ihug and CallPlus

TECHNICAL EXPERT REPORT ON ADSL TRANSMISSION OVER COPPER

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ABSTRACT: ihug and CallPlus has sought a determination from the Commerce Commission in relation to access to a Bitstream service from Telecom NZ. GQ-AAS has been commissioned to provide an expert report in support of that service.

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1. INTRODUCTION

On the 10th March 2006, ihug Ltd and CallPlus Ltd ("ihug" used throughout the document to mean both applicants) filed with the Commerce Commission an application for determination in relation to access to, and interconnection with Telecom's fixed PDN for the delivery of an Unregulated Bitstream Service (UBS).

ihug already has an agreement with Telecom for wholesale supply of some variants of commercial UBS, however ihug would like to obtain UBS on a regulated basis where the download speeds are not constrained to a maximum of 3.5 Mbit/s. ihug has attempted on a number of occasions to reach agreement with Telecom for the supply of this UBS without success.

On the 20th December the Commerce Commission made a determination in favour of Telstra Clear Limited which resulted in the supply of full rate UBS by Telecom. ihug considers that this determination has set a precedent and would like to acquire the same service on the same or similar wholesale basis.

On 12 April Telecom made a submission to the Commerce Commission which argued that it should not be required to supply UBS to ihug for a number of reasons.

ihug is responding to Telecom's claims and has sought expert opinion from Gibson Quai – AAS Pty Ltd (Gibson Quai – AAS) in relation to the technical matters that surround the supply of the UBS. In particular ihug has sought comment on thoes matters which have been raised by Telecom in their submission to the Commerce Commission and what is happening in other jurisdictions in relation to the supply of this service.

The following sections of this report provide our comments in relation to those matters where comment has been sought in order to assist with advice on the New Zealand external plant environment from AAS New Zealand.

2. NETWORK DEPLOYMENT RULES FOR ULLS IN AUSTRALIA

2.1 INTRODUCTION

In July 1999 the Australian Competition and Consumer Commission (ACCC) released its report titled "Declaration of Local Telecommunications Services". This report followed an extensive investigation into the feasibility and impact of the declaration of an unconditioned local loop service, local PSTN originating and terminating services, and a local carriage service.

The unconditioned local loop enables service providers (access seekers) to connect their own networks to communications wires (normally copper) which have no line conditioning equipment connected, and then connect the end users to a point on the access provider's network. In effect, this declared service enables access seekers to use the existing Telstra cable network to provide high speed data services to their customers via Asynchronous Digital Subscriber Line (ADSL) technology.

The deployment of ADSL services in Australia over copper cable pairs requires proper management because of the potential of electromagnetic induction of unwanted signals into adjacent cable pairs. This may be detrimental because this induction of signals could interfere with or otherwise degrade the performance of transmission services on other cable pairs within the same cable sheath as the ULLS.

The declaration process involved considerable industry consultation on the matter of induced electromagnetic interference and the ACCC formed the view that it would be necessary to put in place technical and network management rules (codes) to deal with this matter and to ensure that the interests of all users of the cable access network are protected. In Section 10.3 of the declaration,[1] the ACCC acknowledged the work that had already been started by The Australian Communications Industry Forum (ACIF) to develop these rules and encouraged the industry to proceed with the development of these rules to ensure the protection of the network integrity, and health and safety.[2]

> ACIF was established in 1997 to develop and administer industry technical and operational arrangements that promote both the long-term interests of end users and the efficiency and international competitiveness of the Australian communications industry.

In 2001, the ACIF High Capacity Local Loop (Copper) Working Committee developed and released the original version of the code[3] to deal with amongst other things the deployment of ADSL technologies on the local loop in Australia.

Subsequent to the release of this code there have been a number of revisions and updates to the original version of this Industry Code because, prior to its development, there were no regulatory arrangements that defined performance requirements for the operation of systems using the ULLS.[4]

In 2005, ACIF released their latest code [*ACIF C559:2005 Unconditioned Local Loop Service (ULLS) – Network Deployment Rules Industry Code*] which is currently used

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[1] Australian Competition & Consumer Commission “Declaration of local telecommunications services” July 1999.

[2] Section 10.3.4 Australian Competition & Consumer Commission “Declaration of local telecommunications services” July 1999.

[3] ACIF C559:2001 Unconditioned Local loop Service (ULLS) – Network Deployment Rules Industry Code.

[4] The Working Committee members who developed the original version of this Code (*ACIFC559:2001Unconditioned Local Loop Service (ULLS) – Network Deployment Rules Industry Code*) made a number of compromises in reaching agreement on the performance requirements in the Code, Deployment Classes and Deployment Rules. At the time the Working Committee recommended that industry members review this Code within 12 months of the original publication of this Code in light of field experience and emerging standards.

A review of ACIF C559:2001 commenced in 2002 and resulted in ACIF C559:2003 Unconditioned Local Loop Service (ULLS) – Network Deployment Rules Industry Code. This Code addressed some known editorial oversights in ACIF C559:2001 and updated the content of ACIF C559:2001 that had been based on prepublication versions of international recommendations to align with published recommendations.

by both access seekers and access providers in Australia to regulate and manage the deployment of ADSL services over the existing copper cables.

> The code consists of three parts:
> - ULLS Performance Requirements.
>
> This Part sets out the performance requirements for the operation of systems using ULLS.
> - Spectral Compatibility Determination Process.
>
> This Part sets out the process for determining spectral compatibility of systems using ULLS.
> - Requirements for Deployment Class Systems.
>
> This third part sets out Deployment Classes and associated Deployment Rules that, if complied with, ensures a party to this code meets the obligations in Part 1.

2.2 THE AUSTRALIAN EXPERIENCE.

One of the objects of the *Telecommunications Act 1997 (Commonwealth)* is that telecommunications is regulated in a manner that promotes the greatest practicable use of industry self regulation and does not impose undue financial and administrative burdens on industry participants. The Act provides that bodies and associations that represent sections of the telecommunications industry may develop Industry Codes. The lack of specific industry accepted performance requirements for the operation of systems using the ULLS means that the industry risks uncertainty and inconsistency in the development of the unconditioned local loop service. The lack of performance requirements governing network deployment and compatibility requirements would cause significant detriment for all users of telecommunications services, not only users of the unbundled local loop service, due to the increased likelihood of interference and incompatibility.

2.2.1 What the Code is Intended to Accomplish

The ACIF Network Deployment Rules set out the performance requirements and deployment rules for operation of systems using the ULLS. This is intended to minimise the risk of interference between systems using separate ULLSs and to ensure network integrity. It will promote consistency and transparency in the operation of systems using the ULLS. It will assure end users, industry participants, regulators and government that the networks and services of carriers and service providers are being deployed in accordance with acceptable levels of network and service quality and integrity. This results in greater confidence in the overall performance of services using the ULLS than would be the case without the Industry Code.

