Comments on Alcatel Report and Telecom NZ Copper Spectrum Management

Report prepared for

The Commerce Commission of New Zealand

LAYER 10

TELECOMMUNICATIONS STRATEGY & DESIGN

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Preface

Layer 10 has prepared this report for the Commerce Commission to assist it in evaluating Telecom New Zealand's draft Interference Management Plan for the copper local loop network in New Zealand, titled "Copper Loop Frequency Management Plan (Draft 0.6)" dated 7th August 2006, and associated documents.

This report and the observations it contains were commissioned by and are intended solely for the Commerce Commission.

In preparing this report, Layer 10 has relied on information supplied to us by the Commerce Commission, and information available from publicly accessible sources. Unless otherwise indicated, we make no comment on material that is not explicitly referenced, and offer no warranty, express or implied, as to any information that is contained in this report.

This report is subject to the limitations, assumptions and qualifications referred to in the body of this report.

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Revision Log

Issue Number	Date	Affected Sections	Reason for Change
0816	16 Aug 2006	All	Initial Draft
0819	19 Aug 2006	All	Client Review
Final	22 Aug 2006		

Executive Summary

Background

Telecom New Zealand has been required to develop and offer high-speed ADSL services to wholesale customers as a result of regulatory proceedings concerning access to regulated "Bitrate Services" services throughout 2005 and 2006. These proceedings resulted in Commerce Commission decisions (Decisions 568 and 582) that mandated ADSL services with unconstrained downstream line-rates, known as "unconstrained bitrate services" or UBS.

Arising from these proceedings, Telecom, with advice from its supplier Alcatel, has developed concerns that in some circumstances, unconstrained ADSL services might cause detrimental interference to other forms of services, and they have asserted that a spectrum management regime must be in place before significant numbers of unconstrained services are deployed. Telecom referred to a form of interference management throughout the UBS proceedings during 2005 and 2006 that they named "bit-rate limiting" that would attempt to achieve reductions in cross-talk interference through restrictions on transmission power, achieved indirectly through restrictions on ADSL line speeds imposed within their DSL equipment. We have previously commented on this approach in a report to the Commission[1].

Telecom has released a report by Alcatel (with contributions from Telecom) detailing the results of measurements of changes in ADSL line speed for Telecom subscribers, resulting from a mass line speed upgrade program. Alcatel concludes that about 46% of all lines are unlikely to achieve even the current 2 Mbps and 3.5 Mbps data-rates if unconstrained ADSL services are deployed nationally. Telecom has since developed and released a draft management plan for comment, citing the advice from Alcatel as justification for the requirement for at least an interim management plan is developed before provisioning unconstrained services.

This report comments on the Alcatel report, and a briefing by Telecom released at the same time (24 July 2006), in terms of the justifications for the proposed interim management plan.

[1] Layer10 (2006), *Local Loop Spectrum Management*, online at http://www.comcom.govt.nz/IndustryRegulation/Telecommunications/Wholesale/BitstreamAccess/spectrummanagementreport.aspx

Methodology

We have reviewed the two documents, and provided qualitative comments in this report relying on my previous experience in this field. We have not undertaken extensive modelling or experimentation of various scenarios to determine the likely effect of these measures in reducing cross-talk interference.

Conclusions

Telecom is proposing an interim form of management through Service Delivery Rules where ADSL services on short loops must use reduced transmission power. While the concept itself may be reasonable, this is the first time Telecom have referred to limiting by transmission power directly, rather than limiting by bit-rate. The concept does not appear to be based on any presented measurements or modelling and does not follow at all from the Alcatel report, which does not address impacts by or on HDB3 systems, or distinguish between services on different line lengths. On that basis, the enforced reduction in transmission power has not yet been justified in any manner.

The Alcatel report largely supports the need for a comprehensive interference management plan to be developed, and the qualitative aspects of the report are generally not controversial. The quantitative analysis presented within the report is less convincing. The conclusions drawn regarding the potential impact of unconstrained ADSL services in particular appear to be tenuous at best, either because the chain of inference does not actually seem to prove that the problem is due to the *unconstrained* nature of ADSL services as the culprit, or the chain of logical inference admits many alternative explanations pointing to other causes.

That increasing numbers of ADSL services may cause degradation of adjacent services is well understood and accepted. Telecom and Alcatel must show, however, that *unconstrained services will cause significantly more degradation than the same number of constrained services* – and this is not a conclusion that can be drawn from the analysis presented.

The "Post Upgrade Line Rate Performance" measurements that form the central quantitative basis for the paper omits to indicate the line lengths involved. Alcatel does not show that all the lines that could not meet their planned line-rate were on sufficiently short lines that they would be expected to do so in a realistic noise environment. It would be helpful if Alcatel would publish the line attenuation distribution for each set of downstream provisioned line speeds.

