# InternetNZ
# External Peering Group

## Issues regarding Internet peering and interconnection in New Zealand

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# 2 Executive Summary

## 2.1. Findings and Investigations

2.1.1. In March 2007, InternetNZ formed an external group (the Group) to investigate industry solutions around issues of Internet peering and local data interconnection, and hereby presents its findings.

2.1.2. Differences in what is meant by the word "peering" and emotive responses flowing from historical events can be overcome by defining as far as possible what peering means, or by referring instead to local data interconnection where possible.

2.1.3. The cost of transit appears to be high within New Zealand relative to that in comparable countries around the world. This would appear to be a significant driver of dissatisfaction around issues of interconnection, and many such issues might evaporate if the cost of transit were to reduce substantially.

2.1.4. The availability of complete and reliable traffic statistics for the Internet both within New Zealand and in and out of New Zealand appears to be impossible to obtain. Many sources have partial information, but these partial sources are often misleading and are responsible for creating much misinformation about what is actually happening in the Internet.

2.1.5. Take-up and delivery of rich media content is hampered on two levels. From the content provider's perspective high national transit cost leads to hosting of content offshore and from a consumer's perspective, lack of differentiation between national and international traffic charges limits the volume of rich content that consumers can access at reasonable cost.

2.1.6. There is no recognition that local traffic is cheaper to deliver than national traffic or international traffic. This may change if a local data interconnect proposal that Telecom is proposing to the market is successful. Success for that proposal would lead to a different peering model that would enable New Zealand consumers to react positively to the emergence of rich media content, and which we would expect would be supported by telecommunications firms and ISPs.

## 2.2. Recommendations

2.2.1. The Group does not propose the creation of a Code of Practice or regulation at this point regarding peering. However, there are issues arising from this review that require industry attention.

2.2.2. The Group proposes:

- The adoption of, and consistent use of, the definitions as proposed in this report to minimise future confusion in terminology,

- Active pursuit of transit prices to achieve reductions commensurate with those in other similar countries,
- The active consideration of an industry-wide Internet traffic statistics measurement and reporting process to ensure that all players have access to a similar aggregate view of the Internet traffic flows and volumes,
- Discussion be initiated to determine how best to encourage the take-up of rich media content within New Zealand in an economically rational manner for all parties,
- The active consideration of a two or three level pricing strategy for the Internet in New Zealand, in order to help encourage the take-up of rich media content,
- Encouraging the various interested parties to negotiate in an open and rational manner concerning Telecom's proposals for local interconnection, recognising that in the long term this might be a powerful mechanism to ensure the most cost effective and quality delivery of rich media content to all New Zealand consumers,
- That Telecom negotiate with content providers as a group to ensure their unique issues are addressed in an economically rational manner. InternetNZ is willing to assist in facilitating discussions between the parties.

2.2.3. The Group regards the issues of rich media uptake and delivery to be of such importance to New Zealand's Internet future that failure to resolve these issues in a timely fashion should trigger Government investigation to ascertain whether market power is an issue.

# 3 Introduction

3.1.1. In March 2007, InternetNZ (Internet Society of New Zealand Inc.) tasked an external group (the Group) with the investigation of issues around Internet peering and local interconnect. The Group's Terms of Reference are set out below.

3.1.2. InternetNZ itself is a membership-based not-for-profit organisation and has the management responsibility for the administration of the .nz domain name registry, a critical component of the Internet infrastructure in New Zealand.

3.1.3. The mission of InternetNZ is to protect and promote the Internet in New Zealand; we advocate the ongoing development of an open and uncaptureable Internet, available to all New Zealanders. The Society is non-partisan and is an advocate for Internet and related telecommunications public policy issues on behalf of the Internet community in New Zealand – both users and the Industry as a whole.

# 4 Terms of Reference for the External Peering Group

## 4.1. Objectives:

4.1.1. To facilitate industry discussion on issues relating to Internet peering in New Zealand inclusive of all interested and affected stakeholders and in a collaborative fashion.

4.1.2. To establish policies and principles that will expedite an industry-wide agreement on peering and local interconnection of data.

## 4.2. Consulting Participants

4.2.1. External Peering Group members

- Dr Murray Milner – Independent Consultant
- Dean Pemberton – Prophecy Networks
- Dr Peter Komisarczuk – Victoria University of Wellington
- Neil Bertram - CatalystIT

4.2.2. Stakeholder parties to the consultations

- Telecommunications firms – Telecom, TelstraClear
- Content providers – APN, TVNZ, TradeMe, Fairfax Digital, Radio New Zealand
- Internet advertisers – Internet Advertising Bureau

- Government agencies – State Services Commission, NZ Police, Land Transport NZ, ACC, IRD
- Peering exchanges – CityLink
- Business sector – IBM, ASB, ANZ/National, Westpac
- ISPs – ISPANZ, Ihug, FX Networks, ReiverNet, Maxnet, Compass, CityLink, ICONZ, Orcon, CallPlus.

4.2.3. Project support and review

- Simon Riley, Keith Davidson, and Richard Wood – InternetNZ
- Bill Norton, Equinox

## 4.3. **Background Documents**

4.3.1. *"Internet Interconnection and Peering Report, July 2006"* (Azimuth) (supplied by MED under non-disclosure requirements)

4.3.2. *"New Zealand's Internet Landscape: An analysis of peering, content and scalability"* (Neil Bertram) <www.webbedfeet.net.nz/t3site/fileadmin/stuff/Neil%20Bertram%20-%20BITT489%20-%20NZ%20Internet%20Landscape.pdf>

4.3.3. *"Internet Service Providers and Peering"*
*"Interconnection Strategies for ISPs"*
*"A Business Case for ISP Peering"*
*"The Evolution of the U.S. Internet Peering Ecosystem"*
(Bill Norton)

4.3.4. *"ISPANZ Position Paper Internet Peering"*

4.3.5. *"Comment on Azimuth report on Peering for MED" (*Nick Wallingford for InternetNZ)

4.3.6. *"Handbook of Telecommunications Economics" (2002 Edition. Edited by Martin E. Cave, Sumit K. Majumdar and Ingo Vogelsang)*

# 5 Background: The State of Peering

5.1. Historically, New Zealand's Internet service providers and content providers were very well interconnected. Any party wishing to deliver data to another network needed only to reach one of the de-facto peering exchanges established by CityLink in Auckland and Wellington, where handoff would occur on a bill-and-keep basis. The most expensive component of delivering national traffic was physically transferring the data to and from the peering exchange.

5.2. As telecommunications technology advanced, and the cost of optical networking decreased, there appeared to be a number of new services that were becoming viable on the New Zealand domestic Internet of the time. Indeed the low cost of providing content to consumers at the time has been acknowledged by now-established firms such as TradeMe for being paramount to their success, as in their early days they would not have been able to economically grow their business if today's market conditions had prevailed.

5.3. In 2004, TelstraClear decided to no longer partake in multilateral peering at the established exchanges in Wellington and Auckland. The implementation of this caused an overload on Telecom's router at the Wellington exchange and led to Telecom reconfiguring its router so that only contracted peering arrangements were supported. Subsequently anyone wishing to access content or customers on either the Telecom or TelstraClear networks was required to purchase a retail transit product. The alternative was to deliver or receive content from these providers outside of New Zealand.

5.4. Because a majority of the broadband customers in New Zealand are connected to either Telecom or TelstraClear's networks, the cost of delivering content to New Zealanders increased sharply for most content providers. While some transitioned to the new arrangements smoothly, due to their ability to deal with the telcos directly, others were forced to move operations offshore or not offer their services to the affected customer base.

5.5. Currently, as can be seen in Appendix F in respect to ISPs, New Zealand's Internet is split into roughly three divisions: Those peering freely in Auckland at APE; those doing the same in Wellington at WIX; and Telecom and TelstraClear, who interconnect with each other, but access to other parties is provided only by private bilateral transit arrangements. Almost all ISPs other than Telecom and TelstraClear are still freely interconnecting with each other and content providers, and many of the most popular content providers are also still making the effort to be available over peering exchanges. Notable exceptions are ISPs or content providers located outside of regions where an exchange exists, as the cost of reaching their nearest exchange is not economic given the relatively low customer count available there.

5.6. The events of 2004 was largely seen as a hostile and unfair move by ISPs within the New Zealand market. However, it has since been acknowledged by many as an inevitable progression. The existence of multiple "tiers" of

ISPs within a region is commonplace internationally, although in some markets the interconnection policies are strongly regulated to protect the viability of smaller providers.

5.7. Because of the lack of objective traffic data, it is impossible to tell for certain what the economic or technological impact of the 2004 decisions were. There has been considerable speculation ranging from negligible to significant impact.

# 6 Consultations

## 6.1. Process

6.1.1. The Group met with a variety of stakeholders, presenting a consistent set of questions around Internet peering to ascertain perceived issues, understand differing perspectives, and explore applicable principles. These meetings were held face-to-face in Auckland and Wellington, generally in groups. A summary of the input of each of the consulted groups appears in Appendix E.

6.1.2. One industry representative group, the Internet Advertising Bureau, provided a written submission. Other individuals provided material on a confidential basis, which has been used in an aggregate form to support the conclusions contained in this report.

6.1.3. All of the industry submissions have been gratefully received.

## 6.2. Finding 1: Language and Perception Issues

6.2.1. There are differences among stakeholders as to what the word "peering" means. There is use of the word as relating to the existing peering exchanges as well as emotive responses to the word dating back at least from the time when the two large telecommunications companies "de-peered" in 2004.

6.2.2. There have been situations in the past where disagreements between parties have centered solely on differences in the use of the word "peering". One example of this is where one party assumes that "peering" also denotes the assumption that all traffic will be exchanged for free.

6.2.3. Determining a common definition or alternative terminology is conducive to reaching agreement and industry solutions. At present, there is little communication between stakeholders due to differing perceptions of "peering".

6.2.4. A useful definition of peering is:

> *"An agreement between two or more Internet network and/or content providers to carry traffic for each other and their respective customers. This may include their entire customer base or only a prescribed subset. It does not include the obligation to carry traffic to third parties. The exchange is either at no cost, where the value is equal, or fairly compensated where the value is not equal. Value is defined by each individual party involved in the negotiation."*

6.2.5. International references such as that found in the *Handbook of Telecommunications Economics* clearly state that once payments are involved then by definition the arrangement becomes a transit arrangement, but the Group found that some stakeholders in New Zealand regard paid peering arrangements as possible.

6.2.6. To avoid confusion we recommend that the use of the word peering be qualified as "neutral peering", where the free exchange model is intended. However, the more neutral word "interconnection" in conjunction with other qualifiers can be used in describing all situations, and is preferable as it avoids emotive issues associated with the word "peering".

## 6.3. Finding 2: Auckland Dominates Structure

The New Zealand Internet is dominated by the following features:

6.3.1. An estimated 80% of New Zealand content is carried over the networks of Telecom New Zealand or TelstraClear.

6.3.2. A large proportion of consumers are located in the greater Auckland area.

6.3.3. International connectivity to the Internet is terminated in Auckland.

6.3.4. Interconnection to the Internet at Auckland tends to satisfy the needs of about one third of the population of New Zealand and most large businesses, both corporate and government.

6.3.5. Other than in Auckland, the amount of local interconnection that occurs is highly limited. This leads to the "tromboning" or routing of some traffic via Auckland, where source and destination may be outside of Auckland.

6.3.6. The vast majority of current content (generally not rich media) hosted in New Zealand is not dramatically impacted by the national tromboning, which occurs due to the majority of interconnection being made in the Auckland area.

## 6.4. Finding 3: Cost of Transit is High

6.4.1. The cost of transit within New Zealand appears to be high relative to that encountered in other comparable countries around the world.

6.4.2. The relatively high cost of national transit appears to be driving the hosting of some content offshore, even when the content is intended for majority consumption in the New Zealand market:

- In some cases this might be economically rational due to wider hosting considerations related to content distribution to other global markets. For example, where a content provider would need to host a portion of its content offshore for the global market regardless of the price of domestic transit.
- In other cases there appears to be no rational economic basis for this approach except that the prices for national transit in New Zealand are relatively higher than those which can be

obtained from offshore service providers, especially when both hosting and transit is provided as a package.

## 6.5. Finding 4: Rich Media a Growing Issue

6.5.1. Content providers within the New Zealand market are at a stage in their development where they are hampered in the delivery of rich media content. Rich media content such as streaming media requires high capacity, low-latency and error free performance. This has a flow-on effect economically where potentially advertising could exist alongside that content.

6.5.2. Not all of the issues for content providers are due to the lack of local or national data interconnection, with a large amount of the blame being leveled at slow broadband uptake.

6.5.3. There is, however, a feeling that as broadband uptake becomes more widespread, that the issue of high national transit cost and economically inefficient national paths will replace it as the major rich media roadblock.

6.5.4. Efficient national infrastructure, with low cost of distribution, is anticipated for the evolution of a thriving digital media or digital content industry. Voice over IP will also require efficient local and national traffic paths, as it is susceptible to latency issues.

6.5.5. Some content providers are hosting offshore. The hosting of rich media content offshore intended primarily for the New Zealand market creates two problems:

- The performance of the delivered applications is negatively impacted by the long path between host and consumer (high delay and packet loss),
- The economics of hosting rich content cannot be efficient for New Zealanders, as they will pay for the cost of downloading the content over the Pacific Ocean (10-100 times higher cost than delivering the same content locally).

6.5.6. The volume of traffic hosted offshore that is brought back to New Zealand is small relative to the total volumes of Internet traffic, but this must be an increasing issue as rich media applications grow. Either that, or more likely, the market for rich media applications in New Zealand will only grow very slowly relative to that in other parts of the world.

6.5.7. It is unlikely that all hosting of offshore content would come back to New Zealand while the cost of international bandwidth out of New Zealand remains high, because a proportion of consumption is intended for offshore destinations.

6.5.8. Large corporate and government sectors have little visibility of local data interconnect, as they typically carry transit traffic around New

Zealand on their own Virtual Private Networks and the costs of Internet traffic is swamped by the costs of all other corporate traffic within the same VPN. This may change, as they become larger users of rich media.

## 6.6. Finding 5: Bundled Pricing Issues

6.6.1. Lack of differentiation in price, as seen by the end consumer between locally, nationally, or internationally hosted content, may limit the ability for content producers to grow the market for cost effective rich content:

- With current internationally based volume caps, New Zealand consumers will only ever be able to enjoy around two high definition movies via the Internet per month before they exceed their volume cap,
- This is seen by some as a major inhibitor to the evolution and take-up of rich media applications in New Zealand and needs to be addressed in some manner,
- One estimate is that media companies are missing the opportunity for around $30M per year in rich media advertising revenues due to this limitation (consumers in New Zealand would not want rich media advertising when it costs them through their volume caps).

6.6.2. There is no recognition at present that local traffic is cheaper to deliver than national traffic. The two main telcos do not differentially charge for local traffic, which is an issue cited by content providers. This may change as part of the recent Telecom proposal on local interconnection.

6.6.3. Further, Internet connections can involve uncapped national data combined with user-pays International data charges, where tromboning of traffic would be billed as international traffic.

## 6.7. Finding 6: Telecom's Proposal

6.7.1. Telecom is negotiating in the market parallel to these consultations with an offer to exchange local data through specified interconnect points. The changes proposed by Telecom will potentially allow providers access to some Telecom content for a reduced cost. It is not clear however that all network providers will be in a position to fully utilise this offering.

6.7.2. Telecom's local interconnect proposal received a good initial reception from service providers, with negotiation focusing on number and distribution of interconnect points, fair arrangements around bilateral links, shared connections and connections at peering exchanges.

6.7.3. If successful, Telecom's proposal would provide for value-neutral data exchange with other networks for data with source and destination in local areas - effectively resulting in an unbundling of local and national interconnection.

6.7.4. It is unclear what effect Telecom's unbundling of local and national interconnection will have on TelstraClear's offerings. TelstraClear currently offers a bundled local/national transit product. What is clear is that this will represent a significant point of differentiation between the two main carriers.

6.7.5. Telecom's proposal would be expected to improve traffic routing locally, according to how much of an ISP's traffic that is local or national, and to the degree that an ISP connects locally around the country, while taking a national transit arrangement for the remainder.

6.7.6. Telecom, in reaction to suggestions from the industry has agreed to provide this service in conjunction with other existing Telecom services. This would allow network providers to use their existing links to connect to this new service.

6.7.7. It is not clear to what degree Telecom's proposal would assist content providers, particularly since the requirement, with the evolution of rich media, is for a low-latency low-cost service consistent around the country. Some content providers would embrace an ability to connect in local regions, while others prefer for content distribution to be handled on a national basis by their ISP, telco or other provider. At a minimum, this proposal offers a choice for content providers to either remain with national transit arrangements or look towards local delivery of content with its inherent attractive performance characteristics and potential change in cost structure.

# 7 Investigations

## 7.1. Introduction

7.1.1. Determining how the Internet traffic in New Zealand flows between consumers and application and content providers presents some difficulties as even the largest players in the market do not appear to have rigorous or complete analysis of their traffic flows and associated volumes. It is only possible to determine a rough picture of the traffic flows from many different but incomplete sources of information.

7.1.2. It is unfortunate that there is no definitive source of this information, so that the industry can work with a base of facts at its disposal. It is possible that this lack of information has contributed to the cause of the limited number of billing options (purely national and international) that have historically been available within the New Zealand Internet market. The current situation also results in more emotion around various issues surrounding the Internet than would otherwise be necessary. If there were a good fact base, common to all, then all parties would be in a better position to make enlightened decisions regarding the growth and wellbeing of the New Zealand Internet community.

7.1.3. Many parties taking positions on issues relating to the New Zealand Internet appear to be operating from a position of ignorance. Because such positions cannot be refuted with substantiated facts, they tend to take on a life of their own, as if they really do relate to the facts. In many cases, such positions are based on very limited, incomplete or inaccurate information about the actual traffic flows and hence are less than representative of the overall picture. As indicated elsewhere, there would be value in the industry finding a way to address this shortcoming.

7.1.4. This situation of limited information is the starting point for this investigation also. It is acknowledged that the information used for this investigation is far from complete and far from highly accurate. It consists of a variety of both public and private sources of information, none of which is really representative of the entire New Zealand Internet. Several entities have provided information about their perspective of the Internet on a confidential basis. Hence, we are only able to use this information in an aggregate sense without declaring its source and the associated quantitative details that it represents. Other information has been obtained from public sources, but is also incomplete. Hence, we have had to massage all of these incomplete data sources to provide a broad picture of what is actually happening. Even with this wealth of information from numerous sources, we are far from certain that we have a perfect view of the Internet in New Zealand.

## 7.2. Content Internet Usage

7.2.1. Information on the content and applications sourced by Internet users in New Zealand is provided by ComScore in the UK (http://www.comscore.com/). An extract from their April 2007 report is included in Appendix A attached.

7.2.2. This report provides the following key usage statistics as recorded during March 2007:

- 1.9 million New Zealanders aged 15 or older used the Internet.
- These people viewed 3.6 billion pages of content during the month.
- The average Internet user went online every other day.
- The average Internet user spent a total of 20.4 hours online during the month.
- The Top 10 sites accessed in terms of number of unique visitors were:

| | |
|---|---|
| o Microsoft sites | 1,420,000 |
| o Google sites | 1,387,000 |
| o Yahoo! sites | 1,107,000 |
| o Trademe.co.nz | 977,000 |
| o govt.nz | 621,000 |
| o bebo.com | 582,000 |
| o Wikipedia sites | 519,000 |
| o autotrader.co.nz | 448,000 |
| o eBay | 436,000 |
| o CNET Networks sites | 403,000 |

7.2.3. It is obvious from this data that access to international websites represents a large proportion of New Zealand Internet usage. Out of the total 7.9 million page unique visitors shown above, about 75% of the page views were to international sites and 25% were to national sites. This is one indication of the distribution of traffic between the national and international Internet. These statistics are only an indicator as they do not represent the traffic associated with the pages viewed and they are not a complete set of visited sites. Of these top 10 sites, the total for Google includes YouTube, who provide rich media content. Bebo.com also offers a wide range of rich media content.

7.2.4. The average size of a web page is approximately 100KB, thus the 3.6Billion pages equates to approximately 1.87MB of download per user per month to these top 10 websites. Note these figures do not

include download of email from email servers, but would include online email such as hotmail, gmail, etc. Nor does it include other Internet activity such as voice over the Internet, peer-to-peer file sharing, legal audio and video downloading etc.

7.2.5. It has been shown in some recent studies that the majority of Internet traffic in some countries is now peer-to-peer file sharing.

## 7.3. Traffic Measurement on an ISP

7.3.1. Appendix C presents the results of a measurement exercise under taken on a single large national ISP operating in the New Zealand market. The measurements presented were undertaken by the WAND Group at the University of Waikato under the guidance of Richard Nelson and the report as presented in Appendix C was prepared by Peter Komisarczuk from Victoria University of Wellington.

7.3.2. The analysed traffic consists of all types of Internet traffic from New Zealand broadband domestic customers. The source data consists of a passive trace of all packets on the link between the ISP and the Telecom New Zealand Unbundled Bitstream Service (UBS) connecting the DSL customers to the ISP through a tunnel protocol and a circuit. Within the trace file, captured packet data has been removed (for privacy reasons), but all IP and Transport layer headers have been retained unmodified for subsequent analysis.