2.2.2 Anticipated Benefits to Consumers

The operation of systems using the ULLS without this Industry Code would have occurred in a more ad hoc and less coordinated manner. This would have led to inefficient and ineffective utilisation of access networks for such services.

This Industry Code provides a coordinated approach for operation of systems using the ULLS, which will ensure more predictable and reliable performance of services, especially higher speed services. This should result in a lower average cost to supply the services.

2.2.3 Anticipated Benefits to Industry

The anticipated benefits to industry are expected to include economic growth for the industry. This Code will also assist in the efficient, equitable and responsive delivery of the ULLS to service providers, and by clearly defining performance requirements and deployment standards, the Code will encourage market participation by all sectors of the telecommunications industry.

An example of a benefit to industry is the reduced risk of interference between systems deployed on the ULLS when deployed in accordance with this Industry Code. This reduction in interference and related faults through the application of codes will reduce the incidence of faults and consequential cost associated with the delivery of the service.

2.3 PRACTICAL APPLICATION OF THE ACIF NETWORK DEPLOYMENT RULES

As indicated previously, there are three fundamental ways that access seekers can obtain ADSL broadband services over the Telstra copper access network for use by their clients. These are discussed below.

2.3.1 Wholesale broadband service

The wholesale broadband service is a service which is purchased from Telstra where Telstra takes responsibility for the provision of all equipment in the exchange and in some cases the customer's premises. In many respects, this service is equivalent to the Unconstrained Bitstream Service in the New Zealand environment.

When an access seeker requires a wholesale service, they will request the service from Telstra who will then check availability of cable pairs from the exchange to the customer's premises. In many cases the cable pairs will already be in place with a telephone service connected. Telstra will apply the ACIF Network Deployment Rules to the cable pairs to determine if they will be satisfactory. Telstra will normally find that the proposed service will either meet or not meet the ACIF rules at the proposed ADSL data rate. We are advised that sometimes the proposed service can be delivered over the available cable pairs but at a reduced data rate in which case Telstra will offer the service to the access seeker but at a reduced rate.

2.3.2 Unconditioned Local Loop Service (ULLS)

This service effectively means that Telstra provides full access to the copper pair from the customer's premises to the exchange. This will normally occur when the access seeker proposes to provide both the fixed line telephone service and an ADSL broadband service. It is common for an access seekers to initially provide wholesale ADSL services to their customers and when the number of customers reaches an economical number then the access seeker will convert these services to ULLS install a DSLAM in the exchange to and provide backhaul of one type or another to the access seekers network.

We are advised that when an access seeker applies to Telstra for a ULLS then Telstra will go through the same process as described above to determine if the cable pairs will be suitable for use with ADSL technology. In this case Telstra will apply the ACIF Network Deployment Rules and provide a go or no go answer. If the cable pairs are found to be satisfactory for use with ADSL then our experience is that most access seekers will make available to their customers the full 8mbps bandwidth if ADSL1 is used, 12mbp/s if ADSL2 is used and 24Mbps if ADSL2+ is used. We are however advised that sometimes ADSL2+ will experience drop outs and it may be necessary to wind the data rates back to make the service more reliable.

2.3.3 Line Sharing Service (LSS)

The LSS is effectively the same as ULLS except Telstra will retain the telephone service. This is possible because the telephone service requires the use of the lower transmission frequencies in the cable pair whilst the ADSL service uses the higher frequencies. The use of filters at the customer premises and in the DSLAM enables these services to be split at the telephone exchange. Telstra applies a similar process to that described above for assessing the suitability of the cable pair for LSS. We also understand that access seekers use the LSS in the same way as ULLS in providing broadband services to their customers.

3. DEPLOYMENT OF ADSL IN OTHER COUNTRIES.

In recent years there has been widespread deployment of unrestrained ADSL in a substantial number of developed countries throughout the world. This section examines how some other comparable countries have dealt with the deployment of ADSL and the management of spectral interference within the copper access network.

One of the fundamental commonalities which seems to emerge when considering the successful deployment of ADSL in other countries, is that they all have in place standards or masking specifications which set the rules and guide the deployment of the services. Hence this section also comments on the standards that have been used.

3.1 UNITED STATES / CANADA

The United States and Canada each have their own spectrum management plan. However, these two neighbouring countries share similar design elements in their external plant.

The existing infrastructure consists of a mixture of several different cable gauges, in bundles within the cable sheaths. On average, the distribution of twisted pair copper is made up of approximately 60% 0.4mm diameter conductor, and 40% 0.5mm diameter conductor.

Modern cables uses polyethylene insulation in most cases, however, there are older cable deployments where paper insulated cable still exists. The pairs are twisted with typical twist lengths of approximately 100mm and bundled in groups of 10. The bundles are further grouped into cables consisting of 5 of the 10 pair bundles, bringing the total to 50 pairs per cable.

The spectrum management plan for the United States is documented in the ANSI standard T1.417-2003 and is titled *"Spectrum Management for Loop Transmission Systems*".[5] The following abstract has been reproduced from this standard.

"This standard provides spectrum management requirements and recommendations for the administration of services and technologies that use metallic subscriber loop cables.

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[5] ANSI Standard T1.417-2003 "Spectrum Management for Loop Transmission Systems" released in 2003.

In order to achieve spectral compatibility, the ingress energy that transfers into a loop pair, from services and transmission system technologies on other pairs in the same cable, must not cause an unacceptable degradation of performance.

In addition, the egress energy from a particular loop pair must not transfer into other pairs in a manner that causes an unacceptable degradation in the performance of services and technologies on those pairs."

The standard describes 3 different service classes and addresses signal power limits, including maximum PSD and maximum total transmit power; deployment requirements, including maximum deployed loop length; and electrical interface requirements covering longitudinal balance and longitudinal output voltage limits for each of thoes classes.

All network providers in the United States are required to comply with this ANSI standard.

Although based on the United States spectrum management plan and covering a similar range of specifications, Canada has developed its own regulations titled CS-03, *"Compliance Specification for Terminal Equipment, Terminal Systems, Network Protection Devices, Connection Arrangements and Hearing Aids Compatibility".*[6]

The regulation was developed by TAPAC and issued by Industry Canada. CS-03 defines the mandatory Canadian network protection regulations as part of the country's Spectrum Management and Telecommunications Policy. The following abstract has been reproduced from the standard.

"This Specification, which is divided into eight parts, sets forth the minimum technical requirements for the registration of terminal equipment, terminal systems, network protection devices and associated connection arrangements.

These technical requirements are intended to protect the public switched network from harm. Conformance to these technical requirements will not assure compatibility with wireline carrier services."