Of most concern are the 7% of lines that Alcatel reports achieved a lower line-rate after the upgrade than before. These services hold the key to understanding how significant the effect of rising background interference really is – yet Alcatel fails to quantify the rates these lines achieved before the upgrade and after, or how significant the reduction was, in percentage terms, for these services. In fact this sample, the most important sample, is not discussed in any detail at all in the Alcatel report.

Alcatel did not include a table of 'Line Rate Performance' measurements BEFORE the speed upgrade, preventing a proper 'before and after' analysis. Its analysis assumes that every service in the table failing to achieve its planned line speed does so because of this speed upgrade – which is obviously false for the 8 Mbps 'unconstrained business' services at the very least. As indicated above, particularly for the services that were effectively 'unconstrained' both before and after the upgrade it would have been very helpful to know the line speeds achieved before and after the upgrade, to gain a true feel for the level of degradation caused by the increasing noise environment – this is not reported at all.

Alcatel's measurements are of 'noise margin' of services before and after the line speeds of a large number of services were increased, and show that the noise margins in general decreased as the line speeds increased. Alcatel's analysis appears to attribute the reduced noise margins to increased detrimental background noise, and implies that further increases in line speed will necessarily generate more detrimental cross-talk noise, and even more reductions in noise margin, and that 90,000 further services are 'at risk' of becoming unable to meet their planned speed.

This is a simplistic and incorrect conclusion.

All other factors remaining equal, if the desired line synchronisation rate is raised, the reported noise margin will fall. If the level of background line noise rises, the reported noise margin will also fall. Alcatel's analysis of reported falls in noise margins does not allow these two causes to be distinguished and separated, and so cannot be used to determine by how much the noise environment is changed by increasing desired line-rates. The effect of increasing background noise could have been analysed for the services that did not reach their planned speed before the upgrade – but this analysis was not done or reported.

Further, if the DSLAM is already achieving high 'noise margin' by transmitting at maximum power, increases in the line-rate (to the point of becoming 'unconstrained') WILL be achieved

without increasing cross-talk interference further. Alcatel does not consider this factor, instead assuming a linear proportionality with no justification.

The report also does not discuss (except in general terms) the impact of dissimilar technology services on each other – the impact of ADSL on symmetric technologies, the impact of symmetric technologies on ADSL services, and the impact of different forms of symmetric systems on each other (SHDSL interfering with HDB3 for example). Alcatel does observe[2] that these symmetric technologies "will have a more detrimental impact on ADSL services in the same cable than the other way around." It is my view that these forms of impact are a greater risk, and a greater driver for the comprehensive management plan to be developed, than simply considering ADSL interfering with ADSL.

To assist in enabling valid conclusions can be drawn from the Alcatel report it would be helpful if it could be extended in the following manner:

1) A table similar to 'Table 1' should be included, detailing the situation PRIOR to the speed upgrade;

2) For each downstream provisioned line speed in 'Table 1', a histogram of the distribution of line attenuation should be provided, separated into those services that achieve the provisioned line sped and those that do not. If not measured, the line attenuation might be calculated from the known transmission power, signal SN ratio, and reported 'noise margin';

3) For the 7% of services that achieved a lower line-rate after the upgrade than before, a 3D chart showing 'provisioned line-rate' vs. 'achieved line-rate' (before upgrade) vs. '% drop in line-rate', or alternatively a set of 2D scatter-plots showing 'achieved line-rate vs. provisioned line-rate' and '% change in line-rate vs. achieved line-rate' ; and

4) Charts of the frequency distribution of DSLAM port 'transmission power levels' before and after the speed increase may allow a direct estimate of the number of ports that might generate still higher transmission levels, and hence more interference, if changed to an 'unconstrained' service.

[2] Alcatel Report, Section 4.2, p17.

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1. Introduction

This report is to assist the Commerce Commission in evaluating the need and structure of an interference management plan currently under development by Telecom New Zealand Limited (Telecom) to manage the potential for interference between services on the local loop copper access network. The need for such a plan and related matters including DSL line-rate, reach and interference has been the subject of considerable debate during the determination for Bitstream Access for TelstraClear Ltd (Decision 568) throughout 2005, and continued in subsequent applications for Bitstream Access determinations in 2006 for CallPlus Limited (Callplus) and ihug Limited (ihug), culminating in the Commission's Decision 582.

As a result of these proceedings Telecom, with advice from its supplier Alcatel, has developed concerns that in some circumstances unconstrained ADSL services might cause detrimental interference to other forms of services, and they have asserted that a spectrum management regime must be in place before significant numbers of unconstrained services are deployed. Telecom referred to a form of interference management throughout the UBS proceedings during 2005 and 2006 that they named "bit-rate limiting" that would attempt to achieve reductions in cross-talk interference through restrictions on transmission power, achieved indirectly through restrictions on ADSL line speeds imposed within their DSL equipment.

1.1. Previous Findings

We have previously commented on this approach in an earlier report to the Commission[3].

