LAYER10

TELECOMMUNICATIONS STRATEGY AND DESIGN

Further Comments on Telecom NZ Copper Spectrum Management

Report prepared for

The Commerce Commission of New Zealand

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TELECOMMUNICATIONS STRATEGY AND 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 presentation titled "Copper Spectrum Management Cross Technology Impacts" Version 1.0 dated 1st September 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, on previous reports 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.

To follow up aspects of this report, please contact:

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Revision Log

Issue Number	Date	Affected Sections	Reason for Change
0912	12 Sept 2006	All	Initial Draft
0917	17 Sept 2006	All	Client Review

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 subsequently released a report by Alcatel and a briefing paper presentation detailing the results of measurements of changes in ADSL line speed for Telecom subscribers, resulting from a mass line speed upgrade program. It discusses the impact of ADSL services interfering with other ADSL services, and proposes interim service delivery rules limiting ADSL maximum transmission power in selected circumstances. We have previously commented on this approach in a report to the Commission[2], where we concluded that the broad principle of reducing ADSL transmission power in some circumstances may be a reasonable approach to limiting DSL interference, however the analysis supplied by Alcatel and Telecom did not justify the measures proposed and that further analysis was required.

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[1] Layer10 (2006), *Local Loop Spectrum Management*, 26 July 2006, online at http://www.comcom.govt.nz//IndustryRegulation/Telecommunications/Wholesale/BitstreamAccess/ContentFiles/Documents/Local Loop Spectrum Management.pdf

[2] Layer10 (2006), *Comments on Alcatel Report and Telecom NZ Copper Spectrum Management*, 31 August 2006, online at http://www.comcom.govt.nz//IndustryRegulation/Telecommunications/Wholesale/BitstreamAccess/ContentFiles/Documents/Comments on TNZ Interference Management.pdf

Telecom New Zealand subsequently released another briefing paper "Copper Spectrum Management – Cross Technology Impacts" dated 1 September 2006 which discusses justifications for the proposed service delivery rules due to interactions between ADSL technologies and symmetric technologies (HDB-3 and SHDSL) typically used to deliver business services.

This report comments on the new briefing paper.

Methodology

We have reviewed the two documents, and provided qualitative comments in this report. We have not undertaken extensive modelling or experimentation of various scenarios to determine the likely effect of these measures in reducing cross-talk interference between ADSL and all symmetric technologies in all cases.

Conclusions

Telecom is proposing an interim form of management through Service Delivery Rules where ADSL services on short loops must use reduced transmission power, to protect a portion of services provisioned using symmetric transmission systems such as HDB3 and SHDSL.

Telecom provides measurements of existing transmission power and then uses various idealised assumptions that build on those measurements to derive an estimate of the increase in background noise due to the move to unconstrained ADSL services. In our view those idealised assumptions provide an overly pessimistic view of the likely impact.

Telecom does already have access to a set of data, namely the characteristics of the ~87,000 services reported in the Alcatel report that already cannot reach their planned speed, which should provide a very good indication of the distribution of aggregate transmission power in a fully unconstrained network.

With regard to HDB3 services, Telecom seeks assurance that services up to 900 metres in length will keep operating, while a fully unconstrained ADSL network may reduce the prudent service length to 700 metres. While the proposed introduction of reduced-power requirements on ADSL services will provide this assurance, there are also a number of alternative activities that could also preserve confidence in the end-user services through replacing the at-risk HDB3 transmission systems with a different and less impacted technology.

With regard to protecting SHDSL services, reduced power ADSL systems by themselves would permit the prudent working length of SHDSL systems be extended from ~1.9km to ~2.2km – a gain in length of 17%. However, the introduction of reduced-power ADSL services on short lines is undermined by the permitting of full-power ADSL services on adjacent medium length lines, which causes almost as much interference as if low-power ADSL was never a requirement.

Telecom correctly talks about the tension between interfering services and the need to balance tradeoffs and manage risk, however Telecom does not appear to have adequately considered all the forms of tradeoffs that might be experienced by subscribers forced onto a low-power ADSL service. Telecom has modelled the impact of nearby full power ADSL on its low-power cousins (and there remains some doubt as to the validity of that model), but Telecom has not presented any consideration for the effect on low power ADSL by the symmetric technologies under question – cross-talk interference is a two-way phenomenon – nor on how this might compare with the effect on full-power systems.