Part VIII of the specification contains information directly relating to the Network Protection Requirements for xDSL equipment. This section covers the requirements for Transmitted Spectral Response, Total Signal Power, Transverse Balance and Longitudinal Output Voltage.

Canadian ISPs are not constrained, however many do not offer the full 8Mbit connections due to the market penetration of the much faster cable based internet. There are a multitude of providers however, such as Magma Communications that offer speeds of between 6Mbit and 7Mbit downlink and up to 1Mbit uplink for G.DMT.

ISP's in the US are in a similar situation as Canada and many ISPs such as Covad and Earthlink offer 6Mbit downlink and 768kb uplink.

[6] Industry Canada Regulation CS-03, "Compliance Specification for Terminal Equipment, Terminal Systems, Network Protection Devices, Connection Arrangements and Hearing Aids Compatibility", dated 2006.

3.2 UNITED KINGDOM

The United Kingdom (UK) has a similar external plant cabling to that found in the US, Canada and Australia. Older cables were made up from 0.4mm diameter copper conductors whilst newer deployments use 0.5mm diameter copper conductors.

The current Spectrum Management system operating in the UK was developed in cooperation with the NICC DSL task group and is called the "Access Network Frequency Plan"[7] (ANFP).

The system is applicable to the whole of British Telecom's access network that is provided over unscreened twisted metallic pairs. The following paragraph is reproduced from the scope of the document and gives insight to the purpose of the ANFP.

"To ensure the prevention of undue interference between transmission systems used on different metallic pairs in the same access cable, transmission systems (whether provided by BT, OLO or customer) connected to metallic pairs of the BT access network need to conform to this specification."

The Access Network Frequency Plan for the UK has been developed around the following principals:

1. *The management of the plan will be through the use of hard Power Spectrum Density (PSD) masks.*
2. *Each interface with access into the cable plant will have a PSD mask defined for it.*
3. *The mask will apply to all equipment connected to the cable plant irrespective of modem type.*
4. *The PSD mask will define the limit for power transmitted (or leaked) into the cable plant.*
5. *At each frequency, the PSD of the transmitter must be at or lower than the permitted PSD mask limit.*

ISP's in the UK are offering unconstrained speeds using ADSL2+ of up to 24Mbit downlink and 1.3Mbit uplink. ISP's offering these speeds include BE and BT. In France, Free (Iliad Group) and Neuf (LDCom group) among others offer up to 20Mbit downlink.

3.3 HONG KONG

There is currently no official specification for Spectrum Management in Hong Kong, however, a study conducted by the Telecommunications Standards Advisory Committee, TSAC Paper No. 24/2001 titled *"Report on Testing of Broadband Interference in Local Access Link – Short Loop condition"[8],* found that any of the comparable reference models adopted by the ITU, ANSI, ACIF and ANFP would be suitable for the Hong Kong network.

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[7] OFTEL Regulation OTR004:2000, "OFTEL Technical Requirement Issue 1", dated September 2000

[8] TSAC Paper No. 24/2001, Telecommunications Standards Advisory Committee, "Report on Testing of Broadband Interference in Local Access Link – Short-Loop Condition", dated September 2001

The study was undertaken in order to examine the interference issues associated with the interconnection of broadband equipment over local access links using twisted metallic pairs. It primarily involved carrying out field tests in order to verify the spectral compatibility of different broadband technologies.

Tests were carried out over two pieces of cable connected in series to imitate a typical external plant feed to a customer. The first cable section consisted of approximately 1.3km of 0.32mm diameter copper cable and the second section of the cable was approximately 220m of 0.4mm diameter copper cable.[9]

The following paragraphs in italics have been extracted and reproduced from the TSAC report because the findings of the Telecommunications Standards Advisory Committee illustrate the suitability of the application of any one of the existing ACIF, ANSI or ANFP regulations to the Hong Kong network, despite the differences in physical infrastructure.[10]

"In summary, the results measured on the LAL cable indicate that the background noise level and insertion loss versus frequency characteristics of the cables in Hong Kong are generally in line with overseas published models. The Near End Crosstalk (NEXT) in the local cable environment is not different from that overseas either, while direct comparison cannot be drawn for Far End Crosstalk (FEXT) due to unavailability of applicable model. As for equipment performance under broadband interference, ADSL systems (including G.992.2, G.992.1 and CAP-based) demonstrated reasonable performances in terms of achievable data throughput, when compared to overseas benchmark."

"Regarding the LAL characteristics, all test results measurable and comparable to reference models adopted by ITU, ANSI and ACIF suggest that there are no distinctive features of the LAL of PCCW-HKT, compared with other countries, which would likely exacerbate the interference problem. The relevant overseas standards or models should therefore be generally applicable in Hong Kong, despite some differences in the local environment in terms of the weather, line density and cable used."

For equipment performance under broadband interference, the tested DSL technologies that comply with the Oftel ANFP under short-loop condition have been verified to be capable of achieving reasonable performance under various interfered scenarios as simulated in the test cases, except HDSL and ISDN BRI which need further evaluation.

"The test results suggest that the relevant cable characteristics of LAL in Hong Kong are generally comparable to those reference models adopted by ITU and other standardization bodies. There are no evidences suggesting inconsistency between the local LAL characteristics and cable models published overseas. It implies that spectrum management standards adopted overseas, including the Oftel ANFP

[9] The study noted that the ANSI T1.417 standard defines deployment guidelines in terms of equivalent working lengths, in order to provide equivalence between the length of a multi-gauge loop and that of a straight 0.405mm gauge.

[10] TSAC Paper No. 24/2001, Telecommunications Standards Advisory Committee, "Report on Testing of Broadband Interference in Local Access Link – Short-Loop Condition", dated September 2001

specification, may well be applied to the local environment. The test results of equipment performance in the short-loop condition further substantiate the spectral compatibility of those technologies that comply with the Oftel ANFP specification and intended for deployment in the local short loops."

"Under the worst interference condition of the tested short loop (i.e. maximum disturber-filled as simulated by the test cases), all ADSL systems (including G.992.2, G.992.1 and CAP-based) demonstrated reasonable performances in terms of achievable data throughput, when compared to overseas benchmark."

3.4 OTHER COUNTRIES' SPECTRUM MANAGEMENT

By 2002, NZ was one of only seven OECD countries that had not implemented a full Unbundled Local Loop policy. This is significant because In order to provide full local loop unbundling, a suitable spectrum management plan must also be implemented.

The European Commission produced a report in September 2001 outlying the need for technical coordination during the process of Local Loop Unbundling. This report deals with amongst other things the requirement of the implementation of spectrum management policies coinciding with the ULL policies of OECD countries, including France and Germany.