In that report we concluded that "bit-rate limited" ADSL1 services would provide little benefit over unconstrained services in terms of their impairment of surrounding ADSL services, particularly in the scenarios under debate at the time. In particular, there was no additional risk to marginal services on very long lines from unconstrained services – additional unconstrained services would provide no more degradation than constrained services, and any detrimental impact would be due to the increased numbers of services of any form, not whether they were constrained or otherwise.

[3] Layer10 (2006), *Local Loop Spectrum Management*, online at http://www.comcom.govt.nz/IndustryRegulation/Telecommunications/Wholesale/BitstreamAccess/spectrummanagementreport.aspx

We also recommended that the telecommunications industry should commence constructing a comprehensive spectrum/interference management regime, as the risk of severe impediment between *dissimilar* technologies – between ADSL and symmetric DSL services typically used for business, for example – was very real. Interference and risks of impairment for *symmetric* services was not raised as a major issue in the UBS proceedings, however we showed through simulations that unconstrained or unmanaged deployment of symmetric technologies could cause much more significant problems than would interference between two ADSL services, which are designed to adapt to surrounding crosstalk interference without disconnecting completely. Similarly, crosstalk interference from ADSL technologies (whether constrained in bit-rate or transmission power, or not) could cause symmetric technologies to fail completely if the degree of interference was not managed through an interference or spectrum management regime.

1.2. Alcatel report to Telecom

Telecom has released a report by Alcatel (with contributions from Telecom), titled *Increasing ADSL Line Rate Speeds in the New Zealand Network – Copper Network Impairments*, detailing the results of measurements of changes in ADSL line speed for Telecom subscribers resulting from a mass line speed upgrade program. From statistics on 'noise margin' for each line purporting to show detrimental effects from interference, Alcatel extrapolates those effects, and based on a number of assumptions they conclude that *unconstrained ADSL services* are likely to cause significant degradation through cross-talk interference, and about 46% of all lines are unlikely to achieve even the current 2 Mbps and 3.5 Mbps data-rates if deployed nationally.

Alcatel briefly discusses interference with technologies typically used for business services, such as G.SHDSL, HDSL, and the older HDB3-based systems. While they do allow that such technologies may cause detrimental interference to ADSL, surprisingly they believe "there is insufficient data to be conclusive", and the impacts of ADSL on such services is unknown and requires further study.

Telecom has since developed and released a draft management plan for comment, citing the advice from Alcatel as justification for the requirement for at least an interim management plan to be developed before unconstrained services are provisioned.

This report comments on the Alcatel report, and a briefing by Telecom released at the same time (24 July 2006), in terms of the justifications for the proposed interim management plan.

2. Information Sources

The following documents have been considered during the preparation of this report:

Table 1 - Documents considered in preparing this report

Ref	Document Title	Organisation	Date
Alcatel Report	Increasing ADSL Line Rate Speeds in the New Zealand Network – Copper Network Impairments v6.0	Alcatel	24-Aug-06
TNZL Presentation	Copper Spectrum Management Implementation Options v1.0	Telecom NZ	24-Aug-06
Layer10 Report	Report on Local Loop Spectrum Management	Layer10	26-July-06

3. Alcatel Report

The Alcatel report largely supports the need for a comprehensive interference management plan to be developed, and we are encouraged by the recent activity in establishing working groups to facilitate the development of such a plan within the framework of the TCF.

The qualitative aspects of the report are generally not controversial. The quantitative analysis presented within the report is less convincing. The conclusions drawn regarding the potential impact of unconstrained ADSL services in particular appear to be tenuous at best, either because the chain of inference does not actually seem to prove that the problem is due to the *unconstrained* nature of ADSL services as the culprit, or the chain of logical inference admits many alternative explanations pointing to other causes.

In summary, while the observations certainly seem to indicate that increasing numbers and speeds of ADSL services (of any variety) do cause increasing levels of interference, there seems to be no evidence that *unconstrained* services are likely to cause any more impact than similar quantities of constrained services (constrained either by bit-rate limiting or reduced transmission power). That increasing numbers of ADSL services can cause degradation of adjacent services is well understood and accepted. Telecom and Alcatel must, however, show that *unconstrained services will cause significantly more degradation than the same number of constrained services* – and this is not a conclusion that can be drawn from the analysis presented.

In this section we will comment in turn on aspects of Alcatel's Section 3 analysis of the upgraded line-rate measurements, Section 4's discussion of the effects in general of increasing ADSL line-rates, and then return to comment on the conclusions included in the Executive Summary in Section 2.

3.1. The Effects of Increasing Line Rate (Section 3)

On Page 8 Alcatel details the planned ADSL 'Line-Rates' that were intended to deliver the effective 'data-rates' that form part of the service description that subscribers expect. The 'planned line-rate' is the parameter set as an upper speed limit in the DSLAM port provisioning for each line.

It would have been helpful for Alcatel to detail the maximum target line length, or more correctly the maximum target line attenuation, for each planned line-rate. As the achievable

ADSL line-rate decreases with the length and attenuation of the line, any ADSL line speed should be accompanied by an indication of an upper bound of the line length or attenuation in which that line sped is expected to be achievable.