7.3.3. The results of this study as presented in the appendix can be summarised as follows:

Table 1 Volume of Data (Saturday)

| | Bytes | Packets | Flows |
|---|---|---|---|
| National (APNIC) | 3.7321% | 3.8874% | 6.9086% |
| National (RTT) | 4.6837% | 5.0463% | 10.4374% |
| International (APNIC) | 96.2679% | 96.1126% | 93.0914% |
| International (RTT) | 95.3163% | 94.9537% | 89.5626% |

Table 2 Volume of Data (Weekday)

| | Bytes | Packets | Flows |
|---|---|---|---|
| National (APNIC) | 5.3785% | 5.5796% | 8.6760% |
| National (RTT) | 6.4340% | 6.7624% | 12.4474% |
| International (APNIC) | 94.6215% | 94.4204% | 91.3240% |
| International (RTT) | 93.5660% | 93.2376% | 87.5526% |

7.3.4. The Cumulative Distribution Functions presented in the appendix also show that on one day:

- 40% of the users account for less than 1KB of international traffic per day.
- The next 20% of users account for between 1KB and 10MB,
- The next 30% of users generate 10MB to 100MB of data.
- The remaining 10% of users generate 1GB to 10GB of the traffic.

7.3.5. This data again reinforces the trend that a high proportion of Internet traffic demand from within New Zealand is provided from servers in offshore locations, most notably the USA and Europe. It appears that the proportion of international traffic amounts to around 95% by volume or around 90% by flows (a flow is for example a connection between a client browser and a web server) of the total. It is interesting also to note that most of this traffic is generated by a small proportion of users, with more than 80% of the traffic being generated by less than 20% of the users. The traffic recorded in this study includes web, email, voice, video, peer-to-peer traffic etc, whereas the ComScore data refers only to the web traffic.

## 7.4. Other Traffic Data

7.4.1. A range of ISPs, businesses and content providers have supplied other traffic data on a confidential basis. This traffic data shows that access to government departments and banks online in New Zealand is increasing at a steady pace. This is supported by the content usage statistics from ComScore presented above.

7.4.2. It also shows that consumer Internet volume has grown rapidly relative to business Internet volumes since about 2004. This is important as now the business Internet volume represents around 10% of the total traffic volume and is growing steadily but at a significantly lower rate than that for consumer Internet traffic.

7.4.3. The business Internet use appears to be split about 50:50 between national and international by volume. On the other hand, the consumer Internet usage appears to be split about 90:10 in favour of international usage. This means that the overall split in Internet use is trending towards more than 90% international and less than 10% national. This compares with the situation in 2004 where overall there was about a 70:30 split in favor of International, which was driven by the higher proportion of business usage at that time.

7.4.4. Taking the trends in business and consumer customer growth and the current traffic growth trends in broadband use described above we can predict that the amount of national traffic will reduce further over the next two to three years as we climb the growth

curve towards market maturity. The analysis in Appendix D indicates that national traffic will drop from today's level of around 8% towards 5.6% in 2010. Here we have assumed there is no major market disruption due to a heavy uptake of voice over IP or provision of local multimedia content.

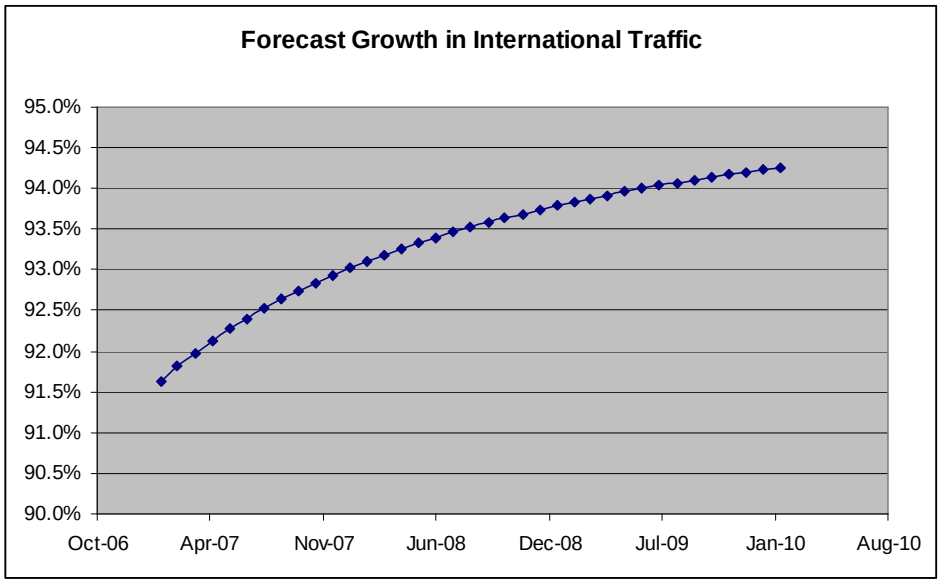


***Figure 1 Forecast growth in international traffic***

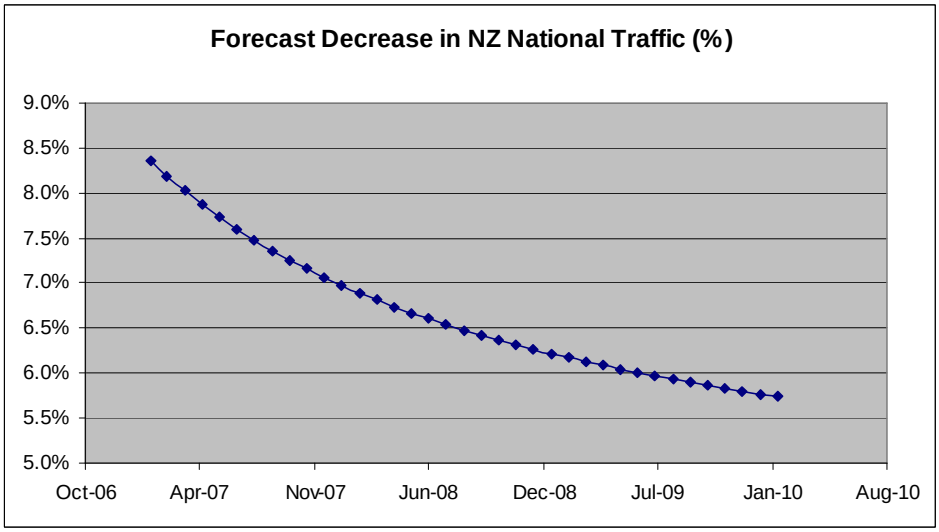


***Figure 2 Forecast decrease in national traffic***

7.4.5. Even with the increased use of New Zealand based Internet sites, the trend towards higher proportions of international traffic will continue as:

- The proportion of consumer Internet users continues to increase, drivers include:
  - Social networking services (YouTube, Facebook etc.) which can contain rich media content
  - Peer-to-Peer sharing of rich media content (generally video and music material) which typically cause huge bandwidth usage
  - Voice over the Internet (Skype etc.) to minimise national and international calling costs and gain video calling capability
  - Online gaming
  - Education (searching for answers/material, e.g. Wikipedia)
- There are more Internet content producers outside New Zealand and thus there will tend to be more international content developed to draw consumers offshore.
- More and more, New Zealand based service providers are hosting their content outside of New Zealand.

## 7.5. Volumes of Traffic "Tromboned"

7.5.1. The term "tromboning" (in the classical traffic engineering sense) refers to traffic that is local being transported to some far point in a network and then back again. This can occur for both national and international traffic. In the case of national traffic, a typical case could occur when a consumer in Dunedin requests traffic from a server located in Christchurch. This traffic is routinely routed via Auckland due to the peering or transit arrangements made by the relevant service providers.

7.5.2. When a host is located outside New Zealand but has content intended for New Zealand consumers it is common for those providers to consider "offshoring" the traffic. This is driven by economic and market forces, as discussed more in the following section. If traffic originates in New Zealand but has to use an international link to be accessed by some New Zealand consumers, then this is another example of "tromboning". This is an unfortunate inefficiency in the Internet, which could be fixed through better national interconnection and more cost effective national web content hosting.

7.5.3. As part of our study, we tried to determine the extent to which providers are "offshoring" content and consumers are

"tromboning" to access content. As with many of the facts relating to the Internet, it was difficult to determine exactly how much traffic was of this form. Some industry players have suggested that "tromboning" occurs in as much as 10-20% of New Zealand Internet interactions. Others suggest that it is as small as 1-2%. Our investigations suggest that the combination of offshore and tromboned traffic only represents some 1% of the total international traffic flowing into New Zealand on the Internet. At most, 0.13% of the total traffic could have been subject to being tromboned (that is, at most some 13.62% of measured national traffic may have been sent through international links to reach the consumers in this measurement study).

7.5.4. However, it is also clear that rich media traffic is on the increase, through user demand and provision of content, such as the TVNZ on-demand program archive service launched in March 2007 (http://www.scoop.co.nz/stories/CU0703/S00226.htm) which is distributed locally through Akamai. (Akamai is a provider of content distribution infrastructure that provides edge servers within a region when economically viable). Two major New Zealand content providers have moved content offshore in recent years. For example, Radio New Zealand has sited servers in the USA for access by some New Zealand customers and made it available on the Wellington Internet eXchange (WIX) for access to a number of local ISPs' customers. Both of these players have taken this action for different and perfectly rational business reasons. However, these changes do contribute to local content being brought over international links (this should not cause tromboned traffic, but uses international bandwidth for consumers to access content sourced from within New Zealand).

7.5.5. Furthermore, we are currently only at an early stage of using rich media content. There has been a huge uptake of rich media social networking in 2006 and the further development of streaming content services. In the UK, entertainment has overtaken retail in web usage and the BBC and YouTube are vying for top spot in terms of market share (see http://www.hitwise.com/press-center/hitwiseHS2004/retailentertainment.php). Two recent examples of content delivery escalation include the link between YouTube and the BBC (the largest broadcaster in the world, who are providing short form content through YouTube, see http://www.bbc.co.uk/pressoffice/pressreleases/stories/2007/03_march/02/you_tube.shtml) and TVNZ's agreement with YouTube for a channel (http://www.geekzone.co.nz/content.asp?contentid=7246).

7.5.6. The provision of rich media content in the UK has caused issues with the Internet service providers. A recent trial of the BBC peer-to-peer based iPlayer in July 2007 is described on a blog from a PlusNet employee (a UK ISP). It is evident that the trial has caused some issues

http://community.plus.net/trafficmanagement/2007/07/24/were-ready-for-the-beebs-iplayer/). The ISP Tiscali has said that peer-to-peer content distribution through the BBC iPlayer could result in up to 30 times more bandwidth being required than that for shorter rich media content found on sites such as YouTube ) and that the ISP infrastructure will need upgrading to support this type of rich media content (http://news.bbc.co.uk/2/hi/technology/6944176.stm, http://media.guardian.co.uk/newmedia/story/0,,2147900,00.html).

7.5.7. It has been suggested that ISPs will throttle BBC iPlayer traffic unless the BBC pays a fair price for network usage based on the network load caused by their VOD distribution system (http://arstechnica.com/news.ars/post/20070813-isps-to-bbc-we-throttle-iplayer-unless-you-pay-up.html). Note that the BBC iPlayer is a solution for a single content producer and distributor in a limited market. A large-scale standard solution has yet to be developed and adopted by the market as a whole.

7.5.8. This move to provision high-bandwidth rich media has the potential to compound the problems caused by offshoring and tromboning of traffic. The carriage of simple web pages across the international transport links does not generate a significant amount of international traffic, so the cost for users is not high. However, when that content transforms into rich media content such as high definition movies, then we could be streaming 20GB per user session. This will rapidly increase the percentage of traffic that is brought into New Zealand from offshore or in the worst case tromboned through international links.

7.5.9. There is a high cost to consumers in hosting rich media content overseas or in tromboning content traffic. At NZD$1 per GB of international transport, a High Definition movie session will cost around NZD$20 in international transport alone. This means that it is unlikely that New Zealand consumers will consume such content, as it will be too expensive, given that the same content could be provided on physical media in the local market for a comparable or lower price. It would be impractical for New Zealand consumers, if content providers were to host such content outside of New Zealand, when it is intended for New Zealand consumers. The cost of transport for the delivery of the same content from a server located within New Zealand could be as low as NZD$2 if delivered nationally or NZD$0.20 if delivered locally. This order of magnitude difference in traffic pricing should be leveraged to provide targeted content at reduced cost to consumers on a geographic region-by-region basis.

7.5.10. However, the current Internet business model is not conducive to optimal location of content by providers in the New Zealand context. The delivery of content is paid for by the consumer irrespective of the location of the content. For the majority of the broadband world, where data caps are not widely deployed, this is

not an issue facing consumers. However, for New Zealand with its limited expensive international connectivity and corresponding low usage caps, the cost of delivery is not conducive to the download of large quantities of rich media. At current data caps, the average New Zealand consumer would be unable to download more than one High Definition movie per month from an international source. If this content was hosted locally, and did not contribute to the user's data cap, they may be prepared to purchase much more such content.

7.5.11. Hence, we have a "chicken and egg" situation emerging. The content service providers are tending to host content offshore for rational economic reasons (cost of hosting, potential for larger international markets etc.), but they also want to deploy more and more rich media content for access by New Zealand consumers. On the other hand, New Zealand consumers will not pay the price required to consume large quantities of rich media content from offshore servers. Hence, we end up with a situation where demand for rich media services is inhibited by the economic reality of network pricing and content providers own actions in international hosting. In order to break this impasse, there is a need to come to a better arrangement in terms of the costs incurred by the content service providers and the costs incurred by the content consumers.

## 7.6. The Problem

7.6.1. The rich media content delivery issue is at the core of the "peering" debate in New Zealand. What drives the application and content providers to source hosting outside of New Zealand, thereby putting their content into the highest pricing tariff for consumer access?

7.6.2. When individual cases are investigated, it appears that it is a rational economic decision on the part of the content and service providers that drives them to host their applications and content offshore. The key factors are:

- The cost of hosting and associated transit is lower offshore.
    - This is often due to leveraging off larger economies of scale available in other countries.
- The association with an offshore entity means there are significant synergies to be gained from offshore hosting as compared to onshore hosting.
    - For example outsourcing content delivery to an international company such as Akamai.
- The content and applications are also intended for consumption by the global market.

- Hosting offshore is a good compromise between addressing the small New Zealand market and addressing a small segment of the much larger global market.

- The content providers do not pay for content delivery to the consumer, just for hosting the content on the Internet infrastructure.

7.6.3. All of these reasons for hosting offshore are entirely rational from the content and application providers' point of view.

7.6.4. However, where does this approach leave the Internet consumers of New Zealand? It leaves New Zealanders in a position of accessing content and applications that are highly relevant to them from servers based offshore – typically in Australia or the USA. The economics for New Zealand consumers does not look good when accessing rich media content and applications offshore, as it can have a tenfold or more increase in relative cost for them.

7.6.5. For a content provider, uploading the information to an offshore server is a very small cost, relative to the total costs of operating the content and applications. However, the downloading of that same information by hundreds of thousands of Internet consumers located in New Zealand represents an enormous cost to the Internet service providers, which then must be passed onto the consumer in the form of high broadband service prices and associated low data volume caps. The data volume caps are particularly limiting if the content is in the form of rich media.

7.6.6. In this way, the service providers optimise their costs of doing business, at the expense of higher costs for every New Zealand based consumer. Every page viewed by consumers must be transported across the Tasman Sea or the Pacific Ocean. This has both a high cost for consumers (service providers don't see this as a direct cost as it is averaged across the entire consumer market in New Zealand) and has a negative impact on the performance of the content as seen by consumers, due to:

- significantly increased transmission delays,
- delay variation and
- potential packet loss due the much larger distances and larger number of internet devices involved in transmission.

7.6.7. It must be recognised that New Zealand is about 15ms in length in terms of the time taken to transmit a bit from one end of the country to the other (limited by the speed of light). In comparison, the equivalent one-way transmission time across the Tasman Sea is around 40ms and that for the Pacific Ocean is about 150ms. Similarly, the probability of bit errors increases roughly in proportion to distance, so that the error probability is typically lowest for short distances and highest for long distances. All of

these factors have a detrimental impact on the end user experience of many forms of content and applications as viewed in New Zealand.

7.6.8. So if the service providers are acting rationally, then why are the consumers suffering increased costs and degraded performance due to their actions? This is because consumers of the Internet have little say in what happens in the development of the Internet. It seems that this is the key issue that needs to be addressed. If the cost of the Internet is to be reduced to the lowest levels possible and the performance for consumers is to be optimised, the hosting of applications and content intended for use by New Zealand consumers should ideally be located in New Zealand. In fact, it should be located as close as economically practical to the end consumers. This requirement particularly applies to the delivery of rich media content, which requires substantial bandwidth for its transport and is most negatively impacted by transmission anomalies such as transmission delay, delay variation and packet loss.

7.6.9. Having rich media content hosted as close as possible to the consumers will always deliver the minimum transmission delay, delay variation and packet loss characteristics and hence deliver the content with the greatest possible fidelity. However, it is not obvious that the overall cost of providing the content is minimised through this approach.

7.6.10. In fact using peer-to-peer (P2P) distribution techniques with geographically optimised distribution is likely to provide the lowest cost base for content distribution, both from the content distributors and the ISP perspective. However there are issues with this approach – both technical and business related today, which means that effective mass scale P2P distribution is not likely in the near-to-medium term. If local traffic were tariffed at a lower rate, the development of P2P distribution technologies may be more attractive.

7.6.11. The telco and content producers/distributor model does not currently allow for this form of delivery. There are, however, new Digital Right Management (DRM) solutions being developed that may allow P2P delivery with the promise of some level of financial security to the industry. The BBC iPlayer solution uses a DRM solution tied to Microsoft Windows that has caused many people to complain (http://arstechnica.com/news.ars/post/20070727-bbc-iplayer-beta-arrives-10000-people-complain-to-gordon-brown.html).

7.6.12. Technically, there are issues with maintaining a high availability, robust and quality infrastructure to distribute the content. This is due to the majority of schemes being based on sharing the resources of consumer machine and the asymmetric nature of ADSL. This level of technology does not provide for a stable platform for commercial P2P distribution as upload capability from consumers machines are limited to a few hundred kilobits per

second in some cases. Furthermore, in order to make use of P2P distribution mechanisms, customers may be required to update their computer/entertainment systems to be able to make these available for others to use. The BBC initiative with the iPlayer in the UK will need to be watched carefully to determine the validity of this approach and its applicability in the New Zealand broadband context.

7.6.13. Recently the Skype P2P voice service was disrupted by a failure in the P2P algorithms, causing loss of service to an estimated 200 million users for several days (http://blogs.zdnet.com/BTL/?p=5973&tag=nl.e622). This is a clear example of the fragility of the current suite of P2P products.

7.6.14. It may be feasible to expect effective industry-endorsed P2P solutions to become deployed in the 5 to 10 year time frame. A P2P solution may have to be driven nationally by those consumer groups that will be in a relatively poor Internet connectivity scenario.

7.6.15. Assuming a more traditional telco/distributor mechanism for content delivery, where we have servers and transmission deployed for content delivery, then we can have two models. Firstly a scenario where there are a few centrally (often located in the USA/Australia) content servers, or alternatively a fully distributed model placing content closer to the consumers.

7.6.16. The provision of local distribution infrastructure for content means that the infrastructure costs are significantly greater for the content providers. Alternatively, the content providers could pay a company such as Akamai to run a shared distribution infrastructure. In this case, the cost of network infrastructure for the ISPs is lower, but is still significant.

7.6.17. The more content that is available from local servers, the lower the OPEX costs. This is achieved mostly through lower national and international transit costs. CAPEX costs can also be reduced through the redistribution and lowering of associated infrastructure to the ISP. The main benefit is that the cost to the consumer in this case is lowest.

7.6.18. The costs of rich media distribution should be optimised for all parties involved. The lowest overall costs for all parties will be achieved by minimising the costs for end users. This is due to the large number of end users whose costs contribute to this equation.

7.6.19. Although network transport costs have reduced dramatically over time, they are still not zero and the cost per unit bandwidth over a large distance is still substantially higher than that for a short distance. When content is hosted offshore, accessing this content is 10 times the cost of accessing that same page off a server located in New Zealand and roughly 100 times that of accessing the same page off a server located in the same local region.

7.6.20. Hence, if millions of pages of rich media content are streamed to consumers asynchronously from offshore, the cost per user is considerable when compared to the cost if the same content were streamed nationally or locally. If the costs of accessing Internet content are going to reduce over time, rich media content in particular must be hosted close to consumers, either through local servers or geographically optimised P2P file sharing.

7.6.21. The current trend however is to host more and more content offshore. This increases the cost to consumers for access to this content. It is this equation for local content delivery, assuming there is a local demand for rich content, that is irrational in terms of economics and needs to be addressed.

7.6.22. From an international perspective, the population of New Zealand does not have a significant market power for content. International content providers would not necessarily be concerned about optimal positioning of content servers for the benefit (cost minimisation) of the New Zealand consumer. For example, a rich media social networking service provider such as Facebook is unlikely to have a viable business case to provide New Zealand located servers, unless sufficient consumers begin to pay for membership or New Zealand targeted advertiser revenues demand better service for New Zealand located consumers.

7.6.23. Similarly, content delivered through a CDN, such as the service from Akamai, will only replicate content servers in order to optimise their infrastructure costs, based on user demand. This replication within New Zealand might take place if local consumer demand increases (that is if demand from a network exceeds 10% of demand at a current server, Akamai would consider replicating the server), thus content providers that use Akamai could transparently optimise delivery to New Zealand consumers.

7.6.24. The problem as identified above is specific to mass consumers of Internet applications and content. Business users of the Internet in New Zealand see quite a different picture, as identified below:

- Companies usually host business content intended for New Zealand businesses onshore, either themselves (e.g. telecom.co.nz, canterbury.ac.nz, ird.govt.nz, etc.) or through a shared content portal hosted in New Zealand (For example, while the consumer Yahoo!Xtra portal content (News, Reviews, Movie Previews etc) is hosted in Australia, the Xtra Business & XtraHost websites (e.g. milner.net.nz, plumbingguys.co.nz, etc) remain hosted in New Zealand).
- Business customers who host their own websites in New Zealand can purchase services such as Corporate Internet Direct, which have a split International/National tariff.