In our view, reduced power ADSL systems may play a part in the New Zealand spectrum management regime, however the current work and reports has not yet been able to show that this is a necessary or balanced requirement.

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1.1. 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 were the subject of considerable debate during the determinations for Bitstream Access for TelstraClear Ltd (Decision 568) and for CallPlus Limited and ihug Limited (Decision 582).

During the UBS proceedings Telecom, with advice from its supplier Alcatel, developed concerns that in some circumstances unconstrained ADSL services might cause detrimental interference to other forms of services, and it has asserted several times that a spectrum management regime must be in place before significant numbers of unconstrained services are deployed.

1.2. Bit-rate Limiting

Telecom referred to a form of interference management throughout the UBS proceedings during 2005 and 2006 that it termed "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 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.

We also recommended that the telecommunications industry should commence constructing a comprehensive spectrum/interference management regime, as the risk of severe impediment

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

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 significantly more severe 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.

1.3. Alcatel ADSL report to Telecom

Telecom later 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. Alcatel primarily considered the effect of ADSL services causing detrimental interference to other ADSL services.

Telecom released a briefing paper on the same date proposing a different set of service delivery rules, this time based around directly limiting transmission power for some ADSL services. ADSL services on 'short' lines in binders with a mix of 'short' and 'medium' or 'long' lines, and in any binder which also contained symmetric services using the HDB3 line-coding system, would have their maximum transmission power reduced by 10 dBm below the maximum permitted by the ITU-T ADSL1 standard.

We previously commented on the Alcatel report and Telecom's new delivery rules in an earlier report to the Commission[4].

In that report we concluded that imposing direct limits on transmission power appeared to be a more reasonable approach than attempting to indirectly control transmission power by imposing direct limits on line-rate, if it could be shown that limits were required at all.

[4] Layer10 (2006), *Comments on Alcatel Report and Telecom NZ Copper Spectrum Management*, 31 August 2006, online at http://www.comcom.govt.nz//IndustryRegulation/Telecommunications/Wholesale/BitstreamAccess/ContentFiles/Documents/Comments on TNZ Interference Management.pdf

However, Telecom did not present any measurements or modelling to justify the proposed limits, nor did the new rules follow from any material in the Alcatel report.

Considering the Alcatel report, we found it to be deficient in many areas that prevented any conclusions being drawn regarding increased cross-talk interference. Some of the criticisms were:

- No 'pre-upgrade' table of planned and achieved line-rate was provided, preventing a 'before-and-after' comparison of line rates. Further, the 'post-upgrade' table of lines that could not reach their planned line-rate included a set of already 'unconstrained' services that would not be expected to reach the planned line-rate, and would have been in this state prior to the upgrade as well, thus skewing the derived result;
- No measurements of line attenuation were provided to correlate with the planned or attained line-rates;
- 'Before and after' comparisons of 'noise margin' reductions failed to distinguish between the effect of increasing line rates or increasing background noise. The subset of lines where such a comparison might have provided valuable insight – those that could only achieve a lower line-rate after the upgrade than before the upgrade - were not discussed;
- When estimating the number of services that might be adversely affected by a large-scale move to unconstrained line-rate, the assumptions used to derive the figure were fundamentally flawed, and as a result the number of affected services is highly unlikely to be of the order claimed in the Alcatel analysis.

The Alcatel report was almost solely based on measurements of ADSL services affecting other ADSL services. Where Alcatel briefly discussed interference with technologies typically used for business services, such as G.SHDSL, HDSL, and the older HDB3-based systems it did allow that such technologies may cause detrimental interference to ADSL. Surprisingly it believe "there is insufficient data to be conclusive", and the impacts of ADSL on such services is unknown and requires further study, however they "will have a far more detrimental effect on ADSL services in the same cable, than the other way around".

In terms of the specific 'Service Delivery Rules' proposed by Telecom, our selected scenario modelling indicated there could be benefits in introducing a 'reduced power' ADSL requirement in some circumstances.

It was not clear that the reduction should be 10dB to achieve the stated goal , and it is possible that a smaller reduction might be preferred, and that a reduced power ADSL is not required at all for at least some business services.

We also deduced that, if a reduced power ADSL system is mandated, that any full power ADSL systems in the same binder will be likely to cause significant degradation to the reduced power systems, rendering the reduced power system undesirable. Telecom appeared to consider the impact of reduced-power ADSL systems on nearby full-power ADSL systems and HDB3 systems, however they did not discuss or consider the converse effect that full-power ADSL systems and HDB3 systems might have on the reduced-power systems.