3.2. Post Upgrade Line Rate Performance (Section 3.1)

The comment regarding line attenuation above is germane to the ability to interpret 'Table 1' which indicates the proportion of ADSL services after the upgrade that were unable to achieve the planned line-rate.

It is puzzling that Alcatel did not include a similar chart showing the number of services at each target line speed that could not achieve their target BEFORE the speed upgrade. It is certain that the number of 8 Mbps 'unconstrained business plans' that did not achieve their planned speed would be comparable before and after the upgrade.

Particularly for these services that were effectively 'unconstrained' both before and after the upgrade it would have been very helpful to know the line speeds achieved before and after the upgrade, to gain a true feel for the level of degradation caused by the increasing noise environment.

Inability to achieve the planned line-rate is only a 'problem' if the planned line-rate is realistically expected to be achievable on a line of that length – indeed, guidance graphs of realistically expected line speeds vs. distance is likely to be an outcome or deliverable for the broader interference plan development. To interpret Alcatel's 'Table 1' we need to see the line length (or attenuation) distribution for the services that did manage to achieve the planned line-rate and for those that did not.

Figure 1 - ADSLv1 achievable line-rate

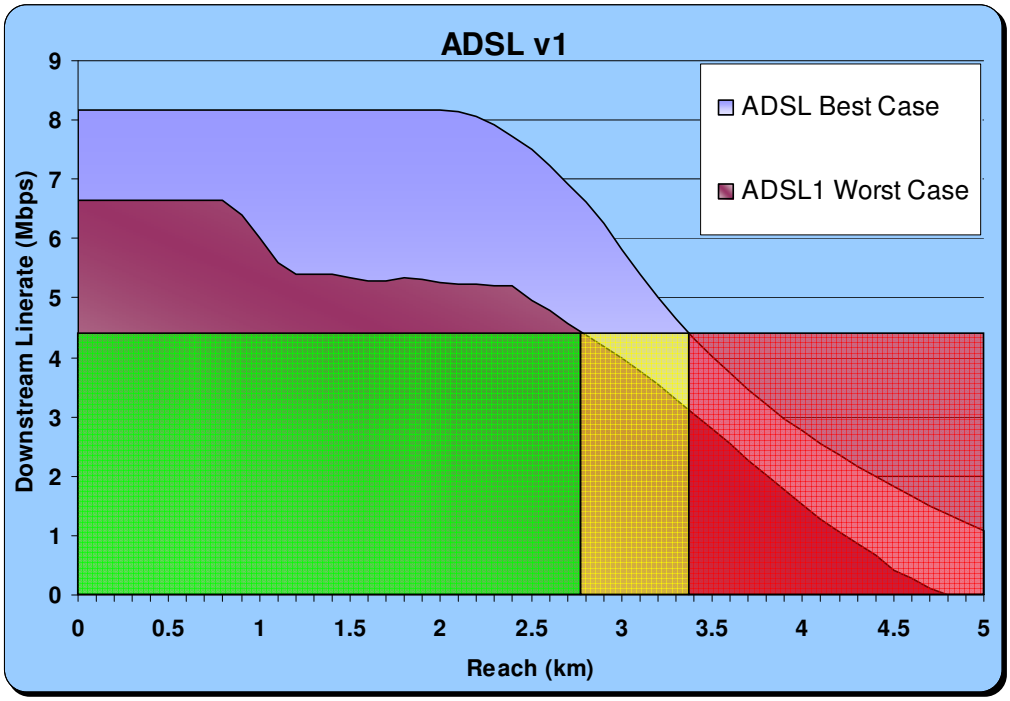

Figure 1 shows the theoretical 'Best Case' performance curve of achieved line-rate as a function of distance (assuming 0.40PIUT cable, standard -140dB background noise, and no other interference). It also shows the ACIF performance benchmark curve for ADSL1, which is the expected worst-case performance (in Australia at 80% penetration. The benchmark curve may be different for the New Zealand network). All operating ADSLv1 services are expected to fall within the blue area.

For the services provisioned with a target line-rate of 4.288 Mbps that fail to reach the planned rate, those on lines shorter than around 2.8 km (falling in the green area) are of real concern. Those on lines between 2.8 and 3.4 km (the yellow area) are expected to be marginal, and those on lines longer than 3.4 km (the red area) could never be expected to reach 4.288 Mbps, and have been sold inappropriately. Alcatel does not discuss the line length/attenuation distribution at all.

Similarly, services at distances of 3.4 km or greater that were happily achieving a constrained line-rate of 2.56 Mbps or less with margin to spare, and then had their plan line-rate raised to 4.288 Mbps, would then be unable to achieve the speed and would contribute to the Alcatel statistics – however inability to reach that plan speed is not due to any increased interference.

