January 1993 to April 2002. In addition, the utilisation data for traffic on the PSTN and ISDN networks between October 2000 and April 2002 can be separated into local, national and international voice traffic and data (Internet, fax, etc.) components. All ISP Internet traffic since 2000 can be accounted for separately from voice traffic, enabling separate analysis of voice and data utilisation. In addition, all local call and Internet data traffic between July 1996 and September 2000, aggregated on an annual basis, has been provided. As Telecom's infrastructure services over 96% of fixed line connections in New Zealand[54], it is presumed that this traffic data can be used as a reliable proxy for the entire fixed line market in the country.

Telecom's mobile operating division has provided aggregate connection and use data, on a quarterly basis, between June 1996 and March 2003. Using publicly declared annual connection data provided by Vodafone and MED (2001) from March 1994, combined with quarterly market share data provided by Telecom, we have extrapolated total mobile market connection data quarterly from June 1996. By presuming that both Vodafone and Telecom customers have similar call usage patterns, we have estimated total market utilisation.

The dataset also includes data from the country's largest ISP, Xtra (around 50% market share) on a monthly basis between July 1999 and June 2002. This includes account data on a national

[53] All data made available for this investigation, with the exception of the broadband mature user survey data provided by CityLink (for which respondent consent was gained), was aggregated and anonymised to protect customer confidentiality.
[54] MED, 2001 *op cit.*

basis by access type (dial-up, ADSL, DSL and ISDN), hours of usage per dial-up account, and the ISP's market share for each of the residential and business markets. In addition, a 'snapshot' of one month's (January, 2002) use by all xDSL customers[55] has enabled some analysis of the types of applications for which consumers are utilising broadband connectivity. By presuming that Xtra's patterns of uptake and usage of all Internet account types are a fair reflection of the population, we extrapolated them using market share data to create estimates of the national uptake and usage.

Finally, access has also been granted to the customer records of broadband data transport provider CityLink, for its entire life since inception in 1996. As CityLink provides a 'dumb network' of the type described by Isenberg (1997), no detailed usage data is available. However, CityLink has provided access to a detailed survey of customer usage patterns conducted in October 2002, which is used to make some qualitative assessments regarding the use of broadband by long-standing and experienced users[56].

This dataset thus provides the foundation for a near population-based analysis of fixed-line telephony connectivity and utilisation within New Zealand, along with detailed information of connectivity and utilisation data of the leading mobile and ISP providers (both over 50% market share). Thus, the findings based upon analysis of this data set have significant credibility, and are supported by a much stronger foundation than sample-based surveys upon which these types of conclusions are generally formed. Furthermore, this can be augmented by qualitative and quantitative connectivity and utilisation data from a mature and experienced group of broadband users.

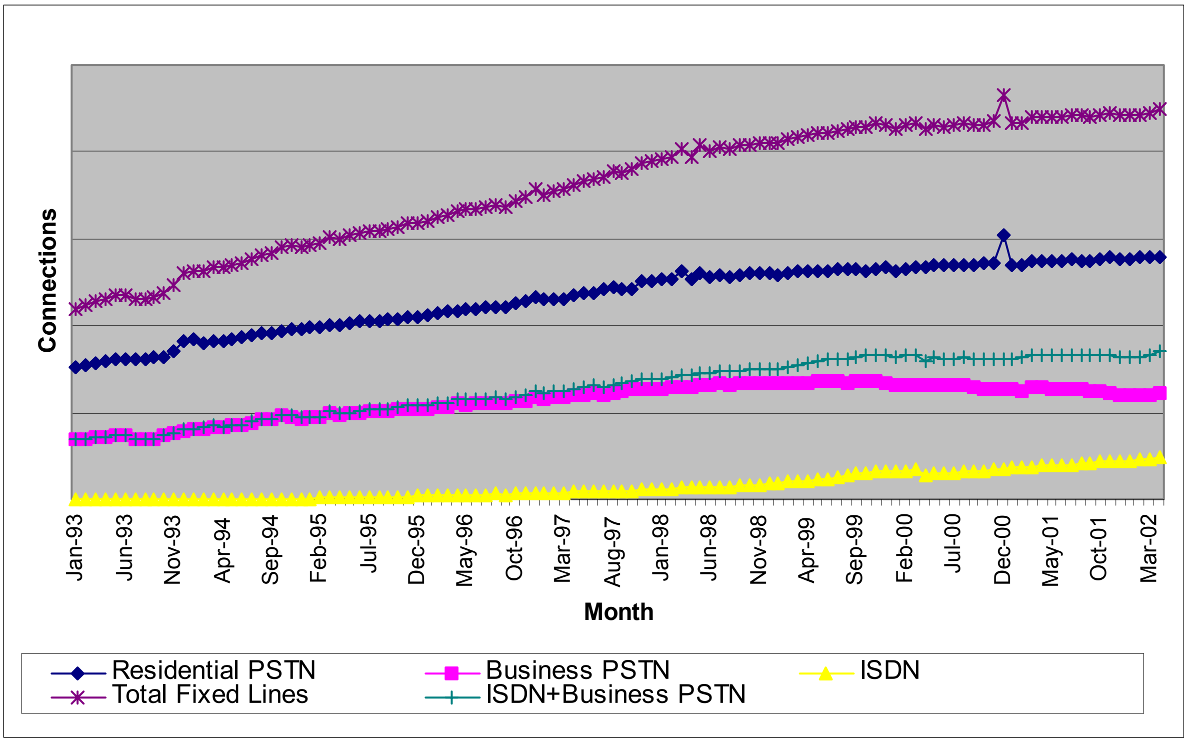
[55] Again, anonymised to protect customer confidentiality.
[56] Howell and O'Connell, 2003 *op cit*.

3. Connectivity Measures

3.1 Fixed Line Telephony Connections

Figure 1 shows the total number of fixed line connections in New Zealand. These show a continued growth (average 0.66% per month) over the entire period, but with a significant slow down since the start of 2000 (average 0.21% per month). This aggregation masks some significant substitution effects that appear to be occurring between PSTN and ISDN lines, and significantly different patterns between residential and business connections. Figure 9 shows that, whilst the total number of lines is growing, change in the number of business lines (the sum of Business PSTN and ISDN) since the beginning of 2000 is comprised primarily of substitution of ISDN lines for PSTN connections. Regression analysis confirms that this relationship is strong[57]. This substitution effect is almost certainly due to pricing for primary rate ISDN connections being substantially less than an equivalent number of PSTN lines for business use.

Figure 9. New Zealand Fixed Lines[58]



In addition, statistical tests[59] on each of the total fixed line connection growth rate, residential connection growth and total business connection (ISDN+PSTN) since the beginning of 2000

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[57] Linear regression with business PSTN connections the dependent variable and ISDN connections the independent variable yields an R^2 of 0.86 – see Appendix 1.

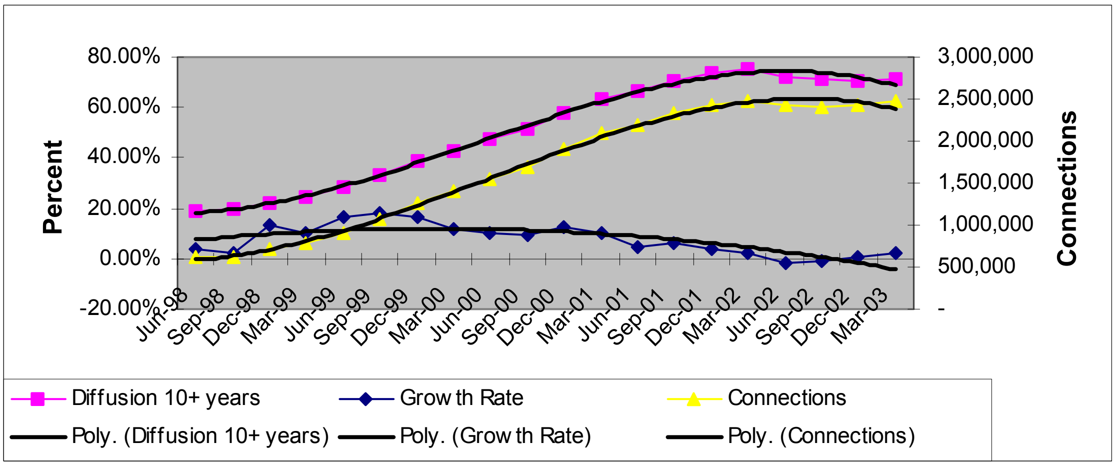
[58] Connection numbers on the Y axis in this graph have been suppressed to protect Telecom data confidentiality.

cannot exclude the possibilty that connection growth is zero in all of these markets. This implies a very mature market with few growth possibilities. This finding puts New Zealand at odds with the findings in other markets (e.g. Australia, the UK and the USA) that fixed line growth is strongly positive, due to the purchase of second lines for Internet access (e.g. NOIE, 2002; OECD, 2001). In the residential market in particular, absence of line connection growth combined with the practice of zero usage charges for local calling indicates a static market with few options for revenue growth from this source. In the absence of apparent demand growth for connections at current prices, significant price reductions may be the only method of encouraging an increase in the numbers of fixed line connections. However, the current worldwide trend[60] is towards rebalancing residential line rental prices upwards, indicating that, on average, the costs of providing fixed line access are increasing in other jurisdictions. If New Zealand costs follow this pattern, then this strategy may not be feasible.

3.2 Mobile Connections

Figure 4 shows the total number of connections in the mobile market in New Zealand since June 1996. A notable feature of this graph is the significant growth following the advent of prepaid mobile telephony, first by BellSouth (later Vodafone) in 1997 and Telecom in 1998. However, the high diffusion level that this technology has reached implies that it may soon also reach its maximum deployment, with a levelling off in the typical 'S' shape of the curve. Fitting a curve to each of the number of connections and the diffusion percentage reveals an excellent fit in each case, with a distinct levelling indicating a turning point around June 2002 (Figure 10). A quadratic polynomial fitted to the growth rate indicates this could be expected to reach zero between March and June 2002.

Figure 10. Mobile Diffusion



[59] T-tests comparing the mean of growth rates between months with zero for each technology were conducted. A zero mean could not be excluded for any at the 95% level – see Appendix 1.

[60] Merrill Lynch, 2002 *op cit*

Hence, the New Zealand mobile connection market seems also to be very mature. If so, very little additional connection growth can be expected at current prices and application bases[61].

