



Telecom New Zealand Limited

**Cross Submission in respect of the Commission's draft
determination on the application for access to and interconnection
with Telecom's fixed PDN service ("Bitstream Access")**

8 June 2005

Public version

CROSS SUBMISSION TABLE OF CONTENTS

A	EXECUTIVE SUMMARY	4
B	LEGAL FRAMEWORK FOR THE DETERMINATION	12
	B1 Pricing	12
	B2 Standard access principles and limits	16
C	PROPOSED BITSTREAM SERVICE	18
	C1 Unconstrained Downstream Speed	18
	C2 Interleaving	19
	C3 Reporting to ensure consistency of service	20
	C4 Scope for innovation	23
D	MARKET DEFINITION AND COMPETITION ASSESSMENT	24
	D1 Market Definition	24
	D2 Competition Assessment	30
E	APPLICATION OF THE INITIAL PRICING PRINCIPLE	31
	E1 Introduction	31
	E2 Telecom's Retail Price	31
	E3 Network Strategies Methodology	36
	E4 Imputation Methodology/Regression Analysis	38
F	SUNDRY CHARGES	42

G	NON PRICE TERMS	44
	G1 Retail/wholesale concurrency	44
	G2 Operational support	44
	G3 Static IP addresses	50
	G4 Future bitstream availability in the new areas	50
	G5 Pro ration billing	50
	G6 Rebates	51
	G7 Other non price terms	51
	G8 Term of the determination	52
H	A WORKABLE WAY FORWARD	53
	Annex A – (a) Consistency Reporting – Non Workable Service Parameters; and (b) Critique of Knossos Report	55
	Annex B - Response to TelstraClear’s Comments on the Utility of the Proposed Unconstrained Service with an Interleaving Option	71
	Annex C – Crosstalk and Spectrum Management, by Dr Lee Garth	75
	Annex D – Response to TelstraClear Submission, by Jerry Hausman	91
	Annex E – eOR/eOR for Broadband and LOLO (Australia) Comparison	100

A EXECUTIVE SUMMARY

1. Overall, having reviewed the other parties' submissions on the draft determination, Telecom considers that the key issues going forward for the conference are most likely to be the differences of approach between Telecom and the Commission - particularly Telecom's proposed way forward. The key issues which Telecom sees as necessary for resolution at the conference are summarised at the end of this executive summary.
2. TelstraClear's submission largely supports the Commission's draft determination and perhaps for this reason it adds little substance to the essential issues the Commission has to decide. To the extent TelstraClear has suggested changes to the draft determination (primarily on the application of initial pricing principle and OSS) Telecom considers there are good reasons not to follow TelstraClear's approach. In this cross submission Telecom will address the main points TelstraClear has made and, where necessary, will comment on the other points made by submitters.

There are positive broadband trends in New Zealand

3. Broadband acquisition is increasing in New Zealand. There are a wide range of broadband offerings from a number of different providers.¹ Eleven wholesale customers are actively selling Telecom's commercial UBS offers. Sixteen wholesale customers provide wholesale JetStream. This has meant that take up of broadband through wholesale providers has and continues to steadily trend upwards. As a result Telecom retail is steadily trending downwards in line with the position in Australia and the UK to which TelstraClear refers. The following graph evidences the New Zealand trend.²

¹ These are set out in Annex G of Telecom's May submissions.

² This graph compares retail and wholesale take up of broadband in New Zealand. Wholesale includes wholesale JetStream and commercial UBS but excludes broadband take up via the Partnering Profile. Jetstream Starter is also excluded.

[

]**TCNZRI**

4. As TelstraClear acknowledges, the MED found that New Zealand residential broadband prices compare well with the OECD average. In the three months to 31 March, 23% of new connections were through wholesale customers. Notwithstanding TelstraClear's absence in the market, the trend continues. In April, wholesale uptake reached new heights taking [] **TCNZRI** of the growth in that month. These are signs of healthy competition even in the absence of TelstraClear and access seekers are actively competing based upon Telecom's current commercial UBS prices.
5. The launch of Telecom's commercial 1 Mbps and 2 Mbps business UBS variants provide continuing options for wholesale customers and ultimately, business end-users. Telecom's revised business retail plans have followed the downward trend by reduced prices and greater value being provided to those business customers. Equally, with the retail minus regime specified in the UBS service designation, these favourable retail trends will be passed through to the UBS wholesale prices.
6. TelstraClear's submission that the Commission needs to "go further" than it has in its draft determination is premised on an unduly negative view of the state of broadband competition in New Zealand³. For the reasons just cited, this view is not supported by the facts and should not influence the Commission in its final determination.

³ Paragraph 1 TelstraClear May submissions.

Single price not consistent with the Act

7. TelstraClear suggests in its submissions that the Commission should set a single price for the designated service regardless of either speed or type of end user. Telecom has already made submissions to the effect that a single price regardless of speed would be contrary to the long term benefit of end users and extending this to a single price regardless of the type of end user makes this even worse. Telecom believes that it is demonstrably more likely to be in the best interests of end users for separate prices to be defined both in terms of whether an end user is a residential or a business customer and in terms of speed.
8. TelstraClear's proposal would see the choices for end users reduced, product innovation stifled and uptake decreased. Requiring a single UBS product to be sold at a single price in residential and business markets (or across those markets as TelstraClear now suggests) means that the market will converge to a single product at a single price. As a result, prices will rebalance such that the lowest priced broadband services (where the majority of uptake continues) may increase in price resulting in stifled demand. The result will be reduced consumer welfare which, as the Business Roundtable⁴ points out, reduces investment incentives.

Claims of high prices not relevant or supportable

9. TelstraClear's assertion that the wholesale price under the Commission's draft ends up being "uncompetitively high", also does not withstand analysis.
 - (a) There is no statutory basis for the Commission to even embark upon an exercise of imputing out Telecom's so called "excessive rents" and to do so would be flawed from a legal perspective.
 - (b) Telecom believes that any adjustment for excess rents in the imputation process is at odds with the retail minus test adopted in the initial pricing principle and would put at risk the investment outcomes which the retail minus construct was designed to preserve. The justification put forward by TelstraClear for making such adjustments appears to be that clause 3(1) of the first schedule "directs the Commission to strip out excess rents". However clause 3(1) only applies to excess profits associated with the retail operations of Telecom and clearly contemplates that such excess profits will be dealt with as part of the avoided costs saved calculations in terms of the

⁴ Business Roundtable submission on the draft determination – *"In summary, we are concerned that the proposed limitation on pricing flexibility could reduce economic efficiency. For example, it might increase prices for some users and reduce effective service choice for others, while also deterring future investment in infrastructure."* and *"In conclusion, we urge the Commission once again to focus on dynamic efficiency, particularly on the need to provide adequate incentives for investors to invest in infrastructure for the long-term benefit of end users, rather than on inducing parasitic competition for existing infrastructure."*

final pricing principle and the benchmarking exercise in relation to the initial pricing principle.

- (c) TelstraClear goes on to suggest that such excess profits can be stripped out by simply excluding them outright from the imputation process. Even if it were appropriate to strip out excessive profits in the imputation process, Telecom does not believe that it is consistent with the regulatory regime to exclude otherwise comparable services from the imputation process on the basis that their prices might be considered too high.
- (d) Quite apart from the legal flaws in TelstraClear's approach, there is no evidence before the Commission on which it can reliably conclude that there are such excessive rents.
- (e) The attack on Telecom's so called excessive rents appears to be the introduction of a new complexity advocated by TelstraClear and a transparent attempt to persuade the Commission to further reduce the imputed retail price to commercially advantage TelstraClear on a basis that has no legal or factual merit.

Simplistic Approach to Regression Analysis

- 10. TelstraClear's submissions (through Network Strategies) on the Commission's regression analysis also do not stand up to scrutiny.
- 11. TelstraClear criticises the Commission's imputation methodology and suggests a methodology which it claims "more effectively and robustly addresses the deduction of the national and international capacity and the risk of excessive rents".⁵ Telecom agrees that there are concerns with the Commission's methodology but equally believes that there are concerns with the methodology suggested by TelstraClear, and does not believe that it appropriately deals with national and international capacity or the risk of excessive rents.
- 12. TelstraClear has suggested that the Commission should err towards underestimation of the wholesale access price rather than overestimation. Telecom does not consider this is appropriate especially given the possible detriments to consumer welfare of underestimation. Telecom considers that the Commission should, as far as possible, attempt to take a balanced view without bias towards either underestimation or overestimation of the initial price.

⁵ Paragraph 3(d) of TelstraClear's May submissions.