That distance, not cross-talk, is likely to be a significant factor in the services that fail to reach their planned line-rate is indicated by the sharp rise in 'failures' as the line speed increases (and hence the service area around each exchange where such speeds are achievable reduces dramatically).

Of most concern are the 7% of lines that Alcatel reports achieved a lower line-rate after the upgrade than before. These services hold the key to understanding how significant the effect of rising background interference really is – yet Alcatel fails to quantify the rates these lines achieved before the upgrade and after, or how significant the reduction was, in percentage terms, for these services. In fact this sample, the most important sample, is not discussed in any detail at all in the Alcatel report. A reduction of 5% to 10% (for example) might be argued to be within acceptable expectations.

Alcatel also does not prove that unconstrained services would affect the sample any more than constrained services have.

3.3. Extrapolation of Line Rate Performance (Noise Margin) (Section 3.2)

In this section Alcatel analyses 'noise margin' as reported by the modems to infer the potential effect of introducing unconstrained line-rate services.

The 'noise margin' reported by a modem is determined by several factors - the transmission power of the DSLAM, the 'signal-to-noise ratio' required to achieve the desired line synchronisation rate, and the level of background line noise (including crosstalk interference). (It is also affected by the level of attenuation of the line, and the quality of the modem, specifically how it measures the noise margin – but as these two factors are assumed to remain constant for a given line, they can be omitted from this discussion).

In this section Alcatel makes a number of claims that unconstrained ADSL services cause more degradation than constrained ADSL services, which are not supported by any evidence. Alcatel states:

> "Over time, it is certain that the performance (line rate) of the 22.7% of services quantified in the table above will deteriorate. These services are already at their performance limit."

This is true to a point, although we observe that the highest speed services are those likely to see the most reduction over time. Low speed services, on long copper loops, are unlikely to

experience much degradation as the crosstalk signals are attenuated along with the main signal[4].

Alcatel continues:

> Due to the introduction of ***unconstrained line rates*** and increased service penetration, cable binder noise will rise, reducing the performance of these lines even further. 22.7% is the lower bound of the number of services that will deteriorate ***because of line rate increases***. (emphasis added).

Alcatel has not shown anywhere that unconstrained line-rates will cause any more cable binder noise than constrained line-rate services. Cable binder noise may well rise, but it is just as likely to be due to increased service penetration and increased numbers of services, even if the new services are constrained in some way – the assertion in the final sentence does not logically follow.

In Figures 1 and 2 on page 11 Alcatel presents histogram charts of measured noise margin before and after the speed increase.

All other factors remaining equal, if the desired line synchronisation rate is raised, the reported noise margin will fall. If the level of background line noise rises, the reported noise margin will fall. Alcatel's analysis of reported falls in noise margins does not allow these two effects to be distinguished and separated, and so cannot be used to determine by how much the noise environment is changed by increasing desired line-rates.

These charts are to be expected – for any given line, as the allowable line-rate is increased the transmission power can also be increased to maintain the noise margin in the 31-33dB range. Once maximum transmission power is reached, noise margin will decrease as line-rate increases until the threshold of around 10-12 dB is reached, at which time the line will not be able to achieve any higher line-rate – it has reached its unconstrained limit. This is by design, and is not a 'problem' that needs to be solved.

Alcatel seems to be making a case that a line moving from a 'high margin' to a 'low margin' situation is to be avoided. Alcatel does not mention that the reason the margin has reduced is that the line is providing a higher line-rate service than before, which is a desirable outcome.

[4] See Layer10 report "Copper Loop Spectrum Management", Section 6.3, pp35-36

On page 12 Alcatel details four assumptions to justify extrapolating the previous measurements of noise margin reduction to an expected effect on future services:

Assumption 1, that the upstream line-rate is not material to the discussion, is not controversial, neither is Assumption 3.

Assumption 2 is stated as:

> "Downstream Noise Margin in the 8 to 15dB (12 ≈±3dB) range correlates with services at highest risk of being unable to achieve planned downstream rates."

While true, this is constructed in an emotive way that may steer the reader into thinking this is an undesirable situation. It could equivalently be stated "Downstream Noise Margin in the 8 to 15dB (12 ≈±3dB) range correlates with services that have been freed of an artificial speed limit and have reached the full downstream performance that the line allows".

Assumption 4, however, is not reasonable in my opinion, on two grounds. Firstly, the statement:

> The increase to ***unconstrained*** line rates will degrade the achievable downstream rates for a number of services that are achieving the target today.

is not reasonable as an assumption, as it is the very situation that Telecom and Alcatel are attempting to prove – that unconstrained services will degrade a constrained service operating close to its performance limit by more than the same quantity of other constrained services will. Further, this text continues:

> The assumption is that the change to unconstrained line rates will cause ***proportional impact*** as increasing downstream bitrates to 2Mbps and 3.5Mbps had.

There is no evidence that the relationship between "line-rate" and "impact" is linear, and no valid way of extrapolating a proportionality, from what is essentially a single 'data point' experiment of the previous line upgrade project as a single 'step up'.