3.3 Fixed Line and Mobile Substitution.

Figure 11 shows the total number of access lines, (PSTN including ISDN, and Mobile), in New Zealand since June 1996. The graph shows that practically all growth in the total number of access lines since the beginning of 1999 has been driven by growth in the number of mobile connections. Furthermore, growth in the number of fixed line connections has, since June 1998, been increasing no faster than the increase in the number of households (Figure 11). Thus, unlike Australia (3.3% cumulative average growth rate (CAGR) 1995-99: OECD, 2001:82), the United Kingdom (3.2% CAGR 1996-01: Oftel, 2001:30) and the United States (4.4% CAGR 1996-99: OECD, 2001:82), where strong growth in fixed lines has been attributed to the acquisition of second lines, in New Zealand (0.4% CAGR 1995-99: OECD, 2001:82) there appears to have been some significant substitution of mobile connections (58.7% CAGR 1997-99 compared to Australia 23.3%, UK 67.4%[62]; US 24.4%: OECD, 2001:86) in lieu of second lines.

This observed pattern may be attributable to the New Zealand residential fixed line pricing strategy of high fixed access costs and zero marginal cost of local calling making duplicate fixed line access relatively expensive. Furthermore, if the purpose of a second residential line is for the user to be contactable when using the Internet on the primary line, then a more cost-effective solution may be a lower cost prepaid mobile where, ignoring the cost of the handset, the marginal cost to the user being contacted is zero as the caller bears the charge.

As Figure 12 shows, the flattening of the average number of residential PSTN lines per household in the vicinity of 1.00 is closely linked with the sharp acceleration in the number of mobile connections per household. From June 1996 to February 1998, the average PSTN connections per household were 0.9098, but from February 1998 to March 2002, the average was 0.9969. Furthermore, a statistical test[63] on the growth in PSTN connections per household between 1996 to 1998 indicates that this growth is not zero, but the same test on the 1998-2002

[61] It is noted that Telecom offers only a small discount (around 15%) for second telephone lines. Discounts in many countries with strong second line purchase are higher. While the discount may encourage connectivity, the effect on total utilisation in minutes consumed is unknown.

62 The United Kingdom, like New Zealand, demonstrates significant uptake of prepaid mobile telephony accounts, and has a similarly high CAGR. Prepaid accounts are less common in the United States and Australia, and the CAGRs in these countries are both similar, and significantly lower than those in New Zealand and the United Kingdom.

[63] A t-test on the change in mean PSTN connections/household growth rate between 1996 and 1998 rejects a zero mean hypothesis at the 95% level, but the same test on the mean PSTN connections/household growth rate between 1998 and 2002 cannot reject a zero mean at the 95% level – Appendix 1.

figures cannot reject that it is zero. This finding further supports the contention that the co-incidental decline in the growth of household PSTN connections, and the sharp rise in mobile connections following the advent of prepaid mobile connections reflects a New Zealand household preference for purchasing mobile connections as a second household telephony connection, rather than second fixed lines, as has occurred in other countries. This finding can explain, New Zealand's faster mobile connection growth and slower fixed line growth relative to other countries.

Figure 11. Total Access Lines[64]

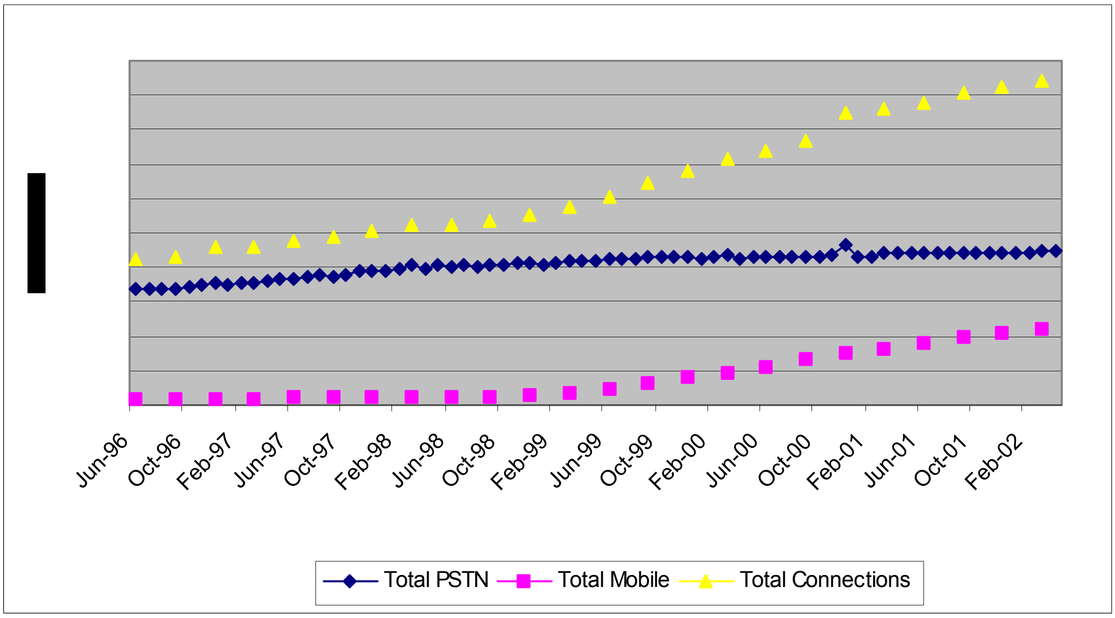
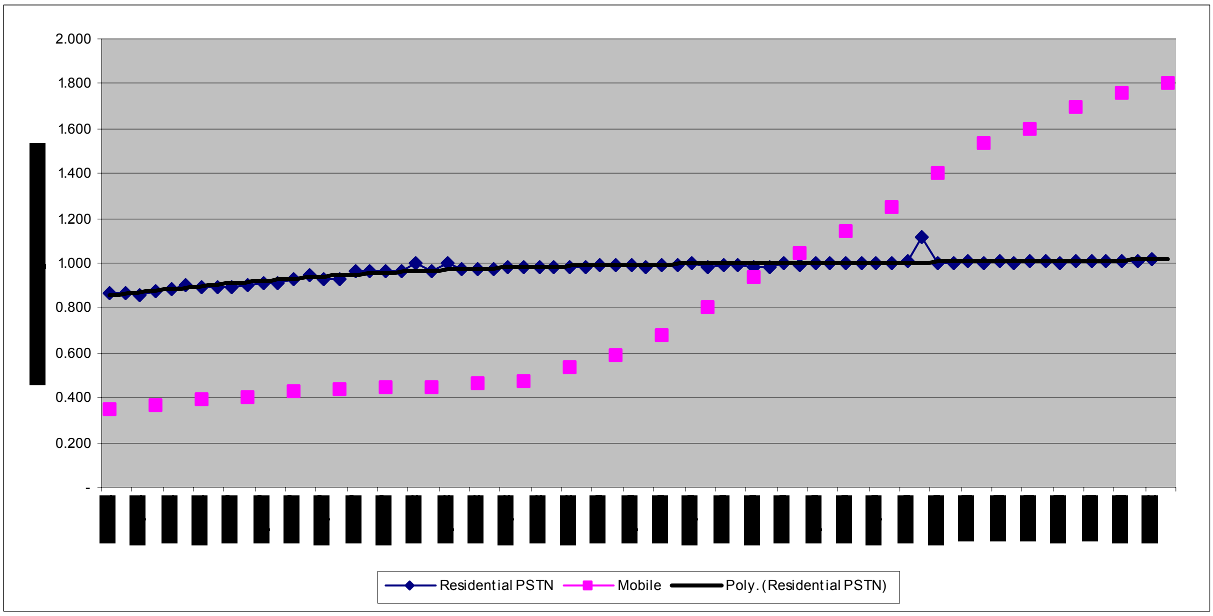


Figure 12. Connections per Household



64 Connection numbers on the Y axis in this graph have been suppressed to protect Telecom data confidentiality

3.4 Dial-Up Internet Connections

A detailed history of the development of dial-up and DSL Internet connections based upon the ISCR data set is contained in Howell and Obren (2002). The key features of this market are substitution of ADSL for ISDN connections in the business data market, but no evidence as yet of significant substitution between dial-up and DSL in the residential market, beyond some lagged effect attributed to application-based learning, and information barriers leading to further lags. As yet, there is insufficient evidence to determine the extent of this lag. Furthermore, the authors find that when unbundled from applications and content, broadband is in fact a close substitute for dial-up Internet access, so it is necessary to analyse statistics from the two 'markets' together. Independent from content and applications, the substitution from dial-up to broadband becomes simply a productivity-based technological substitution within a single General Purpose Technology (GPT), the Internet. The point of substitution between the two forms of this GPT for an individual user is a function of the fixed and variable costs of the technology, and the benefits from the use of each.

The diffusion of dial-up Internet connections in New Zealand is extensive. Figure 13 reveals strong and steady growth, both in the total number of accounts, and the number of accounts per household. Diffusion at the household level passed 50% during 2001. This indicates that with respect to household diffusion, although current growth is steady dial-up Internet connections, are in the second half (post 50%) of the diffusion cycle and strong and consistent growth could be expected to begin to slow in the near future[65](Atkeson and Kehoe, 2001).