7.6.25. These options mean that businesses have much more choice about how their content is delivered to New Zealand consumers. These

business customers can choose how they send/receive Internet traffic since they can have separate routes for International and National traffic; therefore, they do not need to pay international rates to send traffic to domestic users. By exercising the choice offered by these two approaches a business can choose whether to take a "blended" rate for international/national traffic or to take a split tariff. It comes down to scale and the reach that the business wants to deliver to its customer base.

## 7.7. The Solution

7.7.1. What will drive the content providers to move more of their content back onshore? What part does "peering" and "transit" play in this decision process?

7.7.2. There is an expectation that as content providers try to introduce more rich media content into the New Zealand market that they will realise demand from content consumers can only be achieved by getting the price for consumers to access this content down to a realistic level. The best benchmark is the video rental store. If one can borrow a High Definition video from their local store for NZD$10 then the downloading of the same content must cost the same or less than this for the online consumer.

7.7.3. Past business cases have suggested that the convenience of accessing this content without having to leave the house in some way justifies an increase in cost. There are however other studies which suggest that consumers still favour being able to watch the content multiple times without incurring multiple traffic charges. Furthermore, if it takes many hours to download the digital content, so the consumer needs to plan in advance, it is not attractive compared to the alternative of an impulsive trip to the DVD store. There is a desire for more immediate gratification that requires no preplanning.

7.7.4. Hence, if content providers want consumers to increase their demand for rich media content, then they will need to bring it closer to the consumers to remove the transport costs and optimise delivery. This will mean that the content providers themselves will need to take on more costs, which obviously will be re-distributed back to consumers in the price of the rich media itself. The question then remains, what is the right balance for consumer and host costs to minimise the overall cost of content delivery for all parties?

7.7.5. The following discusses three possible approaches to address these questions; The three approaches are:

- Local interconnection,
- Reduced Transit prices,

- Differential data volume pricing.

## 7.8. Local Interconnection

7.8.1. Telecom has proposed a "local peering" solution which offers local peering for any service provider on a "bill and keep" basis at 29 regional peering points. This means that content providers can deliver rich media content to consumers from servers located within a local region. This has some significant benefits for all consumers, as the transport costs are minimised due to the short transport component. It should also be possible to provide media with low delay, low delay variation and low packet loss, thereby providing an optimal quality experience.

7.8.2. However, the content providers do not necessarily see this as an ideal solution as they need to build out network and hosting facilities to serve these local regions, thus increasing their costs many fold. The ISP is also likely to increase their cost base in the short term, as they need to deploy, configure and manage more infrastructure, but this should be offset by lower transit costs in the future.

7.8.3. In order to provide service to all New Zealand consumers this would mean providing these facilities in 29 regions. Some claim that 29 regions are too many. This is a valid argument when the number of consumers is low and the amount of rich media content being consumed is low (thus the revenue stream is insufficient to pay for the required infrastructure). On the other hand, decreasing the number of regions would increase the cost of interconnection, as it would require Telecom to utilise more infrastructure as it further aggregates content into larger delivery regions.

7.8.4. It would appear that content providers would prefer the consumers to pay more and for them to pay less. As the volume of rich media traffic grows relative to the total Internet traffic, this equation will change for both the content providers and the consumers, with consumers demanding to pay less and content providers having sufficient revenue to pay for more infrastructure, in order to reduce the total costs for all parties. Hence, it is not at all clear whether the solution offered by Telecom is optimum for either consumers or content providers in the short term.

7.8.5. On the other hand, it is likely to be the optimal solution for those regions that will have sufficient rich media consumers in the longer term. Hence the remaining questions are, what are the right local regional areas for content delivery and when will the Telecom solution appear to be optimal for all parties?

7.8.6. In order to address some of the short term inefficiencies, Telecom has proposed that service providers interconnect at less than 29 sites and have the remaining content delivered to them at a reduced cost (relative to today). This model may provide a way forward in

the short term.

## 7.9. Lower Transit Prices

7.9.1. Another solution to the content delivery problem would be to reduce the price of national transit. If the cost of transit was zero, then it would not matter where content is located from a cost perspective. It could still matter from a performance perspective, but there would be more room to find optimal distributions of content storage versus customer volume demand density.

7.9.2. The analysis of global transit prices shown in Appendix B shows that the cost of transit in New Zealand is typically higher than that in most other jurisdictions for any size of Committed Data Rate transmission link. In particular, when compared with the OECD countries, for low values of Committed Data Rate (CDR in the order of 2Mbps) the market price for transit is typically twice that experienced in other countries across the globe. For higher values of CDR the New Zealand transit prices converge to be closer to those in other countries, but there remains at least a 10% premium in New Zealand.

7.9.3. Service providers have historically used New Zealand's geographic isolation to explain any difference in Internet pricing. Service providers cite the fact that the international links out of New Zealand cost significantly more than transit existing in other OECD countries. While this is true for international transit, it is not clear that the argument holds for national transit, as the links within a country should be of a comparable cost for a comparable volume and distance. For local transit, the argument is on even more shaky ground.

7.9.4. It is not proposed that transit prices in New Zealand be priced on an economically irrational basis. It is essential that users of transport capacity pay an economically rational price for that capacity. However, it would be expected that transit prices in New Zealand should track those experienced by content providers and ISPs in other similar countries for comparable service characteristics. Hence, on this basis, there is room for transit prices to drop in New Zealand, especially those related to the lower CDR values. If this were to happen, then it would increase the differential in pricing between international transit and national transit, which would make hosting of content within New Zealand more attractive than is currently the case. However, this in itself does not necessarily change the perspective of the service providers in hosting content offshore, as they still do not see the costs incurred by the consumers.

7.9.5. Overall, whether reductions in transit pricing would remove the need for either national tromboning, offshoring of content, or international tromboning of traffic is debatable, but it would help

make the use of local interconnection as proposed by Telecom more attractive than is currently the case.

## 7.10. Differential Data Volume Pricing

7.10.1. A third approach to making the hosting of content locally more attractive is through the introduction of a multi-level tariff for Internet data volume. A typical approach would be to distinguish where content is hosted: locally, nationally or internationally. Different pricing tariffs would apply to each of these segments. Ideally, the cost for a consumer to access locally hosted content would be very low compared to that for nationally hosted content and that for nationally hosted content would be substantially less than that for internationally hosted content.

7.10.2. This approach has been successfully implemented in some other markets, including Australia, where for example, BigPond identifies Australian hosted content clearly to the user, so that when this content is accessed it is not counted against the user's usage volume cap.

7.10.3. Portugal is another country that has implemented an enforced regime of differential volume pricing for end users. End users of content sourced within Portugal experience a substantially lower volume price per GB relative to that for the same volume of traffic sourced from an international source. This has led to some interesting outcomes:

- Most content targeted towards the Portuguese Internet market is hosted within Portugal,
- Content which is frequently accessed by Portuguese Internet users from offshore servers is cached on servers located within Portugal,
- The performance experienced by Portuguese users for access to rich media content tends to be high.

7.10.4. Based on this experience it would be useful to investigate the advantages and disadvantages of implementing a similar approach on a voluntary basis within the New Zealand environment. Certainly the use of differentiated national and international pricing tariffs already apply to some business Internet traffic in New Zealand and this does appear to have some positive impact on the way content and applications are hosted.

## 7.11. Solution Summary

7.11.1. All of the above approaches to address the issues of rich content distribution for New Zealand consumers have both advantages and disadvantages for the various parties involved in both the supply and demand sides of the market. There is no perfect solution that will satisfy the expectations of all players in the market, and typically any

solution requires trade-offs that are highly dependent on market demand for the services and content involved.

7.11.2. Furthermore, it is certain that better information about the various traffic flows is required in order to make optimum decisions concerning the best approach to take. However, even given these constraints, it is essential that all parties involved in the delivery of Internet services within New Zealand do consider these issues carefully in the near term. The alternative will be a highly constrained market for the consumption of rich media content in New Zealand. It is certain that no player in the market wishes to promote this outcome.

7.11.3. As noted at the start of this document, it is essential that better information be available to the industry concerning the types and volumes of traffic flows in the Internet within New Zealand and incoming and outgoing from it, to ensure the best outcome for all parties involved in using the Internet. It is strongly recommended that a mechanism be developed on a collaborative basis to achieve this goal. Obviously it would be essential to ensure that the data is suitably massaged to ensure that competitive positioning by various individual players is not compromised – it is the aggregate data that is important for all players to make the best decisions about how best to develop the Internet in New Zealand.

# 8 Key Outcomes

8.1. Based on the consultation with industry participants and the subsequent investigation of the key issues arising from the consultation, the following key outcomes have been identified. These outcomes are grouped into the following specific subject areas:

- Definitions
- Transit Costs
- Internet Traffic Facts
- Rich Media Content
- Geographic Cost Differentiation
- Local Interconnection
- Market Power

8.2. **Definitions**

8.2.1. **Content provider**
A business that provides information across the Internet to users.

8.2.2. **International traffic**
Traffic with either an origin or destination outside of New Zealand.

8.2.3. **Local traffic**
Traffic with its origin and destination within a region, city, or subset of a city. Also defined as the area that has negligible cost to deliver traffic to. For example, all traffic within a metro area could be delivered within that area at a much lower cost than other national destinations.

8.2.4. **National traffic**
Traffic with its origin and destination in different regions of the same country.

8.2.5. **Network provider**
A business that enables users to connect to other users, networks or content providers by selling bandwidth and network access.

8.2.6. **Neutral peering exchange**
An independently owned network meeting point enabling data exchange with no traffic charges and an open access policy.

8.2.7. **Peering**
An agreement between two or more Internet network and/or content providers to carry traffic for each other and their respective customers. This may include their entire customer base or only a prescribed subset. It does not include the obligation to carry traffic to third parties. The exchange is either at no cost,

where the value is equal, or fairly compensated, where the value is not equal.

8.2.8. **Transit**
An agreement where an ISP agrees, for a charge, to carry traffic on behalf of another ISP or end user. This does include an obligation to carry traffic to third parties.

8.2.9. **Tromboning**
The inefficient routing of data outside of a local region. This occurs when the source and destination of the traffic are in the same local area, yet the traffic leaves that area during delivery. This concept can be extended to traffic sourced and destined within New Zealand which takes an offshore path during delivery.

8.2.10. **Offshoring**
Where New Zealand content or applications sites are hosted offshore and that content returns to New Zealand.

## 8.3. Transit Costs

8.3.1. The costs of transit in New Zealand have been investigated and compared with those available internationally. Although it is accepted that this form of "benchmarking" is difficult, as getting a valid "apples for apples" comparison is challenging, it does appear that transit costs experienced in the New Zealand market do appear to be higher than those experienced in comparable markets elsewhere around the world.

8.3.2. The analysis of global transit prices, as shown in Appendix B indicates that the cost of transit in New Zealand is typically higher than that in most other jurisdictions for any size of Committed Data Rate transmission link. In particular, when compared with the OECD countries, for low values of Committed Data Rate (CDR in the order of 2Mbps) the market price for transit is typically twice that experienced in other countries across the globe. For higher values of CDR the New Zealand transit prices converge to be closer to those in other countries, but there remains at least a 10% premium in New Zealand.

8.3.3. Service providers have historically used New Zealand's geographic isolation to explain any difference in Internet pricing. Service providers cite the fact that the international links out of New Zealand cost significantly more than transit existing in other OECD countries. While this is true for international transit, it is not clear that the argument holds for national transit, as the links within a country should be of a comparable cost for a comparable volume and distance. For local transit the argument is on even more shaky ground.

8.3.4. It is not proposed that transit prices in New Zealand be priced on an economically irrational basis. It is essential that users of transport

capacity pay an economically rational price for that capacity. However, it would be expected that transit prices in New Zealand should track those experienced by content providers and ISPs in other similar countries for comparable service characteristics. Hence on this basis, there is room for transit prices to drop in New Zealand, especially those related to the lower CDR values.

8.3.5. If this was to happen, then it would increase the differential in pricing between international transit and national transit that would make hosting of content within New Zealand more attractive than is currently the case. However, this in itself does not necessarily change the perspective of the service or content providers in hosting content offshore, as they still do not see the costs incurred by the consumers. Overall, whether reductions in transit pricing would remove the need for either national tromboning, offshoring of content, or international tromboning of traffic is debatable, but it would help make the use of local interconnection as proposed by Telecom more attractive than is currently the case (see below).

## 8.4. Internet Traffic Facts

8.4.1. It has become clear from both the consultation with industry participants and our subsequent investigations, that the information available about traffic flows within the Internet relating to New Zealand is extremely limited. For the purposes of our investigations we have sought traffic information from a variety of sources, both public and private, and all of these sources present a constrained perspective on the aggregated traffic flows existing both within New Zealand and in and out of New Zealand.

8.4.2. Based on the limited data available, we have been able to draw some broad conclusions about traffic flows, including:

- Access to international websites represents a large proportion of New Zealand Internet usage,
- Around 80% of the volume of traffic is generated by less than 20% of users of the Internet in New Zealand,
- The proportion of international traffic amounts to around 95% by volume or around 90% by flows of the total,
- In the absence of any significant change in Internet usage, national traffic will drop from today's level of around 8% to 5.6% in 2010,
- The combination of offshored and tromboned traffic only represents 1% of the total international traffic flowing into New Zealand on the Internet,
- The move to provision high-bandwidth rich media has the potential to compound the problems caused by offshoring and

tromboning of traffic, and is likely to drive up volumes dramatically.

8.4.3. Although we are reasonably confident in the conclusions as expressed above, it is also recognised that it would be highly desirable to have much improved data about the traffic flows and associated volumes in order for the industry as a whole to support improved decision making in the future. Hence it is strongly recommended that a mechanism be developed on a collaborative basis to provide a fact base around traffic flows and associated volumes within New Zealand, which can be used by the entire industry.

8.4.4. The information sought would include aggregate macro traffic flows by volume for: NZ consumers to NZ consumers, NZ consumers to NZ hosts, NZ consumers to offshore hosts, NZ consumers to NZ hosts via Auckland, geographic distribution of NZ hosts, and traffic volumes per host.

8.4.5. Obviously it would be essential to ensure that the data is suitably massaged to ensure that competitive positioning by various individual players is not compromised – it is the aggregate data that is important for all players to make the best decisions about how best to develop the Internet in New Zealand.

## 8.5. Rich Media Content

8.5.1. Our investigations show that all players in the industry are currently behaving in an economically rational manner with respect to the delivery of applications and content. This includes those that are choosing to host content and applications intended for the New Zealand market on offshore hosts. However, it is also shown that the current direction being taken by some content and application service providers is likely to inhibit the take-up of rich media content by New Zealand consumers.

8.5.2. Rich media content has the following attributes:

- Large volume of data transfer,
- Sensitivity to network impairments, such as delay, delay variation and packet loss.

8.5.3. When rich media is sourced across a long transmission path such as across the Tasman Sea or Pacific Ocean, the large distance combined with the large volume of data incurs a high cost. Furthermore, the larger the transmission distance, the higher the delay and potential for delay variation and packet loss. Hence when rich media content is sourced offshore from New Zealand, the end user experience will be poor, both in terms of the cost incurred and the quality of the experience.

8.5.4. Ideally rich media content should be delivered from a host close to the end user in order to minimise both transport cost and enable the best possible end user experience. However, the closer the content is located to the end user, the higher the cost for the content service provider. Hence for a given consumer demand, within any defined geographic area, there will be an optimum location for the content host to maximise the end user experience and minimise distribution costs.

8.5.5. While there is low take-up of rich media content in New Zealand, the delivery of rich media services from offshore hosts is probably economically rational relative to the combination of both the New Zealand markets and offshore markets.

8.5.6. Alternatively, if the demand for rich media content in New Zealand is to increase, the cost for end users will need to decrease and the content will need to be delivered with maximum fidelity. Both these criteria can only be achieved in an economically rational manner by bringing the content physically closer to the end user.

8.5.7. If content service providers wish to ensure a high demand for their content, then they will have to host the content within New Zealand and preferably on a regional basis within New Zealand. This will drive the need for improved national and regional interconnection within New Zealand and a reduction in transit costs to enable cost optimised regional interconnection. Hosting in Auckland with comprehensive interconnection in Auckland only, as is typical of today's Internet, will be good for Aucklanders but will do little for the rest of the New Zealand market. Hence the current trend towards offshoring of content will need to be reversed and the value of local interconnection will need to be re-assessed by content service providers.

## 8.6. Geographic Cost Differentiation

8.6.1. The Internet in New Zealand today makes little acknowledgement that transmission costs are dependent on distance traversed between the consumer and the source of the content being accessed. Although transmission costs have rapidly decreased over the last 20 years and are expected to decrease further over the next 20 years, there still remains a distinct cost difference between local, national and international transmission for a given volume of data transferred. For New Zealand, the relative cost for a given volume of traffic is roughly 1:10:100 respectively.

8.6.2. In absolute terms, even with this relativity of cost, with small volumes (a few MB) of data transferred, the differential is not significant in terms of the overall cost structure of the Internet. However, as we move towards the transfer of large volumes (several GB) of traffic per session per user, the absolute cost of the transmission becomes significant and the relativity in cost becomes

important. It is around 100 times more expensive to transfer 10GB across the Pacific Ocean than it is transfer the same volume of data around Wellington. Hence it is essential that consumers of Internet content be provided with appropriate signals about the costs they are incurring.

8.6.3. The current practice is to lump all of the costs on an averaged basis into a combination of the fixed monthly tariff for broadband service combined with a data volume cap. However, most volume caps in existence in the New Zealand market today will only allow a consumer to download a maximum of 1 or 2 high definition videos from an offshore host per month. This severe constraint is not going to encourage the evolution of a vibrant market for rich media content in New Zealand. Hence it is either necessary to dramatically increase the data volume caps, which would incur considerable cost for the ISPs, or alternatively take advantage of the cost differential of distance and host the content closer to the end user and offer a lower tariff or higher cap for access to this national or, even better, locally hosted content.

8.6.4. This differentiated pricing model for data volume is not without precedent. In New Zealand, some business users take advantage of this pricing approach through the Telecom Corporate Internet Direct product, which has a differentiated price for national and international traffic. In Australia, BigPond offers Australian customers unlimited data volumes for access to content hosted off designated Australian based sites. Portugal has regulated a differentiated pricing approach for national versus international Internet traffic.

8.6.5. Given New Zealand's location in the South Pacific, with a predominance of English speaking people and a long distance from the popular markets of Europe and USA, this differentiated pricing approach might offer some value to New Zealand consumers and help encourage them to take-up rich media content.

## 8.7. Local Interconnection

8.7.1. Telecom has proposed a "local peering" solution which offers local peering for any service provider on a "bill and keep" basis. This means that rich media content providers can deliver content to all New Zealanders from servers located within a local region, where as indicated above, the cost of transport is minimised. This has some significant benefits for all consumers, as the transport costs are minimised and, due to the short transport component, it should be possible to provide media with low delay, low delay variation and low packet loss – providing optimal quality experience.

8.7.2. However, the content providers do not necessarily see this as an ideal solution as they need to build out network and hosting facilities to serve these local regions. In order to provide service to all New Zealanders this would mean providing these facilities into

29 regions. Some claim that 29 regions is too many. This is a valid argument, when the number of consumers is low and the amount of rich media content consumed is low (thus the revenue stream is insufficient to pay for the required infrastructure).

8.7.3. Under these circumstances content providers would prefer the consumers to pay more and for them to pay less. As the volume of rich media traffic grows relative to the total Internet traffic, this equation should change for both the content providers and the consumers, with consumers demanding to pay less and content providers having sufficient revenue to pay for more infrastructure, in order to reduce the total costs for all parties.

8.7.4. Hence it is not at all clear whether the solution offered by Telecom is optimum for either consumers or content providers in the short term. On the other hand it is likely to be the optimal solution for those regions that will have sufficient rich media consumers in the longer term. Getting the right balance in terms of costs for both content service providers and consumers relative to demand over time is the critical factor for the success of this proposal.

## 8.8. **Market Power**

8.8.1. There is a question as to whether market power is present in the provision of Internet interconnection within the New Zealand market. Do those service providers that have access to the consumers hold the rest of the Internet service provider market to ransom? Are these network service providers making super profits out of their infrastructure or just making an economical rate of return?

8.8.2. Apart from the investigation of transit pricing as discussed above, there is no definitive indication that any party is exercising market power in the provision of interconnection services in the New Zealand market. Certainly transit prices could be a little sharper, but it is unlikely that this adjustment in itself will lead to substantial change in the operation of the Internet interconnection.

# Appendix A

# Content Consumption by New Zealanders

http://www.comscore.com/press/release.asp?press=1406

**Press Release**

**Nearly 2 Million New Zealanders Spent an Average of 20 Hours per Person on the Internet in March**

***comScore Measures New Zealanders' Online Behavior at All Internet Sites: Microsoft Edges Google as Most Popular New Zealand Internet Property***

**London, UK, April 25, 2007 --** comScore, a leader in measuring the digital world, today released a study from its World Metrix database analyzing the behavior of New Zealand's online population. The study is based on data collected from comScore's research panel of New Zealanders who have given comScore explicit permission to monitor their online activities us ing comScore's patented monitoring technology. Unlike other services which only measure activity on sites that cooperate by installing software on their servers – therefore painting an incomplete picture of the online world – comScore's technology is able to measure users' behavior at all Internet sites.