Alcatel's analysis of reported falls in noise margins does not allow the two causes ('reduction through increased synchronised line-rate' and 'reduction though increased background noise') to be distinguished and separated, and so cannot be used to determine by how much the noise environment is changed by increasing desired line-rates.

Even if the relationship was mathematically linear, the impact is unlikely to be as great as claimed. Alcatel goes on to claim that, because after the upgrade there were 87,000 services with low margin (15 dB or less) that were assumed to be those not achieving the target line-rate, that the next ~90,000 lines were at risk if line speeds were increased to be unconstrained. This logic appears to be flawed in that it fails to account for the ~42,000 services that had margins below 15dB before the upgrade shown in their Figure 1 – the extra number of services that actually changed from having adequate margin to unconstrained margin is ~45,000 services, roughly half that indicated in the simplistic situation. Further, it is reasonable to observe that the number of services that can achieve the higher line-rates (and hence may increase transmission power and cause increased interference) decreases as the high speed threshold is raised higher and higher, which will cause the 'increased' crosstalk noise to be progressively smaller for each proportional increase in maximum line-rate – the transfer function may be logarithmic rather than linear.

Even more pertinent is that once a service is transmitting at maximum power, further increases in line-rate are achieved without any further increase in cross-talk interference being generated. Any 'constrained bit-rate' service operating with less than 33dB noise margin will be transmitting at maximum power, and can be set 'unconstrained' to achieve higher line-rate service (and reduced noise margin) *without increasing generated interference at all*.

It is reasonable to expect some number of services very close to their 'unconstrained' margin may become margin-limited as the maximum line-rate is increased towards an unconstrained regime. What number of services that will likely be, how significant the line-rate reduction is, and the relationship between that and the line-rate of the surrounding services, has not been determined, and is highly unlikely to be of the order claimed in this Alcatel analysis.

3.4. Post-upgrade affects on G.SHDSL and HDB3 (Section 3.3)

Alcatel argues here that it is important to consider the impact on and caused by symmetric services, as they are not able to adapt easily to excess background noise. Alcatel indicates it needs more analysis to look at the effect of increasing ADSL line-rates, and we are surprised Alcatel doesn't offer any guidance from either measurements or modelling they might have conducted for other national networks. Nevertheless, we agree with Alcatel that these need to be analysed in detail – unlike ADSL, if a symmetric service is operated with inadequate noise margin it is likely to fail completely as it cannot adjust itself to a reduced speed, and this is a more serious impact than a reduction in line speed for ADSL.

3.5. Section 4

Section 4 of the Alcatel report is largely tutorial in nature, and in general, we concur with most of the discussion. It highlights that symmetric technologies, such as SHDSL and E1-HDB3 are likely to cause more degradation than ADSL (all other things being equal), and that symmetric services that are currently operating at their technical limits are likely to be impacted by increasing ADSL penetration and line-rates – and also by increasing penetration of other symmetric services. To the extent that the symmetric technologies 'are likely to cause more impact on ADSL than the other way around', we believe it is interactions with the latter that will prove to be the major issue for marginal services, and that all technologies must be considered in a comprehensive interference/spectrum management plan.

We concur completely with Alcatel that "an industry accepted Copper Spectrum Management framework with an associated Access Network Frequency Plan (ANFP) is preferable to govern the use of Telecom's copper access network."

Importantly for the debate of 'constrained' vs. 'unconstrained' line-rate ADSL services, nothing in section 4 indicates that 'unconstrained' services are any more likely to cause significant interference than 'constrained' services.

3.6. Executive Summary (Section 2)

It is possible now to comment on assertions incorporated in the Executive Summary.

Alcatel assert:

> …a conclusion has been reached that the introduction of unconstrained ADSL line rates will unavoidably affect the performance of some DSL services.

As shown above, Alcatel has not shown to what degree, if any, *unconstrained* services might affect other services performance more than *constrained* services. That increased numbers of services of either type will affect the performance of surrounding services is not in dispute – however the relationship between 'line-rate' and 'transmission power' (which affects interference) is a loose form of control at the best of times and only controllable on relatively short lines.

Alcatel's main argument is summarised as follows:

> There were 383,000 broadband services monitored during the migration to the new plans. Of this number of services nearly 23% or 87,000 services could not achieve the new plan rates. In addition, 7% of customers (16,118 of 235,027) on ASAM, which can be extrapolated to around 5% of all customers, experienced a reduction in performance to below what they received prior to the upgrade."

Alcatel's "23% or 87,000 services" includes those that could not achieve the old plan rates, let alone the new ones – roughly half this number (~42,000 services) had noise margins 15dB or less even before the upgrade. Of the 7% that experienced reduced performance, no indication is given as to the relative degree of reduced performance, or any other information that could allow a cause to be inferred. Alcatel continues:

> If unconstrained line rates are implemented nationally, under the current network conditions, there will be a wider service impact. Extrapolating the reduction in available noise margin from the higher speeds, about 170,000 services (46%) are unlikely to achieve even the current rates of 2Mbps and 3.5Mbps.