No need for interim OSS solution

13. The Commission took a reasonable approach to the OSS issue in its draft determination by concluding that Telecom must provide a level of operational support to TelstraClear whether manual or automated, such that there is no material difference in provisioning or fault repair in regard to the retail customers whether the retail services are reliant on bitstream access supplied to TelstraClear or Telecom.
14. While purporting to endorse this approach, TelstraClear spends a significant part of its submission arguing for an interim OSS solution that will provide for an electronic exchange of data. TelstraClear's premise for needing an interim solution is that current OSS is holding it back from entering the market – a claim which does not stand up to scrutiny in light of the successful entry of many far smaller players. Given the ongoing development of eOR, and additional functionality provided by eOR for broadband, as well as the commitment to consistency between retail and wholesale there is simply no need to move to the electronic data exchange process that TelstraClear has outlined in its submission. TelstraClear requests a far greater involvement of the Commission in the development of OSS solutions than the Commission has proposed and than Telecom considers necessary or desirable in the New Zealand context.
15. TelstraClear requests that the Commission determine liabilities for costs associated with any OSS even if this is left to the industry or the parties.⁶ Clearly it would be inappropriate for the Commission to deal with the costs of any matter on which the detail and substance has not been worked through.

Resolved issues

16. A number of the issues raised by this application have largely been resolved in the regulatory process to date as set out below.
 - (a) Telecom and TelstraClear are agreed that the proposal for an unconstrained (non rate shaped) service is out of step internationally;⁷
 - (b) Consistency between retail and wholesale for ordering, provisioning and fault repair is agreed. Telecom has confirmed that current processes are colour-blind as between retail and wholesale. Details as to the implementation of eOR for broadband and Singleview have also been provided;
 - (c) In response to the determination process Telecom has confirmed that advice as to the future availability of service is available on the Wholesale

⁶ Paragraph 110 of TelstraClear's May submissions.

⁷ Paragraph 10 of TelstraClear's May submissions.

JetStream & UBS LineCheck Toolkit.⁸ Telecom has also offered to agree with TelstraClear additional advance notice of upgrades to ADSL in a way which is consistent with retail;

- (d) Pro ration billing at wholesale will occur as soon as the current IAF billing system (the existing technical limitation) is replaced by Singleview. This replacement process is underway;
- (e) Telecom agreed with the Commission's view on rebates.⁹ TelstraClear has confirmed that its original request for rebates is effectively withdrawn;¹⁰
- (f) The parties are agreed that wholesale markets are derived demand for the retail service. Accordingly, an analysis of the retail market is logically prior to the definition of the wholesale market and the geographical scope of the wholesale and retail markets should be the same;¹¹
- (g) Charges for reassignment and new connections are appropriately charged on a retail minus basis as proposed by the draft determination. The parties and the Commission are agreed.
- (h) Telecom supports the Commission's proposal for a revision of the bitstream access prices.¹² As retail prices change over time this will enable a flow through to the wholesale prices. For example, if retail prices continue to trend downwards it is appropriate that these flow through to retail. TelstraClear has not commented so it is inferred that they have no objection to a revision mechanism; and
- (i) Benchmarking – Telecom is not challenging the draft determination and TelstraClear is not (explicitly) doing so.

Issues to be left to commercial negotiation

17. Preserving incentives to negotiate and thus the benefits and flexibility that commercial arrangements can bring, is an important principle. Telecom supports the Commission's approach to filtering those issues on which it should determine and those which it should leave to the parties. The parties should in this case be able to agree the following outside the determination process:

⁸ Paragraph 399 Telecom's May submissions.

⁹ Paragraph 299 of the draft determination and paragraph 405 of Telecom's May submissions.

¹⁰ Paragraph 122 of TelstraClear's May submissions.

¹¹ Paragraph 29 of TelstraClear's May submissions.

¹² Paragraph 367 Telecom's May submissions.

- (a) All sundry charges, namely new connection, MAC¹³ and reassignment charges;
- (b) Any additional non price terms;
- (c) Detailed implementation matters to ensure consistency of OSS as the draft determination proposes; and
- (d) Any future interleaving option. The evidence before the Commission sets out the potential adverse risks of an interleaving option evidenced by overseas experience. There is no evidence before the Commission that provides confidence that these risks are minimal. Notwithstanding the apparent lack of interest from the rest of industry, if the Commission considers that an interleaving option should be further considered, Telecom requests that a test be permitted, following which, the parties can discuss commercially. The backstop regulatory process remains in place if commercial negotiations are not concluded. This proposal from Telecom is consistent with that taken by other regulators in relation to issues that potentially adversely impact on the network and ultimately end users.

Remaining areas for focus at the conference

18. The key areas for focus for the Commission's determination process are:
- (a) The downstream speed configurations for regulated bitstream access (The submissions of other parties add little to the technical debate on this point);
 - (b) Whether the standard access principles permit the Commission to mandate an interleaving option on the evidence available and whether mandating an interleaving option gives best effect, or likely to give best effect to the section 18 purpose;
 - (c) Reporting to ensure consistency of service by reference to the common network between wholesale and retail – resolution of the service parameters and whether it is possible to demonstrate consistency where the regulated service is fundamentally inconsistent with the retail service (Telecom notes that submitters who have focused on service parameters in isolation from the proposed unconstrained service with an interleaving option have pursued avenues based on misunderstandings which are unworkable);
 - (d) The appropriate, geographic dimensions of the relevant markets and the consequential effect this has on any competition assessment;

¹³ Moves, adds and changes.

- (e) Imputation of the retail price – both the legal and economic issues; and
 - (f) Telecom's proposed way forward as a fair and workable alternative to the draft determination.
19. Telecom considers that it would be expedient for the Commission to issue further preliminary views on (c) and (e) above with advice as to the conference format at the earliest opportunity. Telecom suggests that doing so will enable a focused conference and will avoid submissions being requested and/or required post the conference.
 20. These submissions respond to TelstraClear's submissions on the draft determination dated 20 May 2005 ("**TelstraClear's May submissions**") and the submissions of other interested parties. The content of these submissions are an update on Telecom's 20 May 2005 submissions ("**Telecom's May submissions**"). Telecom does not reiterate previous submissions but does provide cross references to assist the Commission.
 21. The rest of Telecom's cross submissions largely follow the section headings in Telecom's May submission for ease of cross reference between the two.

B LEGAL FRAMEWORK FOR THE DETERMINATION

B1 Pricing

Introduction

22. This section is limited to legal issues arising from the submissions on the draft determination.
23. The section in TelstraClear's May submissions which deals with the initial pricing principle is flawed. TelstraClear appears to be seeking an application of the initial pricing principle which is both contrary to the long term benefit of end users and contrary to the language of the Act. It is crucial that the initial pricing principle is applied correctly and in accordance with the purpose set out in section 18.

Section 18

24. The draft determination is inconsistent with sections 18 and 19 of the Act.¹⁴ TelstraClear's proposed adjustments to the application of the initial pricing principle only serve to exacerbate the problems under sections 18 and 19 for the reasons explained below.
25. TelstraClear appears to agree with the Commission that a single access price regardless of speed should be imputed. TelstraClear goes further however and proposes the imputation of a single imputed retail price for residential and business end users.
26. While TelstraClear can be expected to benefit commercially from having a single access price regardless of speed or end user, the Act is not designed to benefit individual competitors but rather for the long term benefit of end users as set out in section 18 of the Act. The Commission must always have this end in view as emphasised in the paper by Professor Hausman at Annex D of this cross submission.¹⁵
27. Telecom has already expressed the view in its earlier submissions on the draft determination that different prices for different speed variants would be significantly more likely to promote competition for the long term benefit of end users in accordance with section 18 than would a single access price regardless of speed. On that point Telecom reiterates its earlier submissions and the analysis in the paper by Professor Hausman at Annex C of those submissions.¹⁶

¹⁴ At paragraphs 22 to 23.

¹⁵ Annex D at paragraphs 1 to 2.

¹⁶ Refer section E1.3 of Telecom's May submissions. Also refer to the remainder of section E1 for other concerns with a single access price regardless of speed.

28. Telecom agrees with the Commission's views on price discrimination between residential and business end users:

"Separate bitstream access prices for ultimate supply to residential and business end users who purchase broadband services from access seekers using the bitstream access as a wholesale input is unlikely to hinder materially service innovation or prevent further price discrimination of end-user services."

29. The importance of maintaining a split between business and residential users is discussed in a further paper by Professor Hausman at Annex D. In summary, Professor Hausman points out that there are different price elasticities of demand for residential and business users and both groups have quite mixed preferences for different speeds of broadband, hence offering differential prices to the two groups for the similar plans increases uptake and is in the long term best interests of end users. It is not in the interests of end users for regulatory arbitrage (to give TelstraClear "flexibility") to remove price discrimination and fail to maximise the long term best interests of end users.¹⁷
30. Accordingly, Telecom does not believe it is to the long term best interests of end users for the Commission to define a single price regardless of speed or end user as requested by TelstraClear but rather that it is more likely to benefit end users in the long term for separate prices to be defined both by user and by speed.