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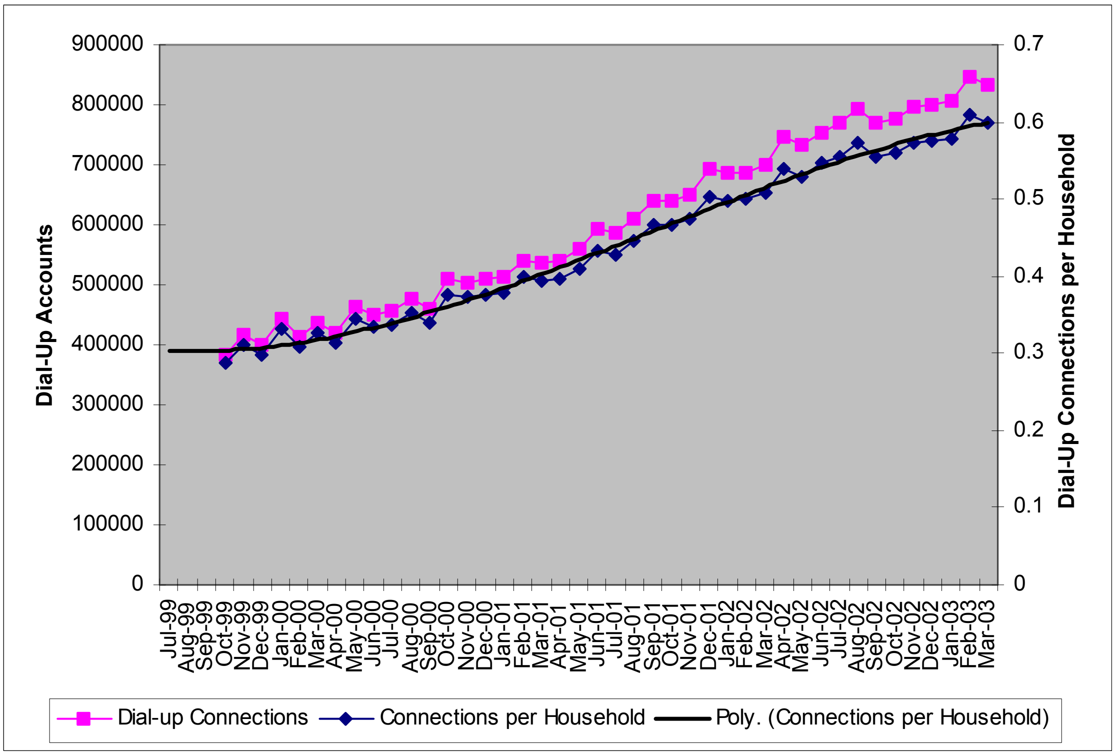
Figure 13. Dial-Up Internet Connections



3.5 Broadband Internet Connections

Uptake of DSL connections is as yet small, standing at fewer than 1.7% per capita and 3.2% per household at April 2002 (Figure 14). However, there are marked differences between business and residential connectivity rates for DSL. Figure 15 shows that while the number of DSL connections sold to businesses (as per the Telecom definition of a business, which is one paying business line rental rates, as opposed to the significant business unit base maintained by Statistics New Zealand) was initially greater than that sold to residential customers, residential customers exceeded business customers in December 2001. However, as there are around 100,000 more significant businesses recorded on the Statistics New Zealand database than Telecom records as business customers of its fixed line services, we infer that the Telecom 'residential' DSL customer figure includes multi-use residential connections that serve both residential and micro business use[66]. Thus, we are confident that the Telecom 'business' connections relate solely to business use, while the 'residential' connections will contain a mix of both residential and business use.

[66] This feature of the market is probably a result of the higher price of business access compared to residential access driving micro businesses to bundle access purchase with lower-cost residential access.

Figure 14. NZ DSL Connections per Capita and Per Household

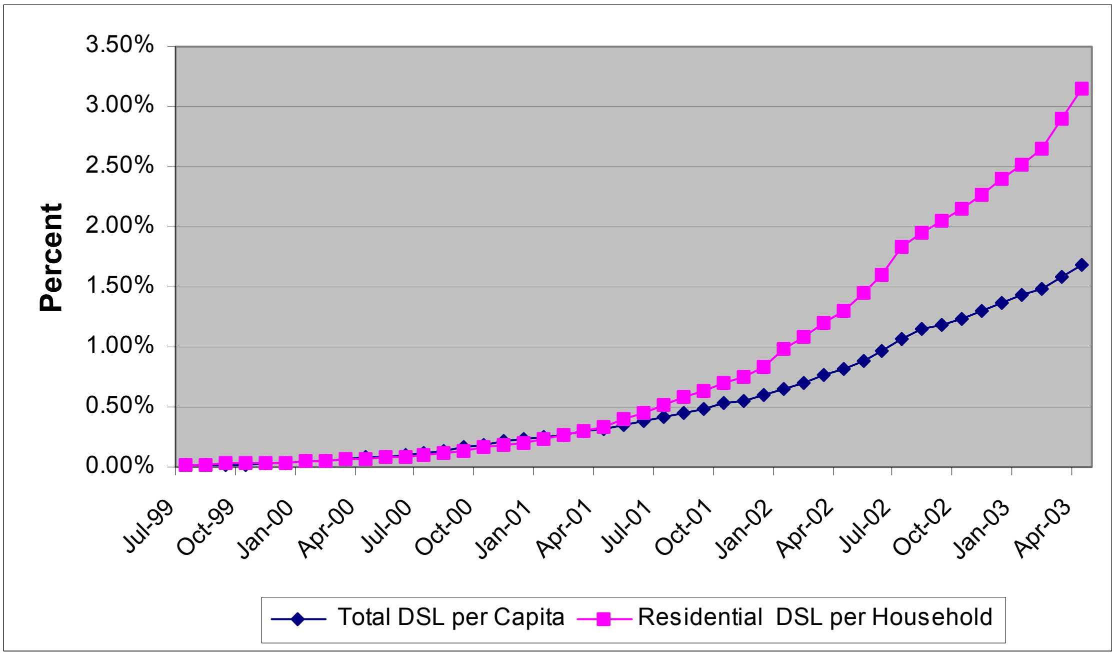
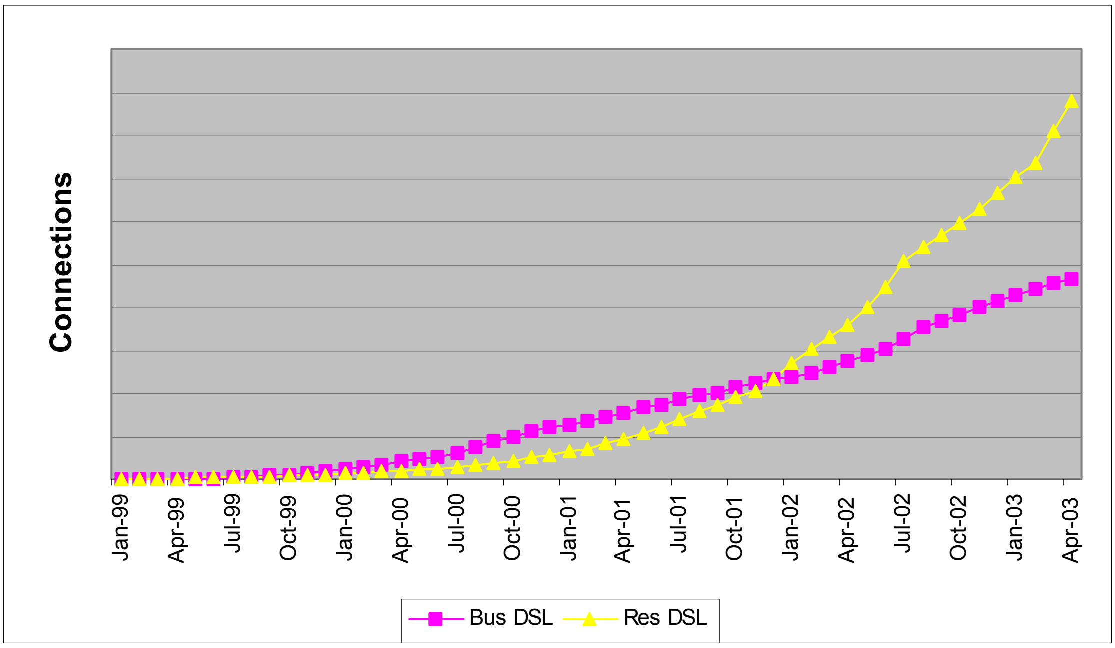


Figure 15 shows the rate of increase in business DSL connections has been at a much lower rate than the increase in residential connections.

Figure 15. DSL Connections by Market Segment[67]

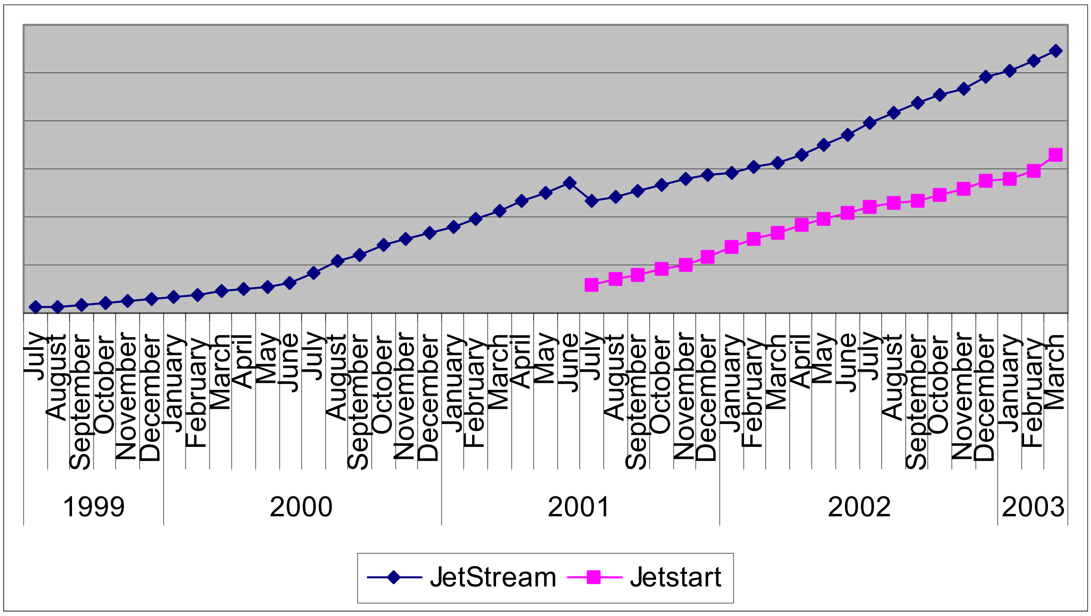


[67] Connection numbers on the Y axis in this graph have been suppressed to protect Telecom data confidentiality

Whilst the Telecom figures record the sale of DSL-capable connections, Xtra sales figures show the capacity of the data service sold to each customer. Xtra has two DSL products available – Jetstart, a 128kbps upstream and downstream (symmetrical transmission speed) product sold at a 'flat rate' with umlimited usage[68] available only to residential customers, and Jetstream, an asymmetrical product of varying speeds (high downstream transmission speed of 2Mbps and low upstream transmission speed 0f 250kbps), sold with a low fixed cost and per megabyte charges effective after a relatively modest level of traffic[69] has been passed. Jetstart is available only to residential customers, while Jetstream is available to both residential and business customers. Hence, Xtra's Jetstart data are indicative of residential connections solely.