In my opinion, this estimate is not valid or even credible, as the linear extrapolation proposed is not valid, logical, or supported by the evidence.

Apart from these issues, we support and encourage Alcatel's recommendation that in industry-accepted Copper Spectrum Management Plan be established in New Zealand.

4. Telecom New Zealand Presentation

In conjunction with the Alcatel report, Telecom has distributed a short presentation titled "Copper Spectrum Management Implementation Options" (24 July 2006 Version 1.0). This section comments briefly on that presentation.

4.1. Summary (slide 2)

Mitigation of risks to services, particularly symmetric services that are relatively intolerant of excessive interference if operating at their technical distance limits is a necessary goal.

A Fifth 'tool' available to the operator to control interference is separation of technologies into different cable binders.

4.2. Different Philosophies (slide 3)

Without recommending any particular philosophy, we point out that different stakeholders are likely to be attracted to philosophies that maximise their own experience over others – regional/rural subscribers are likely to favour prioritising 'reach' for example.

Philosophy 4 incorporates an ingrained assumption that "maximum service" can necessarily only be available for "a few", and implies an "either/or" relationship. In practice, there exists a continuum of approaches between these two extremes, and the continuum is not a linear tradeoff – an intermediate "maximum enough for most" goal is likely to be an optimal middle ground.

We agree with Telecom that New Zealand should not arbitrarily adopt a particular international approach, and that the development of a New Zealand plan, specific to the New Zealand network conditions, should be informed by the most up-to-date information and experiences generated by other approaches in other jurisdictions.

4.3. Plan Outcomes (slide 4)

In some circumstances, an additional option for controlling interference is separation of services into a separate binder, which might be considered a variation of 'Item 3' that is relatively tractable. This is the approach recommended by Alcatel and implemented in several international jurisdictions to deal with legacy HDB3 services in particular.

4.4. Telecom's Proposal (slide 6)

The first bullet-point effectively blames the need to implement copper spectrum management on the introduction of unconstrained ADSL services. In our opinion these management rules were required when HDB3, HDSL and then G.SHDSL services were introduced into the copper plant, as well as constrained ADSL services, and these symmetric technologies have potentially greater impact on business services requiring more stringent copper spectrum management than ADSL is likely to have, whether constrained or not.

Telecom proposes to use direct "power control" to control maximum power across all frequencies, without any specific limited "bit-rate". In our view, this is certainly preferable, more transparent and easier to predict the behaviour for than indirectly attempting to control transmission power through limits on bit-rate as proposed earlier.

Telecom undertakes to perform testing "…to determine the impact of unconstrained (ADSL) services on business services on other technologies and on existing ADSL services." We believe it is also critical that Telecom perform testing of the impact of "business services" particularly symmetric technologies including HDB3, SDSL, HDSL and SHDSL on ADSL and on each other to inform the applicability of the proposed rules. We would also expect that Alcatel could provide experience from measurements of these impacts from other international jurisdictions, albeit they may need adjusting for differences in copper loop gauge.

4.5. Telecom's Proposal – Service Delivery Rules (slide 7)

Telecom is proposing a reduction of maximum transmit power by 10dB for unconstrained ADSL services on "short" pairs mixed with longer pairs, and short pairs where the bundle includes HDB3 or HDSL services. "Short" is defined as less than 25dB attenuation at 160kHz, which we calculate corresponds to a nominal distance of ~2.3 km of 0.4mm gauge copper pair wire.

Telecom has not provided any justification for why a 10dB reduction is required in binders containing HDB3 systems, as neither Telecom not Alcatel measured any actual changes or address any theoretical impacts ADSL might have on HDB3 or vice-versa. HDB3 systems are noted as needing particular treatment in other jurisdictions, and impacts should be modelled.

With regard to the effect of ADSL on other ADSL systems in "short" binders, the victim ADSL services would all be operating with high noise margins on such short lines, and neither Telecom nor the Alcatel report has provided any evidence that unconstrained services would generate sufficient extra background noise to cause material degradation on such lines, or

materially more background noise than services constrained in some manner. As commented on earlier, length/attenuation of lines was not analysed as a factor at all in the Alcatel report.

While the concept itself may be reasonable, it does not appear to be based on any presented measurements or modelling and does not follow from the Alcatel report.

More modelling is likely to be required to determine the likely impact of these deployment rules on other ADSL services and on symmetric services.

5. Spectrum Modelling

This future section (in preparation) will present graphs and figures demonstrating the effects of crosstalk interference on DSL services under a variety of scenarios and service penetration proportions, based on DSL simulation software and Telecom's proposed "Copper Loop Frequency Management Plan" deployment rules.

6. Project Brief from the Commerce Commission

We were asked by the Commerce Commission to review a presentation from Telecom New Zealand and a technical report prepared by Alcatel, both dated 24 July 2006, relating to Copper Spectrum Management and ADSL Line Speed measurements, detailed in Section 2 above.