Initial Pricing Principle

31. The Commission considered the pricing of a bitstream access service as part of the local loop unbundling investigation and concluded that it was most appropriate to adopt a retail minus pricing principle in order to encourage further investment in the network.¹⁸ The retail minus approach was carried forward into the Act in both the initial pricing principle and the final pricing principle for access to the fixed PDN. The Commission is required to consider the initial pricing principle for the purposes of the current application for access to the fixed PDN and it is convenient to again set out the initial pricing principle:

"retail price (as imputed by the Commission having regard to any comparable service) less a discount benchmarked against discounts in comparable countries that apply retail price minus avoided costs saved pricing in respect of the service".

32. It would appear that TelstraClear is attempting to relitigate the retail minus approach by seeking to have the Commission interpret the initial pricing principle in a way that any excess rents earned by Telecom at retail are removed at the imputation stage. This notion is articulated best in the report by Network Strategies at Annex III of the TelstraClear submissions:

¹⁷ At paragraphs 6 to 7.

¹⁸ At paragraphs 39 to 41.

*"Clearly the Commission should seek to impute a retail price as a starting point for the 'retail-minus' calculation that does not carry through high retail pricing (and excess profits), caused by a lack of competition, into the wholesale price."*¹⁹

33. Such an approach is at odds with the retail minus construct and is more akin to rate of return regulation for the reasons explained by Professor Hausman at Annex D.²⁰ TelstraClear appears to justify this on the basis of clause 3(1) of the First Schedule to the Act:

*"The Act does not take the approach that the regulator need not worry about excessive profits because 'they will be competed out eventually'. Instead, clause 3(1) of Schedule 1 directs that the Commission strip out excess rents in setting both the initial and final prices."*²¹

34. Clause 3(1) provides:

"In relation to a telecommunications service, in applying an applicable initial pricing principle or an applicable final pricing principle that takes a retail price for the service and subtracts any avoided costs saved by the applicable access provider of the service, the applicable access provider is not entitled to recover any of the following things in respect of those costs that form part of the avoided costs saved associated with its retail operations:

- (a) inefficiencies in the provision of the service giving rise to higher costs:*
- (b) profits in excess of what would represent a reasonable return (including reasonable profit) on capital invested."*

35. When clause 3(1) is viewed in its entirety, it becomes clear that any adjustment for excess rents was intended to be made not in respect of the imputed retail price but in respect of the avoided costs saved associated with the retail operations of Telecom. As such, it is inconsistent with the language of the Act for TelstraClear to suggest that the removal of excess rents should be made at the imputation stage.
36. Perhaps even more importantly, an adjustment for the removal of excess rents under the initial pricing principle would already have been made under the benchmarking exercise to the extent that the overseas jurisdictions selected for the benchmarking exercise include an allowance for excessive rents. Any other explicit adjustment for excess rents contemplated under clause 3(1) would effectively result in 'double counting' and cannot have been contemplated by clause 3(1).
37. TelstraClear's advisors are also misapplying the initial pricing principle by confusing a costs based approach with a retail minus approach. The Network

¹⁹ At page 7.

²⁰ At paragraphs 13 to 14.

²¹ At paragraph 45.

Strategies report says that it is appropriate to adjust for excess rents on the following basis:

"pricing strategies – especially for unregulated services – may be far more complex than being purely cost-based. While covering costs is the usual objective (at least in the medium to long term), other aims that may influence pricing include:

- *increasing market share...*
- *positioning the services relative to other products and services...*
- *creating some perceived additional value for consumers, and pricing at a premium that reflects this perceived value*
- *maximising profit (pricing what the market will bear).*

If the pricing principle being used for wholesale products is pure 'retail-minus' then the above retail pricing strategies will be embedded within the resultant wholesale prices."

38. Contrary to what is being suggested by Network Strategies, the initial pricing principle *is* a retail minus approach and not a cost based approach and it is entirely appropriate for the retail price to take into account factors other than cost. Indeed that is necessary in order to achieve the investment outcomes which the retail minus regime was designed to preserve. Telecom has explored this in greater detail in its May submissions.²²
39. For these reasons Telecom submits that it is inconsistent with the Act for the Commission to interpret the initial pricing principle in the manner suggested by TelstraClear and Network Strategies. Excess profits associated with the retail operations of Telecom will be dealt with as part of the avoided costs saved calculations in terms of the final pricing principle and will already have been adjusted for through the benchmarking process in relation to the initial pricing principle.
40. In any event, Telecom strongly disputes that it is earning excess rents in respect of its retail broadband offerings for the reasons set out in the section in these cross submissions on the initial pricing principle.

Underestimating Initial Price

41. TelstraClear suggests that the Commission should underestimate the initial price on the basis that underestimation does less damage to the long term best interests of end users than overestimation:

"Accordingly, if the Commission has underestimated Telecom's costs, Telecom can be compensated when the final price is set. Given the long lead times involved in making investment decisions, it is unlikely that Telecom will be discouraged from investing as a result of the application of an initial access price which turns out to be too low... However, an initial wholesale price that turns out to be too high on final review is likely to delay market entry and keep prices high during the period pending the final price review."²³

²² At paragraphs 38 to 42.

²³ At paragraph 52.

42. Telecom does not believe it is appropriate to underestimate or overestimate the initial price but rather the Commission should attempt as far as possible to take a balanced view without bias towards either underestimation or overestimation.²⁴ Both overestimation and underestimation are problematic. TelstraClear seems to have disregarded the dynamic efficiency problems which would be caused by the underestimation of the initial price. An initial price which is too low could delay any investment Telecom would have otherwise been planning to make to the detriment of the long term best interests of end users - especially since Telecom expects the initial pricing principle to apply for three years on the basis of current experience.
43. Furthermore setting an artificially low wholesale price during the initial pricing principle would effectively prevent Telecom from remaining competitive with access seekers. It could be the beginning of a regulatory distortion with Telecom continually having to reduce its retail prices to compete effectively with access seekers who have an artificially low cost base and one which gets progressively lower as Telecom reduces its retail prices. This would make it rational for Telecom to withdraw the product from the market at both retail and wholesale until the price review was completed, again to the considerable detriment of the long term benefit of end users.
44. In these circumstances Telecom believes that the dangers associated with an artificially low wholesale price outweigh those associated with an artificially high price. However Telecom recognises that both could have distortionary effects and that the Commission ought not to accept a submission to have a conscious bias on this issue.

B2 Standard Access Principles and Limits

45. Telecom has provided detailed evidence to the Commission as to certain and potential adverse technical, operational, legal and economic consequences of a proposed unconstrained service with an interleaving option.²⁵ To date no evidence has been placed before the Commission by other parties that counters Telecom's evidence in this respect. The Commission will need to reach its final determination with due regard to the weight of the evidence on these issues.
46. TelstraClear makes a number of references to the term 'equivalence'²⁶ and the term 'key performance indicators' in its non price terms section.²⁷ It is important that use of these terms does not obscure or alter what the Act in fact prescribes. The standard access principles provide:

²⁴ The Commission should also remain cognisant of the previous discussions on these issues and its previous rulings.

²⁵ Section C1.2 and C2.2 Telecom's May submissions.

²⁶ Paragraphs 5(d), 104 and 109 TelstraClear's May submissions.

²⁷ Paragraphs 74 and 75 TelstraClear's May submissions.

"the access provider must provide the service on terms and conditions (excluding price) that are consistent with those terms and conditions on which the access provider provides the service to itself."

47. The focus should be on consistency- not equivalence or otherwise. The Commission should ensure that it bears these distinctions in mind in reaching a final determination. The parties and the Commission are agreed that consistency should be with Telecom's retail services.
48. Telecom recognises that it may be useful to have parameters against which service levels provided to TelstraClear can be compared with the service Telecom provides to itself, but beyond that, the service parameters create no obligations on Telecom and it is potentially misleading to attribute terms other than consistency.

C PROPOSED BITSTREAM SERVICE

C1 Unconstrained Downstream Service

49. Not surprisingly, TelstraClear supports the Commission's proposal to require Telecom to provide an unconstrained service, although TelstraClear acknowledges that such a service is out of step internationally and offers up no evidence that assists in negating the potential adverse impacts such a service will cause.²⁸
50. A requirement to provide an unconstrained service would significantly impair Telecom's ability to manage its network.²⁹ The management of the shared resources within Telecom's network (such as the copper cable sheath and DLSAM) is a task that can only be performed by one party, Telecom. While TelstraClear is understandably concerned only with its own customers, Telecom must manage these shared resources for the benefit of all users, including both its retail and wholesale customers.³⁰
51. Telecom has provided detailed submissions throughout this process about the potential adverse affects that an unconstrained service may have on its network, and in particular, the reduction in reach that will be the unavoidable trade off associated with such a service.³¹ Telecom has provided further support for this in the report of Dr Lee Garth of the University of Canterbury who explains that if increased noise and crosstalk are not managed properly as more and more high bit rate ADSL subscribers are added to the network this can lead to severe performance degradation. Dr Garth's report is attached as Annex C to these cross submissions.
52. Other parties (including their experts) have not (to date) provided evidence to rebut the technical arguments brought by Telecom. In reaching its final determination the Commission will need to factor in the weight of evidence in relation to these technical issues and have due regard to Telecom's position as the network operator which makes it well placed to project the potential risks associated with the proposed service.