Figure 15 shows that connection to the Jetstream product outnumbered connection to the flat rate, lower risk Jetstart product by a ratio of around 1.6:1 at March 2003. Whilst the increase in customers of each product is approximately equal each month, in terms of absolue numbers, eac, Jetstart's customer base is growing proportionately faster than Jetstream's (6.1% on average compared to 4.6%). In order to reconcile the connection numbers between Telecom and Xtra, a significant number of residential customers are presumed to be purchasing the metered Jetstream product. We note that the monthly charges by both Xtra and Telecom for the two products have been unchanged over the period of the graph. However, connection charges have decreased, and Telecom has offered periodic discounts on the residential connection charge.

Figure 16. Broadband Product Mix[70]

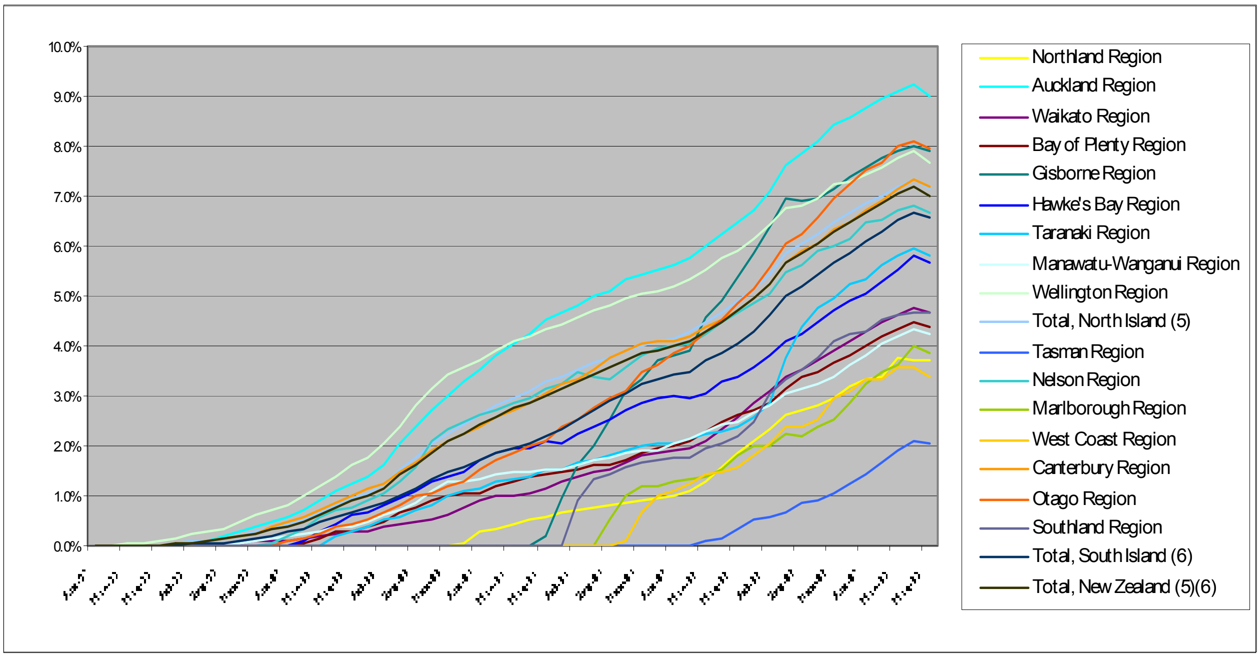


[68] A 5Gb per month limit was imposed in April 2002

[69] The caps stood at 400Mb and 6000Mb per month until mid 2002, when they were raised to 500Mb and 1000Mb.

[70] Connection numbers on the Y axis in this graph have been suppressed to protect Xtra data confidentiality

Figure 17. ADSL Geographic Unit Business Diffusion



Using Statistics New Zealand's database of significant business units applied to the business ADSL connection sales provided by Telecom, we find that diffusion of the business ADSL product stands at around 8.3% of significant business units at March 2003. We note that this is a 'low estimate', as it does not include the residential connections servicing mixed business and residential purposes.

When analysing business purchase by region against Statistics New Zealand's database of significant geographic units (includes each separate location at which a business conducts activity, diffusion stands nationally at 7% of significant geographic units. Diffusion in the larger metropolitan areas of Auckland and Wellington, which have had access to the technology longest, stood at approximately 9% and 7.7% respectively at this date (Figure 18). Notably, regional areas Otago (8.0%) and Gisborne (7.9%) show a higher diffusion than metropolitan Wellington.

Furthermore, there is a noticeable 'flattening' of the diffusion curve in both of these markets, indicating that this diffusion pattern may be maturing. An analysis of the Auckland and Wellington diffusion growth rates (Figure 18) confirms that these are approaching zero. This further reinforces the mature market conclusion.

Figure 18. ADSL Business Diffusion – Auckland Region

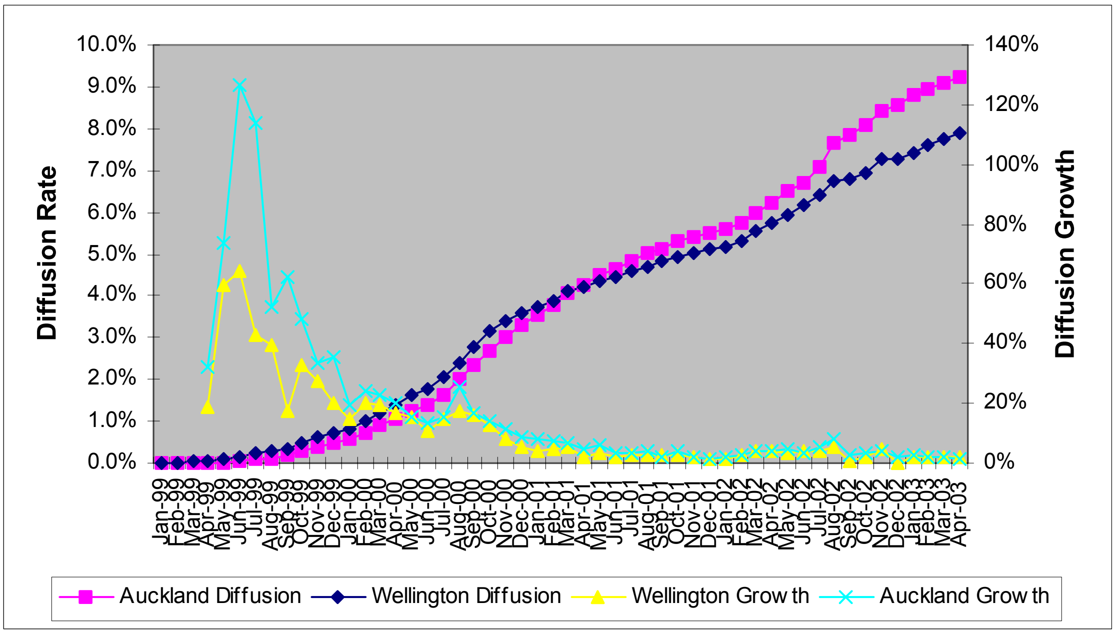


Figure 14 shows per capita connectivity for all DSL lines in New Zealand, and the diffusion of all residential connections provided by Telecom per household, as recorded by Statistics New Zealand. Whilst total per capita uptake is less than 1.5%, more than 3.2% of households had DSL connections at April 2003. Although this is significantly less than the 8.3% of significant businesses recorded as having ADSL connections, when combined with the nearly 60% of households with dial-up connections, it reinforces the widespread use of Internet connectivity in New Zealand generally. New Zealand is also positioned favourably against the Australian rate of 52% of households online at September 2001 (NOIE, 2002:16).

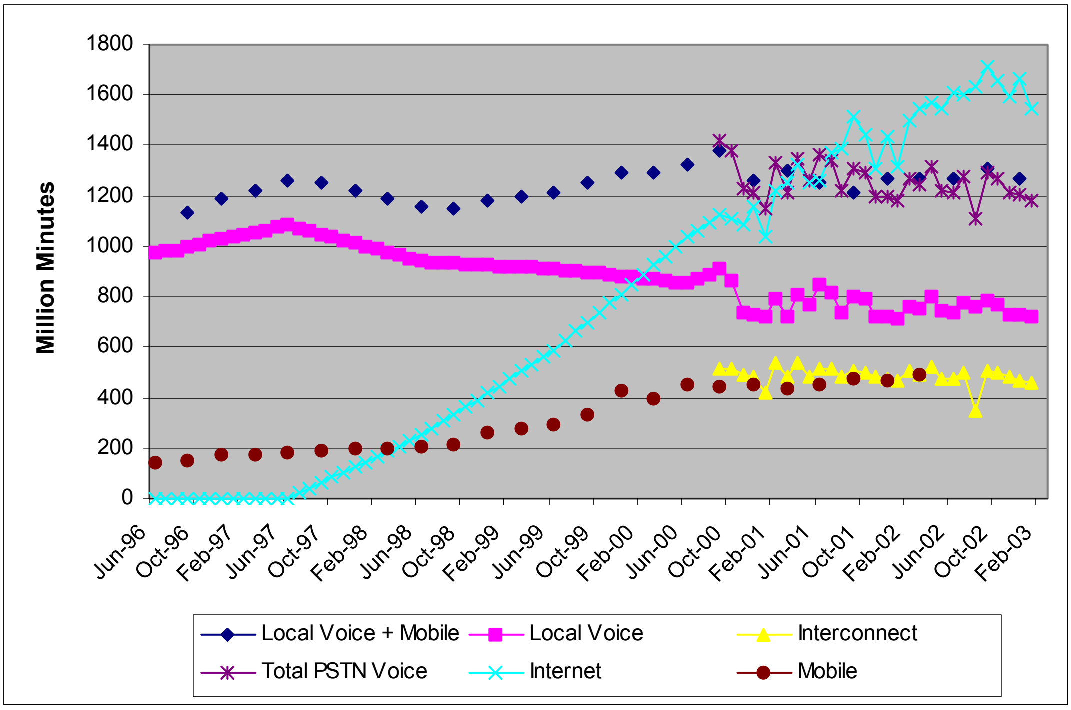
Whilst there is evidence of decline in the diffusion of business DSL connections in mature markets, there is no such evidence of slowing in the per capita and per household diffusion rates (Figure 13). This is consistent with Howell and Obren's (2002) conclusion that learning effects associated with applications are a significant factor in the growth of residential DSL connectivity, and that as yet, the amount of learning that has been undertaken on dial-up technologies has been sufficient only for a very small proportion of users to be able to justify switching to the more expensive DSL technology. As more learning is accumulated, more switching can be expected, in addition to the more general demand attributes that also affect the switching decision.