1.4. Further briefing paper

Telecom has developed and released a new briefing paper titled "Copper Spectrum Management – Cross technology impacts" (version 1.0, 1 September 2006) which discusses the effects of ADSL services on symmetric data or "fixed rate" services, typically used for business services. Telecom believes these services must be protected and given a greater level of importance compared to technologies such as ADSL that are typically used to deliver consumer services such as broadband Internet access.

This report comments on Telecom's paper in terms of the justifications for the proposed service delivery rules surrounding reduced ADSL maximum transmission power.

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
TNZL Presentation	Copper Spectrum Management Cross Technology Impacts v1.0	Telecom NZ	1-Sept-06
First Layer10 Report	Report on Local Loop Spectrum Management	Layer10	26-July-06
Second Layer10 Report	Comments on Alcatel Report and Telecom NZ Copper Spectrum Management	Layer10	31-Aug-06

3. Telecom New Zealand Cross Technology Impacts briefing paper

As with the previous papers, the qualitative aspects appear on the surface to be reasonable, however the quantitative aspects leave doubts as to the severity of the issues presented.

3.1. Introduction (slide 2)

As with the previous briefing paper, Telecom proposes to limit the maximum transmission power per frequency channel, and the maximum aggregate transmission power, by 10dB, on some short lines in various circumstances.

The circumstances with regard to binders containing HDB3 services are slightly different to those proposed previously. In the previous briefing paper, all ADSL services in binders containing HDB3 services would be limited in transmission power. In this current paper, only services on short lines would be limited, and services on longer lines will be permitted to operate at full power, even in binders containing 'legacy' (assumed HDB3) services. We note that the later discussion on slide 5 does not indicate that full-power services on longer lines would be accepted, and the difference in definition may be an error arising from attempts to over-simplify a complex technical specification.

In binders without HDB3 systems, and a mix of line lengths longer and shorter than a threshold (25dB attenuation at 160 kHz, which is approximately 2.3 km of 0.4mm reference cable), then ADSL systems on the shorter lines would also be reduced in maximum transmission power. Telecom has not previously indicated which other technology this rule is designed to protect, but later material in this paper appears to indicate that 2312 kbps SHDSL services form the situation Telecom is concerned to protect.

3.2. Why do we need new spectrum rules now (slide 3)

Telecom presents a graph showing the measured distribution of aggregate transmission power across the existing line population, and calculations of the distribution after all lines are set to 'full speed – and uses the calculations to assert that 'the percentage of lines operating at maximum power (will rise) from 7% to 81%'. This assertion is unlikely to be correct.

The distribution of measured power levels appears to accord with our expectations, although the large granularity in the crucial area between 16-20 dBm makes it difficult to draw

comparisons. Telecom does not indicate whether the figures along the 'Aggregate Power' axis represent the centre value or the lower value of the 'bin' – that is, whether the bin labelled '19' contains the services with aggregate power between 18.5 and 19.5 dBm, or the services with aggregate power between 19.0 and 19.9 dBm for example. The distinction is material, as 'aggregate power' is usually measured to a precision of 0.1 dBm, and while it may vary in extreme cases to 20.4 dBm the nominal value within ITU-T G.992.1 for spectrum management purposes is 19.9 dBm.

Telecom indicates in this chart that only those services with aggregate transmission power of 20 dBm are transmitting at full power, and that currently this is 7% of services. In the Alcatel paper in Table 1, Alcatel asserted that 22.7% of all services, or over 86,000 services including around 40,000 'unconstrained' lines were unable to reach their planned speed and so would be transmitting at full power. Clearly, these two sets of figures are not presenting a consistent picture, and if Telecom's assumption that all unconstrained lines would report 20dBm transmission power were correct then we would expect considerably more than 7% of current lines to do so.

In reality, there is scope through variation in gains from channel to channel, and implementation differences between modems for maximum power to vary by several dB up or down. It is common for services operating in an 'unconstrained' manner to nevertheless report aggregate transmission power less than 19dBm. For instance, the popular Linksys range of ADSL modems sold in New Zealand indicates a maximum transmission power of only 18dBm[5], one user measurement indicates transmission power of only 17.9 dBm on a 6km long line with attenuation of 57dB[6], and another user measurement indicates downstream transmission power of 15.96 dBm on a 6.3 km line with SNR margin 7dB[7].