²⁸ Paragraph 68 of TelstraClear's May submissions.

²⁹ Paragraph 101 of Telecom's May submissions.

³⁰ Paragraphs 98 to 101 of Telecom's May submissions.

³¹ Section C1.2 of Telecom's May submissions.

C2 Interleaving

53. Similarly, TelstraClear supports the Commission's proposal to require interleaving to be turned on or off on a per port basis without addressing technical issues.³²

Rest of the industry neutral on interleaving

54. Submissions on the draft determination indicated that the rest of the industry do not regard optional interleaving as a priority. In particular, InternetNZ states that its inquiries "indicate that many Access Seekers will choose to leave interleaving on in most instances, in view of overall improved performance..."³³ and ihug states that "we do not see interleaving as an issue of concern provided Telecom is required to meet the performance criteria in Appendix A".³⁴
55. As Telecom explained in its May submission, Telecom's current policy is to have interleaving turned on for all of its ADSL services. Telecom does not have actual field experience with having interleaving turned off or with a hybrid environment. The evidence to date points to a number of potential adverse consequences that might occur if interleaving is simply turned off as the draft determination proposes.³⁵ Telecom has obtained information from another network operator that provides further evidence that turning interleaving off will have a detrimental impact on packet loss, and will make comparison against services with interleaving on difficult. Telecom does not have authority to provide this information to other operators, but would be prepared to provide it to the Commission on a "Commission Only" basis. The potential adverse consequences of turning interleaving off create an unacceptable risk for a prudent regulator to take in the absence of clear evidence that these risks can be mitigated and, if these events occur, how Telecom is to deal with them.
56. Given the apparent lack of interest in optional interleaving by other members of the industry, and the potential adverse consequences that might occur if interleaving is turned off, Telecom requests the Commission to reconsider its proposal to require optional interleaving. Should the Commission be minded to pursue an interleaving option, it must have regard to the evidence before it as to the potential impacts. Telecom requests that testing occur first. Following that the parties should deal with interleaving as a matter of commercial negotiation.

³² Paragraph 115 of TelstraClear's May submissions.

³³ Paragraph 9.2 of InternetNZ's submission.

³⁴ Page 5 of ihug's submission.

³⁵ Refer to section c.2 of Telecom's May submissions.

Cost involved with turning interleaving off

57. TelstraClear's submissions do not fully reflect the costs associated with turning interleaving off. There are currently three different types of DSLAMs in Telecom's network and each type of DSLAM handles interleaving in a slightly different way. All provisioning of the DSLAMs is handled through appropriate support systems which use profiles to manage service characteristics. It is therefore not just a matter of remote keystroke entry. There will also be an initial set up cost associated with creating the additional profiles required, and transaction costs equivalent to a MAC for each request to turn interleaving on or off. If Telecom is required to implement optional interleaving through any means other than standard profiles, there will be significant up front costs required to develop systems to manage this process. Even with this profile management approach there are additional complexities caused by the profile limits associated with each DSLAM type that will need to be carefully managed.

C3 Reporting to ensure consistency of service

Fundamental problems with the reporting regime yet to be resolved

58. Telecom's May submission outlined two fundamental problems with the reporting regime proposed by the Commission:
- (a) It is not possible to provide meaningful reporting on consistency between Telecom's retail services and the unconstrained service proposed in the draft determination. This is because the proposed service and Telecom's retail services are fundamentally different so it is like comparing apples with pears; and
 - (b) It is not possible to provide meaningful reporting on consistency between Telecom's retail services and a service with interleaving turned off. This is because it will not be possible to gather statistical information in the reporting process which is comparable to the statistical information gathered on Telecom's retail services.³⁶
59. Furthermore, Telecom has advised that there is first order consistency between retail and wholesale through network design and management. To date, none of the other submissions on the Commission's draft determination have addressed these issues.
60. In addition, as Telecom noted in its May submission, the criteria at Annex A of the draft determination do not meet the Commission's objective (or that of the relevant Standard Access Principle) of ensuring consistency of service as between

³⁶ Paragraph 163 of Telecom's May submissions.

wholesale and retail. Instead those parameters, and the submissions of other parties on them, introduce substantial complexity about reporting of consistency and the bitstream service that is proposed.³⁷ In both cases Annex A does not work with the proposed unconstrained service. For example, the definition of contention ratio simply makes no sense. It cannot be defined in relation to an unconstrained service other than by reference to the maximum theoretical downstream speed. There are also difficulties with the limits set out in the UBS service designation in relation to the minimum of 32 kbps and an average of not less than 256 kbps.³⁸

61. Telecom has responded at a high level to some of the submissions made by TelstraClear and other parties in Annex A to these cross submissions. In particular Telecom has addressed the report attached to the submissions of Internet New Zealand on the service parameters - see Annex A (part b) of these cross submissions.
62. Telecom considers that if the detail on the correct service parameters is to be sensibly progressed at the conference the Commission should consider all of the comments and confirm exactly what it is that it is seeking to achieve and how (bearing in mind the contradictions that currently exist). Telecom notes that the submission made by Medialab is the most constructive of the third party submissions.
63. There will be significant costs associated with the introduction of any reporting regime, such as that outlined in Telecom's May submission, or that proposed by Medialab (potentially millions of dollars). The actual cost may not be known until a decision is reached on what is required to be measured and reported, and secondly until a baseline report is designed. Telecom has estimated that it will take 90 days to provide a baseline report following the determination. Until such costs are known, Telecom reserves the right to further submit on these costs.

Reporting regime proposed by Telecom goes further than those used in other countries

64. As detailed in Telecom's May submissions, reporting to ensure consistency of service becomes workable once apples and apples are being compared. Preliminary views on how this might occur are set out in paragraphs 181 to 189 of those submissions.
65. When the Commission is considering the submissions of other parties (which extend and complicate the reporting regime) it should bear in mind that the regime proposed by the Commission already goes much further than those used in

³⁷ Subject to Telecom's comments in section B about the use of the term "equivalence", Telecom agrees with the comments made in paragraph 51 of the Knossos report that the focus should be on equivalence, rather than specific metrics.

³⁸ See paragraphs 10 to 15 of Telecom's May submissions.

other countries. For example, Telstra and BT only report on the contention ratio of their comparable wholesale bitstream services and do not provide any form of measurement around delay variation, packet loss and latency.

66. Telecom re-iterates that, subject to resolving issues around service comparability and the details of the parameters, it is willing to provide reporting to ensure consistency of service on the cost basis set out in paragraph 189 of its May submissions. Some of the comments around 99% and better confidence limits on the measurements make no sense as they would require very high sampling rates which would be prohibitively expensive to implement. Of course, any regime the Commission proposes will form part of the input to determining sampling rates and confidence intervals. Telecom expects to identify, via expert advice, the optimum sampling rates required to achieve valid confidence intervals at a reasonable cost during the preparation of the baseline report.

Attempts to expand the reporting regime inappropriate

67. TelstraClear appears to be trying to extend the scope of the reporting regime beyond what was proposed by the Commission to other operational matters.³⁹
68. The draft determination proposes that "Telecom should be required to provide regular reporting on key service parameters *to ensure consistency of service is achieved*" and that "specific service parameters should be measured on Telecom's underlying network at OSI layer 2, *common network* supporting Telecom's provision of its own layer 3 retail Jetstream service, and bitstream access to wholesale customers at layer 2."
69. It is clear from this that the sole focus of the reporting regime is the technical service parameters outlined in Annex A of the draft determination. The Commission has not proposed nor consulted on reporting on other matters. The reporting regime envisaged by the Commission does not extend to ordering, provisioning or fault reporting as suggested by TelstraClear in its submissions. The Commission has already said that these operational matters have to be dealt with on a consistent basis and section G of this submission, and Telecom's May submission, outlines how this is achieved.
70. Service parameters of the kind suggested by TelstraClear are not necessary and would simply drive additional cost for no benefit. Telecom already has service levels around ordering, provisioning and fault reporting in its wholesale services agreement. Telecom suggests that these service levels could be made available to TelstraClear in the same way as for the rest of the industry.

³⁹ Paragraph 75 of TelstraClear's May submissions.

C4 Scope for innovation

71. Telecom disagrees with TelstraClear's submission that the proposed unrate shaped service, together with the requirement to turn interleaving off, will provide competitors with substantial scope to innovate.⁴⁰
72. In its submissions on the draft determination Telecom commented on the utility of an unconstrained service given that none of Telecom's copper access lines will synchronise to a downstream speed of more than 7.6Mbps and then only about 20% of lines will achieve that rate (and this will further decline over time due to increasing noise within the copper cable sheath).⁴¹ Telecom submitted that the actual downstream rate achieved for the majority of lines will be between 2Mbps and 4Mbps .
73. Telecom has provided a revised version of TelstraClear's Figure 6 in Annex C to this submission which clearly illustrates that an unrate shaped service with interleaving off will not offer significant benefits in terms of end user experience over a rate limited service with a downstream speed of about 3 Mbps.