Consistent with the European Commission's report, the French regulatory body known as ART (Autorité de Régulation des Télécommunications), produced a decree in September 2000 mandating the usage of their unbundled local loop. A related ART document states the following regarding the scope of the decree.[11]

"To reduce interference on the copper pairs of France Télécom's local network, the operators, including France Télécom, will have to comply with the spectrum management plan devised by the working group for the deployment of broadband services via xDSL technology. The final objective is to transmit the most data possible under the best possible conditions on the cables in general and on each copper pair in particular."[12]

A further report produced by WTPISP in 2003 in regards to ULL states the following.[13]

LLU requires operational co-ordination between the incumbent and new entrants regarding such processes as ordering, provisioning, billing, fault handling and service-level agreements. Agreement is also required in areas such as pricing, collocation and spectrum management on broadband local loops. Operational co-ordination and other agreements can be facilitated through self-regulatory frameworks or detailed intervention by regulators. The role of the regulator in arbitration remains essential.

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[11] Decree no. 2000-881, Modifying the post and telecommunications code and relating to access to the local loop, Sept 2000

[12] Recommendations from the French Telecommunications Regulatory Authority (ART) related to the Spectrum Management Plan (*Plan de Gestion du Spectre* - PGS) for the deployment of broadband services on the local loop

[13] Working Party on Telecommunication and Information Services Policies, DEVELOPMENTS IN LOCAL LOOP UNBUNDLING, Sept 2003

Other European countries that currently provide full LLU, and hence would have in place a suitable Spectrum Management Plan include: Austria, Belgium, Denmark, Finland, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, Portugal, Spain and Sweden.[14]

3.5 CONCLUSIONS

We have carried out an investigation in relation to how the United States, Canada and the UK deal with the deployment of ADSL services and spectrum management within their copper access networks. We have also reviewed a recent report by the Hong Kong Telecommunications Standards Advisory Committee which has made recommendations on how spectrum management might be handled in Hong Kong. As a result of this investigation we draw the following conclusions:

1. The copper access network cable types and configurations in the jurisdictions examined are very similar to those in Australia.

2. All countries considered use standards similar to the ACIF standards in Australia and define a spectral density mask which is applied to the management of interference in cables which could result from the deployment of ADSL equipment in the copper access network.

3. There is a high level of similarity between reference models adopted by the ITU, ANSI, ACIF and ANFP in their respective standards, and in fact, any one of the reference models would be suitable for management of interference in the Hong Kong copper access network and probably similar networks in other countries

4. EXTERNAL PLANT IN AUSTRALIA AND NEW ZEALAND

4.1 INTRODUCTION

This section discusses the external plant environment in both Australia and New Zealand with the view to assessing similarities and differences which might affect the deployment of ADSL devices over underground copper cables in both countries.

In reality the external plant environment includes a wide range of technologies including optic fibre cable, coaxial and aerial cables, pair gain equipment, Remote Integrated Multiplexers (RIM) and the large range of related hardware, pipes, pits, equipment housings and cable support systems.

However it is the characteristics of the copper cables which are used in the external plant environment have the major impact on the operation and performance of ADSL equipment and its influence on other services that might be carried by the same cables. As indicated previously, ACIF has developed a set of standards which govern the deployment of ADSL technology in the Australian environment.

[14] European Commission, OPERATIONAL IMPLICATIONS OF LOCAL LOOP UNBUNDLING AND THE NEED FOR TECHNICAL CO-ORDINATION, September 2001

4.2 Cable Characteristics

The underground copper cables typically found in PSTN environments, are either made up from pairs of insulated copper wires (twins), or 4 wires (quads), which are usually twisted together over their entire length of the cable. Historically, two twins twisted together and four twins laid in a star configuration have been used. However whilst some of these still exist, all new cables are made up from twisted pairs.

Furthermore, most cable manufactured today further twists the individual twisted pairs into groups of pairs, called units. These units may consist of 10 pairs in smaller cables, whilst larger cables can have 25, 50 or 100 pairs within a unit. The units are then twisted together, (sometimes in layers) and enclosed by the cable sheath.

The physical construction of the cable has a significant impact on mutual inductance, and hence cross talk between cable pairs. This in turn will influence the reach and speed of ADSL services deployed over the cable, as indicated by the ACIF code.

Other influencing factors include conductor diameter and insulation between the conductors.

The insulation of choice for many years was paper, however, whilst this provided a low cost solution with good dielectric properties, it did present some challenges in order to keep it dry. This is especially true when cable sheath integrity was breached. For a number of years paper has been replaced by plastic insulations including Polyethylene and cellular Polyethylene. Polyvinyl Chloride (PVC) has poor dielectric qualities but higher heat resistance and hence is often used in internal cables but seldom used in external plant.

In Australia, the copper conductor usually comes in diameters of 0.4mm, 0.64mm and 0.9mm, although, there is a smaller sized conductor (0.32mm) which is sometimes used for short runs, and a larger conductor (1.27mm) which has been used in the past for long runs in rural settings.

The insulation material will affect the dielectric properties and hence capacitance between the conductors, and the conductor diameter will have an impact on the conductor resistance and series inductance.

The combined effect of these components results in the cable exhibiting the characteristics of a low pass filter with impedance increasing as the frequency increases.

This is of particular relevance to technologies like ADSL because the modulation techniques involve the use of frequencies much higher than voice and hence, in order to achieve reasonable transmission distances, the spectral density of the transmission at the higher frequencies must be increased. This in turn increases the level of cross talk, in particular, at the higher frequencies.

As discussed, the ACIF ULLS – (Network Deployment Rules) Industry Code has considered all of these factors in particular in the Australian context, and has proposed a framework or otherwise referred to as a mask which is used to regulate the deployment of ADSL services in Australia.

4.3 AUSTRALIAN EXTERNAL PLANT ENVIRONMENT

The copper access network in Australia has traditionally been developed around the local telephone exchange, which effectively forms the hub of a cable distribution network which was designed to connect customer telephones to switching equipment in the exchange building.

This cabling system was designed to ensure that the resistive loss over the cables between the exchange and telephone was within certain limits, in order to ensure that:

There is sufficient DC transmission feed for the telephone instrument.

There is sufficient low frequency alternating current to ring the bells.

The attenuation over the voice frequency band is within acceptable limits.

The dialling impulses could be accurately reproduced by the exchange equipment.

The other requirement was to match the characteristic impedance of the line, with that of the equipment at the exchange and the customer's premises, typically in the range of 600 Ohms to 1200 Ohms.

The major influencing factors which define the distance between the exchange and the customer are the maximum allowable attenuation at DC and within the telephone operational frequency band over the interconnecting cables.

The conductor diameter has a direct impact on its DC resistance and impedance for a given conductor length.