I would expect the distribution of aggregate out put power if all lines were operating at full speed to be similar in many facets to the presented measured distribution, skewed slightly more towards the 19 and 20 dBm columns, but not to the extent presented by Telecom.

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[5] Linksys WAG54GP2 'data sheet' specification, page 2, online at http://tinyurl.com/z6ndy

[6] Whirlpool posting by 'Jock M' (iinet technical staff), 7/9/2006, online at http://forums.whirlpool.net.au/forum-replies.cfm?t=585195&r=9037363#r9037363

[7] Whirlpool posting by 'surferdude', 24-05-2005, online at http://forums.whirlpool.net.au/forum-replies.cfm?t=341026&p=2#r27

Telecom could actually provide the distribution from their own data, by charting the measured transmission power of only those 86,858 services presented in the Alcatel report as not reaching their provisioned data rates. I would expect this chart to mirror the distribution if a larger number of lines were also to be operated in an unconstrained manner.

Given the doubts as to the 'full speed (calculated)' distribution, the conclusion by Telecom that the average noise in all cables could rise by 2.7 dB appears to be tenuous. It is probable that the background noise will rise, but not to this extent on average. We agree with the final point on this slide that symmetric services operating at or below a noise margin of 6dB are at risk – but we would argue that these services are at risk in any case, not just from unconstrained ADSL services but from a general increase in services of all types, and they should be re-engineered to a more sustainable solution regardless of rules surrounding ADSL deployment.

3.3. Our methodology to mitigate the impact on symmetric technologies (slide 4)

This slide reveals Telecom continues to view acceptable ADSL line rates under interference constraints to be 4 Mbps, essentially setting this as a form of 'benchmark' that ADSL should not be driven below. This is consistent with the 'bitrate limited' regime argued for in the UBS proceedings, where an information rate of 3.5 Mbps was proposed. A limit of 4 Mbps does not appear to coincide with views of the rest of the industry.

Other observation regarding HDB3 and SHDSL systems are picked up in later slides in more detail.

We agree with Telecom that bit-rate limiting is unlikely to be effective, and that explicit tone control is not likely to be viable given implementation shortcomings in the ADSLv1 specification.

3.4. Impact of reduced power on HDB3 (slide 5)

In this slide Telecom indicates for the first time that it considers the benchmark performance for HDB3 systems must allow for at least 900 metres for single (unregenerated) spans.

Our modelling concurs with that of Telecom, that 4 full-power ADSL interferers will reduce the effective range of HDB3 services to around 700 metres, while 4 reduced-power ADSL interferers will allow an effective range of 900 metres as required by Telecom.

We are curious as to why, when modelling with other HDB3 services as interferers, Telecom has chosen to model only a single HDB3 service as an interferer. Our modelling with 2 x HDB3 interfering services brings the effective range of HDB3 systems back to 800 metres. In our experience it would be expected that, if a technology has been selected as being appropriate to deliver a particular form of service, that other similar nearby services would be delivered using the same technology. On this basis we would expect a realistically severe model (comparable to the use of 4 ADSL interferers) to use more than a single HDB3 interferer.

We note that Telecom has a number of alternative mitigating steps it might take to preserve services at risk on this situation, without limiting ADSL transmission power. Telecom could redeploy such services using SHDSL technology, which will easily encompass not only a single span HDB3 link, but also replace a repeatered HDB3 link with an unrepeatered SHDSL link. Telecom could also redeploy HDB3 repeaters it might have in inventory, splitting the lines at risk into two segments 400 – 500 metres long, which would permit much higher levels of background noise to be imparted without risking the service dropping below the 6dB SNR threshold.

We note that Telecom has not presented modelling of the expected effect the interference from HDB3 systems will have on the low power ADSL services, and whether the resulting ADSL service will provide acceptable performance, nor any modelling of the effect of another parallel HDB3 service or two on a victim HDB3 service.

3.5. Impact of reduced power on 2316 kbps SHDSL (slide 6)

In this slide Telecom indicates for the first time that it considers the benchmark performance for 2316 kbps SHDSL systems must allow for 2.23 km for single span.

Our modelling is very close to that of Telecom, that a single SHDSL and 4 full-power ADSL interferers will reduce the effective range of SHDSL services to around 1.9 km, however with low-power ADSL interferers instead our modelling give a limit of 2.1 km, not 2.23 km as presented by Telecom.