⁴⁰ Paragraph 68 of TelstraClear's May submissions.

⁴¹ Paragraph 129 of TelstraClear's May submissions.

D MARKET DEFINITION AND COMPETITION ASSESSMENT

D1 Market Definition

74. It appears to be agreed that:
- (a) the demand for wholesale broadband internet access products is derived from the demand for retail broadband internet access products. Accordingly, an analysis of the retail market is logically prior to the definition of the wholesale market and the boundaries of the wholesale and retail markets will generally correspond to each other;⁴²
 - (b) the product dimension of the retail market includes, at a minimum, asymmetric broadband internet access services supplied over ADSL fibre, coaxial cable and fixed wireless access; and
 - (c) 3G wireless mobile broadband internet access services are not yet a close substitute for the broadband internet access services referred to in paragraph (b) above.
75. The following matters are not agreed by Telecom:
- (a) that asymmetric and symmetric broadband internet access services are supplied in different retail and wholesale product markets;
 - (b) that the geographical scope of the relevant retail and wholesale markets is national; and
 - (c) that Telecom faces limited competition in the wholesale and retail markets for the supply of broadband internet access products in metropolitan areas of New Zealand.
76. Telecom responds only on these points as an update to its May submissions.

Asymmetrical & symmetrical broadband internet access services are supplied in the same retail and wholesale market

77. TelstraClear is incorrect to claim that "demand and supply side factors strongly point to symmetrical and asymmetrical services being in separate markets".⁴³ The evidence supports the opposite conclusion: that asymmetric and symmetric broadband internet access services do compete in the same retail and wholesale product markets in New Zealand.

⁴² Paragraph 29 of TelstraClear's May submissions.

⁴³ Paragraph 20 of TelstraClear's May submissions.

Demand Side

78. On the demand side, a "symmetrical" broadband service simply means, to a broadband customer, that the service has the same upstream and downstream speed. "Asymmetrical" broadband services have different upstream speeds that are generally slower than the downstream speeds offered.
79. Broadband customers in New Zealand enjoy a wide variety of broadband plans and prices to choose from, that have a mixture of different upstream speeds, downstream speeds and data usage allowances.⁴⁴ Prices vary mainly because of the different speeds and data usage allowances offered on each plan.
80. Differentiated products are a sign of healthy competition in this product market, rather than a sign of many different product markets separated by false distinctions such as symmetrical versus asymmetrical speed offerings.
81. TelstraClear claims that higher prices for symmetrical broadband internet access plans vis-à-vis asymmetrical broadband plans is evidence that asymmetrical and symmetrical products are supplied in different product markets.⁴⁵
82. As a matter of economic theory, it is not correct to automatically take differing price points of products as "evidence" that products are not competing against each other in the same market. Different product prices can simply be a sign of different quality levels for products competing in the same market. It is the latter explanation that fits the case at hand: customers gain a faster upstream speed with the symmetric products offered in the New Zealand market, thus any higher prices witnessed for symmetrical broadband products are in fact explained by the higher quality of these services.
83. Furthermore, the evidence does not support TelstraClear's claim that symmetrical broadband plans are systematically priced higher than asymmetric broadband plans.
84. Telecom has taken the business broadband plans offered by the competitors named by TelstraClear at paragraph 21 of its May submissions, and compared the pricing of their business broadband plans.
85. The most striking feature of this review is the wide variety of business broadband plans available to suit the needs of business broadband customers in the market. The second striking feature is how competitively priced symmetric broadband internet plans are, particularly if a broadband customer values large data caps.

⁴⁴ See Annex G of Telecom's May submissions.

⁴⁵ paragraph 21 of TelstraClear's May submissions.

This is in direct contrast with TelstraClear’s claim that symmetric plans are systematically more expensive in the New Zealand market.⁴⁶

Comparison of TelstraClear’s selection of business broadband offerings by firm, ranked by speed (symmetric plans marked in italics)

Company	Plan	Speed		Usage Allowance	Price per month (excl. GST)
		Down	Up		
Telecom	Xtra Jetstream Venture 3 GB	256kbs	128 kbps	3 GB	\$79.95
<i>Wave Internet⁴⁷</i>	<i>Wired Wave</i>	<i>1 Mbps</i>	<i>1 Mbps⁴⁸</i>	<i>25GB</i>	<i>\$249</i>
<i>TelstraClear⁴⁹</i>	<i>HighSpeed Internet</i>	<i>Up to 2 Mbps</i>	<i>2 Mbps⁵⁰</i>	<i>1 GB</i>	<i>\$199</i>
<i>Wave Internet</i>	<i>Wired Wave</i>	<i>2 Mbps</i>	<i>2 Mbps</i>	<i>50 GB</i>	<i>\$349</i>
<i>Orcon, Maxnet (Vector’s ISP channel partners)</i>		<i>2 Mbps</i>	<i>1 Mbps</i>	<i>Unlimited</i>	<i>\$349</i>
Telecom	Xtra Jetstream 1200	2-8 Mbps	600 kbps	1.2 GB	\$137.78
Telecom	Xtra Business Broadband	2 Mbps	128 kbps	15GB	\$299.95
Telecom	Xtra Jetstream 20000	2-8	600	20GB	\$1617.78

⁴⁶ It appears that TelstraClear has made two errors at paragraph 21 of its submission to reach its incorrect conclusion that Actrix’s “slower” plan is “20% more expensive”. (1) It states Actrix’s symmetrical service is 1 Mbps up and downstream. Actrix’s website states the speeds are 4 Mbps up and downstream. (2) It also appears TelstraClear has taken Xtra Jetstream 600 as the closest comparable service. However Xtra Jetstream 1200 is the closest comparable service as it has a data cap that is 1.2 G, when compared to Actrix’s 1 G data cap. Actrix’s 4Mbps plan is 40% more expensive than Telecom’s Xtra Jetstream 1200 plan, but this price differential is explained by the much greater speeds: Actrix offers twice the minimum speed downstream, and is 31 times faster upstream than Jetstream 1200.

⁴⁷ <http://www.wave.co.nz/business/wiredwave.html>

⁴⁸ Assumption made that the plan is symmetric, based on information in TelstraClear’s May submission.

⁴⁹ <http://www.clear.net.nz/services/pricing.html#highspeed>

⁵⁰ Telecom belief. The upstream speed is not detailed on TelstraClear’s website.

		Mbps	kbps		
Telecom	Xtra Jetstream 30000	2-8 Mbps	600 kbps	30 GB	\$2417.78
Actrix	FibreLite 1	4 Mbps	4 Mbps	1 GB	199.00

86. This table shows that a Wave Internet customer will pay only \$349 a month for a guaranteed minimum speed of 2 Mbps both upstream and downstream, with a 50 G data allowance. In comparison, Telecom’s asymmetrical full speed service, with a 30 GB data allowance, is priced at \$2417.78 per month.
87. Further, it appears Actrix is positioning itself to target customers who value speed above large data caps. Customers can access 4 Mbps both upstream and downstream (with a 1 GB data cap) for only \$199 per month. Telecom’s closest comparable business plan, Xtra Jetstream 1200, is priced at a cheaper rate of \$137.78 per month, but only offers unguaranteed downstream speeds of up to 2-8 Mbps and upstream speeds of up to 768 kbps.
88. The benefits of platform competition become obvious from the large range of business broadband plans available to customers. Customers can choose which dimension they most value (i.e. speed downstream, upstream, both, or large data caps) and then choose the plan that meets their requirements best.
89. Any price differences are explained due to quality differences between plans in the market. The symmetrical broadband plans reviewed in the table above generally have significantly higher upstream speeds than the asymmetrical plans offered, which explains the price premium observed for the Actrix plan when compared to Telecom’s Xtra Jetstream 1200.
90. From the table above, it is clear that the different competitors in the market are pricing their offerings relative to others in the market. There is certainly no separate trend of symmetrical competitors pricing differently to asymmetrical competitors. This indicates that a chain of substitution is constraining the pricing of asymmetric vis-à-vis symmetric competitors in the broadband market. (Of course, there are also many more offers in the market than just those selected by TelstraClear).
91. Telecom does not understand the relevance of TelstraClear’s reference⁵¹ to Telecom’s pricing for its traditional data services. Telecom agrees with TelstraClear that traditional data services such as Frame Relay are supplied in a

⁵¹ Paragraph 22 of TelstraClear's May submissions.

separate product market to broadband internet access services. Telecom has never submitted that symmetrical data services compete in the same product market as symmetrical broadband internet access services.