4. *Utilisation (Uptake) Measures*

4.1 Voice Telephony Usage

Figure 19 shows our estimates of the total number of minutes of telephony traffic exchanged over New Zealand telephony networks in the period June 1996 to March 2002. We calculate this as follows. Telecom traffic data for the fixed line network is, at over 96% of fixed lines, presumed to provide a robust and reliable proxy for total fixed line traffic. Mobile traffic is estimated by taking the minutes of traffic per customer generated on the Telecom network (over 50% market share over this entire period) and applying this to the estimated total mobile market size calculated above. We note that during the period to October 2000, the figures are derived from quarterly averages. From October 2000, the figures are monthly traffic flows, hence the more 'noisy' data. Separation of interconnect traffic is possible only after October 2000.

Figure 19. New Zealand Telephony Network Traffic: 1996-2003[71]

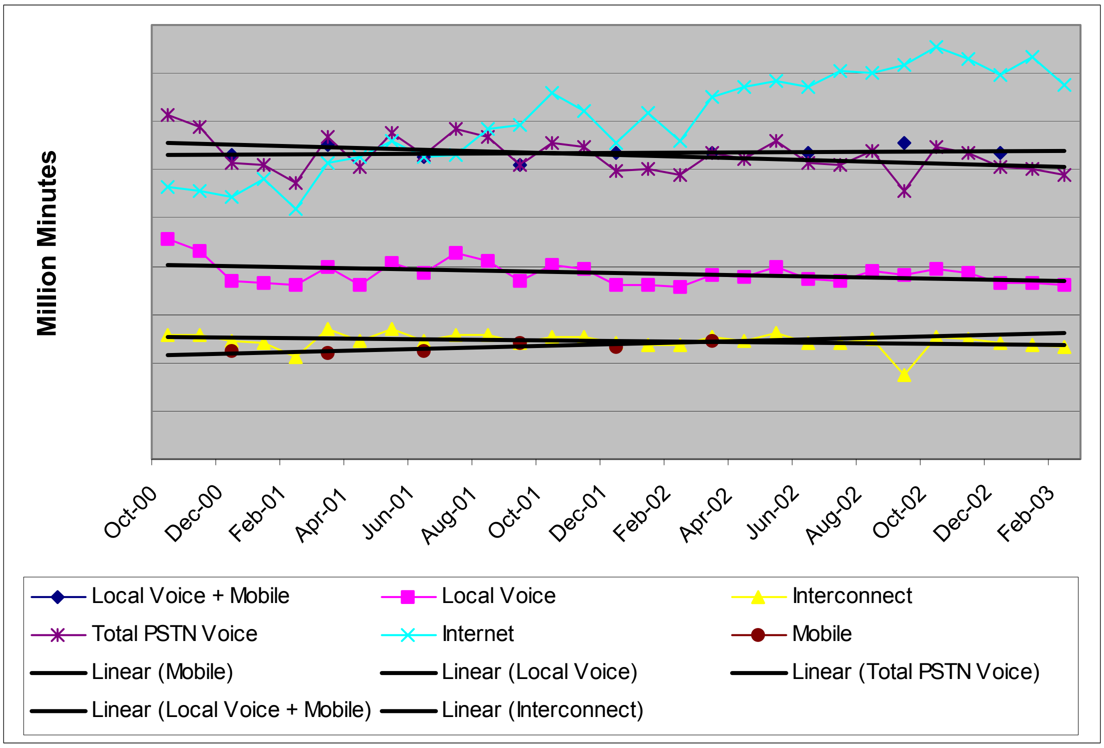


Total local voice utilisation has been declining consistently since around June 1997, but mobile voice traffic has been increasing, suggesting mobile voice traffic is substituting for fixed line local voice traffic. The graph indicates little growth in any of total voice traffic, local voice, mobile traffic or interconnect traffic since the beginning of 2000. Statistical tests[72] covering

[71] Minutes data on the Y axis in this graph have been suppressed to protect Telecom data confidentiality.
[72] T-tests on mean growth rate compared to zero cannot be rejected at the 95% level for any – see Appendix 2.

October 2000 to February 2002 cannot reject a zero growth rate for any of these traffic figures. Fitting lines[73] to each of these shows a negative slope for all except mobile (Figure 20).

Figure 20. Utilisation: Voice and Data Traffic October 2000-February 2003[74]



These data support the contention that the market for utilisation of voice telephony applications, as with the market for both fixed line and mobile connections, is mature in New Zealand. The total quantum of local voice and mobile traffic has been fluctuating around an average of 1300 million minutes a month over this period. This further supports the proposition that given the prices of all goods and services, and the technology of the day, there is a maximum total amount of voice traffic that consumers and businesses can be expected to exchange. This maximum would seem to have been reached in New Zealand. The emergence of new voice technologies, such as mobile telephony, are hence resulting principally in a substitution between applications, rather than growing the total quantity of traffic that is exchanged, as has been contended is the case in other markets (e.g. Taylor, 1999; OECD, 2001).

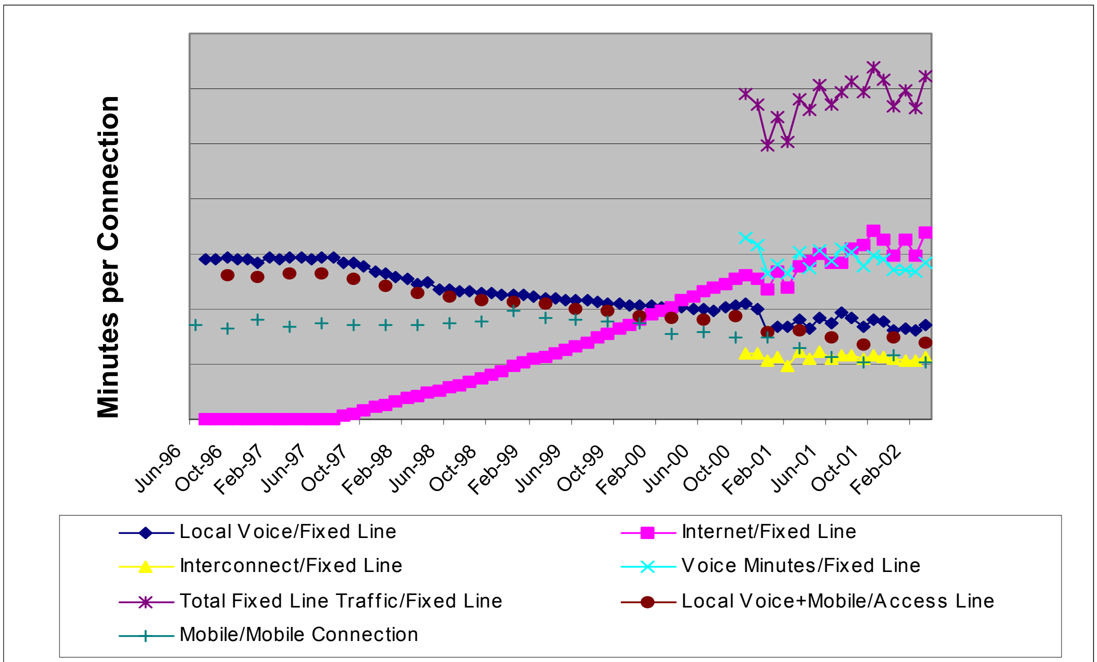
The maturity contention is further supported by the per-connection utilisations shown in Figure 21. Fixed line connection numbers have already been shown to be not growing in the preceding section, while mobile connections are increasing. Despite rapid growth in the number of mobile connections (Figures 5 and 10), the total volume of mobile traffic has been stable since

[73] Linear regressions – see Appendix 2.
[74] Minutes data on the Y axis in this graph have been suppressed to protect Telecom data confidentiality.

the beginning of 2000 (Figure 19), leading to a decline in the average minutes of traffic per connection (Figure 21). Thus, for mobile telephony, the growing number of connections is reflecting substitution and purchase of the technology by progressively more marginal users – that is, users for whom the maximum potential benefits from the new technology are less than for earlier purchasers, presuming that users with the greatest potential benefits to gain will substitute or purchase sooner than those with lower potential benefits, in order to maximise their gains[75].

Taken together, the static connection numbers per household, static traffic volumes per fixed line, and static mobile voice traffic volumes despite an increasing number of connections, imply a very mature and stable voice communication telephony market in New Zealand. This indicates very limited growth potential in the market. That this stability has occurred over a period of static prices further reinforces the contention that the substitutions that are being observed (e.g. mobile for local voice and distance calls) are reflections of utility gains from factors other than price adjustments.

Figure 21. Per Connection Utilisations: June 1996 – March 2002[76]



[75] Atkeson, Andrew; and Patrick J. Kehoe. 2001. *The Transition to a New Economy After the Second Industrial Revolution*. National Bureau of Economic Research Working Paper 8676. http://www.nber.org/papers/w8676

[76] Minutes data on the Y axis in this graph have been suppressed to protect Telecom data confidentiality. Interconnect and hence total voice traffic are measured only from October 2000.

4.2 Fixed/Mobile Substitution Explored

The decline in local voice minutes and its apparent substitution by mobile telephony minutes is occurring despite the fact that for residential users, there is a zero usage charge (in dollar terms) in making a fixed line local call. Also, the decline in local voice minutes occurred *after* prepaid mobile telephony became available. Business users were paying per call charges throughout the period of analysis, and both local call volumes and fixed line connections were all consistently growing up until prepaid connections became available. Hence, the changing pattern in usage could be attributed to a significant change in the residential market, such as the introduction of a new product like prepaid phones.

Prior to 1997, minutes of utilisation per connection for all technologies were static, indicating an equilibrium level of usage for each connection existed at the prevailing prices. The decline in local voice minutes occurring after this date is undoubtedly due to a substitution of some form, and could be occurring either because of a substitution of voice exchanges to mobile technology, or an application-based information communication substitution to Internet applications (such as chat rooms and email). Undoubtedly, substitutions of both kinds are occurring, but can we determine which is the dominant effect contributing to the utilisation patterns we observe?

The number of fixed local voice minutes and mobile minutes both flatten out together at about October 2000 suggesting that a rebalancing is occurring between these voice technologies. Statistical tests[77] suggest that the substitution relationship between mobile minutes and local voice minutes is significant. However, statistical tests[78] also show a significant negative relationship between Internet minutes and local voice minutes, meaning neither can be rejected as significant factors in the decline in local voice. Further tests[79] show that a relationship between local voice minutes and a combination of mobile and Internet minutes is slightly stronger than each of the separate relationships. Thus, we conclude that both forms of substitution are occurring, and it is difficult to determine which effect is the stronger.