Hence, the maximum distance between the exchange and customer is ultimately driven by the conductor diameter of available cables, which in turn, ultimately defined the maximum size of exchange catchment areas. In some rural settings it was uneconomic to create new exchange areas to connect a small number of remote customers. Therefore, it became common to insert inductive devices (loading) into the symmetric pair transmission line which altered the characteristics of the cable and extended the range.

The larger the diameter of the conductor, the further the reach, however the diameter of the conductor was also directly proportional to the cost of the cable, and so, in the interest of ensuring an optimum economic balance, it would be important to select the optimum conductor size. In other words, customers close to the exchange would be connected via small gage cables and customers at the outskirts of the exchange area would be connected by cables with large diameter conductors.

These requirements are best met by a tapered cable distribution system where the conductor size of those cables close to the exchange will be small, and as the distance from the exchange increases, the conductor size will also increase.

The following table summarises the major types of cable that are deployed in the Australian external plant environment.

Conductor Diameter	Identification code	Description
0.4mm	PIUT	Paper insulated unit twin construction
0.4 mm	PEIUT	Polyethylene insulated unit twin
0.4 mm	CPIUT	Cellular polyethylene insulated unit twin
0.4 mm	CPFUT	Cellular jelly filled polyethylene insulated unit twin
0.64 mm	PIUT	Paper insulated unit twin construction
0.64 mm	PEIUT	Polyethylene insulated unit twin
0.64 mm	CPIUT	Cellular polyethylene insulated unit twin
0.64 mm	CPFUT	Cellular jelly filled polyethylene insulated unit twin
0.9 mm	PIUT	Paper insulated unit twin construction
0.9 mm	PEIUT	Polyethylene insulated unit twin
0.9 mm	CPIUT	Cellular polyethylene insulated unit twin
0.9 mm	CPFUT	Cellular jelly filled polyethylene insulated unit twin

Table 1 Standard external cables used in Australia

The table above is not fully comprehensive as there are some aluminium conductor cables as well as other copper conductor cables with 0.32 mm and 1.27 mm diameter copper conductors in use, however they are not widely deployed.

4.3.1 Typical cable distribution

The cables that normally feed the exchange distribution areas are called Main Cables. They will normally be large capacity cables (up to 4200 pairs) with small diameter (0.32mm or 0.4mm diameter conductors). These cables will normally be jointed to MDF termination (or lead-in) cables in the MDF cable chamber or man hole immediately outside the exchange building.

These Main Cables will feed away from the exchange toward the customers, and at a suitable branching point they will be connected to a number of smaller capacity branch cables. The connection to the branch cables will normally be done in a sealed joint located in a manhole, however, sometimes where required, the connection will occur at a jumperable cross connect device called a cabinet or pillar.

The length of the main cables will of course vary depending on the geography and teledensity of the exchange distribution area. However, it will normally be less than two km. The branch cables will typically be 0.64mm diameter conductors, and will normally be connected to the distribution cables via random pair joints in order to minimise cross talk. The length of distribution cables can vary considerably, from less than a km to several km.

The Branch cables normally connect to distribution cables, which in turn, provide the connection to the customers. The connection to distribution cables is usually through a jumperable cross-connect device called a pillar. A single pillar will normally serve a maximum of 350 customers. Distribution cables typically start with a maximum capacity of 100 pairs at the pillar, and then taper in capacity as they pass customer premises and connect telephone services. These distribution cables usually consist of 0.64 mm diameter conductors. In rural or other settings where customers are located at an extended distance from the exchange, 0.90 mm diameter conductors are used. Distribution cables may range in length from 100m to 4-5km and sometimes further in rural settings.

In urban areas, the external plant for a single exchange service area will typically connect between 2000 and 20,000 customers within area of less than 8km diameter.

However in lower teledensity regions and typically in rural regions, the customer numbers in a single exchange service area may be less than 100 and the diameter of the area may be up to 20km.

4.3.2 Optic Fibre rollout

In the early 1980's, Telstra (Telecom Australia) embarked on a major program to replace the old copper trunk cables and aerial wire between exchanges with optic fibre cable and develop a national digital trunk network.

Towards the end of the 1980's, Telstra started to run optic fibre to major city buildings in order to supply services to tenants, and installed RIMs mounted in roadside cabinets in order to service new developments, and to reduce the pressure on existing main cables as older suburbs were redeveloped with higher density dwellings.

These RIM's would be connected to equipment in the local exchange by optic fibre cables, thus effectively creating pockets of active equipment within the exchange service area and reducing the opportunities for the deployment of ADSL equipment unless the RIM's were equipped with DSLAM capability.

4.4 NEW ZEALAND EXTERNAL PLANT ENVIRONMENT

Note: this section of the report has been prepared by AAS New Zealand Ltd

The list of cable types commonly found in the New Zealand outside plant network is as follows:

Conductor Diameter	Identification code	Description
0.4 mm	PCUT	Paper Covered Unit Twin
0.4 mm	PEUT	Polyethylene insulated Unit Twin
0.4 mm	CPUB	Cellular Polyethylene Unit Twin Barrier
0.4 mm	PEFUT	Polyethylene insulated Unit Filled Twin (petroleum jelly filled)
0.63 mm	PCUT	Paper Covered Unit Twin

0.63 mm	PEUT	Polyethylene insulated Unit Twin
0.63 mm	CPUB	Cellular Polyethylene Unit Twin Barrier
0.63 mm	PEFUT	Polyethylene insulated Unit Filled Twin (petroleum jelly filled)
0.9 mm	PCUT	Paper Covered Unit Twin
0.9 mm	PEUT	Polyethylene insulated Unit Twin

Table 2 Standard external cables used in New Zealand

It should be noted that the New Zealand Post Office (NZPO) also used some 0.32 mm, 0.5 mm and 1.27 mm cable. These sizes were discontinued early on (in the early eighties) and were never widely used, so we would not expect there to be large quantities of them in the network. Most of the 0.9 mm and 1.27 mm cables would have now been replaced by fibre optic cable.

The cable used in New Zealand's network has, since 1961, been manufactured locally. In that year a separate manufacturing facility (Austral Standard Cables) was established to supply telecommunications cable solely to the New Zealand Post Office (now Telecom New Zealand) as an import substitution project.

It is our understanding that the electrical characteristics and parameters of cables used in the New Zealand network are slightly different to those used in the Australian network. In Australia 0.64 mm cable is used, whereas the New Zealand equivalent is 0.63 mm. This amounts to a 3% variation in cross-sectional area.

In addition, New Zealand employed 'Random Jointing' for some time in the construction of its network, meaning that a pair could change its position in the cable at each joint. We would not expect these differences to produce wide variations to the performance of cable pairs in Australia.