In March 2007, 1.9 million New Zealanders age 15 or older used the Internet, viewing 3.6 billion pages of content. The average Internet user went online every other day and spent a total of 20.4 hours online during the month.

| **New Zealand's Online Population<br>New Zealand Unique Visitors, Age 15+<br>March 2007<br>Total New Zealand – Home and Work Locations*<br>Source: comScore World Metrix** | |
|---|---|
| | **March-07** |
| Online Population (000)* | 1,923 |
| Total Pages Viewed (millions) | 3,571 |
| Total Time Spent (millions of hours) | 39 |
| Average Usage Days Per User per Month | 16.6 |
| Average Time Spent (hours) per Month | 20.4 |

** Excludes traffic from public computers such as Internet cafes or access from mobile phones or PDAs.*

**Top New Zealand Sites**
comScore also revealed New Zealanders' most popular sites, ranked by the number of unique visitors age 15 and older in March 2007. Three of the top five sites are U.S.-based companies, including Microsoft Sites (with 1.42 million visitors from New Zealand), Google Sites (with 1.39 million visitors), and Yahoo! Sites (with 1.1 million visitors). New Zealand-based Trademe.co.nz and Govt.nz round out the top five, garnering 977,000 and 621,000 visitors, respectively.

| **Top 10 New Zealand Online Properties<br>Ranked by Unique Visitors Age 15+*<br>March 2007<br>Total New Zealand – Home and Work Locations**<br>Source: comScore World Metrix** | |
|---|---|
| **Property** | **Unique Visitors (000)** |
| ***Total New Zealand Internet Audience, Age 15+*** | ***1,923*** |
| Microsoft Sites | 1,420 |
| Google Sites | 1,387 |
| Yahoo! Sites | 1,107 |
| TRADEME.CO.NZ | 977 |

| | |
|---|---|
| GOVT.NZ | 621 |
| BEBO.COM | 582 |
| Wikipedia Sites | 519 |
| AUTOTRADER.CO.NZ | 448 |
| eBay | 436 |
| CNET Networks | 403 |

**Ranking based on the top 200 New Zealand properties in March 2007; a property is the highest level of reporting, representing all full domains, pages, applications or online services under common ownership or majority ownership for a single legal entity.*

*** Excludes traffic from public computers such as Internet cafes or access from mobile phones or PDAs.*

"Independent third-party measurement of the size of site audiences is critical to the development of advertising on the Internet, just as it is in TV or print," commented Ian Smith, CEO of Yahoo! 7 and interim CEO of Yahoo! Xtra. "Though tags and server logs are useful, they require the cooperation of all sites if they are to represent the entire market – and that cooperation is not forthcoming. Moreover, these methodologies often overstate true audience size due to cookie deletion. Consequently, Yahoo! supports panel-based audience measurement and comScore's robust sample gives us the accuracy and visibility into the entire market that we need to help build our business."

**About comScore's New Zealand Panel**

comScore has built a research panel of more than 5,000 New Zealanders who have given their explicit permission to allow comScore to continuously monitor their online activities. This panel was recruited to be representative of the online population in New Zealand age 15+ accessing the Internet from a home or work computer. The benefit of a panel based approach (versus a site-centric tagging approach) is that it does not require the cooperation of site operators and provides a measure of visitation to all sites – not just the ones that cooperate. In March 2007, comScore was able to report on visitation behavior by New Zealanders across more than 1,000 Internetsites.

**About comScore World Metrix**

comScore World Metrix is the first service to continuously measure and report online behaviour on a world-wide basis, providing visitation metrics and demographic characteristics for Web site audiences around the world. With active representation of countries that comprise the vast majority of the global Internet population, World Metrix provides its clients with worldwide Internet population estimates and harmonised online performance metrics based on a consistent methodology across all countries. More than 100 companies subscribe to comScore's World Metrix service, including 8 of the top 10 interactive advertising agencies.

**About comScore**

comScore, Inc. is a leader in measuring the digital world. This capability is based on a massive, global cross-section of more than 2 million consumers who have given comScore permission to confidentially capture their browsing and transaction behavior. comScore panelists also participate in survey research that captures and integrates their attitudes and intentions. Through its proprietary technology, comScore measures what matters across a broad spectrum of behavior and attitudes. comScore consultants apply this deep knowledge of customers and competitors to help clients design powerful marketing strategies and tactics that deliver superior ROI. comScore services are used by global leaders such as AOL, Microsoft, Yahoo!, Verizon, Best Buy, The Newspaper Association of America, Tribune Interactive, ESPN, Fox Sports, Nestlé, MBNA, Starcom USA, Universal McCann, Merck and Expedia. For more information, please visit **www.comscore.com**.

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# Appendix B

## Transit Pricing

International Transit pricing data for April 2007 was purchased from Telegeography Research and analysed along with locally-sourced data. The data is shown in Figure 3, which provides the Committed Data Rate (CDR) price range. The CDR is the data rate a customer must pay for, although the circuit is usually larger, e.g. a 200Mbps CDR would be provided over an STM-4 (622Mbps) or a 1GbE circuit. The customer pays for additional bandwidth over the CDR if used.

The data indicates that the lowest price for transit is around US$10 per Megabit per second, although at lower committed bandwidth rates there is larger variability with the cost at 2Mbps being US$45 per Megabit per second. The data is not normally distributed and there is a long tail from the average price, so that the maximum cost for bandwidth in OECD countries is around US$500 from 34Mbps up to 155Mbps, which is around 10 times more than the average price. At higher data rates we see a significant drop in maximum price. This is due to a number of OECD countries no longer present in the data, as these larger bandwidth services are not provided or not reported by Telegeography. The services at 200Mbps and above are provided on 10GbE, STM-16 and STM-64 bearer circuits indicating the availability of an advanced transmission network in those OECD countries.

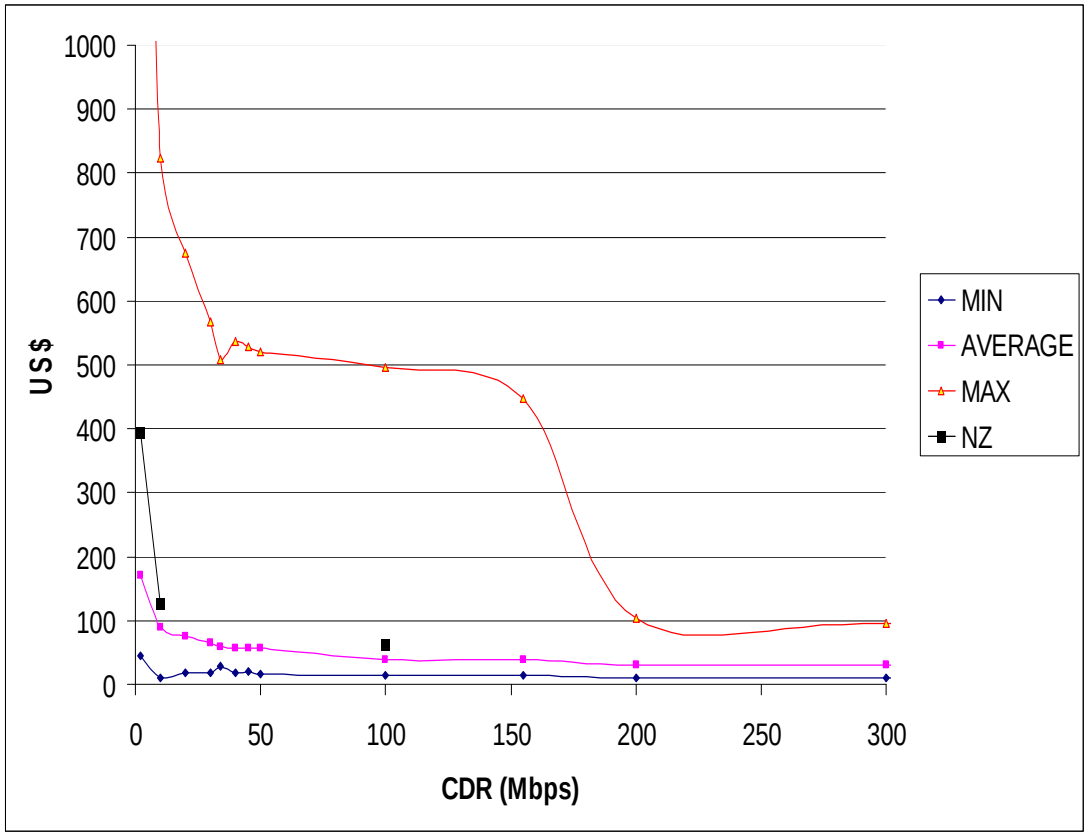


***Figure 3 Transit costs (April 2007) based on OECD countries, showing minimum, maximum and average process. Three price points for New Zealand transit costs are shown.***

Key conclusions from comparison to New Zealand price points:

- At 2Mbps New Zealand transit is twice the average world price, but well below the maximum OECD price. This service is not likely to be used by broadband ISPs
- At 10Mbps the price of NZ transit is only 10% worse than the world average price. A 10Mbps transit service might serve for a small broadband presence in a region – based on a 50:1 contention ratio and a 50% network load level this would support 250 customers at an average broadband speed of 5Mbps.
- At 100Mbps the NZ transit price is 30% above the world average price. This is likely to be a reasonable transit service level for a broadband ISP with reasonably large numbers of regional customers.
- Data was not available for larger transit prices, but these should reflect a similar trend.

In Figure 4 we see the price points for higher bandwidth services, indicating that the typical prices are between US$10 and US$30 per Megabit per second for large bandwidth CDR.

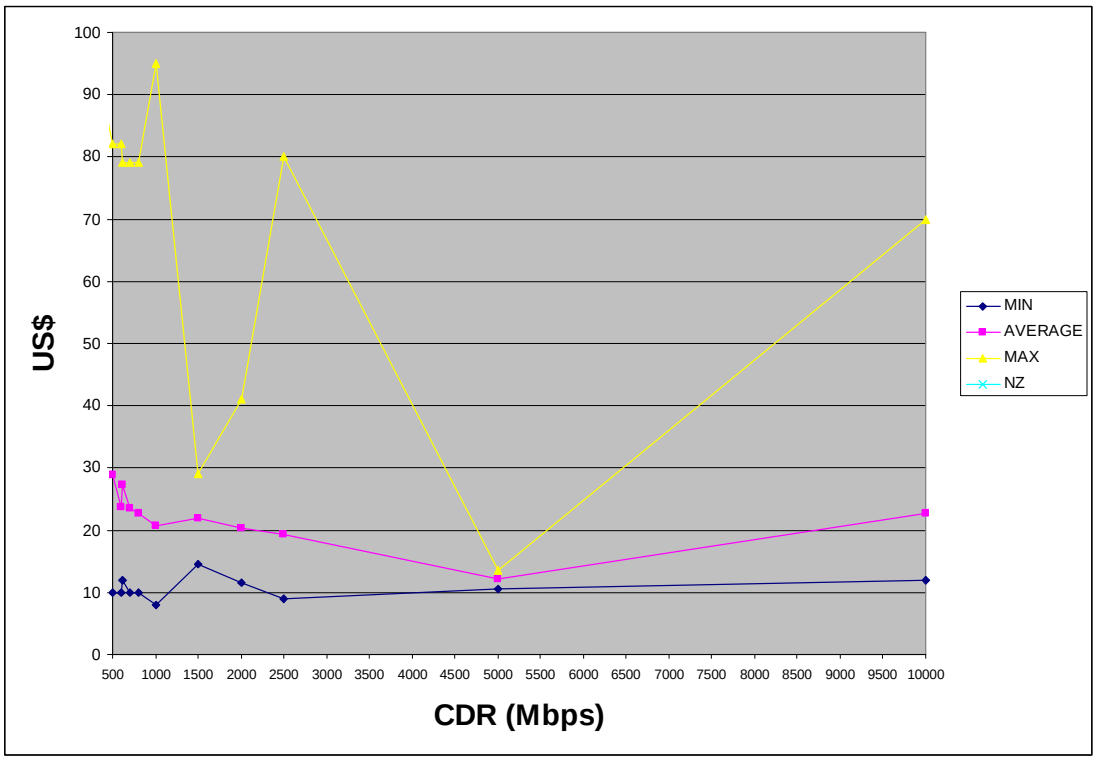


***Figure 4 Transit prices from 500Mbps to 10Gbps. There are relatively few services at 1500Mbps, 2Gbps and 5Gbps, which explains the narrow range in service prices.***

# Appendix C

## Broadband ISP Traffic Analysis

This Appendix presents the results of a measurement exercise undertaken on a single large national ISP operating in the New Zealand market. The measurements presented were undertaken by the WAND Group at the University of Waikato under the guidance of Richard Nelson and the report was prepared by Peter Komisarczuk from Victoria University of Wellington.

### Abstract

What are the aggregated traffic characteristics of broadband customers in New Zealand? What is the volume of national/local traffic and International traffic? Can we determine whether local traffic is being transited internationally by analysing the RTT for these customers? All are important questions some of which are answered in this document.

Key outputs:

- Approximately 95.4% of measured traffic is international in this study
- Approximately 4.6% of measured traffic is national traffic
- Of the national traffic as much as 1.74% of traffic **may** be New Zealand content accessed from international servers
- Of this 1.74% as much as 0.4% might be tromboned from New Zealand servers through international links.
- There is little impact of national traffic on international transit (maximum of 1.74%)
- There appears little benefit to Telecom "Local Peering" currently.
    - The ISP would probably not remove very much volume of traffic from their national transit volume, if they employ national transit.

### Background

The data presented in this report has been gathered from a relatively large national New Zealand ISP, the traffic is from broadband domestic customers, these are predominantly likely to be residential in nature. The source data consists of a passive trace of all packets on the link between the ISP and Telecom NZ UBS (Unbundled Bitstream Service) connecting the DSL customers to the ISP through a tunnel protocol and an optical circuit. Within the trace file captured packet data has been removed, but all IP and Transport layer headers have been retained unmodified for analysis.

The traffic discussed here is of a national ISP with several tens of thousands of customers connected through the UBS (Unbundled Bitstream Service), which provides customers to an ISP through a high speed link and L2TP tunnelling to the ISPs BRAS. The connection is at ATM/STM-4 or a Gigabit Ethernet (deduced from the average bandwidth). Customers are then connected either through the ISPs own national

infrastructure to national and international gateways or connected to national transit services to other national networks and international gateways. See Figure 5 for a description.

The data presented is from a Saturday, a 24 hour period from 1am to 1am, captured in early February 2007. The ISP customers are domestic broadband accounts (predominantly residential consumers) so this is one of the busiest days with respect to traffic. The overall statistics from a weekday have also been checked and there is a slight difference. The overall data for the Saturday and the weekday are presented in tables 1 and 2 below.

### Traffic Data Analysis

How do we determine whether traffic is national or international? There are effectively two mechanisms we can employ. Firstly we can check whether the IP address is allocated to a New Zealand company using the APNIC database. If a server is in the .nz domain then we may assume that it is likely to be based in New Zealand, or located overseas for a New Zealand company. Secondly we can look at the Round Trip Time (RTT - the time taken to transmit to a destination and receive a response) characteristics. Fundamentally the speed of light in a fibre optic cable determines how long it takes to reach a destination, the USA is around 150ms from New Zealand, Australia around 40ms, and therefore we can use the RTT to differentiate traffic as an alternative to the APNIC database.

The difference between the RTT and the deduced location from registry data may give us an indication for web servers that are not located in New Zealand. By looking at both the RTT and the APNIC database we can then estimate whether web content from New Zealand registered internet hosts/servers may have been transmitted from offshore hosts, or even worse have been tromboned.

Here the term tromboning is used to describe traffic that originated in New Zealand but went over an international connection to reach a New Zealand host that had requested that content from that server. Tromboning is an undesirable network problem as it uses international bandwidth from New Zealand and then back to New Zealand. This causes excess delay, increases the probability of packet loss and therefore retransmission as well as an extra financial component in the use of the expensive international connectivity.

We cannot be 100% certain whether the traffic with a long RTT is from overseas or whether the server is just very busy and therefore very slow to respond to a users request. However a long RTT is an indication that the correspondents in a communication session could be internationally connected.

The RTT is calculated using the three-way TCP handshake as minimum and by tracking sequence number on longer flows of packets between hosts and servers. The RTT is dependent on distance, the number of network devices the packets must traverse, the transmission delays (the speed of connections) and the queue delays in the network. The RTT value used is actually the smoothed RTT as TCP calculates it (using an exponential moving average mechanism), not the minimum RTT which would perhaps have been a better measure to determine server locality. Most of the data has been

determined using APNIC delegation information to identify sources within New Zealand and internationally.

For all the RTT graphs International ("inter") and National ("nat") traffic have been determined as per APNIC allocations. In addition we have assumed that all customers on the DSL network are in New Zealand to deal with the case where they were using addresses not allocated to NZ by APNIC - apparently many of the ADSL customers are leaking RFC1918 addresses from their ADSL routers.

Some notes on the data nomenclature:

- "Inside" means from the observation point into the DSL network.
- "Outside" means from the observation point to the rest of the Internet.

Doing this enabled the WAND group to remove the effects of excessive buffering in the DSL network. The observation point might be considered a point where a local interconnect may be located. In the "combined" data file (shown in table 1) the RTT figures have defined National as flows with external RTT <120ms and International as flows with external RTT > 120ms. The analysis based on defining traffic by RTT or by APNIC numbers appear to be very close, and can be considered roughly equivalent. The international web content with a low RTT may be cached content (in ISP web caches) or servers located in New Zealand for international content providers.

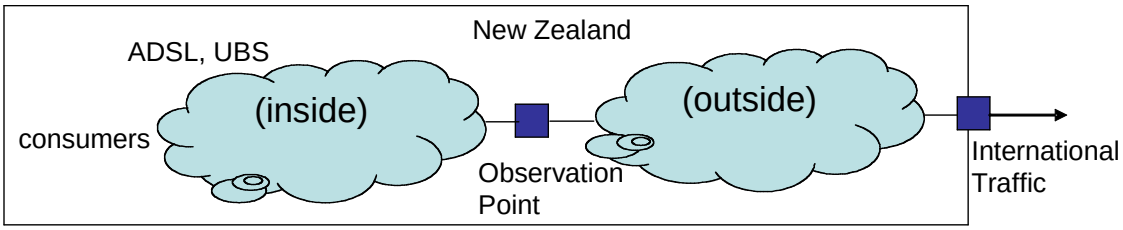


***Figure 5 Measurement Scenario – observation point is located at the telecom UBS – ISP boundary.***

## National versus International Traffic Analysis

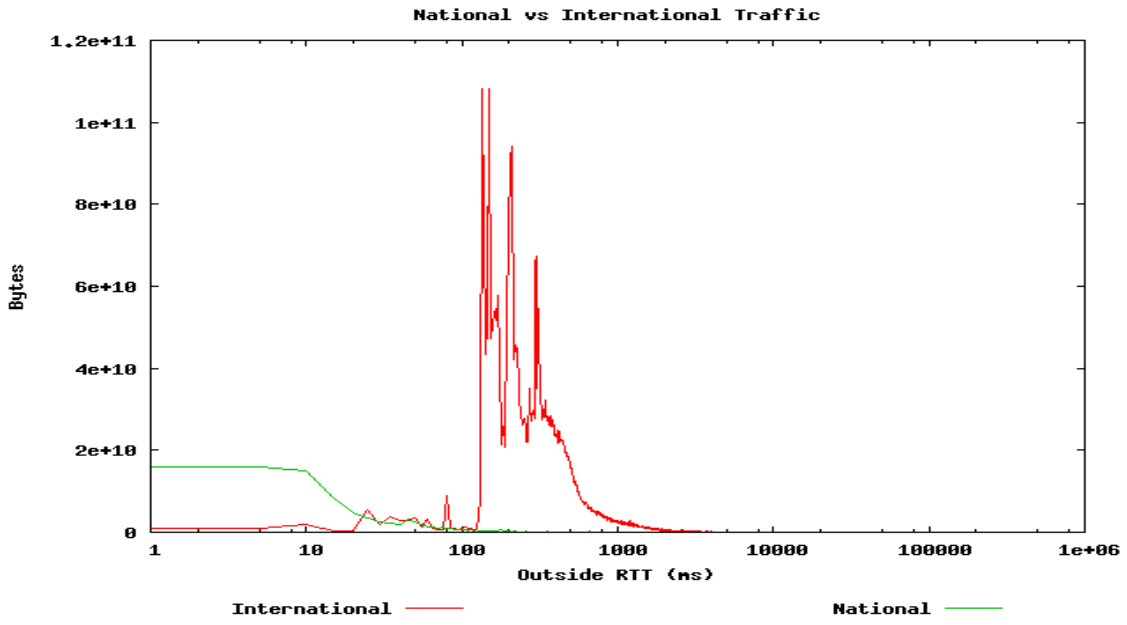

***Figure 6 Volume of data versus RTT for national and international traffic (flowing externally/outside from the observation point).***

Figure 6 shows that international traffic (identified as red using APNIC data to identify whether the traffic is within New Zealand or not) has generally a larger RTT (in excess of 120ms). There is a significantly larger volume of international traffic than national traffic – note the log scale on the graph in Figure 6. Note a number of international sites have a short RTT indicating perhaps servers located in New Zealand belonging to an international AS (Autonomous System) or business. The volumes of national and international traffic as a percentage are indicated in Table 1.

Table 1 shows the breakdown of data volumes (bytes), by number of packets and by number of flows. Here only 4% or so of data (by volume in bytes) is national. Table 2 indicates the data captured during a weekday, indicating a similar characteristic to the weekend data.