The steady decline of total voice minutes per connection as mobile connections grow steadily, and the decline and levelling in local voice minutes occurring with the rise and levelling of mobile minutes, particularly following a period of steady rise in both, is consistent with

[77] A correlation analysis shows a negative and significant relationship at the 99% level, while a linear regression between mobile minutes and local voice minutes yields a negative coefficient $(R^2 = 0.85)$ - Appendix 2.

[78] A correlation analysis also suggests a significant relationship at the 99% level between Internet minutes and local voice minutes, with the regression of Internet minutes on local voice yielding $R^2 = 0.82$ - Appendix 2.

[79] A linear regression with local voice minutes as the dependent variable, and both mobile and Internet minutes as independent variables realises an R^2 only slightly higher than each alone $(R^2 = 0.88)$.

significant substitution of a zero usage charge product with a non-zero marginal cost product post 1997. When usage of a product does not reflect the marginal cost (free local calling) there will be very high usage, as use is not constrained by direct costs. This may be the maximum possible level achievable within budget constraints (e.g. time, other demands). When calls are substituted from the 'free' product to one with positive marginal cost (mobile telephony), then we would expect the total volume of call minutes to reduce, eventually (given constant prices) reaching equilibrium when the substitution process is complete. As the differing utilities derived from mobile telephony mean it is not a perfect substitute for fixed line telephony (e.g. mobile telephony offers benefits to the user from receiving and making calls in a variety of locations, and being able to participate in calls immediately the need arises, without having to delay the call until a fixed line is reached), there may also be some new use within the new technology, which will add new usage to the call volume. Given constant prices, this new utilisation too will reach equilibrium when all new users for whom there is a benefit have purchased.

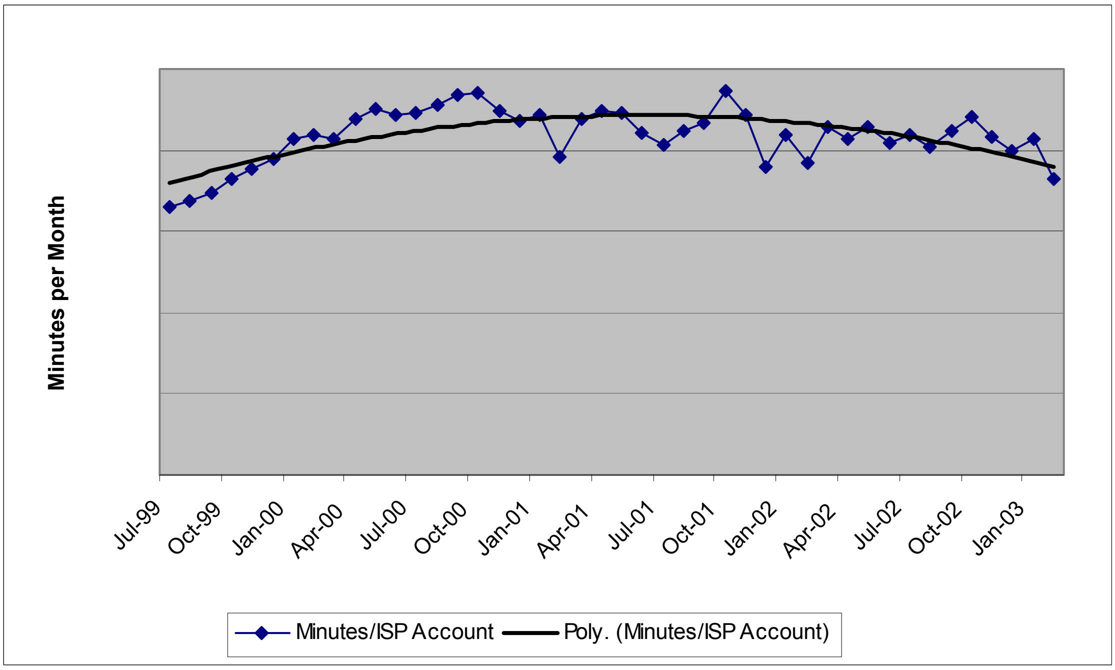
If, as we have proposed above, mobile telephony is now mature and well-diffused, the static number of minutes of voice traffic in New Zealand occurring in a period where there have been few significant changes in the prices of mobile telephony relative to the prices for fixed telephony, indicates that we may have reached an equilibrium level in the amount of voice information exchange. This is further evidenced in the concurrent levelling of the total minutes of voice and mobile minutes per access line (either fixed or mobile). The only activity occurring is substitution of one voice medium for another, determined by the relative levels of increased utility or productivity accrued from the applications that use each medium.

The continued rise of the number of minutes of Internet use per fixed line, however, implies that the substitution of Internet applications for voice telephony is still occurring.

4.3 Dial-Up Internet Usage

The only utilisation factor to show significant and consistent growth over the period of our examination is dial-up Internet traffic, which by early 2001 had exceeded the sum of all fixed line voice traffic and the sum of local voice and mobile traffic. It is also the only utilisation factor to show an increase in minutes of use per fixed line, although there is evidence that even it may be starting to slow down in the period following June 2001 (Figure 21).

Figure 22. Internet Telephony Usage per ISP Account[80]



When the total number of minutes of Internet usage on the Telecom network is averaged per ISP account as estimated for Figure 13 above, the pattern of Figure 22 is derived. This graph reveals a steady increase in the number of minutes per month spent on the Internet for each ISP account until late 2001, when it too began declining. A similar pattern is also evident in the independently measured data held by Xtra on usage by dial-up Internet customers of this ISP alone[81] (Figure 23). Furthermore, when the average usage of flat rate customers are separated from pay per use customers, the extent of increased learning occurring within the flat-rate customers compared to pay-per-use customers is clearly evident. Average usage per account per month for all customer types has appeared to have reached its peak, with the curves fitted to total use per customer and use per flat-rate customer indicating a downward turn in the near future. Use per pay-per-use customer has been declining over the entire period.

These findings, consistent with those of Howell and Obren (2002) and the finding above that more than 50% of households now have dial-up Internet connections, confirm that this rapidly growing market is also approaching maturity, with the lower total potential learning effects of the more marginal users joining being insufficient to maintain the increase in the average number of hours that the earlier users were able to establish. Thus, despite more dial-up ISP accounts being sold, average use will progressively decline, as established learners reach their

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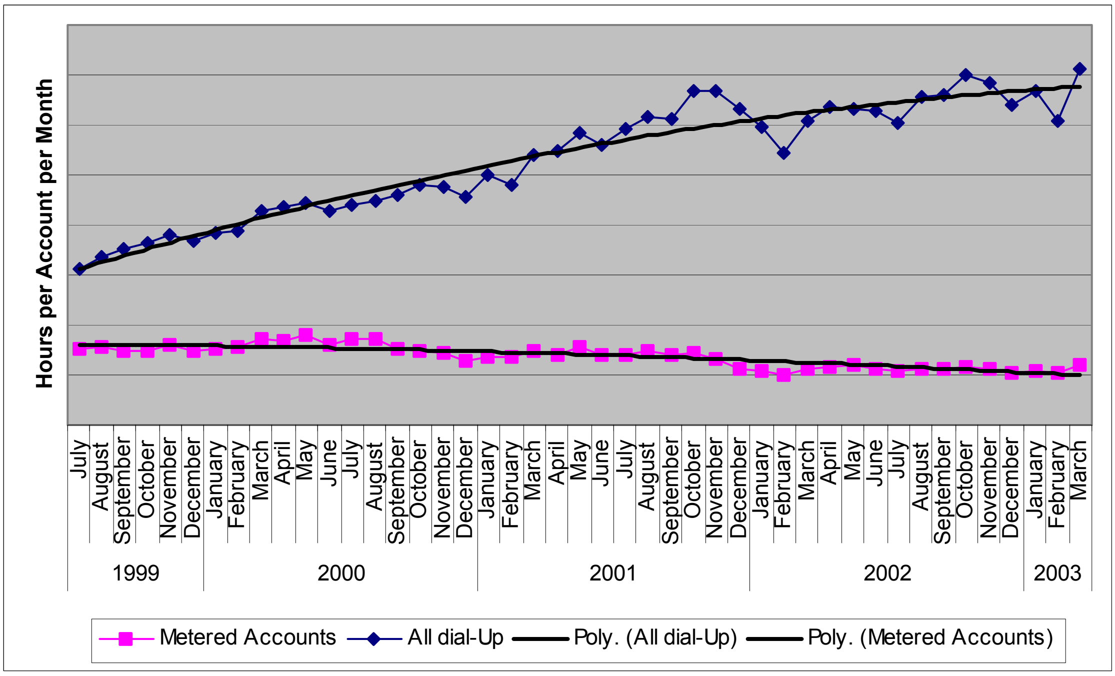
[80] Minutes data on the Y axis in this graph have been suppressed to protect Telecom data confidentiality.
[81] Xtra records the hours its customers are connected to their servers independent of the records Telecom keeps in respect of minutes connected via the exchange.

learning potential, and those learned users for whom DSL or other broadband technologies provide a more productive option, migrate to these technologies.

Figure 23. Dial-up Internet Account Usage per ISP Account[82]



4.4 Broadband Internet Usage

This leaves replacement of dial-up accounts by broadband accounts (e.g. DSL, cable modem, satellite, wireless, Ethernet LAN) as the only area of potential current and future significant change in the telephony market in New Zealand.