4.4.1 Typical Cable Distribution

New Zealand's cable distribution network is architecturally similar to Australia's as described in paragraph 4.3.1 above. Different terminology is used, however, and this is noted in the following description.

The New Zealand suburban local access network typically consists of large pair-count copper 'feeder' cables (called '*Main Cables*' in Australia) connected from the Local Exchange (LX) to cross-connection cabinets ('*cabinets*' or '*pillars*' in Australia), with distribution cables connecting customers to the cross-connection cabinet. In New Zealand, no distinction is drawn between distribution cables and the '*Branch*' cables described in the Australian network. Customers close to exchanges are generally fed directly from the Main Distribution Frame (MDF) without a cabinet. The use of cross connection cabinets is more common in the New Zealand network than it is in Australia.

Generally, the New Zealand transmission limits dictate that the total length of copper in a local access circuit did not exceed 3.6 kilometres of 0.4 mm cable or 7 kilometres of 0.63 mm cable. We understand, however, that these limits were not always adhered to, particularly in the Auckland area.

4.4.2 Optical Fibre Cable Roll-Out

Telecom has embarked on a programme to replace all copper in its Transport network. The transport network is the network that connects telephone exchanges together. Telecom now has a national digital transport (‘*trunk*’) network

Since the late 1990s, Telecom has been serving new subdivisions in urban areas by using fibre-fed cabinets (called ‘*RIM*s’ in the Australian network, see paragraph 4.3.2), generally with shorter copper distribution cables. We understand that Telecom also has a low-key programme to convert one hundred existing copper-fed cabinets to fibre-fed per year. This level of activity is clearly too low to have any appreciable impact on the overall characteristics of Telecom’s network. Fibre feeder cables to transmission cabinets have also been used extensively in rural areas, with 0.4 mm and 0.63 mm distribution cables.

Telecom also announced in 2005 that it is embarking on a programme to replace its existing network with its IP-based Next Generation Network. This will involve the replacement of its existing exchanges with fibre fed cabinets, with only a small number (not yet specified) of network nodes located in buildings. Telecom announced that it expects to complete this process by 2012.

4.5 CONCLUSION

The cables used by Telecom New Zealand are substantially the same as those used in Australia. The only obvious difference is in the conductor diameter of the mid size cable. In Australia the conductor diameter is 0.64mm whilst in New Zealand it is 0.63mm diameter, this represents a cross sectional area difference of approximately 3%.

This very small difference in conductor size will result in minor differences in the primary parameters of the cable however the resultant difference in transmission characteristics will be so small that the ACIF standards would be entirely appropriate to apply in the New Zealand environment. We would therefore expect that there would be no appreciable difference in spectral management requirements and hence bandwidth and reach variables between New Zealand and Australia.

5. RESPONSE TO TELECOM SUBMISSION IN RELATION TO IHUG APPLICATION.

5.1 INTRODUCTION

On the 12 April 2006 Telecom New Zealand Limited (Telecom) made a submission to The Commerce Commission in relation to ihugs application for access and interconnection with Telecom’s fixed PDN service (Bitstream Access). In that submission Telecom made a number of claims and assertions which in our opinion are either incorrect, misleading or need further elaboration. The following sections deal with the primary areas of concern.

5.1.1 Signal to noise ratio

In paragraph 36, Telecom explained that it sets its target noise margin to 12dB for ADSL which it maintains is in line with international best practice. It claims that if the maximum line speed setting of a line already operating at close to the 12dB target is increased, the actual line rate achieved will not materially increase. Lines operating below the 12dB noise margin target are at risk of being unstable.

Telecom further claims that that over 40% of DSL lines are now operating close to their target performance margin, and any further significant increase in the current constrained speed of DSL lines would increase DSL power and put these lines at risk of decreasing their speed and not achieving their plan speed, or becoming unstable.

The Signal to Noise Ratio (SNR) Margin is the maximum allowable noise that may be targeted in order to maintain a specified Bit Error Rate (BER). This value is able to be configured on the DSLAM and providers may increase the SNR Margin in order to provide an improved BER, at the cost of a reduced data rate.

In theory, SNR margins of around 1dB are required for correct operation, whilst the practical minimum operation limit is around 5dB. Examination of the practices engaged by Australian ISP's would indicate that an optimal target SNR margin lies at approximately 7dB, with a desired outlying maximum SNR margin sitting at about 9dB, as any increase above this level yields little performance benefits.

Our experience is that industry standard SNR is well below the 12dB proposed by Telecom and is closer to 7dB.

In paragraph 35, Telecom has provided a chart which it claims provides actual SNR data. This chart is extremely general in its nature and is of little practical value. If it was taken into consideration that the operating limits found in Australia are within a +/- 2dB range of the optimal margin of 7dB, and then these limits were applied to Telecom's recommendation of 12dB, this chart incorrectly bundles those lines with noise margins between 14db and 18dB as being at risk. As there is no evidence displaying the spread of margins over this range, it is possible that there are few lines within the 12dB – 14dB margin.

Also, following lack of further evidence to prove otherwise, applying the optimal Australian practice of 7dB to this entire chart would make it possible to interpret that all lines tested by Telecom may be above the 7dB margin.

5.1.2 Reach and speed trade off

Telecom claim in paragraph 38 of their submission that they have adopted a bit rate limiting approach because they wished to manage the trade off between speed and reach. They also claimed that in New Zealand, a bit rate limiting approach had been used to manage spectrum in order to maximise reach. Furthermore they said that *"if a spectral comparability benchmark the same as that implemented by ACIF for the Australian market is applied the consequence would be that approximately 73,114 Telecom access lines should not be offered broadband service."* Telecom also introduce the argument in paragraph 39 that if an unconstrained service with a IP packet upstream PIR of 128kbit/s is used then the practical throughput of the downstream IP service is around 3.5Mbps.

Firstly in relation to the proposition that bit rate limiting of the downstream service would somehow reduce interference and hence preserve the integrity of the external plant so that approximately 73,114 lines would be available for future broadband services is not supported. The constraint of the downstream bit rate to 3.5 Mbit/s will hardly assist in minimising the power spectral density in the cable network for long lines because Far End Cross Talk (FEXT) which is a major contributor to the spectral density is not materially controlled through the reduction of bit rate. In fact, reach is more likely to be impacted by other external interference than by that interference driven by increasing the ADSL downstream bit rate above 3.5Mbit/s. The presumption that 73,114 lines would be made unavailable if Unconstrained Bitstream access is provided is not supported in any way.

For this assertion to be supported, Telecom would have to know where future ADSL services would be deployed, which cables and cable pairs would be used, and what speeds would be used. Telecom would have to also specify what other external or internal interference like radio frequencies and Power would be present.