*Table 1 Volume of Data (Saturday)*

| | Bytes | Packets | Flows |
|---|---|---|---|
| National (APNIC) | 3.7321% | 3.8874% | 6.9086% |
| National (RTT) | 4.6837% | 5.0463% | 10.4374% |
| International (APNIC) | 96.2679% | 96.1126% | 93.0914% |
| International (RTT) | 95.3163% | 94.9537% | 89.5626% |

*Table 2 Volume of Data (Weekday)*

| | Bytes | Packets | Flows |
|---|---|---|---|
| National (APNIC) | 5.3785% | 5.5796% | 8.6760% |
| National (RTT) | 6.4340% | 6.7624% | 12.4474% |
| International (APNIC) | 94.6215% | 94.4204% | 91.3240% |
| International (RTT) | 93.5660% | 93.2376% | 87.5526% |

Figure 7 shows the number of national and international flows in this traffic sample as an alternative to data volume. A flow identifies packets exchanged between two specific hosts, identified by their IP addresses. The flow pattern is similar to the data volume pattern shown in Figure 6. Again we see there are relatively few local flows versus international flows and by observation a similarity distributed to the data in Figure 6.

The data in Figure 6 and Figure 7 indicate the different delay characteristic of international traffic compared to national traffic. Rich media content would best be served locally, to minimise delay, jitter (delay variation) and packet loss, which would optimise "quality of experience".

The Cumulative Distribution Function (CDF) graphs in Figure 13 and Figure 20 are per-unique IP seen in the ISP's range in the whole trace. By inspecting the CDF data shown in Figure 13 and Figure 20 we can further determine the traffic characteristics. The CDFs are calculated per-unique IP address seen in the ISP's range during the 24 hour period of the whole trace. As shown in Figure 13, 40% of the unique IP addresses

account for less than 1000 bytes of international traffic per day and the largest amount was nearly 10GB attributed to one IP address (a single customer).

After the 40% of very low data users (perhaps attributed to aborted connection requests, and low bandwidth activities such as virus update checking etc.) we see that the next 20% of IP addresses account for between 1000 bytes and 10 million bytes of data transmitted. Then the next 30% of IP addresses generate 10 million to 100 million bytes of data and the remaining 10% of customers generate 1GB to 10GB of the traffic.

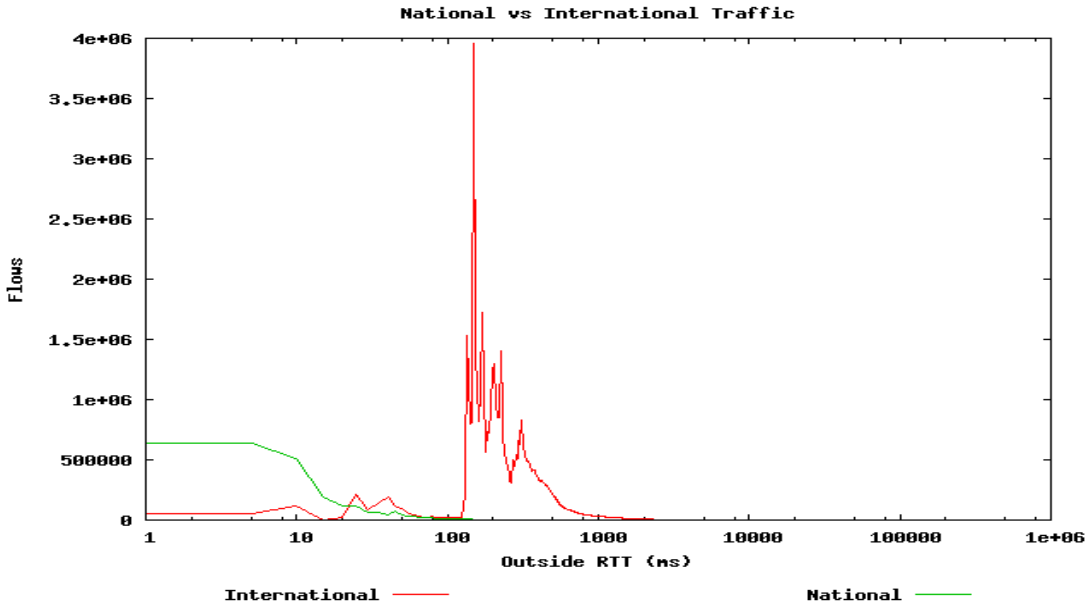


***Figure 7 Traffic Flows versus RTT (flowing externally/outside from the observation point)***

In Figure 20 we see the CDF figures from national traffic. Again a similar picture emerges. Just under 40% of customers generate less than 1000 bytes of traffic within the 24 hour period. These are aborted connection requests etc. Regarding heavy traffic users we see a similar distribution to international traffic usage, except that the volumes generated are an order of magnitude lower than the international traffic volumes detected.

In Figure 18 we see the distribution of RTT for national traffic. The vast majority of this traffic has a RTT of 40ms or less. The data tails off with only a few flows having a RTT of 100ms or greater. The RTT observations greater than 120ms may be for local content that is located internationally (Australia or US) and again much longer RTT, in excess of 300ms at least, may be or for data that has been tromboned from New Zealand and back again. The volume of this data would not seem to indicate any significant problem; however there is no detailed analysis of the correlation between these long RTT observations and the data volume generated.

The total data captured during the 24 hour period was $3.66 \times 10^{12}$ bytes. This is made up of $3.53 \times 10^{12}$ bytes of international data and $1.37 \times 10^{11}$ bytes of national data. This equates to an average of 326.5Mbps of international traffic and an average of 12.66Mbps of national traffic. Some of the international traffic has a low RTT (less than 120ms) and some national traffic has an RTT which may indicate it is located internationally or even

tromboned. Likewise some international traffic has an RTT of less than 120ms indicating it is possibly located in New Zealand rather than internationally, either because of web caches, content delivery networks such as Akamai or replicated servers for large international companies.

We know that national traffic is very small compared to international traffic, for these observations national traffic (see national inside data) is less than 4.6% of the total traffic observed. Of this national content, approximately 37.95% (i.e. 1.74% of total traffic) of the observed traffic had an RTT time of 120ms or greater. Analysing the data further we see that approximately 8.76% (i.e. 0.4% of all traffic) of all the national traffic has an RTT greater than 300ms. Some of the traffic in excess of 300ms may be tromboned New Zealand traffic. The remaining 29.2% (i.e. 1.34% of total traffic) of traffic between 120ms and 300ms RTT may be from New Zealand servers that are internationally located.

Note that some of these RTT figures may be for busy national servers responding slowly to national users. However we cannot determine this without significant analysis and knowledge of the network infrastructure. Note that these measurements were taken before the TVNZ ondemand service became available. It may be of interest to repeat this study periodically to see the effect of future deployment of rich media content in New Zealand.

Analysing the international traffic we see that 1.4% of international web content to "outside" has an RTT time less than 120ms. Of "inside" traffic 36.8% has an RTT < 120ms. This is likely to be cached pages held in web caches and perhaps some servers of international content providers located in New Zealand.

### Analysis of the Effects of Local Interconnect

From these samples we can see that only 4.6% of traffic is local New Zealand content. As much as 1.74% of all Internet traffic (by volume) accessed by New Zealand residential consumers **may** be downloaded from International based servers, and that 0.4% of all traffic **may** be tromboned. This is a small percentage overall, it amounts to a small amount of the international transit service that an ISP must purchase. We do not know how much of this content is actually hosted overseas and so we do not know if any of this traffic has actually been tromboned from NZ and back. Tromboned traffic is probably a very small fraction and should not have a significant impact <unless the ISP business is so fragile that such a small volume of traffic is considered significant>.

Within the New Zealand ISP ecosystem the majority of the 550K or so of broadband customers are located on the Telecom network and use the Xtra ISP. As a content provider predominantly providing content for local consumption you would seek to connect to Telecom/Xtra first and then worry about how to get to the other 140K or so of broadband customers (probably by hosting at WIX/APE). Telecom (retail) currently has a predominant place in the broadband market due to their significant customer base and so content. Local interconnect may be used to optimise content delivery locally but few content providers have the market power to make good deals with Telecom retail and the cost of a large number of distributed servers is likely to be high so the content must have a high value (price).

As 90% of content is international (from Telecom NZ data) – and from this study around 95% is international, the cost of transporting international traffic must predominate the ISPs network costs and design. An ISP can choose to use national transit services to connect within New Zealand and to the international gateways, or choose to build their own infrastructure. The choice is made on a cost and business requirements basis. Telecom NZ have proposed a "Local Peering" service where an ISP can interconnect with Telecom and other ISPs in up to 29 regional points of presence. This would allow local traffic to be kept local and minimises transit costs, however it may impact the ISP in other ways, with increased CAPEX and a more complex infrastructure is likely to increase OPEX as well.

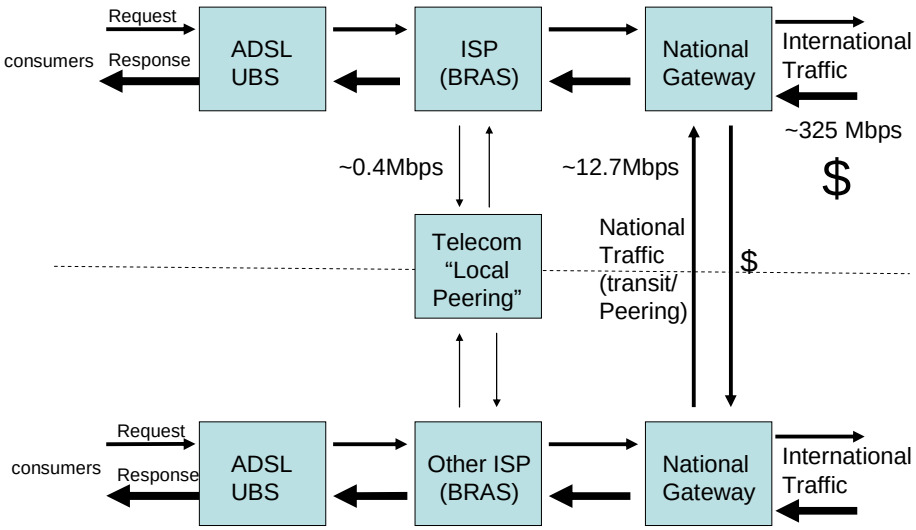


***Figure 8 Traffic Flow – largest cost component is international traffic***

If an ISP chooses to use national transit services, around 92% of traffic would be transmitted over the transit service to the international transit services. From the WAND measurements around 95% of all traffic is international and 5% national. The volume of national internet data measured here has an average rate of about 12.66Mbps and for the international traffic the average bandwidth is approximately 325Mbps. This was generated by a few tens of thousands of customer computers on ADSL (on the UBS). This is not a large average national bandwidth but we cannot determine whether the flows are local or national which needs a mapping of IP addresses and content geographically (which we don't have).

Thus Telecom's "Local Peering" could only hope to provide a solution for at most 8% of an ISP's traffic. In fact there are likely to be few areas of New Zealand with significant amounts of content and so the "Local Peering" service is tinkering with a very small cost and traffic component. Assuming an even spread over the 29 regions in "Local Peering" we might expect that on average only 0.4Mbps of traffic would be truly "local". Thus it is not likely to make sense to use "Local Peering" to save the cost of transporting this average rate of data.

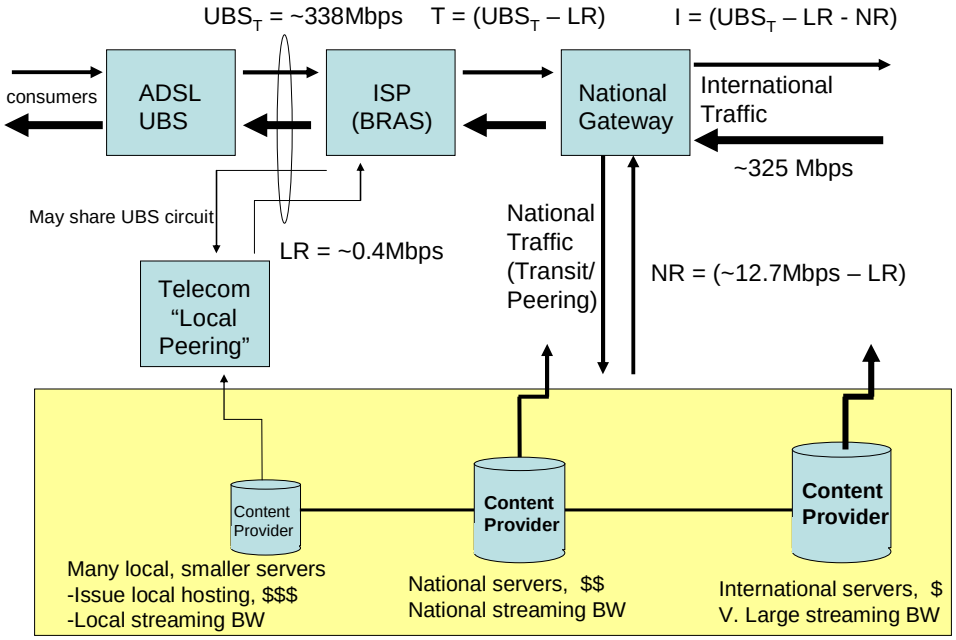


***Figure 9 Traffic (LR = local, NR = national, T = total transit, I = international transit) and the Content Provider dilemma***

The issue with developing local content provision is the availability of quality local hosting infrastructure (appropriate equipment room, air conditioning, power supply and diverse fibre for high availability). Large servers in the core of a network aggregate the demand from a large number of users and are highly cost effective. As servers are located closer to the consumer the utilisation and cost effectiveness can be reduced and thus costs increase for the content providers. For local interconnection to make sense the national infrastructure needs to be low cost such as to minimise the extra costs incurred on the content providers in distributing the content to a large number of small regions.

This changes when/if:

- We have lots of local/regional content that consumers want to pay and download (the questions are - what is it? who will pay for it?)
- Voice over IP (VOIP) - this could be a significant driver for local interconnection as many calls in the PSTN are local. However the telecommunication industry may not be happy using local interconnection for VOIP because the standards for Next Generation Networks and VOIP interconnect are being developed and are not likely to be a simple interconnection point such as envisaged for the current "Local Peering" service. Some examples:
- If a call last 10 minutes at standard PSTN quality (64kbps) then 1000 calls per hour would generate about 480MB of data - that is about 10.7 Mbps average traffic and this could easily be the demand in a regional area.

- Assume a standard quality VOIP call requires about 80kbps in each direction for the duration of a call for about 40% (on average) of the time in each direction.

- If we consider TVNZ's on demand video - which provides encrypted Windows® Media video content, a 30 minute program is 200MB and a 60 minute program 400MB, downloaded as a .WMV file. In real time this would amount to 8.9Mbps, so full quality video is not streamed, but downloaded. On the web site flash content is available (clips, information etc. in flash video format, 640 x 480, 512Kb video, 128Kb audio) encoded at 640kbps, so for one hour of the freely available streamed content, you would be downloading about 29MB of data.