7. CV for Dr Paul Brooks

Dr Paul Brooks

Technology Director

BSc (Hons) Physics & Computer Science, University of Adelaide
PhD Astrophysics & Optics, UNSW
Foundation Member, Internet Society of Australia

Overview

Paul's expertise in telecommunications design, planning and operation has been forged through a number of executive and consulting appointments within the Australian Internet and telecommunications industry. His practical and pragmatic knowledge of communications protocols, leading equipment suppliers, carriers & service providers and the Australian regulatory environment has assisted many organizations build critical services.

Paul has extensive hands-on experience in Broadband Access and data networking, having designed and built networks based on ATM, Frame Relay, Gigabit Ethernet, IP, either directly or through wholesale/other carrier services and lead implementation teams for carriers and ISPs. In Australia, most of these have also been based on Wholesale products from other carriers such as Telstra Unconditioned Local Loop (ULLS) and various DSL flavours, and included negotiating access conditions and working through regulatory concerns.

He has been involved in a diverse range of projects, from small, such as assisting a leading Australian DSL network builder in its early days to understand the options and intricacies of deploying telephony services over broadband networks – to large - engaged by Telstra's NDC division to work on very dense broadband network designs in China and India, and developing a national $130 million DSL network architecture.

Experience

Founding an independent consulting practice in 2004, Paul's project leadership has encompassed:

- Assessing technical arguments surrounding DSL interference management – NZ Commerce Commission
- Assessing operational and cost aspects of ULLS & LSS undertakings and access disputes – ACCC
- ADSL2+ spectral modelling - ACIF
- WAN Strategic Planning/Analysis – Southcorp, Flowcom
- Voice Telecoms Strategic Planning/Analysis – Southcorp
- RFP generation, evaluation & vendor selection – Flowcom, Southcorp
- Remote & Rural Telecoms – Macrocom
- Carrier Network Redesign & Operations – Flowcom, Macrocom, NTLT, Digital Distribution Australia

- Training – Central Queensland University
- Network/Service Audit – Flowcom, NewSat, NTLT

Before consulting, Paul's career encompassed executive management roles in a number of influential firms. Sample projects and career highlights include:

- **CTO, TransACT Communications:**
  As Chief Technology Officer for TransACT in Canberra, Paul had overall responsibility for expansion design and planning the "triple-play" voice/data/video integrated broadband FTTC/VDSL network and the internal IT infrastructure, including vendor selection, management of equipment, and the technical/IT support of service development. He designed and led the trials for the first commercial TV over ADSL services in Australia outside Telstra.
- **CTO, eCom Communications:**
  With this seed-stage start-up telco Paul covered the evaluation, selection and deployment of a planned national broadband network and organisation to design and operate the network. Providing strategic direction on current and future technologies and business practices to Board members, Investors and other executives, and hands-on selection of equipment, transmission, services and management/billing systems suppliers to build underlying infrastructure to support the business.
- **Director, Asia-Pacific Network Engineering, Global One:**
  A core Executive Management role in Global One Australia/New Zealand (now Equant / France Telecom), providing strategic technical leadership and responsible for network planning, design and deployment of the ATM, Frame Relay and Internet backbone networks throughout the APAC region, with personal involvement in pre-sales complex network designs for large customers, and expansion projects within the global backbone networks.
- **Windows Sockets Team Leader:**
  In the infancy of the Internet, Paul was a leader in the global Windows Sockets (WINSOCK) software standardisation effort, which opened up the use of MS Windows PCs to run TCP/IP-based applications, helping enable the explosion of the World Wide Web.

Paul is an active participant within ACIF, ATUG and the Australian ISP community, is a Foundation Member of the Internet Society of Australia, and is regularly invited to present at industry conferences and seminars.

Technical

Paul has the benefit of exposure to most aspects of telecommunications and IT, having worked with many data and voice technologies as both service provider and customer. He is

familiar with most communications technologies and protocols including:

- LAN – Ethernet, Fast Ethernet, Gigabit Ethernet, FDDI
- WAN – Frame Relay, ISDN, DDS, ATM, X25, MPLS
- Metro – SDH, PON, xDSL
- Internet Protocols and operation – DNS, BGP-4, OSPF, ISIS, SNMP, etc, VoIP, VoATM, VoDSL, Video, troubleshooting, IP-VPNs
- OSS/BSS – Network/Service Management, Operational Processes, Billing, Provisioning – eTOM and FCAPS models
- Capacity Planning & Modelling

Summary

Paul is a senior consultant, respected internationally through his various roles and activities on industry panels such as ACIF. He personally assisted many of the leading Australian ISPs in the early 90's with designing their global Internet backbone connectivity.

Paul is able to liaise at all levels of an organisation, from Board and executive management to technical staff and has the insight to work on virtually any IT&T consulting assignment from high-level strategy to technical design and specification.