5.1.3 Impact of upstream bitrate on downstream service

In paragraph 39, Telecom assert that *“the practical download which would result from the use of an unconstrained downstream service with an IP packet upstream PIR of 128 kbit/s (referred to as unconstrained/128) is around 3.5 Mbps.”*

To justify the assertion, Telecom refer to the ACMA report on the Australian internet reliability[15]. In particular Telecom refers to Figure B1 with a footnote that indicates that the graph demonstrates that the use of an unconstrained service with a theoretical peak of 10Mbit/s provides an average of 3.5Mbit/s download.

The process adopted for generation of the Figure which Telecom refers to involved customers downloading a program which in turn downloads a number of files from selected web sites. This process generates a report on download speed which had been collected and averaged. To develop the cable curve referred to in the figure a number of results were compiled from self test customers. The problem is that ACMA did not know what bit rate the customer’s access network is operating at and what other factors might be limiting the download data speeds.

Telecom also refers to the cable services used to generate the results in the ACMA report as having a theoretical PIR of 10Mbit/s which is the maximum cable speed and has suggested that the resultant 3.5 Mbit/s actual download is caused by the upload constraints in bandwidth. We have discussed this report with the ACMA (Louise Bradford) and we were advised that ACMA was not provided with information which would confirm the Telecoms assumption. In fact we were advised that it is most likely that some of the customers would have systems that are throttled back for one reason or another.

Furthermore, on page 2 of the ACMA report there is a discussion of factors affecting internet service performance and the following factors are identified:

[15] Australian Communications and Media Authority (ACMA) “Understanding your Internet Quality of Service 2004-05” dated February 2006.

- The customer's PC, modem and software should be of minimum specifications to support internet applications and being well configured and not infected by viruses, malware or spyware;
- The application of content used by the consumer (for example, email, music or video);
- The protocols used by internet applications (used for link management), which utilise part of the internet connection data transmission capacity;
- Capacity on shared domestic and international internet resources;
- Capacity of ISP-provided resources such as backhaul and internet servers—lower ISP resourcing may be a legitimate business model based on intentional price-quality trade-offs for product differentiation, but may also be due to under-resourcing of service capacity or backhaul dimensions;
- The popularity and capacity of content providers' web resources; and
- Packetisation' of information, which means that there are no dedicated data

As can be seen, there are a number of factors which might affect download data rates. Not just the impact of upload data rates and application of internet protocols.

However, there may be some merit in what Telecom is suggesting. In order to test this, we have performed a calculation to determine the maximum theoretical download bit rates given a maxim upload bit rate of 128Kbit/s and found that the downlink would be limited to 4.8Mbit/s. The following box summarises the assumptions related to this calculation.

Downlink bandwidth calculation and assumption

Traffic generated by the TCP/IP protocol is the most common traffic found on the internet, with ACK packets contributing to a substantial portion of this.

TCP/IP data packets are constructed of a header and a payload of data. The maximum total TCP packet size (MTU) is 1500 bytes, which includes both the header and data. The header is 40 bytes in size and the payload may be up to 1460 bytes in size. For each packet that is sent, a 40 byte acknowledgement packet must be returned to the sender to indicate the error free receipt of the data.

Using this information it is possible to calculate the maximum download speed that can be achieved using TCP with a given upload speed. For example, given an upload speed of 128kbps, (16000 bytes/sec), a maximum of 400 acknowledgement packets can be returned per second. 400 acknowledgement packets per second at 40 bytes each corresponds to a maximum download speed of 4.8Mbit, as using the maximum packet size, each data packet is 1500 bytes in size.

Therefore, a link with a 128kbit uplink cannot send acknowledgements for more than 4.8Mbit of downlink TCP traffic. Even if the link was unconstrained in the downlink, real TCP traffic would not be able to continuously flow in this direction at higher than 4.8Mbit.

5.1.4 Spectrum management regime

In paragraph 42, Telecom has expressed a view that New Zealand should move to higher speed ADSL line PIRs only once a sensible spectrum management regime is in place. Telecom claims that it has chosen to discourage the application of full speed services and claims that without the implementation of a spectrum management regime, the continued rollout of unconstrained services would have adverse effects.

In paragraph 47, Telecom also claims to be working on a spectrum management plan which wont be available until late 2006, and in order to complete this Telecom will have to work through the following steps:.

1. Simulation prediction of scenario outcomes;

2. Configuration laboratory testing completed;

3. Validation of prediction against field data;

4. Impact assessment on existing network;

5. Supporting operational capability definition; and

6. Peer review from partners.

In effect, what Telecom is saying is that unconstrained ADSL services should not be available until next year at the earliest.

This would mean that New Zealand end users will have to wait even longer before they can access reasonable internet access speeds that have been available to many countries for a number of years. Telecom could adopt the ACIF standards almost immediately and apply them without any chance of permitting the connection of unconstrained services which would be detrimental to existing users.

The practical application of the ACIF standards may initially involve the use of cable drawings (in some cases) to assess the suitability of certain proposed connections. However, in the longer term Telecom could complete the steps associated with the implementation of a spectrum management regime whilst in the short term providing access seekers with unconstrained services which will benefit the end users.

As indicated previously, the difference between the New Zealand external plant (cables) environment and the Australian external plant environment is minimal. The ACIF standards have successfully been applied in Australia for the rollout of hundreds of thousands of ADSL services including ADSLII+ services. They should therefore be applied in New Zealand.

5.1.5 Interleaving Option

Telecom provided detailed submissions on an interleaving option during the Decision 568 process about the potentially adverse impacts that turning interleaving off on a per port basis could have on its network and other end users. The DSL specifications include interleaving to enable carriers to better mitigate the impact of external noise and interference present on copper cables. Paragraph 73 is repeated in italics below.

"73. Telecom now has a tool that enables it to monitor and report on performance on a line by line basis. However the adverse impacts of turning interleaving off may not become fully apparent until a material number of lines in a cable have interleaving turned off. Telecom therefore considerers it prudent to undertake a trial where interleaving is turned off on a significant number of working lines in selected DSLAMs and performance monitored for at least 2 weeks.

As previously submitted, Telecom does not agree with turning off interleaving. Telecom is monitoring lines on an ongoing basis and is a position to identify issues with lines in cables where interleaving is turned off. Adverse impacts on any line can be identified. If the Commission confirms that interleaving can be turned off on a case by case basis, it should also:

(a) Telecom reserve the ability to deal with any potential adverse effects by, for example, reapplying interleaving to the line or reducing power to the line;

(b) take into account the additional technical and operational effects, for example, management and consumption of available profiles; and

(c) permit Telecom to recover the cost of applying and removing interleaving, and undertaking remedial action to remedy adverse impacts."