92. For Telecom's views on the appropriate product market for symmetrical *data* services, Telecom refers the Commission to its submissions on TelstraClear's Retail Services Application (including Private Office Networking).⁵²

Supply side substitution

93. Even if there were doubt on the demand side that symmetric and asymmetric services are close substitutes (which Telecom submits there is not), examination of supply side constraints definitively supports the conclusion that asymmetric and symmetric broadband internet access are in the same product market.
94. TelstraClear appears to argue at paragraphs 26 to 27 of its May submissions that competitors using fibre and FWA access technologies are not able to offer competitively priced asymmetric broadband internet access products because of the higher underlying cost structures of fibre and FWA when compared to ADSL.
95. However, it is not necessary for fibre and FWA competitors to need to be able to find it profitable to supply solely asymmetrical broadband services over their networks. Rather, the test is the "SSNIP" test:

"In the event of a hypothetical monopolist increasing the prices of asymmetrical broadband internet access products by 5%-10%, would suppliers of symmetrical broadband internet access products be able to quickly and easily switch to the production of asymmetric broadband internet services?"

96. It appears there is nothing to constrain symmetrical broadband internet access suppliers from expanding or switching to the production of asymmetric broadband internet access products, in the event of a hypothetical monopolist raising the price of asymmetric broadband products by five to ten percent.
97. The market evidence supports this conclusion. Fibre-based competitors are supplying asymmetric broadband internet access products now. Vector Communications is using its fibre network to launch a competitively priced asymmetric broadband internet access product in the Auckland business broadband market. It is using its ISP channel partners Orcon and Maxnet to offer an asymmetric retail broadband internet access product of 2 Mbps/1Mbps and an unlimited data cap. It is priced at \$329 + GST per month. The comparison in the

⁵²<http://www.comcom.govt.nz/IndustryRegulation/Telecommunications/Wholesale/WholesaleDeterminations/telstraclearretailservicesapplication.aspx>

table in paragraph 84 above shows how competitively priced this plan is in relation to other offerings in the market.

98. TelstraClear⁵³ also quotes an Ofcom conclusion that, in the UK, symmetric service providers would not find it profitable to supply asymmetric broadband internet access services.
99. It is not correct to apply Ofcom's conclusion to the New Zealand market. Partial Private Circuits (PPCs) and Leased Lines are predominantly used in the UK. Ofcom concluded that, as these types of technologies are not contended, the cost associated with them is much higher than that associated with ADSL and cable technology (para 2.85 Ofcom Wholesale Broadband Access Review).
100. The technologies used to supply symmetric broadband internet access services in New Zealand are different. Symmetric services primarily supplied over fibre and FWA. These technologies are able to be contended, just like ADSL. This means that more efficient use can be made of fibre and FWA technologies and symmetric competitors in New Zealand do not face the cost disadvantages of symmetric broadband competitors in the UK.
101. There is also no technical reason, to Telecom's knowledge, that prevents fibre and FWA based competitors from expanding from supplying symmetrical broadband offerings to asymmetrical offerings. Fibre and FWA based competitors have already incurred the entry costs of constructing the network. Therefore the marginal cost of expanding to offer asymmetrical broadband internet products is low.

Geographical Dimension

102. As the definition of the retail market is logically prior to the definition of the wholesale market Telecom has referred back to the Commission's previous regulatory decisions. In Decisions 497 and 525 the Commission defined the relevant markets for broadband internet access as residential and business markets in metropolitan and non metropolitan areas.⁵⁴
103. The Commission and TelstraClear proposed that the geographic boundaries have changed such that there is now a national market and there are not separate wholesale residential and business markets. Neither has provided any evidence or reasoning for this change in approach upon which Telecom may comment.
104. Telecom considers that the competitive dynamics of sub national retail broadband markets has not changed to the extent that a national market is now operating in

⁵³ Paragraph 26 TelstraClear's May submissions

⁵⁴ The Commission did not need to define a residential metropolitan market.

New Zealand for retail broadband services. To the contrary, the state of competition has increased such that the metropolitan markets have expanded⁵⁵.

D2 Competition Assessment

105. Telecom does not agree with TelstraClear⁵⁶ that it faces limited competition in the supply of wholesale bitstream services. As set out in its previous submissions, Telecom faces effective competition in the retail metropolitan markets for the supply of broadband internet access services. This competition is effectively constraining any attempt to exercise market power in the metropolitan wholesale broadband internet access markets.
106. Telecom also rebuts TelstraClear's assertion that Telecom equates the test of "limited competition" with "faces no competition".⁵⁷
107. As the Commission sets out in its Merger Guidelines, effective or workable competition is judged through assessing the confluence of competitive constraints working together in a market.
108. Telecom applies the same approach and considers that it is clear that it faces effective competition in metropolitan broadband internet access markets in New Zealand. The market outcomes of this effective competition are clear: broadband customers in metropolitan areas are benefiting from falling prices, an increasing range of innovative broadband offers and increasing service quality.

⁵⁵ See Section D of Telecom's May submissions.

⁵⁶ Paragraph 33 TelstraClear's May submissions.

⁵⁷ Paragraph 33 of TelstraClear's May submissions.

E APPLICATION OF THE INITIAL PRICING PRINCIPLE

E1 Introduction

109. As discussed in section B, TelstraClear now appears to be:

- (a) seeking a single access price for access to the fixed PDN regardless of end user or speed which Telecom believes to be contrary to the long term best interests of end users and contrary to the language in the initial pricing principle;
- (b) requesting that the Commission interpret the initial pricing principle in such a manner that any excessive rents earned by Telecom at retail are removed at the imputation stage. Telecom has made detailed submissions in section B to the effect that this is inconsistent with the Act; and
- (c) advocating how any excessive rents should be stripped out at the imputation stage either by the outright exclusion of services where it is considered Telecom earns excessive rents or through the imputation methodology suggested by Network Strategies.

110. Telecom emphasises that it does not believe it necessary or permissible to make *any* adjustments for excessive rents during the imputation process and that neither of these approaches should even be countenanced by the Commission as set out at section B. However, for completeness, Telecom will provide its further comments on TelstraClear's suggested amendments.

E2 Telecom's Retail Price

111. Telecom strongly disputes as a matter of fact that it is earning profits in excess of what would represent a reasonable return on its investment in broadband and here refers the Commission to the analysis of Professor Hausman at Annex D.⁵⁸

112. The only evidence put forward by TelstraClear in support of its contention that Telecom is making "excessive rents"⁵⁹ was the finding by the Ministry of Economic Development that retail prices for business broadband services were above the OECD average and the assertion that residential broadband services overseas deliver more 'value per dollar' for end users. Curiously, TelstraClear also observes at paragraph 26 that Telecom's Jetstream prices are so low that TelstraClear is unable to compete with them even in areas where it already has its own network.

⁵⁸ At paragraphs 10 to 12.

⁵⁹ Paragraph 3(b) of TelstraClear's May submissions.

113. Telecom makes the obvious observation that the retail price charged is only part of the equation in assessing whether Telecom is making excessive rents and international benchmarking of retail prices is not an appropriate proxy for this for the very simple reason that other countries will undoubtedly have different cost structures to the cost structure facing Telecom.

114. Even if it were appropriate to compare retail prices Telecom believes that both its residential broadband prices and its new business broadband prices compare favourably with overseas offerings. Telecom deals with business broadband prices and residential broadband prices in turn.

Business Broadband Prices

115. Telecom has been aware for some time that its prices for its Full Speed services have been priced relatively high and these services have attracted very few new customers in recent months. The new business plans which Telecom announced on 8 June 2005 offer higher speeds than the earlier Venture plans, at prices substantially less than the existing full speed offers. For example, the new 10GB plan is 83% cheaper than its existing full speed counterpart.

116. Telecom presents here a comparison both with the previous Full Speed prices for corresponding plans and with the OECD benchmarked prices.

117. There are plans having a 3GB, 10 GB and 15 GB data or high speed allowance with the 3GB and 10GB options being directly comparable to corresponding Full Speed plans and the 15GB being compared to the average of the 10GB and 20GB options:

Data Allowance	Full Speed price	New broadband price*	Percent change
3 GB	\$309.78	\$119.95	- 61%
10 GB	\$905.78	\$149.95	- 83%
15 GB	\$1261.78 (average of 10 and 20)	\$299.95	- 76%

*These new prices include the ISP component and are accordingly compared to the ISP inclusive prices for the Full Speed plans.

118. The OECD benchmark prices are not noted explicitly in the report by the Ministry of Economic Development but the percentage variation of Telecom's current prices from the benchmark is recorded and this variation can be used to derive the difference between the new business broadband prices and the OECD averages:

Data Allowance	Full Speed price	Old OECD variance	Percent change	New OECD variance**
3 GB	\$309.78	80% above	- 61%	30% below
5 GB*	\$475.78	160% above	- 73%	30% below
10 GB	\$905.78		- 83%	18% below OECD 5GB price

*The new plans do not have a 5GB option but the implied price for this can be inferred by interpolating between the prices of the 3GB option and the 10GB option to give an implied price of \$128.52.