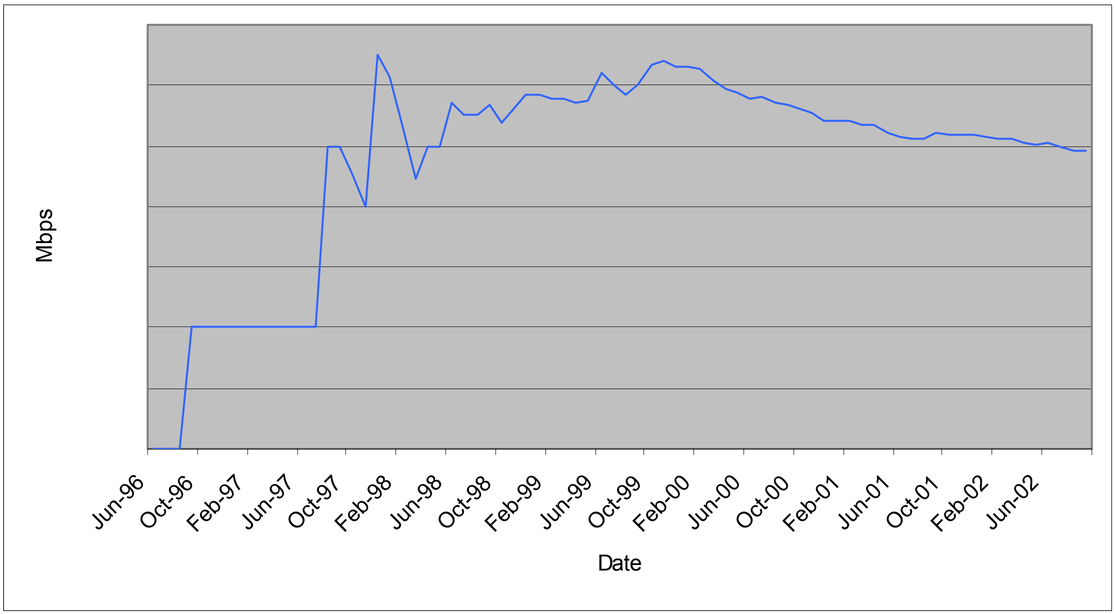
Howell and Obren (2002) found substitution of dial-up or ISDN Internet access with DSL connections in the business market to be a function principally of the fixed costs of telephony lines and the variable call charges associated with either telephone calls or megabyte usage volumes. Whilst no exact figures for DSL broadband usage (as opposed to connectivity) could be determined from the telecommunications data in our dataset, anecdotal evidence from Xtra indicates that demand for broadband services is strongest in the evening, suggesting that business demand for broadband data exchange capacity is significantly less than that for residential capacity.

Whilst we cannot assess the usage patterns of DSL customers, the flattening diffusion patterns exhibited in the more mature markets (e.g. Auckland, above) indicate that business broadband

[82] Hours per account data on the Y axis in this graph have been suppressed to protect Xtra data confidentiality.

demand may, at current prices and with current applications, be approaching some level of maturity. To assess whether the same patterns apply in mature broadband markets, we examined data from New Zealand's longest-standing broadband provider, Ethernet LAN provider CityLink. We found that capacity analysis per user shows the familiar pattern of average capacity purchased per customer initially increasing (to June 2000), and then decreasing as the technology becomes more mature (Figure 24). Thus, broadband technologies are also exhibiting the same pattern of additional connections from users with lower demands and learning potential eventually resulting in declining average consumption per customer. This pattern closely echoes the utilisation figures we are observing for dial-up Internet access, indicating that the potential for usage-based growth in the DSL market may be limited.

Figure 24. Average Capacity to the Customer per LAN User – CityLink[83]

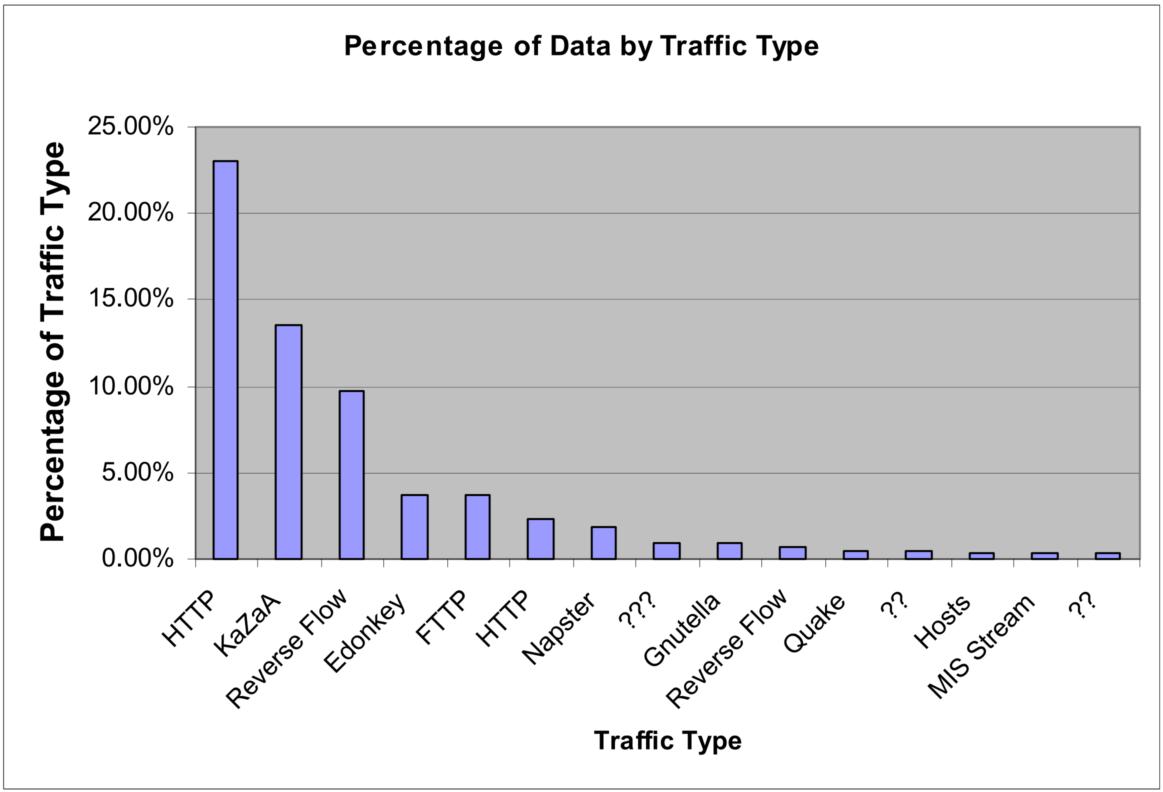


This finding strengthens the hypothesis of Howell (2002) and Howell and Obren (2002) that with the currently available range of business applications, we may be close to the maximum volume of data exchange occurring in business markets where connections have been available for an extended period, in particular the Auckland and Wellington markets that we identified as approaching maturity by connectivity diffusion. Although it is difficult to extrapolate uses of new technologies, this contention appears to be reinforced by Howell and O'Connell's (2003) survey, which reveals that mature broadband users, aside from those whose product was video content, rated applications such as video-conferencing and video file transfer upon which great hopes for increased broadband demand have been pinned, as not productivity-raising in their contexts, and unlikely to be used by many of them in the short or medium term future.

[83] Mbps data on the Y axis in this graph have been suppressed to protect CityLink data confidentiality.

Howell and Obren (2002) found residential broadband usage to be much more strongly determined by learning effects associated with applications and the valuation of personal time than by price. They found that the average Xtra residential broadband customer consumed more than three times the amount of information exchange than it would be feasible for a dial-up customer to physically exchange in a month, indicating a strong linkage between actual demand and the substitution decision. As more dial-up consumers learn about applications, and use them more, then the rate of information exchange will increase and broadband substitution will follow. Furthermore, the applications, which broadband consumers utilise, impact on broadband usage. A sample month's usage of Xtra's residential, unmetered broadband product shows that most bandwidth is used for web browsing and file transfer (Figure 25). Moreover, in excess of 50% of the available bandwidth was consumed by fewer than 10% of the customers, indicating that there is a very small number of very intensive residential broadband users, with the majority gaining benefit from time savings in addition to application feasibility.

Figure 25. Residential DSL Application Usage – Sample Month[84]



[84] In this graph, HTTP represents general web browsing; KaZaA, Edonkey, Napster and Nutella are all media-sharing applications (e.g. video, audio files); FTTP represented other file downloading; Quake is an online game; Reverse Flow is traffic back to source confirming message flow; X axis categories of '???' and '??' indicate uncertain, but common, aggregate applications.

5. *Connectivity and Utilisation in Perspective*

The data suggest that the telecommunications market in New Zealand is mature and we infer that the potential for growth is limited. There has been negligible growth in any of the number of fixed lines, either business or residential, since 2000. The number of residential lines is growing only in proportion to the number of households, with approximately one residential line per household, indicating that household penetration at this level is now saturated. Business line connections have been constant since approximately August 1999, although there is evidence of substitution away from PSTN connections towards ISDN connections in this market.

While the number of mobile lines has been increasing, the total volume of voice-based telephony traffic (local and long distance fixed line and mobile) has settled at a constant level. Diffusion of mobile telephony sits at approximately 75% of the population over 10 years of age and while still growing, growth rates appear to be slowing, implying that this technology is also close to saturation. Average usage per mobile account is declining, indicating that the growth that is being recorded is that related to users with lower than average demand for the service.

The data offer significant evidence of substitution between technologies, such as fixed line to mobile, for voice traffic. Thus, the presumption that mobile and fixed line telephony are separate markets must be questioned. This is particularly evident in the residential market; as the evidence supporting substitution (reduction in the growth of local voice traffic, slowing of the number of residential fixed line connections and acceleration in both the number of mobile connections and the volume to mobile traffic) coincides with the introduction of prepay accounts, which have been targeted at residential consumers.

The only telephony volume to show significant growth is that of dial-up Internet traffic. However, even this traffic is showing signs of slowing, both on measures of volume per fixed line and volume per ISP account. Diffusion of this technology is also widespread, with nearly 60% of households having connections. Thus, this technology may also be approaching maturity in the New Zealand market, as, with mobile technology, new connections represent users with lower than average demand. And while there is some evidence of substitution of dial-up Internet access technology with DSL in the business market, in the residential market substitution still appears to be dominated by learning effects associated with the applications that consumers use, and individuals' valuation of time.

5.1 Implications for Competition and Regulation Policy

These findings have significant implications for competition policy in New Zealand. If the fixed line and mobile markets are substitutes for each other, and both are effectively mature technologies, then regulating price and access conditions on the fixed line technology is likely to have little effect on either connection numbers or call volumes. Indeed, the evidence presented here indicates that residential consumers are eschewing the benefits of free local voice calls in favour of higher-priced, higher-utility mobile telephony calls in significant numbers: local voice traffic fell by 30% over the same period that mobile traffic increased by 330%.

Whilst dial-up Internet traffic is currently growing, there is evidence that the market for ISP connections is starting to mature, and that the limitations on greater use of this technology in New Zealand are not so much related to infrastructure as to applications and user learning. This is also significant for any regulation that seeks to alter the dynamics of the market for broadband connections. Whilst infrastructure price may govern the point at which users substitute one technology to some extent, it is by no means the only factor governing the decision[85]. Application availability and demand, in the business market in particular, are significant, and applications, learning and time allocation are important in the residential market. Whilst price regulation may influence specific technology connection rates by adjusting the relative prices of broadband and dial-up technologies, it may have negligible effects upon the extent of usage if the applications to take advantage of it are neither available nor extensively used.