## International Traffic Volume Analysis

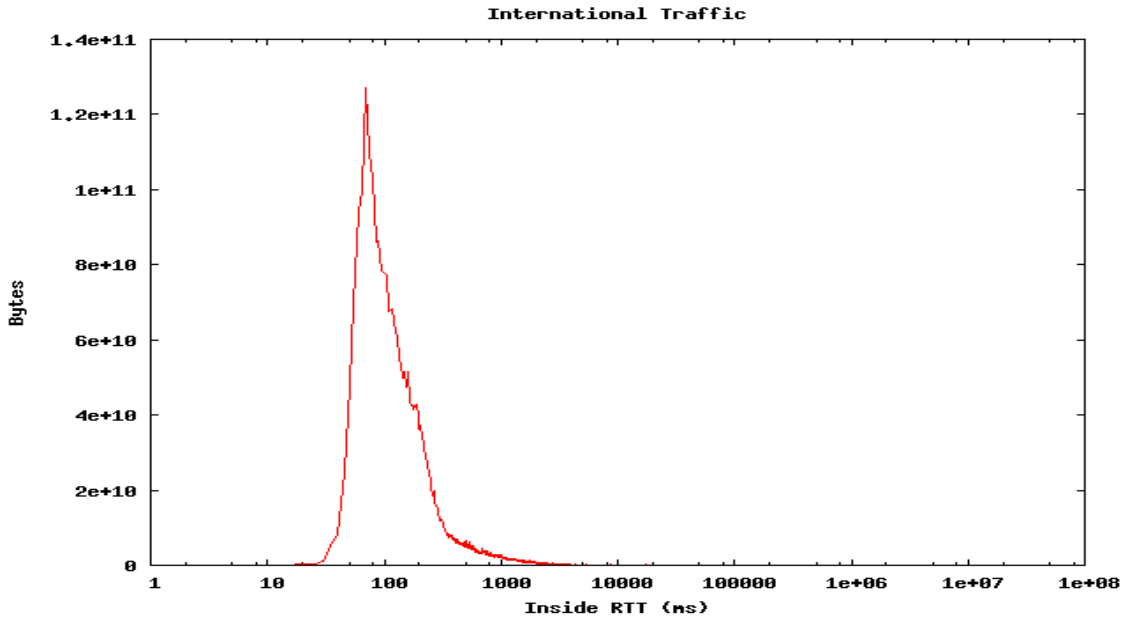


**Figure 10 International traffic volume versus RTT (to inside network)**

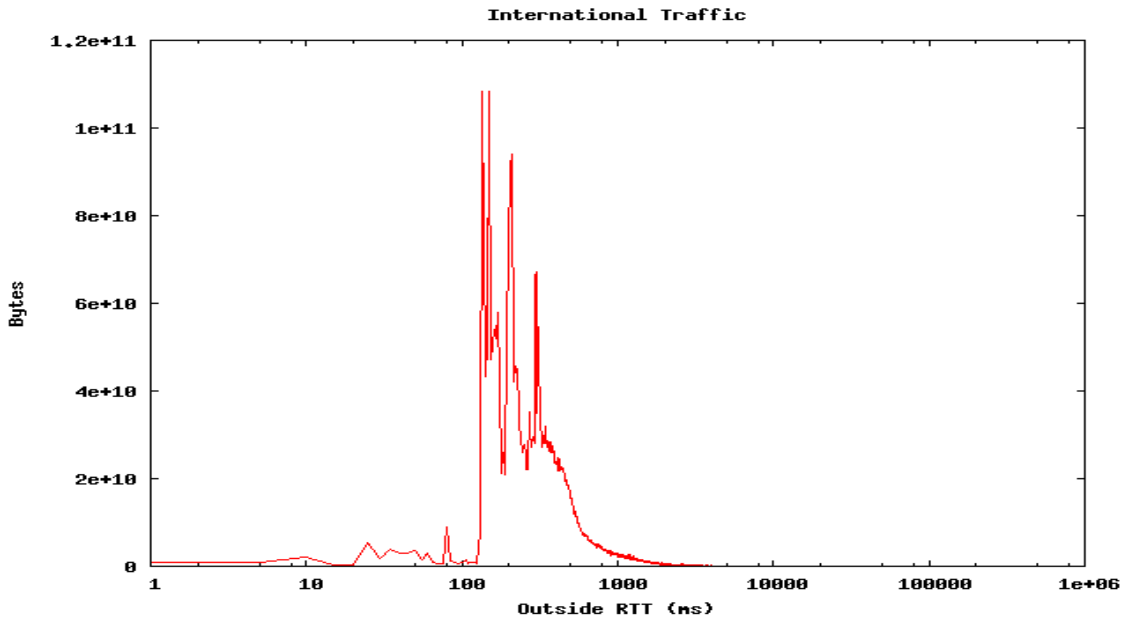


**Figure 11 International traffic volume versus RTT (to outside network)**

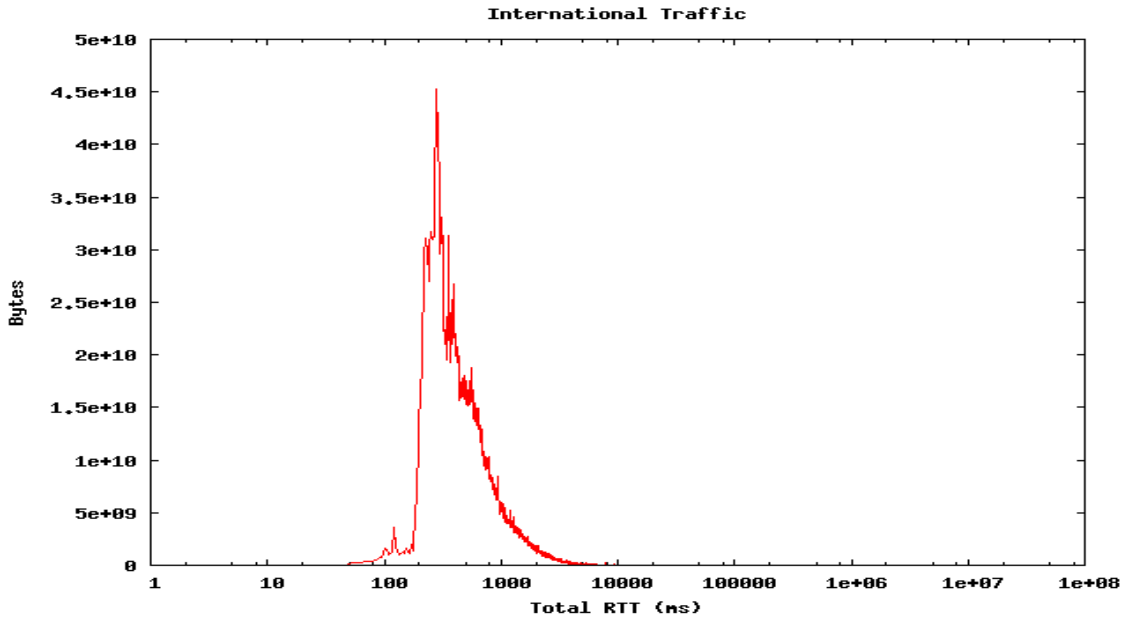


***Figure 12 International bytes (total) versus RTT (total inside+outside)***

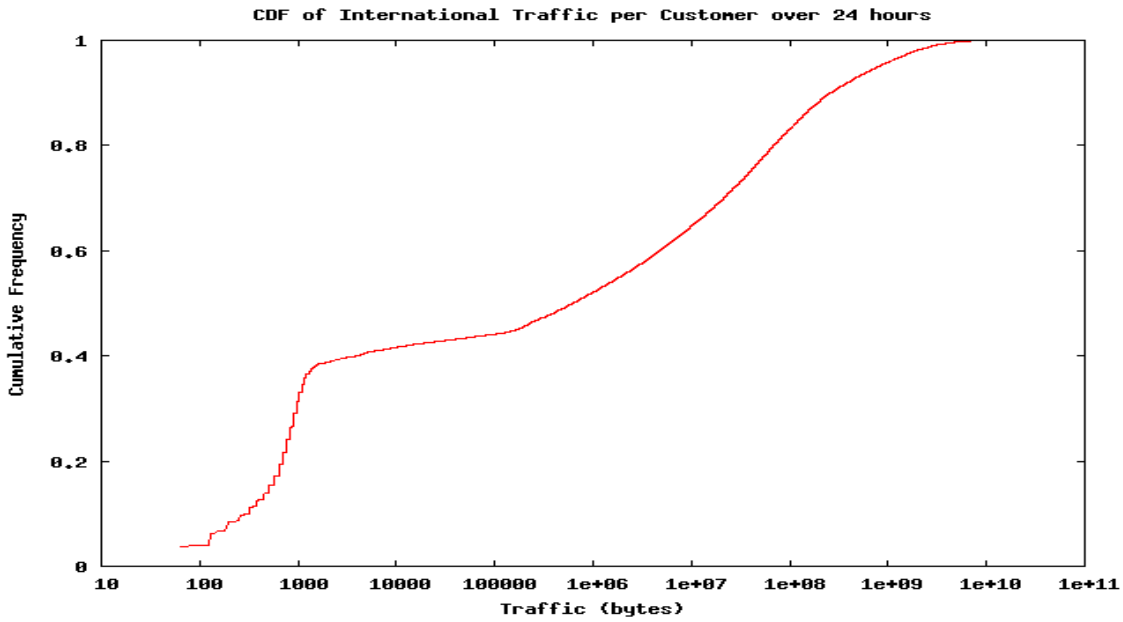


*Figure 13 International Traffic CDF (Cumulative Distribution Function)*

## International Network Flow Analysis

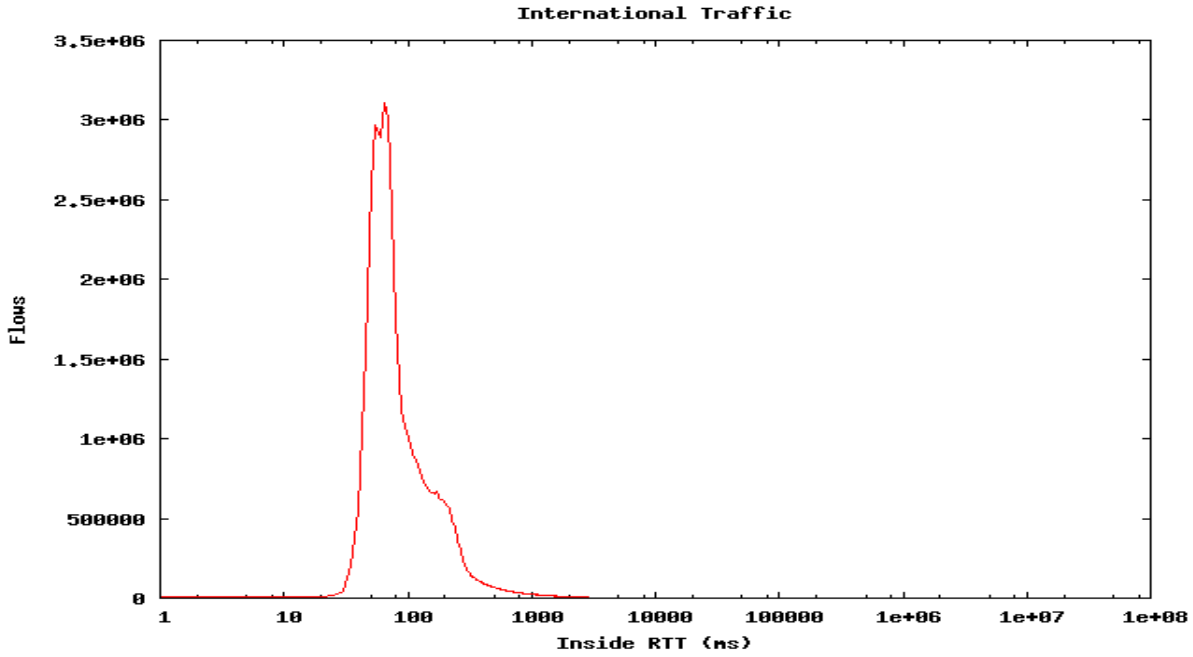


*Figure 14 International traffic flows versus RTT (inside network)*

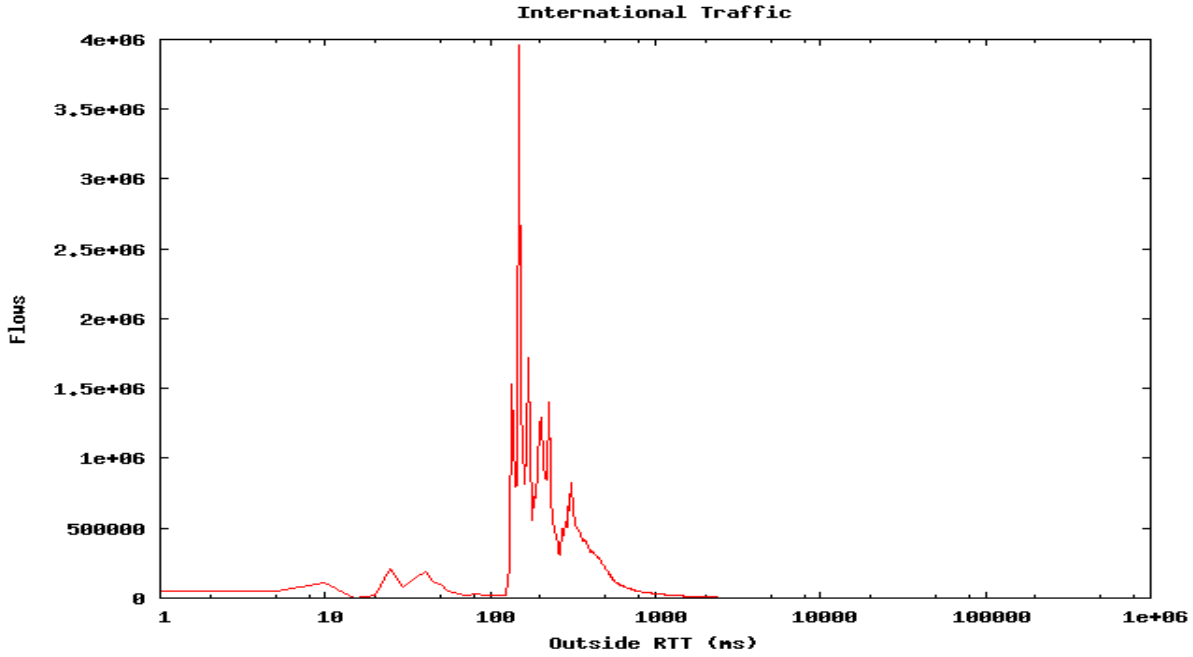


*Figure 15 International traffic flows versus RTT (outside network)*

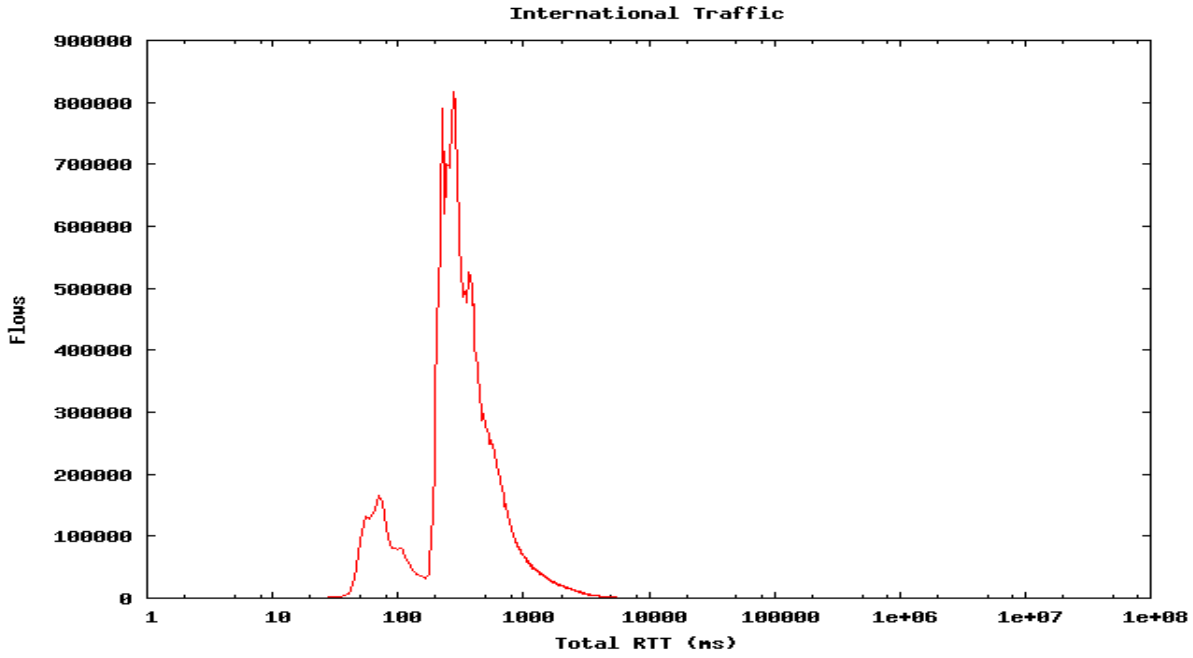


*Figure 16 Total International flows versus RTT (inside + outside)*

## National Traffic Volume Analysis

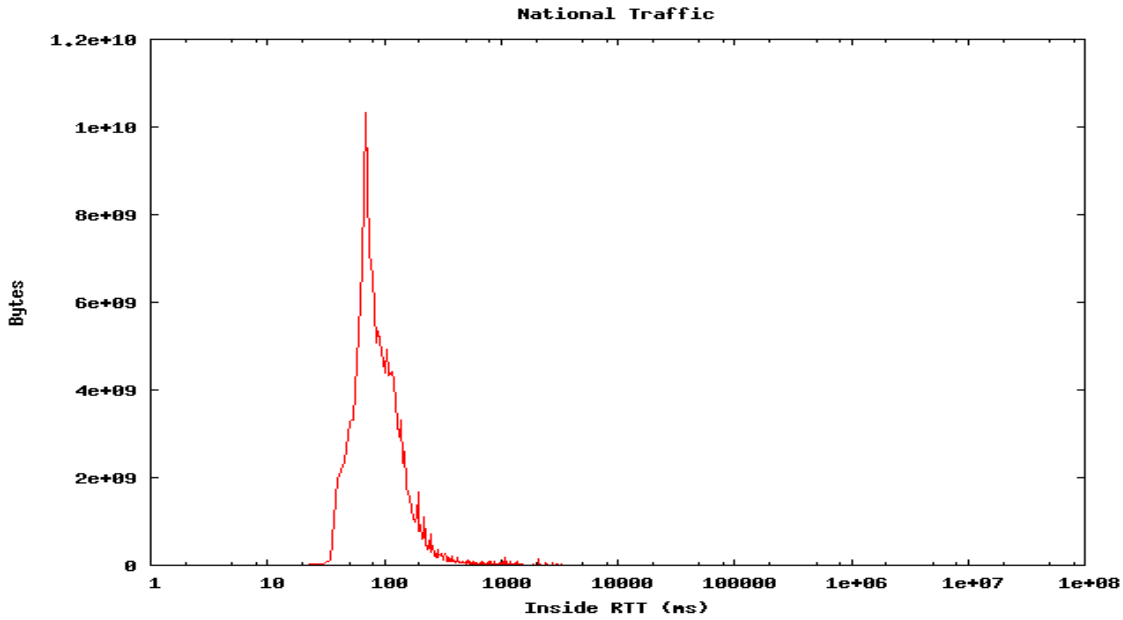


*Figure 17 National Traffic versus RTT (inside network)*

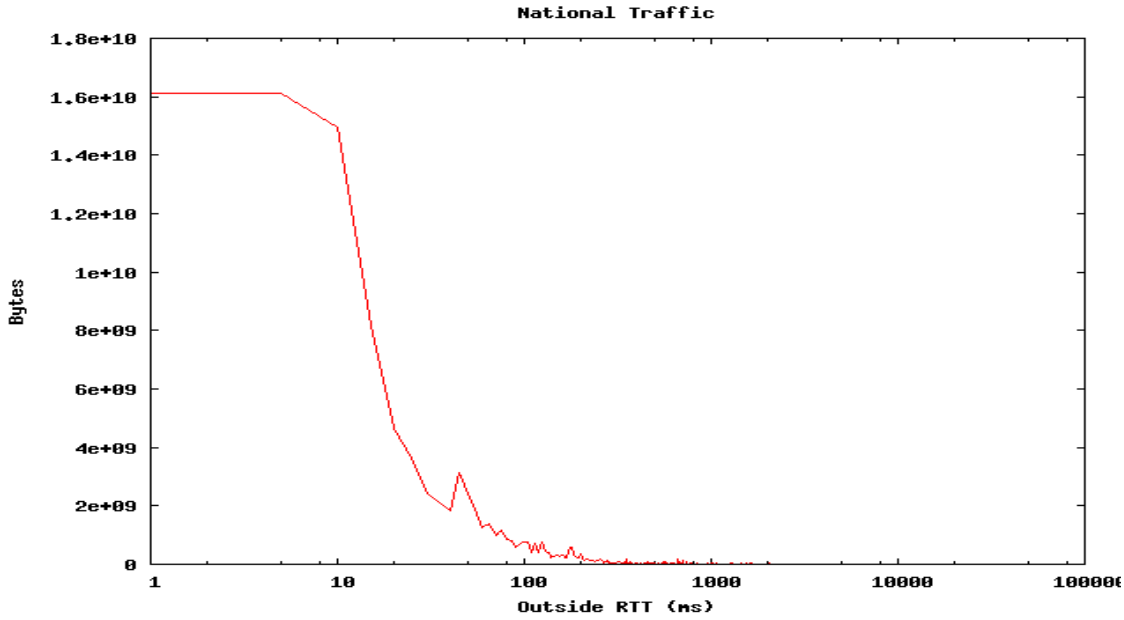


*Figure 18 National Traffic versus RTT (outside network)*

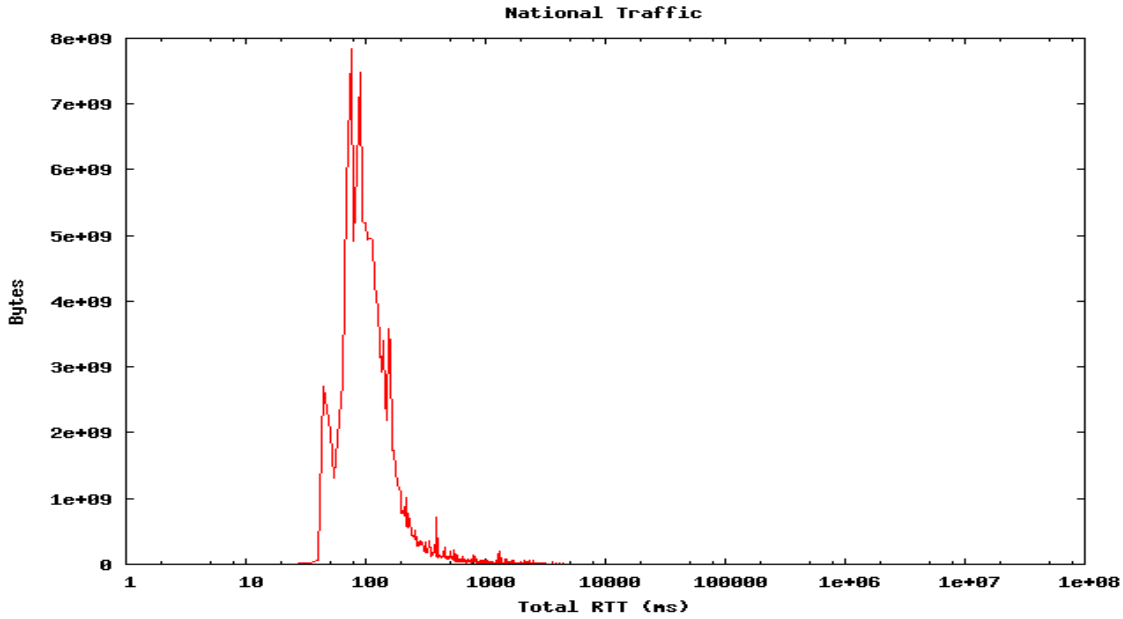


*Figure 19 National Traffic total (outside + inside)*

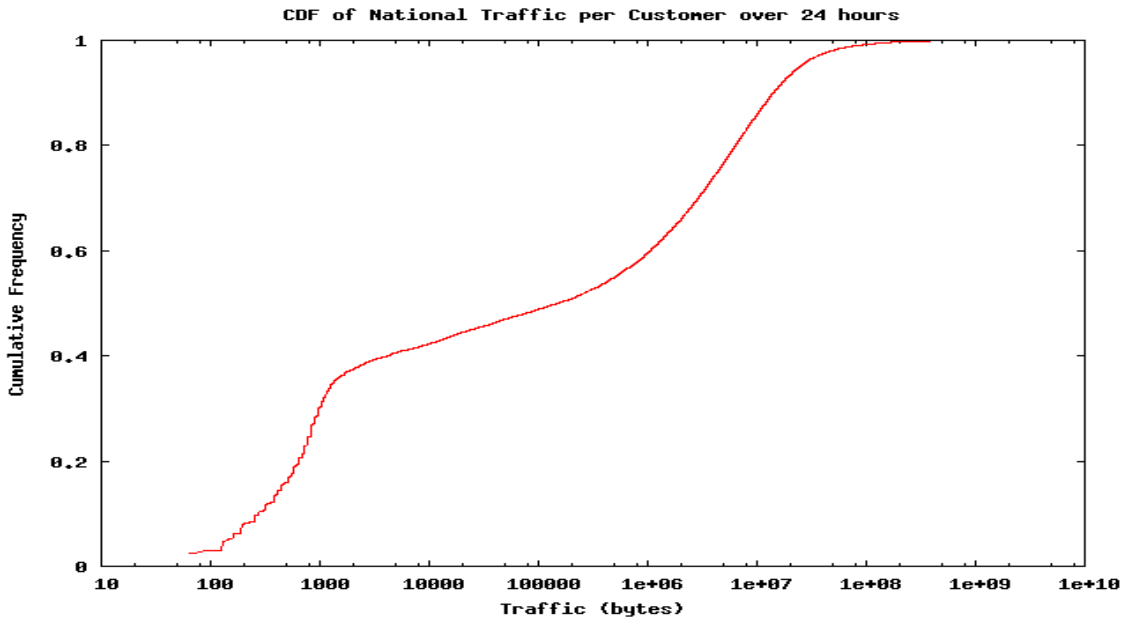


*Figure 20 National Traffic CDF*

## National Traffic Flow Analysis

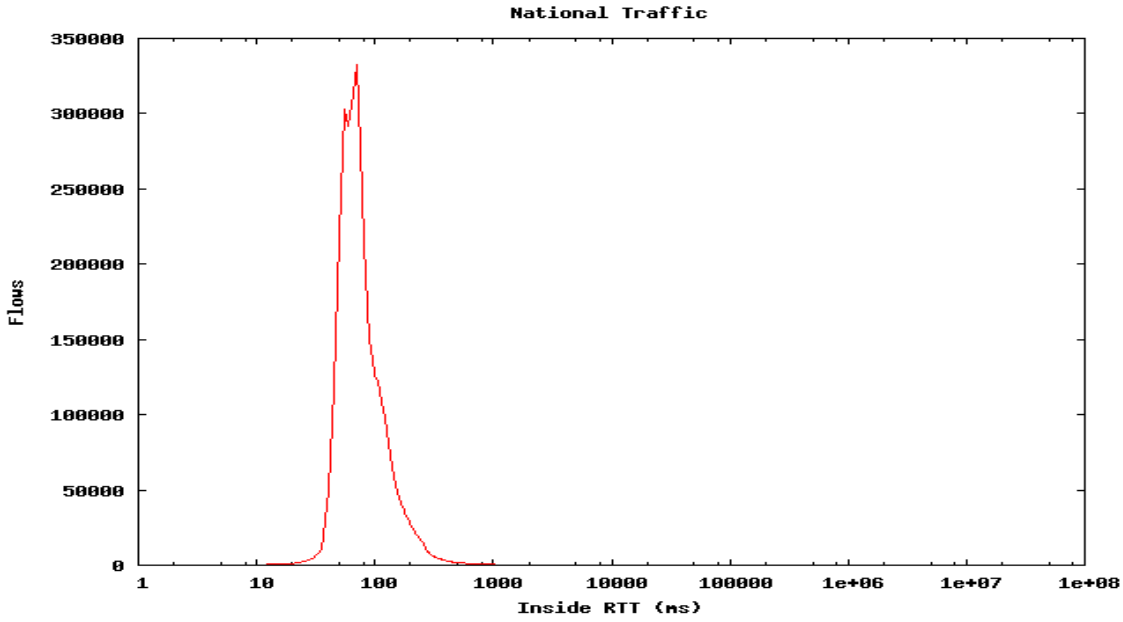


*Figure 21 National traffic flows (inside network)*

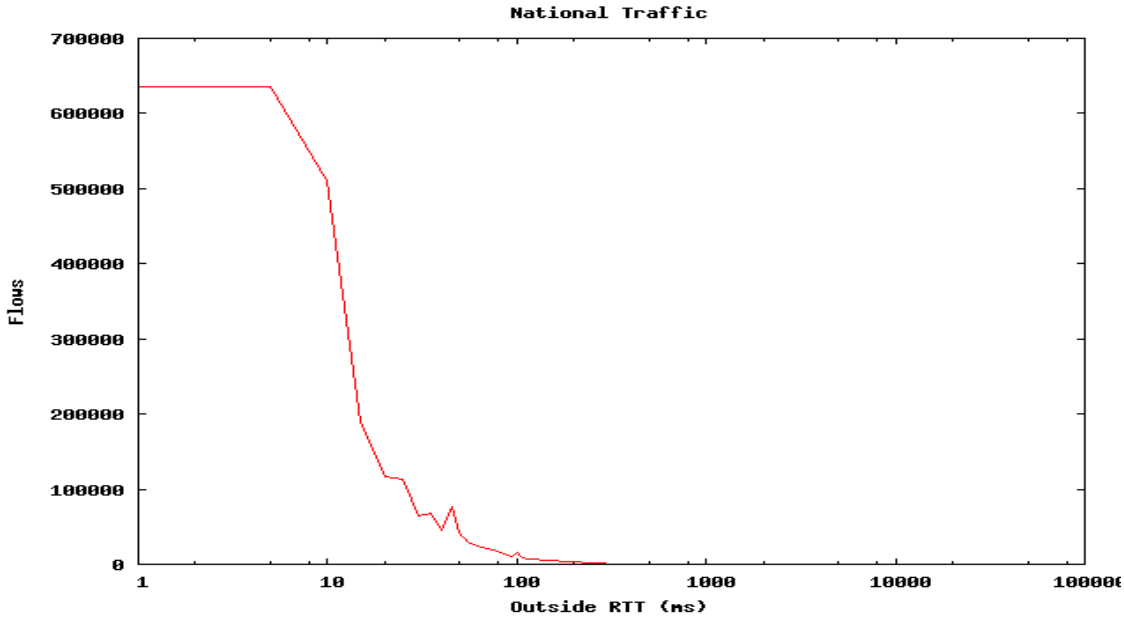


*Figure 22 National traffic flows (outside network)*

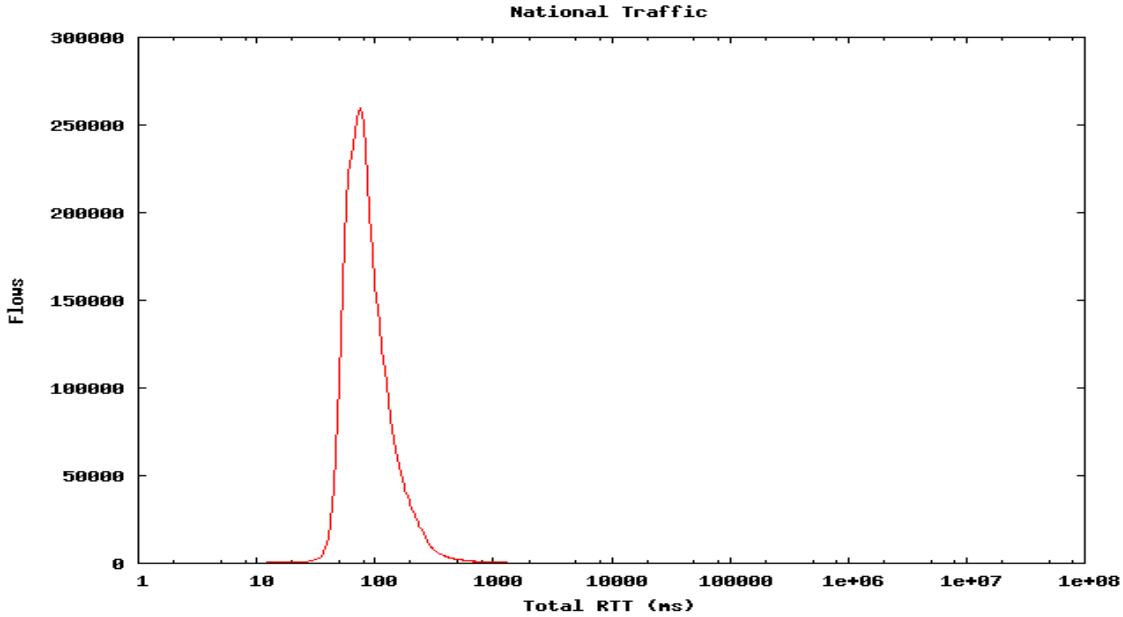


*Figure 23 Total National Flows (outside + inside)*

# Appendix D

## Traffic Growth Forecast.

A brief analysis of the trend in New Zealand broadband consumer and traffic growth is required to gain a perspective on how Internet traffic might change over the next few years. The starting point is a presentation from Telecom New Zealand which provides an estimated number of subscribers and how the number of subscribers has changed over the last few years and the amount of national and international traffic that has been seen over the last few years. The data identifies the number of business and national customers and the traffic which is normalised to the 2001 level to obfuscate real traffic levels as this data is commercially sensitive.

The forecast presented here is simple because of the limited data available and the constraints on the use of the data; we have assumed the status quo is maintained and no adverse factors affect the New Zealand economy. We have assumed that Telecom New Zealand maintains its investment in broadband – this may change with the split up of Telecom. We have also assumed sufficient large scale competition allows broadband pricing to become more aggressive and thus maintain market take-up.

Unfortunately there are a large number of factors that can positively or negatively effect broadband take-up. These include:

- A content driver that attracts or forces customers to choose broadband delivery, these include:
    - More content becomes available over the Internet at reasonable cost, such as the equivalent of iTunes,
    - Availability of standard and HD video content over broadband (and equipment such as STB etc).
    - Consumer devices gain Internet content/TV capability, such as the BBC iPlayer or an iTunes equivalent etc.
    - Lack of agreed standards would inhibit consumer device availability and market take-up
- A positive economic outlook for New Zealand would keep broadband take-up moving forward, whereas a negative outlook may cause a slow down
- Targeted applications and business delivery through broadband provision in vertical markets could encourage business user take-up
- LLU (Local Loop Unbundling) when it happens will enable new and existing players to provide new pricing plans and better service offerings e.g. by installing new DSLAM equipment etc. This may have a number of effects:
    - Telecom believe there may be more business users attracted to cheaper broadband service offers causing an increase in the number of business users,