**Comparison has necessarily had to be in respect of prices prevailing at the time of the benchmarking survey in October 2003. However Telecom does not believe it likely that the prices used for the purposes of the benchmarking survey would have declined by more than 30% since October 2003 and as such Telecom believes that its new business broadband prices would compare very favourably even as against current OECD prices.

119. This comparison shows that Telecom's new business broadband prices compare very favourably with international benchmarks and as such Telecom does not believe that there are any grounds to conclude that Telecom is making excess profits even if the Commission were to adopt the suggestion put forward by TelstraClear to compare Telecom's retail prices against those charged internationally.

Telecom's regression methodology applied to these new prices

120. Telecom's new Business Broadband prices announced today do not include an ISP-exclusive option. Only a version including the Xtra ISP layer is provided. This means that the first step in the regression analysis is to remove the costs of the Xtra component from the retail prices. This cost has previously been disclosed as [] **TCNZRI**. The input values for the regression are:

Plan	Speed	Gbytes	Price excl GST
Venture 1GB	256	1	\$59.95
Venture 3GB	256	3	\$79.95
Venture Flat Rate	256	10	\$99.95
Business 3GB	1024	3	\$119.95
Business 10GB	1024	10	\$149.95
Business 15GB	2048	15	\$299.95

121. The old Full Speed plans are still available for purchase however they are not included here. The prices in the table (after subtraction of the ISP cost) can then be modelled using the same functional form as Telecom has recommended in relation to the Residential Broadband prices. This was:

$$\text{Price} = a + b.\ln(\text{Speed}) + c.\ln(\text{Data})$$

122. The Business regression produces the following fit line:

$$\text{Price} = -\$311.302 + \$61.946.\ln(\text{Speed}) + \$30.206.\ln(\text{Data})$$

123. The adjusted R squared is 0.711, which indicates that the fit is not as good as was the case for residential, but pursuing this approach in the regression is still appropriate.

124. Again, an adjustment needs to be made to calculate a Data=0 equivalent price. The price for Data = 1Gb and the price for Data = 15Gb can be evaluated and one fourteenth of the difference subtracted from the Data = 1 price to produce a Data=0 imputed value.

125. The results produced are:

Speed	Imputed Retail Price	Resulting Bitstream Access Price
256	\$26.36	\$22.14
1024	\$112.23	\$94.27
2048	\$155.17	\$130.24

126. The price for any desired higher speed can also be derived.

Residential Broadband Prices

127. TelstraClear has recognised that the Ministry of Economic Development has found that residential broadband prices in New Zealand compare favourably with the OECD average. However, TelstraClear seeks to demonstrate that Telecom is making excessive profits in residential broadband through the assertion that residential broadband services overseas deliver more value per dollar for end users. TelstraClear bases this assertion on a table purporting to show a comparison of low end residential plans for selected incumbent operators.⁶⁰

⁶⁰ Figure 4 in TelstraClear submissions and Exhibit 2 in Network Strategies report.

128. It is difficult to validate this table as no explanation is given as to the source of the data nor is it clear what services are included or excluded nor is any information provided about the PPP rates used for the conversion.
129. Telecom notes that the table is potentially misleading in at least the following material respects:
- (a) Certain plans set out in the table do not adjust the price to allow for monthly usage limits and excess usage charges:
 - (i) The plan quoted for TDC has a 0 MB monthly usage limit and an excess charge of 7 cents per MB so that an end user would need to pay an extra \$70 per month to reach the 1000 MB allowed under the Telecom plan – increasing the total cost per month from \$18.61 to \$88.61 i.e. \$44.21 above the price quoted for Telecom;
 - (ii) The plan quoted for Telstra has a monthly usage limit of 200 MB and an excess charge of 15 cents per MB so that an end user would need to pay an extra \$120 per month to reach the 1000 MB allowed under the Telecom plan – increasing the total cost per month from \$30.56 to \$150.56 i.e. \$106.16 above the price quoted for Telecom; and
 - (iii) The plan quoted for Belgacom has a monthly usage limit of 400 MB and an excess charge of 1 cent per MB such that an end user would need to pay an extra \$6 per month to reach the 1000 MB allowed under the Telecom plan – increasing the total cost per month from \$42.04 to \$48.04 i.e. \$3.64 above the price quoted for Telecom
 - (b) The plan quoted for Telecom uses the price inclusive of an internet service provider component and without any allowance for the tolls discount available whereas once this correction is made the price for the Telecom plan falls below that of Belgacom;⁶¹ and
 - (c) Telecom notes also that the plan quoted for BT is not 256 kbps upstream service but is rather a rate adaptive service between 64 kbps and 256 kbps.
130. In these circumstances Telecom does not believe it appropriate for TelstraClear to use this table as the basis for its assertion that residential services in overseas markets deliver more value per dollar for end users and certainly does not believe it is appropriate for the Commission to give any weight to this assertion. If anything the table could be taken as illustrating that the value per dollar offered by Telecom actually compares reasonably favourably with the providers listed in the table.

⁶¹ The Commission provided for a methodology to adjust for the value of the tolls discount and Telecom has advised how this calculation can be corrected in its submissions on the draft determination.

131. As such Telecom does not believe that TelstraClear has shown any grounds to conclude that Telecom is making "excessive rents" even if a comparison with overseas broadband pricing were appropriate.

E3 Network Strategies Methodology

132. The methodology used by Network Strategies is not permitted by the Act. Telecom has submitted in section B that the stripping out of excessive rents at the imputation process is inappropriate under the language of the Act and has submitted in section E2 that there are in any event no demonstrable "excessive rents" to strip out.

133. Network Strategies' report included at Annex 3 of the TelstraClear submissions goes on to suggest approaches to the removing of "excessive rents" at the imputation stage and in this section Telecom submits that the methodology suggested by Network Strategies is fundamentally flawed.

134. Network Strategies suggests two alternative approaches to removing excessive rents at the imputation stage:

"One approach would be to exclude from the imputation calculations those prices which are shown to be excessive via international benchmarking. Another approach is to adopt a methodology for the imputation exercise that minimises the risk of results skewed by excessive rents."⁶²

135. Telecom now deals with each of these approaches.

Outright Exclusion

136. The outright exclusion from the imputation process of prices which are shown to be excessive is based on reasoning which is both faulty and contrary to the Act.

137. In suggesting that it is appropriate to exclude inconvenient observations outright Network Strategies says :

"Retail-minus does not result in efficient prices if retail prices are not competitively set or regulated at near competitive levels. The key question is whether certain prices should be excluded when imputing the access price, for example loss leaders or exorbitantly priced services. Price selection needs to be based on whether the inclusion or exclusion of a particular price would be viewed as anti-competitive..."

While we believe that potential loss leaders should remain within the analysis, the inclusion of exorbitantly priced plans may lead to an anti-competitive result. Thus, we should consider whether any of Telecom's plans fall into this category."⁶³

138. The retail minus approach in the initial pricing principle does not provide for the Commission to impute a retail price at or near competitive levels. The

⁶² At page 4.

⁶³ At page 5.

Commission may properly exclude services from the imputation process on the basis that they are not comparable to the service sought to be designated but Telecom submits that there is nothing in the initial pricing principle which suggests that the Commission should exclude services on the basis that their inclusion would be viewed as "anti-competitive". The ultimate end in view under section 18 must be to work towards the long term benefit of end users *through the promotion of competition*. Contrary to the submissions made by TelstraClear, Telecom believes that allowing the alleged 'anti-competitive' prices to be competed away would be in keeping with this, whereas seeking to arbitrarily exclude prices on the basis that they would be "anti-competitive" would represent a significant and unwarranted move towards a more interventionist approach.

139. Telecom turns to examine Network Strategies' submissions on what should and should not be included in the imputation calculations. Network Strategies submits that 'potential loss leaders' should be included in the imputation process on the basis that their exclusion could be seen as facilitating a retail price squeeze or predatory pricing. These "loss leaders" should be part of the imputation process as long as they meet the comparability criterion specified in the initial pricing principle.⁶⁴ TelstraClear suggests that there is a potential retail price squeeze or predatory pricing as the reason for including any particular plan as part of the imputation process.⁶⁵ Telecom simply makes the point that it is impossible for it to engage in a price squeeze under a retail minus approach.⁶⁶
140. Network Strategies goes on to submit that "exorbitantly priced plans" should be excluded from the imputation process. Telecom believes that it is inappropriate to exclude comparable plans whose prices are thought to include excessive rents because, as discussed above, this is more appropriately dealt with not at the imputation stage but at the avoided costs saved stage pursuant to clause 3(1) of the Schedule 1 to the Act.

Imputation of the retail price

141. The imputation methodology suggested by Network Strategies purports to be an alternative approach which "*without excluding plans, takes into account 'premium' pricing*" to "*minimise the risk of results skewed by excessive rents*".⁶⁷
142. Telecom does not see the imputation methodology suggested by Network Strategies as explicitly attempting to remove the effect of excessive rents

⁶⁴ Although Telecom has made the point at paragraph 331 of its submissions on the draft determination that it does not believe that any of the services within the Jetstream suite of services are in any relevant sense comparable to the non speed restricted service sought to be designated by the Commission.