Indeed, it may be more efficient to encourage learning to occur on lower cost existing dial-up telephony infrastructure and progress to implementing broadband technologies progressively as user learning increases and new applications become available, thereby avoiding the risks of over-investment in broadband technologies that have been a factor in the financial failure of a number of firms, particularly in the United States (e.g. Global Crossing, WorldCom). An undifferentiated universal broadband provision policy based upon one single infrastructure may result in a less than optimal technological choice for some users, by not waiting for stronger signals of user preference and technological advances.

The New Zealand market has broadband infrastructure options that are not telephony-based. Regulating the telephony market to induce broadband uptake in ignorance of these technologies (e.g. Ethernet LAN, short-range wireless broadband based upon the 802.11b protocol and

[85] Howell and Obren, 2002 *op cit*

satellite services) which comprise approximately 10% of the broadband market in New Zealand, would distort the market for broadband services in the same manner as has been found in the asymmetric regulation policies in the United States (e.g. Hausmann, 2001; Ferguson, 2002).

The New Zealand telecommunications market is characterised largely by the absence of any regulatory distortions that would influence the purchase of any particular technology in the period of our examination (barring the regulatory requirement for universal fixed price, zero usage charge local residential telephony, and a cultural preference for flat-rate pricing of ISP, long distance and mobile services). That our evidence shows such low levels of uptake and approaching maturity even at low prices (by world standards) implies that the 'applications problem' might be the object of primary interest.

5.2 Implications for Information Economy Policy

The New Zealand data contain implications for information economy policies. Whilst universal service policies and flat rate pricing of telephony-based infrastructures have been pillars of support for policies promoting the advancement of information-based economies, the New Zealand experience suggests further consideration is warranted.

Firstly, the zero usage charge provision of local telephony services has promoted telephony use in the past. However, confronted with an information exchange infrastructure with greater utility but at a positive marginal cost, we see significant substitution *away* from the universally available, flat-rate product. People are prepared to pay an increased cost for information transfer if the benefits of the application and transfer together justify the expense.

Secondly, even in the presence of a flat-rate broadband product, substitution from flat-rate dial-up services is slow, and governed more by application and learning factors than infrastructure prices. Information transportation services are valuable only if there is a need to transfer the information in the first place. Thus, resources devoted to developing applications and promoting learning are likely to increase economic welfare from the use of information more than focusing only on the transmission infrastructure.

Thirdly, despite emphasis in policy literature that the potential gains from an "Information Economy are larger in the business sector[86], universal access policies are targeted at residential markets. It is not clear how universal residential access of itself facilitates achieving these

[86] For example, NOIE (2002); OECD (2003).

business sector gains, given that the vast majority of information transferred via digital infrastructure is exchanged within businesses on dedicated linkages rather than between businesses and businesses and consumers over the Internet[87]. Moreover, gains in the residential sector may be limited. Consumer contribution to welfare gains is typically achieved through substitution of one consumption good for another[88]. Household budgets usually have upper limits which constrain the extent of substitution. For example, Saether (1999) finds that telecommunications spending has not risen significantly as a proportion of household spending in Norway over the past thirty years, despite more products and applications coming available. Furthermore, Galbi (2001) finds that the total household budget spent on entertainment has not altered over the twentieth century any more than can be accounted for by the increase in household leisure hours. Hence the extent of welfare gains that are achievable from universal infrastructure policies at the residential sector may be capped, whereas targeted policies in the business sector where caps may not be so limiting may be more effective in raising welfare.

Fourthly, available evidence appears to support the contention that the greatest potential for growth of broadband services at present lies in residential leisure (i.e. entertainment) applications. These products have been regarded traditionally by policy-makers as discretionary spending items, and they have not received a high priority when compared to other calls on state resources. As entertainment applications (e.g. video and audio on demand, interactive gaming) are among the few applications that require the capacity and speed offered by broadband, it is not surprising that willingness-to-pay surveys in the United States find that the price elasticities for broadband access are comparatively high compared to basic Internet access and voice telephony[89]. This reinforces the apparent 'luxury good' definition of broadband given current applications. Moreover, CityLink finds that even in the business sector, willingess-to-pay for additional services is strongly correlated to business trading hours. Few of their customers pay for a 24/7 technical support policy, as most only require the service between Monday and Friday during business hours. This implies that the 'necessary' component of broadband access given current applications lies in the business rather than the residential sector, and raises further questions about the prioritisation of policies that promote residential broadband access over policies that promote business access.

[87] Galbi, Douglas. *Growth in the "New Economy": US Bandwidth Use and Pricing Across the 1990s.* Washington: Federal Communications Commission, 2000 finds that in the United States, over 90% of data travels over leased lines rather than Internet connections. This is echoed in New Zealand data. Only 10% if CityLink's fibre capacity is deployed for Internet-like connections – the balance is dark fibre linking business operation sites directly.

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

[89] Rappoport, Paul; Lester D. Taylor; and Donald J. Kridel. 2003. *The Analysis of Broadband Demand Using Data on Willingness-to-Pay*. Paper presented at the International Telecommunications Society Asia-Australasia Regional Conference Perth June 22-24, 2003.

Fifthly, the New Zealand data show that two-part pricing does not appear to be constraining business connectivity, as businesses are prepared to pay the efficient price to access information and, as a consequence, are not inefficiently over-consuming to the detriment of other users. Moreover, this is occurring in a culture that has enshrined a flat-rate pricing system into every aspect of its residential telephony market. Residential consumers also show considerable willingness to pay for welfare-raising mobile telephony, even though a 'free' fixed line product is available. There is no reason to believe that the same preparedness to pay for broadband information exchange does not exist, or that the potential to encourage efficient use of the resource does not exist in the residential sector.

5.3 Conclusion

If the patterns of information exchange evidenced by the telecommunications market in New Zealand over the period examined are indicative of the changes in demand for information transfer facing all economies, then the issues raised above are of significant importance for all markets. Although they have been the tangible manifestation of the 'information economy', telephony infrastructures are but a tiny part of the value-adding equation. The fact that we are seeing substitution away from free services to pay-per-use implies that the economics of information transfer via telecommunications networks are but a very small part of the value-adding equation, and that it is the value contributed in the applications that use the information that is paramount. Until this is confronted, we risk spending all of our investigation and policy-making effort on the horse and cart, at the expense of the cargo and its production processes.

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Appendix 1. Connectivity Analyses

Regression $PSTN\ Business\ Lines = \kappa + \alpha.ISDN\ Lines$

R	R Square	Adjusted R Square	Std. Error of the Estimate
.927	.859	.855	9590.406

a Predictors: (Constant), ISDN

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	19087335643.819	1	19087335643.819	207.525	.000
Residual	3127180464.487	34	91975896.014		
Total	22214516108.306	35			

a Predictors: (Constant), ISDN
b Dependent Variable: BUS

T-Test: Business PSTN and ISDN % change against 0, from May 99

N	Mean	Std. Deviation	Std. Error Mean
36	.002339	.0122236	.0020373

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
Test Value					Lower	Upper
= 0	1.148	35	.259	.002339	-.001797	.006475

T-Test: Residential PSTN/Household June 96-Feb 98

N	Mean	Std. Deviation	Std. Error Mean
20	.00564483	.011394522	.002547893

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
Test Value					Lower	Upper
=0	2.215	19	.039	.00564483	.00031203	.01097763

T-Test - PSTN/Household Feb 98-Mar 02

N	Mean	Std. Deviation	Std. Error Mean
50	.00096399	.025813015	.003650512

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
Test Value					Lower	Upper
=0	.264	49	.793	.00096399	-.00637199	.00829997

Appendix 2. Utilisation Analyses

Regression $Local\ Voice\ Minutes = \kappa + \alpha.Mobile\ Minutes$

R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
.923	.852	.845	42.94485917523

a Predictors: (Constant), MOBILE

ANOVA

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	223511.716	1	223511.716	121.193	.000
Residual	38729.480	21	1844.261		
Total	262241.196	22			

a Predictors: (Constant), MOBILE
b Dependent Variable: LOC_VOIC

Coefficients

	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	Std. Error	Beta		
(Constant)	1140.414	23.300		48.944	.000
MOBILE	-.707	.064	-.923	-11.009	.000

a Dependent Variable: LOC_VOIC

Correlation: Local Voice Minutes and Mobile Minutes

		LOC_VOIC	**MOBILE**
LOC_VOIC	Pearson Correlation	1	-.923
	Sig. (2-tailed)	.	.000
	N	69	23
MOBILE	Pearson Correlation	-.923	1
	Sig. (2-tailed)	.000	.
	N	23	24

** Correlation is significant at the 0.01 level (2-tailed).

Correlation: Local Voice Minutes and Internet Minutes

		LOC_VOIC	**INTERNET**
LOC_VOIC	Pearson Correlation	1	-.904
	Sig. (2-tailed)	.	.000
	N	69	56
INTERNET	Pearson Correlation	-.904	1
	Sig. (2-tailed)	.000	.
	N	56	56

** Correlation is significant at the 0.01 level (2-tailed).

Regression $Local\ Voice\ Minutes = \kappa + \alpha.Internet\ Minutes$

R	R Square	Adjusted R Square	Std. Error of the Estimate
.904	.818	.814	40.56311399190

a Predictors: (Constant), INTERNET

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	398322.185	1	398322.185	242.087	.000
Residual	88849.776	54	1645.366		
Total	487171.961	55			

a Predictors: (Constant), INTERNET
b Dependent Variable: LOC_VOIC

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1021.258	10.366		98.516	.000
INTERNET	-.183	.012	-.904	-15.559	.000

a Dependent Variable: LOC_VOIC

Regression $Local\ Voice\ Minutes = \kappa + \alpha.Internet\ Minutes + \beta.Mobile\ Minutes$

R	R Square	Adjusted R Square	Std. Error of the Estimate
.937	.878	.863	36.97256614635

a Predictors: (Constant), MOBILE, INTERNET

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	157191.144	2	78595.572	57.496	.000
Residual	21871.530	16	1366.971		
Total	179062.674	18			

a Predictors: (Constant), MOBILE, INTERNET
b Dependent Variable: LOC_VOIC

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1030.089	47.576		21.652	.000
INTERNET	-.192	.076	-.911	-2.528	.022
MOBILE	-2.014E-02	.272	-.027	-.074	.942

a Dependent Variable: LOC_VOIC