    - There may be new service offerings – increased speed, data caps etc. these new service offerings may cause a considerable churn in the marketplace causing bottlenecks in the provision of new services and may adversely affect new customers being connected.
- Price sensitivity – is a key factor in market take-up, especially for commodity consumers later in the market penetration.

- The Telecom Next Generation Networks may require consumers to change from PSTN technology to NGN technology in certain regions according to network upgrade requirements, which would tend to increase customer numbers more aggressively.
- The Internet has seen a number of service innovations and there are likely to be many innovations over the next three years which may attract new consumers.

The data analysis presented here is not extensive and requires a much more detailed time series analysis, and market analysis, for a more complete forecast. The data presented here is meant to emphasise the current general trends and assumes there are no significant changes causing market disruption. This forecast is not endorsed by Telecom New Zealand and is provided as indicative of where current trends may be leading and this data should not be viewed as a comprehensive assessment of the broadband market in New Zealand.

The raw data is not available and so there are errors both in terms of estimating the data and also in terms of future prediction. In this analysis we have made the following assumptions:

- It looks from data supplied that we are in a linear growth phase for broadband customers (both for business and residential customers), we can assume this will continue (if there are no major market disruptions) until we are close to around 70-80% market penetration, as a first approximation.
- The estimated error in reading graphs is about 5%, then the error in estimating the gradient = 7% approximately
- The rate of increase in residential broadband consumers is approximately 10,500 per month
- The rate of increase in business broadband customers is approximately 1,100 per month.
- National traffic increases at 4.7 normalised bandwidth units per month +/- 0.33 units, based on normalised national growth figures that appear to have been in linear growth from June 2003
- International traffic increases at 125 normalised bandwidth units per month +/- 8.75 units from February 2006 to February 2007, based on the last one years growth (prior to that there was a flat period and an earlier growth period but with a different gradient of growth during 2004-2005.
- 50/50 national/international business traffic split (from discussions with market)
- 90/10 national/international business traffic split for consumer traffic (from discussion with the market – note that the data analysed in Appendix C would indicate the split could be more like 95/5, but this is only two single days, whereas the Telecom data seen is over a number of years)

The analysis is shown in Figure 24 to Figure 27, indicating the probably increase in broadband customers, the national and international traffic growth and the percentage of national traffic we can expect on the network through to February 2010. Error bars indicate the range of the prediction. The bottom line is that with the current traffic ratios and consumer growth we are looking at more and more traffic being international in nature (Figure 27), but national traffic will increase and almost double in three years (Figure 26), assuming there is no change in current trends or market disruption.

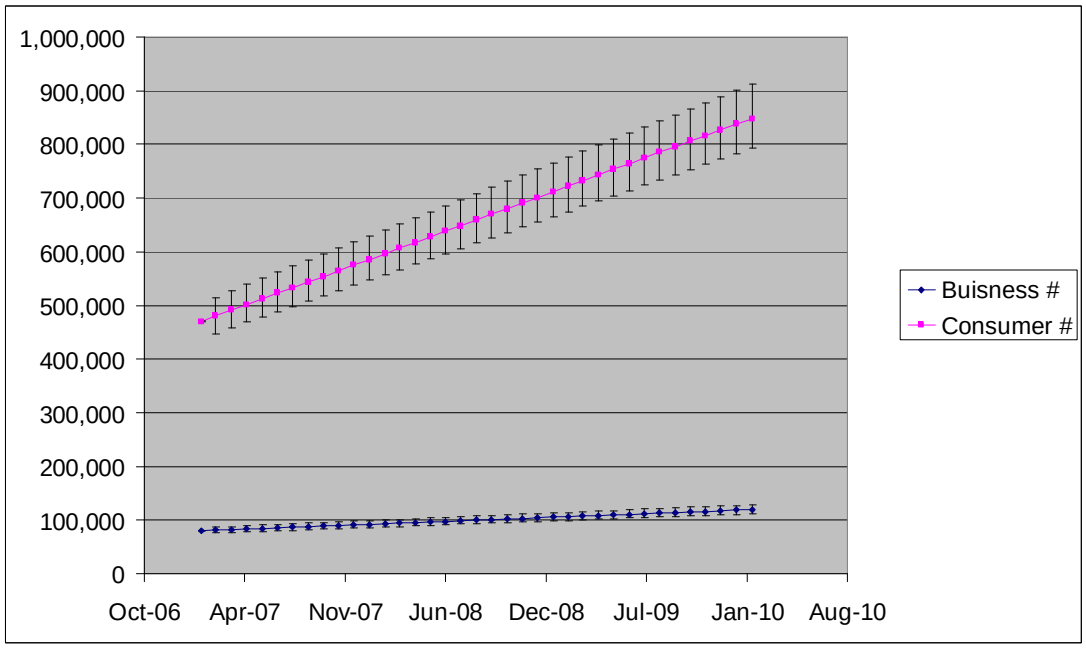


***Figure 24 Predicted growth in broadband consumers (see assumptions)***

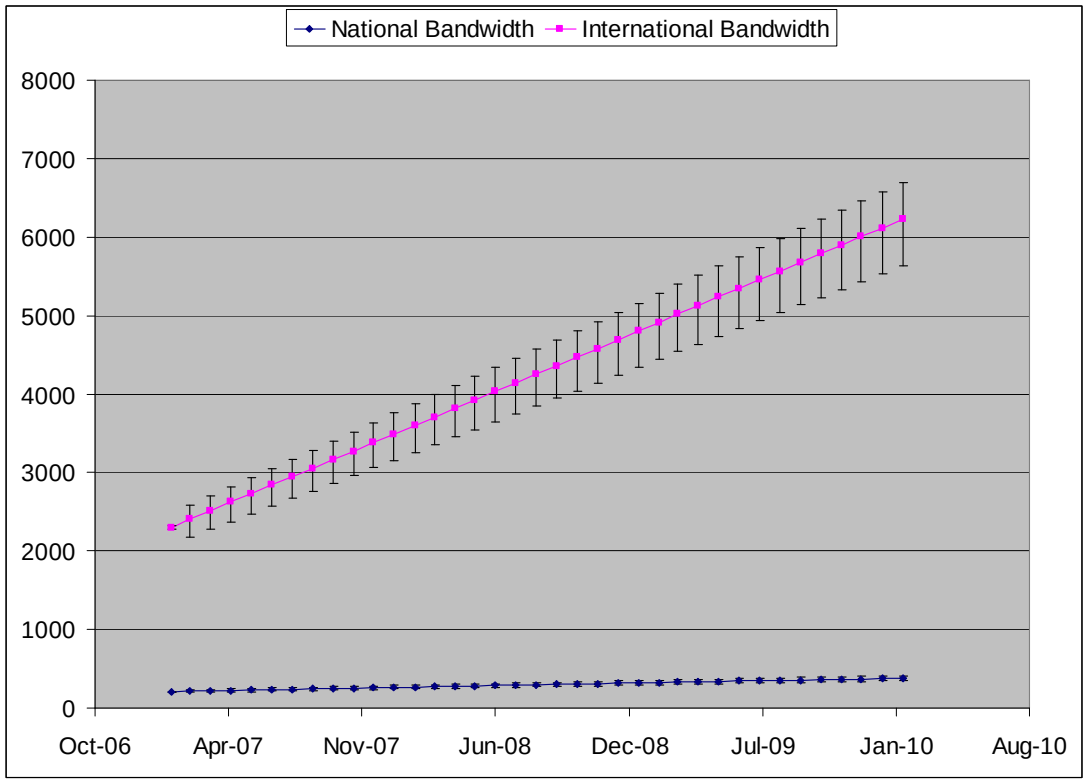


***Figure 25 Growth in national and international traffic (see assumptions, normalised to 2001 traffic levels)***

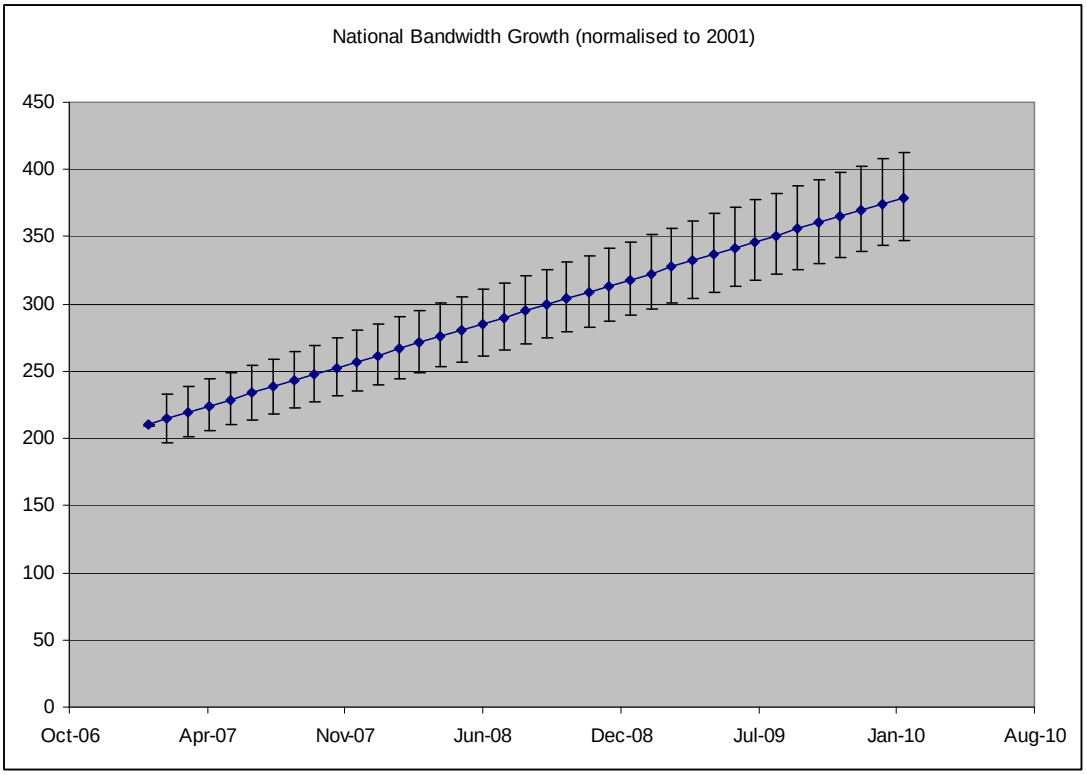


***Figure 26 Growth in national bandwidth (normalised to 2001 traffic levels)***

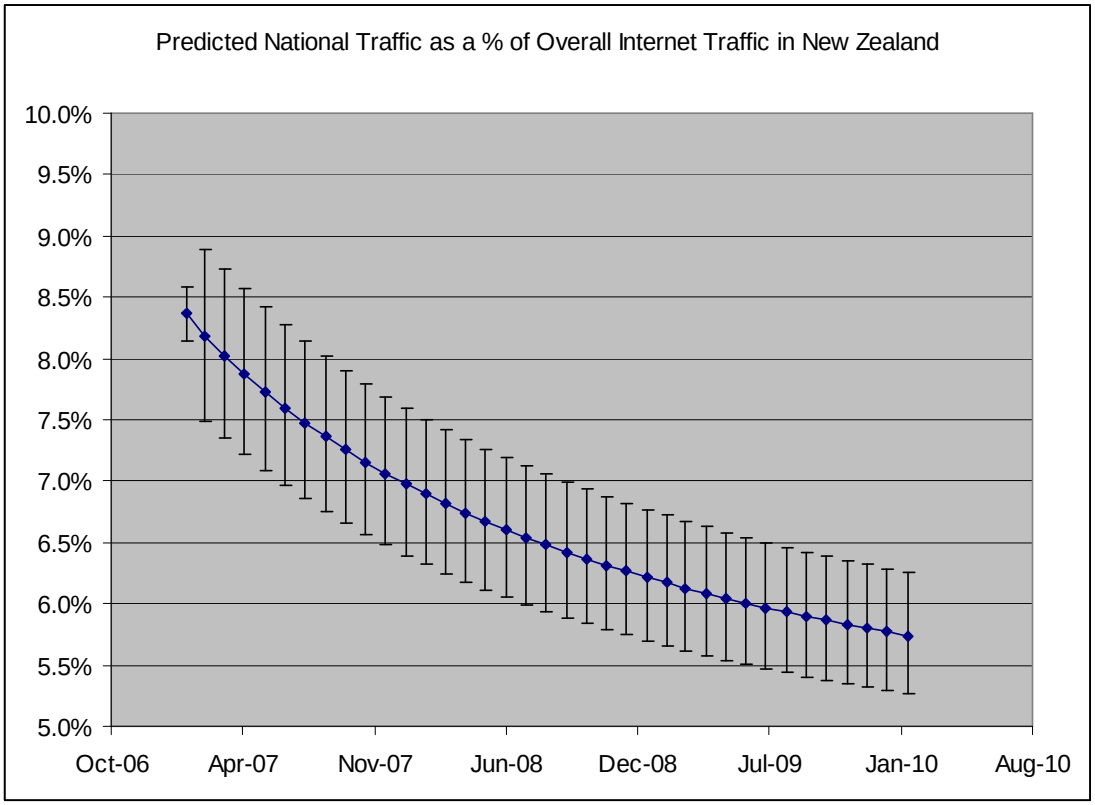


***Figure 27 Percentage of national traffic in New Zealand – the bandwidth from offshore will increase unless local content distribution is put in place***