Moreover, our modelling indicates that it is the SHDSL interferer service which has the greatest impact, not the ADSL services (of any power), as presented in our last report[8]. Even with low-power ADSL interferers, increasing the number of SHDSL interferers to two reduces the

[8] Layer10 (2006), *Comments on Alcatel Report and Telecom NZ Copper Spectrum Management*, 31 August 2006, Figure 2, pp31

effective range of the victim SHDSL service to 1.9km. We are of the view that at least two symmetric interferers should be modelled to simulate an advanced deployment environment with relatively high take-up, equivalent to the environment that justifies modelling four ADSL interferers (implying a broadband penetration around 50%).

Further, we consider the modelling of only low power ADSL services as interferers in this scenario to be optimistic. Telecom's proposed deployment rules in the presence of SHDSL requires low power ADSL only on lines shorter than 2.23km within the bundle, and on longer lines full-power ADSL is permitted. Within an early submission by Telecom in the TelstraClear UBS proceedings[9] they presented a chart showing the distribution of loop line lengths in the New Zealand network. This indicates that approximately 45% of lines are longer than 2.2 km - so a more realistic noise environment for SHDSL services is with 2 x full-power ADSL and 2 x low-power ADSL interferers (along with one or two SHDSL services as well). Under these conditions the full-power ADSL dominates the crosstalk effect contributed by the ADSL services, and the maximum workable range of SHDSL 2316kbps reduces to 1.9km again.

Thus we conclude that these delivery rules for reduced power ADSL, as they are currently expressed, will still not allow SHDSL 2316kbps services to be safely deployed beyond 1.9km, and there remains little benefit in mandating reduced power ADSL to protect SHDSL services in this scenario. Any existing SHDSL services operating beyond ~21dB attenuation at 160 kHz (1.9km equivalent) would appear to be truly unsustainable and should be re-engineered.

3.6. Calibration of the 25dB limit (slide 7)

Telecom re-presents the chart showing the predicted performance of low-power ADSL services on lines shorter than ~2.23 km, and full power ADSL on longer lines. The title of the chart indicates this is under 'modest DSL penetration' but does not specify the precise number and nature of interferers.

Our modelling of ADSL performance, under the influence of 4 x full power ADSL interferers, indicates line-rate performance significantly lower than presented by Telecom by more than a full megabit-per-second. The Telecom chart is possibly with only one or two ADSL services as interferers.

[9] Telecom New Zealand, Draft Copper Loop Spectrum Management Approach vers. 1.5, 10 April 2006, Appendix 4 slide 20

Telecom cites two other jurisdictions – Ireland, which permits SHDSL 2316kbps services up to ~ 2.7 km (of 0.4mm copper cable), and BT in the UK which permits SHDSL 2316 kbps services up to ~2.15 km. Not mentioned is the Australian ACIF rules permitting SHDSL 2316 kbps only up to 1.9km.

We are unsure why this is included, as there has not been any discussion or proposal to limit SHDSL service distances in New Zealand. The proposed service delivery rules being evaluated here relate only to restrictions on ADSL services, not on SHDSL services.

3.7. Practical Implementation (slide 9)

Telecom provides four statements relating to ADSL1 spectrum. We agree with these statements.

3.8. Summary (slide 10)

We agree with Telecom that deployment rules are about balancing tradeoffs and managing risk, and that the precise circumstances will vary between different jurisdictions.

We are not convinced that the tradeoffs have been adequately balanced in the currently proposed rules on ADSL services. As discussed above, when protecting the robust deployment of SHDSL system, the fact that the deployment rules permit the lines interfering with SHDSL services to operate a mixture of full power and reduced power ADSL means that the full-power systems, and/or other SHDSL systems dominate the effect, and reducing the power on only some of the services has little value. As outlined in our earlier report, the only way for reduced power ADSL to be effective in reducing interference on SHDSL services to the extent desired by Telecom is for full-power ADSL services to be eliminated in those binders – a situation not being proposed.

With regard to HDB3 systems, it would appear that Telecom considers less than 20% of services, numbering approximately 1500 in total, are at risk once ADSL penetration approaches 30% – 40% takeup. Even if all the ADSL services in operation were converted to unconstrained operation today they would still represent only approximately 15% of lines, and provide little threat to HDB3 services today. In the time the industry approaches 30% takeup there appears to be opportunity to switch the at-risk HDB3 services to SHDSL, at once both eliminating the risk and reducing the noise environment for nearby services.

4. 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.