Interleaving serves to reduce the BER by reordering the bit-stream in order to prevent errors occurring from noise with bursty properties. However, interleaving introduces a processing delay, which results in increased latency to the user, at an amount proportional to the depth of the error correction plan in place. The amount of latency introduced can increase DSL ping times from 2ms to up to 60ms, depending on the strength of the error correction scheme in place. Typically, the increase in latency is approximately 20ms.[16]

As bandwidth can have a major affect on the latency performance of a connection, constraining the bandwidth with interleaving turned on, coupled with the limited amount of data payload available to the user, may prematurely introduce the affects of latency caused by data congestion. However turning interleaving on will not have a direct impact on the cross talk because it does not increase the spectral density of the transmission but it will reduce the BER as indicated above. Interleaving should be part of the bitstream service and therefore it should be up to the access seeker to decide if interleaving is turned on or off.

5.1.6 Higher bandwidth services should cost more

In paragraph 94 of their submission Telecom maintain that in relation to the cost of the service there are material economic costs associated with plans that use higher amounts of the limited spectrum capacity available within any distribution cable. Telecom also suggests in paragraph 95 that the provision of bandwidth for the delivery of broadband services exhibits properties of a private good as an individual's use of bandwidth and suggests that if one customer was permitted to have a high speed service then it would limit the opportunity for other customers on the same cable to receive a broadband service.

[16] DSL Forum, Technical FAQ, http://www.dslforum.org/aboutdsl/tech_faqs.html

This is certainly not the case in other jurisdictions. The use of appropriate spectrum management of the copper network will enable many customers to have access to very high speed services on the same cable. There is no clear evidence of a trade-off between reach and/or speed as claimed by Telecom. This can be demonstrated in the Australian environment by ADSL speed distribution maps which are available from the iiNet website[17] which are based on actual data speeds which have been obtained in some exchange areas. These maps illustrate that the majority of customers within a distance of 1-1.5km from the exchange are able to obtain speeds of 12Mbps or more and as the customer distance from the exchange increases the speed decreases. There is no requirement in Australia to either charge more for higher speed services or limit the speed of services so that more customers can make use of the cable network for broadband services.

In paragraph 96 Telecom further suggests that because of the problem that it raises in paragraph 95 the supply of the service should be bit rate limited and demand for higher speed services should be managed through differential pricing.

Telecom goes on to say that if "*the unconstrained service with a single wholesale price, does not make any allowance for the economic management of this trade-off by simply allowing the trade-offs to be managed by congestion, resulting in a negative congestion externality which is detrimental to all users."*

Again this is not the case in Australia and as discussed previously the Australian access network is very similar to that in New Zealand and hence we are of the view that Telecom's argument is illogical and not supported.

In paragraph 116 Telecom are suggesting that a significant proportion of customers will see no difference at all between a 3584/128 service and am unconstrained/128 service. But because some customers will obtain greater download speeds with an unconstrained service, Telecom is saying that the UBS charges should be greater to cover the claimed incremental spectral consumption.

Again this argument comes back to the fact that there is no evidence that some customers with a download speed of greater than the proposed limit of 3.5Mbps will some how create interference which will reduce availability or access to broadband services for other access seekers which is adequately dealt with in the paragraph above.

As for the proposition that the vast majority of users will not experience any increase in data speeds if the service is unconstrained again this is not supported in other jurisdictions and as indicated previously the uplink speed will be the most likely constraining factor and that will constrain the theoretical downlink speed to 4.8Mbps which is never-the-less considerably better than 3.5Mbps.

[17] http://www.iinet.net.au/about/media/releases/iinet_speed_results.pdf

6. CONCLUSIONS.

6.1 THE AUSTRALIAN EXPERIENCE

In the late 1990's it was clear that the Local Loop in Australian was going to be unbundled as part of the natural process associated with the deregulation of the Telecommunications industry in Australia. One of the fundamental drivers for unbundling the local loop was that technologies were emerging known as Digital Subscriber Line (DSL) technologies which could be connected to the local loop and deliver considerably more functionality (bandwidth) than was available through the use of the telephone

However as pointed out in section 2.0 above these new technologies involved the introduction of a frequency spectrum into the local loop copper cables which were potentially capable of interfering with other services carried within the same cable. The ACCC recognised this potential problem and encouraged the industry to develop spectrum management rules which would guide the efficient deployment of potentially disruptive technologies in particular ADSL over the local loop access network.

As indicated in Section 2 ACIF developed and released a code which sets out spectral density masks for the deployment of ADSL devices in Australia which has been adopted and used for a number of years. This has enabled the successful deployment of ADSL technology which is currently operating at data speeds of up to 24Mbit/s over the Australian local loop copper cables.

6.2 THE INTERNATIONAL EXPERIENCE

In section 3 it can be seen that most of the developed world has adopted similar standards as thoes adopted in Australia for the management of the deployment of ADSL technology. Relevant countries that have taken this path include United States, Canada, United Kingdom, France, Germany, Austria, Belgium, Denmark, Finland, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, Portugal, Spain and Sweden.

Whilst each of these countries has developed or embraced standards/policies/codes which are structured to meet their specific requirements and comply with the deregulation framework of that country they are all very similar at a technical level in terms of the spectral mask which is proposed to manage spectral interference within the copper cable access network. By inference, they allow unrestrained speeds subject to spectral masking.

The other fundamental commonality between all of these countries is the design of the copper access network. The cable characteristics (which define the performance of ADSL equipment connected to the cables) are almost the same from one country to the next. It is therefore not surprising that the standards/policies/codes would all specify a very similar spectral mask. In fact when the Hong Kong government was deciding what to do about the deployment of ADSL in their jurisdiction they commissioned a study by the Telecommunications Standards Advisory Committee. The committee found that any one of the existing ACIF, ANSI or ANFP regulations were applicable and could be adopted for the Hong Kong network, despite the differences in physical infrastructure.

6.3 THE AUSTRALIAN AND NEW ZEALAND EXTERNAL PLANT COMPARISON.

Section 4 makes a direct comparison between the external plant environments in Australia and New Zealand and in particular the copper cables which control the bandwidth and reach of ADSL devices deployed over them.

The fundamental conclusion is that the cables used by Telecom New Zealand are substantially the same as thoes used in Australia. There are some very minor differences however they are so insignificant that the reach, bandwidth and potential interference from ADSL would be almost identical on both networks.

We there for conclude that the ACIF standards would be entirely appropriate to apply in the New Zealand environment. Furthermore we see no valid reason why ADSL bit rates should be limited to 3.5Mbit/s in New Zealand whilst in Australia end users are being offered services which operate at bit speeds of up to 8Mbit/s using ADSL1 or 12Mbit/s for ADSL2 and up to 24Mbit/s using ADSL2+.