## Appendix E

## Consultations

| CONTENT PROVIDERS | |
|---|---|
| What do you think are the issues with data interconnection and the Internet today? | **High supplier charges**<br>• There is a high cost in delivering rich content to New Zealand consumers.<br>• Transit costs too much within NZ relative to international transit - $15/MB in USA versus $150/MB in NZ. Smaller content providers who can't leverage size to gain a cost benefit have been forced to consider offshore hosting, albeit there can be other motivating factors for such a move.<br>**High consumer cost**<br>• Customers don't want too much rich media as it costs them in terms of data caps. These data caps bundle local, national and international traffic despite the lower costs of local and national. Two movies a month will break the data cap for most New Zealanders.<br>**Poor performance**<br>• Large hop counts and tromboning of content up and down NZ and potentially offshore is inefficient in the use of bandwidth and delivers poor end user performance.<br>• Content providers forced into knowledge of peering because telcos aren't ensuring proper efficiency.<br>• Resiliency must be ensured and reliability is more important than cost.<br>**Lost opportunity**<br>• Opportunity for $30M per annum in rich media advertising is being wasted due to a combination of poor broadband performance and inefficient peering.<br>• There is low uptake of broadband. Increased uptake would be aided by rich media and a better user experience through peering or local interconnection. |

| | |
|---|---|
| Who do you want to interconnect with? | **Target market**<br>• All New Zealand consumers and many international consumers.<br>**Method**<br>• Generally keen to ensure local delivery to local consumers, national delivery to national consumers and international delivery to international consumers to ensure best performance.<br>• Some want to connect to ISPs, peering exchanges or networks locally wherever practical to minimise cost and maximise performance.<br>• Others want to leave all networking and understanding of interconnect to one or more providers, but to set specific performance requirements around customer experience.<br>• TVNZ use Akamai as a distributed content delivery mechanism to remove the complexities of negotiating peering arrangement – they outsource these complexities. |

| | |
|---|---|
| What do you think is a fair price for interconnection? | **Transit cost**<br>• Generally Transit pricing within NZ is regarded as too high and should be comparable with transit pricing offshore.<br>• There appears to be some significant market power being applied by the larger Telcos to drive the transit costs so high.<br>• There is a strong need to benchmark New Zealand transit and content delivery costs with those in other comparable countries – e.g., Scandinavia.<br>• For those interested in peering they are not against paying for national interconnect.<br>**Double dipping**<br>• Telcos appear to want to clip the ticket both from consumers of content and providers of content.<br>• It appears as if nationally there are trade barriers while internationally there is a "free" market.<br>**Alternatives**<br>• Local caching for rich media is often not an option due to content licensing models. |
| How do you think interconnection should work in New Zealand? | **Local/National/International**<br>• The concept of local delivery for local content, national delivery for national content and international delivery for internal content is strongly supported.<br>**Neutral exchanges**<br>• Neutral regional "peering" points are strongly supported.<br>• APE and WIX as they are configured today are not considered to be neutral peering points as CityLink is an interested party in terms of access.<br>**Lower barriers**<br>• Those already connected to WIX and APE will continue to do so. Other providers, and in particular, smaller providers, would like to see a decrease in the cost of national transit. This would lower the barrier to entry. |

| | |
|---|---|
| What is your view on the local interconnection policies of other New Zealand Internet stakeholders? | **Telecom proposal**<br>• Telecom's local interconnection proposal sounds interesting but the devil is in the detail.<br>• The number of local interconnection points needed is of interest.<br>• Those that connect via one or more upstream providers have little interest in the detail of Telecom's proposal but are interested in the potential lower hop counts. |
| What principles should be applied by the industry for data interconnection within the Internet to achieve the best outcome for NZ? | **Local/National/International**<br>• Local to Local, National to National and international to international delivery. This will minimise the delay and cost, particularly of delivering rich media, and enable deployment of distributed delivery systems.<br>**Fair pricing**<br>• Costs for delivery of content to New Zealand consumers should be comparable to that experienced by consumers in other comparable countries. Free is not necessary but fair is.<br>• Upstream providers should provide efficient cost-effective distribution services for all sizes of content provider.<br>**Performance critical**<br>• Performance for all content and particularly rich content delivery is critical – especially resiliency, low latency and low packet loss.<br>• Hop count for rich content really does matter and needs to be covered by interconnection SLAs. |

| **INTERNET ADVERTISERS** | |
|---|---|
| What do you think are the issues with data interconnection and the Internet today? | **Inefficient traffic routing**<br>• Current national peering infrastructure and commercial agreements are resulting in inefficient traffic routing, with national-to-national traffic often "tromboning" via international circuits because of high-interconnect fees between national ISP's. This is tremendously inefficient and results in two issues:<br>• 1. Vastly increased latency of national-to-national connections where tromboning occurs. This can have very adverse effects on certain sorts of traffic, for instance streaming media, where high-latency can result in unacceptable performance for end consumers.<br>• 2. Hard to quantify until the level of tromboning is known, but one would expect this to be increasing costs. Commonly business end-users have internet connections that allow for uncapped national traffic, but user-pays charges or overage charges for international traffic. Where national-to-national traffic is tromboning internationally this will be counted as international traffic for billing purposes. Moreover, tromboning traffic must be causing artificially high traffic levels on international connections – thereby artificially increasing the "scarcity", and hence increasing the cost, of available bandwidth. |
| Who do you want to interconnect with? | • Not applicable |
| What do you think is a fair price for interconnection? | **Transit cost**<br>• In the interests of the industry as a whole, interconnection rates between ISP's should be established on an "at-cost" basis (or cost-plus small and regulated margin) that recognises the true cost of providing that interconnection service for the providers of that interconnection. |
| How do you think interconnection should work in New Zealand? | • As above. |

| | |
|---|---|
| What is your view on the local interconnection policies of other New Zealand Internet stakeholders? | • Not applicable. |
| What principles should be applied by the industry for data interconnection within the Internet to achieve the best outcome for NZ? | **Efficient peering, minimised interconnection fees**<br>• What has been adopted to date is a "scarcity" model with respect to internet connectivity in general. This has led to slow broadband uptake, high prices, and low broadband speeds in comparison to other developed countries.<br>• Interconnection clearly has the potential to create barriers to effective competition – incumbent suppliers that control national connectivity can keep interconnections artificially high, making it difficult for smaller competitors to compete on a level playing field.<br>• It is essential that national and regional peering is efficient, and interconnection fees are minimised in the interests of establishing a competitive environment. Only in such an environment will New Zealand be able to create a thriving interactive industry.<br>• Keeping interconnection fees to an absolute minimum will encourage industry growth, which in turn will provide better, higher-value opportunities than those currently offered by margins on interconnection charges. |

| | |
|---|---|
| Other | **Impact**<br>• In order to operate on the bleeding-edge with respect to interactive content, readily available, reliable, low-cost broadband is essential. New Zealand has a reputation as a provider of world-class content – in movies, music, and media and many other areas. New Zealand has the potential to develop a thriving export market in high-value, high-margin content, but it cannot do so unless it has an internet infrastructure that enables this. Creating this infrastructure is critically important given New Zealand's geographic.<br>• The Internet has already revolutionised global communications and media. It has changed the landscape for media companies such as magazine publishers, newspaper publishers, music publishers and radio broadcasters, and offered up tremendous new business opportunities. In the UK, for instance, spending on interactive advertising currently represents 11.4% of total advertising spending and is forecast to be over 20% by 2009. Estimates in New Zealand, in comparison, put interactive advertising spend at under 4% percent of total advertising spend currently (ASA Advertising Industry Turnover, 2006). |

| **CORPORATES** | |
|---|---|
| What do you think are the issues with data interconnection and the Internet today? | **No visible problems**<br>• Most of the corporates don't see any problems with data interconnection today. Any inefficiency is not visible to them.<br>**Provider deals with it**<br>• They typically host at one or two locations (often one being in Auckland) and interconnect at Auckland with one or other major Telco and any interconnection they use is whatever is provided through those arrangements.<br>• Any intra-company content delivery is carried on their own intranet via a virtual private network. |
| Who do you want to interconnect with? | **Target Market**<br>• Content delivery is typically to all New Zealand consumers.<br>**Method**<br>• They are happy to interconnect with one of the two large telcos (typically in Auckland) and leverage off their interconnection arrangements. |
| What do you think is a fair price for interconnection? | **Minor component**<br>• They believe they have a fair price for data interconnection today or are unaware of it. It is a small component of their overall volume deal with the major telcos for a wide range of services and so unlikely to receive a focus in the short term.<br>**Rich media**<br>• They acknowledge that as rich media becomes more prevalent, the costs for data interconnection may become more visible and hence they will need to be more vigilant. |
| How do you think interconnection should work in New Zealand? | **Satisfied with status quo**<br>• The corporates appear to be satisfied with current arrangements.<br>**Watching brief**<br>• However, they all expressed an interest in the outcome of the current investigation as the future use of rich media applications may change this perspective. |

| | |
|---|---|
| What is your view on the local interconnection policies of other New Zealand Internet stakeholders? | **No impact**<br>• Local interconnection would have little impact on most of the corporates under their current operational models. |
| What principles should be applied by the industry for data interconnection within the Internet to achieve the best outcome for NZ? | **Customer priority**<br>• Customer experience is the main driver.<br>• Supportive of there being economically efficient data interconnection principles for New Zealand.<br>• Reliability is important |

| **ISPS AND NETWORK PROVIDERS** | |
|---|---|
| What do you think are the issues with data interconnection and the Internet today? | **Inefficiencies**<br>• There are network inefficiencies impacting delivery performance and there is no need to trombone traffic internationally or even nationally when it can be delivered locally.<br>• Some ISPs such as CityLink are also concerned about the quality of delivery as seen by the end user which results from the tromboning of traffic both nationally and internationally.<br>**Market power**<br>• Telecom is exercising market power.<br>• Telecom does not recognise de-facto peering exchanges.<br>• Transit is expensive when local interconnect is all that is required but no issue with using transit for national data. |
| Who do you want to interconnect with? | **Target market**<br>• The ISPs want to interconnect with all New Zealand consumers, ISPs, networks, telcos, and the international Internet in the most economically efficient manner possible.<br>**Method**<br>• Interconnection with other ISPs and telcos is preferred at an established interconnect point such as WIX or APE. |

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| What do you think is a fair price for interconnection? | **International relativity**<br>• All ISPs would like to see a reduction in transit prices – a price around 10% of the typical encountered today would remove most of the commercial concerns around interconnection today.<br>**Zero-cost**<br>• Zero cost is not the focus but rather free where there is equal value.<br>• Some parties chose to connect and exchange data at zero cost. Where there is some cost to the other party for presenting data at a connection point there is some cost involved.<br>• Free local interconnect is attractive for key areas subject to definition of local. The cost of the connection should be shared equally.<br>**Fair price**<br>• A fair price for interconnection is one that represents the cost of the traffic being delivered. This will differ depending on the traffic source and destination so a single price is oversimplified. |

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| How do you think interconnection should work in New Zealand? | **Best practice**<br>• The ISPs wanted interconnection in New Zealand to be aligned to best practice for comparable countries elsewhere around the world.<br>• Would like to see interconnect happen at common points such as WIX and APE, whether multilateral or bi-lateral.<br>• Ideally would like peering as it was in 2004 with telcos multilateral at exchanges, albeit resiliency issues are important so bilateral arrangements are useful.<br>• However, happy to pay national transit for national traffic or traffic for destinations where a presence isn't worthwhile for them.<br>• The location of local connection should relate sensibly to the location of MUSH networks and small regional players.<br>• Want one Telecom meeting place only in each region, not one for LLU, one for local interconnect etc.<br>• Language needs to be defined – local data exchange, peering, transit, neutral interconnect point. |

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| What is your view on the local interconnection policies of other New Zealand Internet stakeholders? | **Telcos**<br>• TelstraClear's position is unsatisfactory. Telecom's position shows promise but certain issues would need to be ironed out.<br>• Concerns that Telecom's proposal would require the purchase of additional Telecom circuits even when circuits for LLU and UBS are already present.<br>• Would like to be able to resell transit to Telecom's local interconnect points to make it more worthwhile.<br>• Would like to be able to group-buy connection to Telecom local interconnection points where possible to reduce cost and avoid having to buy excessive capacity.<br>**Exchanges**<br>• There is general support for neutral peering points<br>• CityLink conceded that they need to change there current processes around both APE and WIX to deliver improved neutrality. |
| What principles should be applied by the industry for data interconnection within the Internet to achieve the best outcome for NZ? | **Neutrality**<br>• Peering has nothing to do with equals in terms of size.<br>• Peering is about a trade in value and can include money as part of the trade.<br>**Efficiency**<br>• Local to local, national to national, international to international.<br>**Self-regulation**<br>• A fair cost interconnection system should emerge without regulation or other government intervention<br>• A code of practice would be useful. |

| **TELCOS** | |
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| What do you think are the issues with data interconnection and the Internet today? | **Situation**<br>• Both Telecom and TCL state that there is nothing wrong with the data interconnection arrangements which exist within New Zealand today.<br>• All New Zealand consumers can access all available content, both within New Zealand and overseas.<br>• If the emergence of rich media content drives a need for changes in the current interconnection arrangements then they will respond accordingly with new commercial service offerings.<br>• There is inefficiency in core networks.<br>**History**<br>• It costs to carry data across a national backbone and this historically wasn't being covered by the price, which was often free. This was resolved by removing unbilled interconnection.<br>**Future**<br>• Enabling future services is important – recognise the benefit both to the economy and themselves.<br>• Increasingly consumers are moving traffic that can't be economically tromboned around the country.<br>• Latency will be in issue in NGN systems such as IPTV and VoIP.<br>• LLU data handoff locally will be desirable. |

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| Who do you want to interconnect with? | **Target market**<br>• Other telcos and service providers.<br>**Method**<br>• Telecom is prepared to interconnect locally at a number of points around the country. TelstraClear will continue to sell bundled national transit services.<br>• Happy to interconnect with networks of similar size, and not content providers.<br>• Telecom is proposing to connect to other network providers locally to exchange local traffic. |

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| What do you think is a fair price for interconnection? | **Cost-base**<br>• There are significant investment costs associated with the provisioning of a national data network. Telcos have therefore been keen to recoup these costs by charging a representative amount for national transit.<br>• In the case of Telecom's proposal, there is a differentiation between "local" traffic and "national" traffic, therefore recognising that it does not cost the same to deliver a packet across Wellington as it does to deliver it from Auckland to Twizel. TelstraClear on the other hand have rolled all these different delivery costs into a single business offering.<br>• A fair price is one which ensures a suitable return on investment in local, national and international infrastructure.<br>• There is no such thing as "free" peering – all peering involves an exchange of value between two mutually consenting parties.<br>**Pricing**<br>• Transit prices are driven by the market and reflect the cost of delivery of traffic to consumers located throughout New Zealand.<br>• TCL believe that a good analogy for data interconnection is the advertising market in a Newspaper – the advertisers pay rates for advertisements which relate to the consumer base being accessed via the newspaper, combined with the space required for the advertisement in the newspaper – each newspaper consumer then pays for the delivery of that newspaper to their home. |

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| How do you think interconnection should work in New Zealand? | **Status quo**<br>• Interconnection should deliver national and international content to consumers throughout New Zealand.<br>• Interconnection should be based on rational economics of scope and scale.<br>• There should be no freeloading by any party relative to any other party.<br>• Domestic transit – easiest to sell and easiest for customers.<br>**Telecom proposal**<br>• Local interconnection for "free" in Telecom's case<br>**Exchanges**<br>• Not at WIX, APE as these are not neutral and are just collections of another network's customers (e.g. a competitors customers)<br>• Over their own networks preferred (e.g. TCL, TCNZ fibre tails) but open to third-party access networks. Telecom proposes to share costs of local interconnection.<br>• Telecom open to taking a Gig-E tail to somewhere near APE for a group buy scenario |
| What is your view on the local interconnection policies of other New Zealand Internet stakeholders? | **Telecom proposal**<br>• Telecom is promoting a Local Interconnection approach at up to 29 interconnection points distributed around New Zealand.<br>• TCL does not support the Telecom proposal.<br>• TCL supports their current combined local interconnection and national interconnection approach as being the simplest way for any party to connect with their customers, both end users and downstream ISPs. |

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| What principles should be applied by the industry for data interconnection within the Internet to achieve the best outcome for NZ? | **Market driven**<br>• Data interconnection should be driven by rational economics and commercial negotiation between parties.<br>• There should be no opportunity for any party to freeload off any other party.<br>• The price of interconnection should ensure that those that invest in delivery infrastructure get a fair return off that infrastructure.<br>**Efficiency**<br>• Telecom looking to minimise inefficiencies through interconnection.<br>**Volume neutral**<br>• TCL believes that interconnection should not be volume based. |

| **GOVERNMENT** | |
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| What do you think are the issues with data interconnection and the Internet today? | **Content control**<br>• Government agencies are concerned about any New Zealand based government content that is hosted offshore as it removes many of the content controls that can be implemented onshore.<br>**Exchanges**<br>• Government would like to see much more local interconnection at neutral peering points (this is being achieved to some extent through GSN).<br>**Innovation**<br>• There is a concern whether the current cost structure of the Internet within New Zealand is leading to the stifling of innovation in terms of new content and applications. |
| Who do you want to interconnect with? | **Target market**<br>• They want to deliver information and e government applications to ALL New Zealanders, throughout the country.<br>• Government agencies have little concern about international connectivity, other than for their own internal research. |
| What do you think is a fair price for interconnection? | **Reasonable rates**<br>• Current pricing for data interconnection appears to be reasonable, as part of a total services package.<br>• Government agencies are using the GSN initiative to drive down their costs to best in market.<br>• Government agencies use their own VPNs to transport traffic to interconnection points, so any tromboning of traffic is hidden.<br>• It is recognised that the current situation does not lead to the lowest possible cost for consumers. |

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| How do you think interconnection should work in New Zealand? | **Business to consumer**<br>• Government agencies use VPN technology for business to business connectivity, with the Internet only being used for business to consumer connectivity.<br>• Government agencies don't really care how business to consumer connectivity is routed.<br>**Other**<br>• Why don't transit aggregators and interconnection operators exist in New Zealand? |
| What is your view on the local interconnection policies of other New Zealand Internet stakeholders? | **Local interconnect**<br>• In principle, local interconnection is to be preferred – whether the Telecom offer delivers to right outcome is uncertain at present. |
| What principles should be applied by the industry for data interconnection within the Internet to achieve the best outcome for NZ? | **MED represents Government policy**<br>• Individual government agencies do not represent government policy on data interconnection – this would be determined by MED.<br>**Open neutral interconnect**<br>• Open neutral interconnection is preferred with geographic distribution to keep local traffic local.<br>• Peering should be as efficient as possible to ensure that consumers experience the lowest possible costs and the best possible performance.<br>• The public good should be maximised by any interconnection principles.<br>• Any government traffic originated in NZ should remain in NZ. |

# APPENDIX F

## Multilateral Peering of ISPs at APE and WIX

(data source: ispmap.co.nz)

All ISPs in this list are reachable by domestic transit. Nearly 79% of ISPs are currently peered multilaterally at either APE or WIX. This is by simple ISP count, disregarding size and duplication by ISPs running other ISPs. It's worth nothing that a lot of the best-peered ISPs do their peering through an upstream provider such as WorldXchange, iHug or Actrix. Smaller providers tend to peer in their locality, or not at all if they're not within economic reach of an exchange.

| Name | ASN | APE | WIX | Either |
|---|---|---|---|---|
| Actrix | 9343 | 1 | 1 | 1 |
| Airnet NZ | 9876 | 0 | 0 | 0 |
| BayCity NZ (Farmcity) | 10026 | 0 | 0 | 0 |
| CallPlus | 9790 | 1 | 1 | 1 |
| ClearNet | 4768 | 0 | 0 | 0 |
| Compass | 9245 | 1 | 0 | 1 |
| Contact Internet | 4770 | 1 | 1 | 1 |
| DMZ Global | 17649 | 0 | 1 | 1 |
| DTS | 9343 | 0 | 1 | 1 |
| EnterNet (EOL) | 4768 | 0 | 0 | 0 |
| FX Networks | 9503 | 1 | 1 | 1 |
| Helix Wireless | 24025 | 1 | 1 | 1 |
| ICONZ | 4770 | 1 | 1 | 1 |
| iGRIN | 17746 | 1 | 0 | 1 |
| iHug | 7657 | 1 | 1 | 1 |
| Inspire | 17705 | 1 | 1 | 1 |
| Internet Hawkes Bay | 24005 | 1 | 1 | 1 |
| KC Internetworks | 10200 | 1 | 0 | 1 |
| Kiwi OnLine | 17746 | 1 | 0 | 1 |
| Kordia (BCL) | 24324 | 1 | 0 | 1 |
| LinuxNet | 18119 | 1 | 1 | 1 |
| MaxNet | 9889 | 1 | 0 | 1 |
| NetSpeed | 23655 | 1 | 1 | 1 |
| NZNet | 9303 | 1 | 0 | 1 |
| NZWireless | 24111 | 1 | 1 | 1 |
| Orcon | 17746 | 1 | 0 | 1 |
| Packing Shed | 17746 | 1 | 0 | 1 |
| Paradise | 9345 | 0 | 0 | 0 |
| PCNet | 4648 | 0 | 0 | 0 |
| Plain Communications | 9559 | 0 | 0 | 0 |
| PowerLink | 4770 | 1 | 1 | 1 |
| Quicker Net | 7657 | 1 | 1 | 1 |
| Quicksilver | 9727 | 1 | 0 | 1 |
| Raider | 9872 | 1 | 1 | 1 |
| SafeNZ | 24005 | 1 | 1 | 1 |
| Satlan | 9303 | 1 | 0 | 1 |
| Slingshot | 9790 | 1 | 1 | 1 |
| Snap | 23655 | 0 | 1 | 1 |
| South Net | 9303 | 1 | 0 | 1 |
| Tasman Solutions | 24382 | 0 | 0 | 0 |
| TelstraClear | 4768 | 0 | 0 | 0 |
| the Pacific | 24382 | 0 | 0 | 0 |
| Ubernet | 24324 | 1 | 0 | 1 |

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|---|---|---|---|---|
| UnixCo | 24466 | 1 | 0 | 1 |
| Watchdog Corp | 9889 | 1 | 0 | 1 |
| Web World | 17746 | 1 | 0 | 1 |
| WebNet | 7657 | 1 | 1 | 1 |
| WISE Net | 17746 | 1 | 1 | 1 |
| Woosh | 17412 | 1 | 1 | 1 |
| World Xchange | 17435 | 1 | 1 | 1 |
| Xtra | 9325 | 0 | 0 | 0 |
| Xtreme | 18400 | 0 | 1 | 1 |
| Total count | 52 | 37 | 25 | 41 |
| % | **100** | **71.15** | **48.08** | **78.85** |

**REPORT ENDS**