⁶⁵ Network Strategies Report at page 5.

⁶⁶ Refer to section III of Annex D.

⁶⁷ Network Strategies Report at page 7.

although their method may well have this effect – so Telecom cannot comment on this. However the Network Strategies methodology does pose a number of other concerns which are dealt with in section E4 below.

E4 Imputation Methodology/Regression Analysis

Introduction

143. TelstraClear criticises the Commission's straight line regression model to identify and remove transmission charges on the basis that there is not a constant per MB price across Telecom's retail services. Instead TelstraClear suggests that:

"the simpler arithmetic approach set out in the annexed report by Network Strategies more effectively and robustly addresses the deduction of the national and international capacity and the risk of excessive rents."⁶⁸

144. Telecom agrees that the straight line regression model adopted by the Commission does not fit well with the observed data. However Telecom believes that the imputation methodology suggested by Network Strategies is also seriously flawed and does not believe that it provides a more effective and robust way of addressing the deduction of national and international capacity.⁶⁹

Network Strategies Alternative Model

145. Network Strategies correctly notes that the regression model suggested by the Commission does not fit well with the observed data. In particular it observes that prices are not linear with respect to included data allowances. It concludes from this that if a statistical analysis approach is to be used then a curve will need to be fitted to the data.

146. Telecom agrees with Network Strategies to this point. However Network Strategies then constructs a "straw man" in order to dismiss the opportunity to use regression analysis. It proposes a non-linear functional form and then observes that there are insufficient data points available to develop estimates of its parameters. On this basis it concludes that it is impossible to estimate any curved functional form with the number of data points available.

147. Network Strategies does not appear to recognise that there is a conceptual difference between functional forms which are nonlinear in the independent

⁶⁸ At paragraph 3.

⁶⁹ As noted above Telecom does not see Network Strategies' methodology as explicitly attempting to remove excessive rents. Telecom notes in passing that Network Strategies does not explicitly claim that their method is better at removing excessive rents than the approach adopted by the Commission. This is an interpretation placed on Network Strategies' report by TelstraClear. In fact Telecom believes that Network Strategies' approach will have exactly the same effect as the Commission's proposed approach insofar as the removal of any excessive rents is concerned.

variables and functional forms which are inherently nonlinear. The fact that a set of observations can best be explained by a (non linear) curve does not imply that the functional form is nonlinear. For example a polynomial, a log or an exponential functional form will all show as a curve when graphed but such equations can be estimated using linear methods by performing transformations on the independent variables. Telecom's suggested functional form of using logs of the independent variables is one example of a curve being fitted using linear methods.⁷⁰

148. Network Strategies' assertion that the number of parameters should be no more than one quarter of the data points is also a "straw man". This rule of thumb applies in relation to observations of stochastic explanatory variables which may be subject to measurement error and where the underlying relationship is uncertain. When the underlying relationship is known the number of observations required is much fewer. For example to "estimate" a straight line (two parameters being intercept and slope) only two observations are needed. The estimated line is an exact fit to the data. A quadratic (three parameters) can be fitted to three observations. The distinction here from the one quarter rule of thumb is that the functional form is proposed with respect to Telecom's marketing behaviour and the general proposition that the marginal benefit customers derive from additional speed or data caps will reduce as the speed or cap increases. In addition, there are no errors in the measurement of the explanatory variables.
149. Telecom does not believe the rule of thumb is applicable here. The observations are measured exactly – the dependent variable is a set of specific prices set by Telecom. These prices are not simply specified to the nearest cent but are instead quoted to the exact cent. Similarly the speed and data caps are what Telecom specifies for the service parameters of the respective plans. The functional form is the perception Telecom has about what customers will be prepared to pay for the two components of value being offered to those customers. Telecom notes that this perception may be inexact in that Telecom does not completely understand every customer's preferences. The important point though is that the regression model Telecom is proposing is a statistical analysis of the way Telecom has chosen to price its products. These observations then imply that there are sufficient degrees of freedom for the analysis given the other knowledge which is able to be applied to the data.
150. Network Strategies criticises the Commission's approach of using a linear model to explain Telecom's retail broadband prices relative to data caps.⁷¹ Telecom agrees that the Commission's method has problems and has proposed a better solution.

⁷⁰ Such analysis does not require 'specialised statistical software' as suggested by Network Strategies at page 10 of its report. Indeed a set of log tables could even be used if one did not have access to a computer.

⁷¹ For example at page 13 where Network Strategies states that "We do not consider it appropriate to model the prices using a regression model with the only predictor variable being the data cap."

Network Strategies meanwhile has criticised the approach but then proceeded to use the exact same approach, just in a modified form.

151. For example the first calculation Network Strategies proposes produces a business access price of \$2.66. This is based on a linear regression being applied to the two observations {0.6, \$61.33} and {1.2, \$120.00} for the Full Speed 600 and 1200 plans respectively. While Network Strategies goes to some length to expose the shortcomings in the Commission's linear regression approach it uses the exact same approach (albeit with fewer observations) itself. The only difference between the two approaches is that Network Strategies selects only arbitrary pairs of points to which to fit a line (Full Speed 600 and 1200 in the example above or Full Speed 600 and 20000 in the example which produces the value of \$13.74) rather than the Commission's approach of using all of the observations.
152. This problem is not resolved by Network Strategies' approach of fitting other lines to other data price sets (Venture plans as a set and Residential plans as a set) and then averaging an arbitrary subset of the results. This does not address any of the three invalid assumptions Network Strategies presents on page 14 of its report:
 - (a) It sets a fixed price per MB in each of its linear fit lines, despite noting that the price is not fixed;
 - (b) It takes no account of downstream speed, although it acknowledges that this is an influence on price; and
 - (c) It takes no account of the different pricing strategies across business and residential apart from ignoring the residential observations when calculating its average.
153. The conclusion then is that the Network Strategies approach does nothing to change the method of deduction of national and international capacity.⁷² Although the proposed method is arguably simpler, it is certainly no more effective or robust.
154. Telecom's proposed method addresses the concerns raised in paragraphs 3(c) and 3(d) of TelstraClear's submission. It fits a curve to the observed data points, thereby allowing for a non-constant per-MB price. It addresses the deduction of national and international capacity within retail prices in an analogous method to those proposed by the Commission and Network Strategies in that it calculates an implied price for Data = 0. It deals with the issue of excessive rents to the extent that the initial pricing principle requires – that is, it subtracts an allowance for

⁷² Or, for that matter, the risk of excessive rents, although, as Telecom has submitted above, it is in any event inappropriate to strip out any excessive rents at the imputation stage.

them to the same extent as overseas jurisdictions do within their calculated discounts.

155. For these reasons Telecom believes that the Commission should adopt the imputation methodology suggested in Telecom's May submissions.

F SUNDRY CHARGES

156. TelstraClear, Telecom and the Commission are agreed that new connection and MAC charges should be charged at the retail price minus the benchmarked discount (proposed to be 16%).
157. On this basis Telecom does not see how any other principle can be applied for the remaining reassignment charge. Telecom does not therefore agree with the Commission's proposal in the draft determination (not surprisingly adopted by TelstraClear) that TelstraClear should be charged for reassignment at or below incremental cost. Telecom reiterates its previous comments.
158. As Telecom has committed to a TSLRIC based charge to the industry, Telecom is willing to commit this same charge to TelstraClear as part of the regulatory proceedings. Alternatively, the Commission can choose not to determine this on the basis that Telecom will provide TelstraClear with the same reassignment charge as the rest of the industry.

Blurring regulatory and commercial arrangements

159. While Telecom disagrees that a reassignment charge set either at, or below Telecom's incremental cost is not permitted by the Act, Telecom responds to the request of TelstraClear's commercial team in TelstraClear's May submissions. TelstraClear's commercial team requests that it be provided with Telecom confidential information through the regulatory proceedings for the purpose of commercial negotiations⁷³. The commercial and regulatory processes should be kept separate. The Act is premised on commercial negotiations occurring first. If agreement cannot be reached, the Act provides a backstop regulatory process.
160. Any suggestion by TelstraClear that Telecom is unwilling to negotiate in the absence of confidentiality obligations should be dismissed as misleading and incorrect. Commercial negotiations about the matters in the regulatory proceedings or any other matters between the parties can and do occur in parallel. This has in the past resulted in applications, or large parts of them, being withdrawn as a result of commercial settlement. The parties have many choices as to how they approach commercial negotiations. They may occur with a blanket commercial in confidence/without prejudice such that bona fide and open discussions may occur or the parties may agree to put some other framework in place to meet their needs.
161. Commercial relationships and arrangements should not be distorted, as TelstraClear requests, by using the regulatory proceedings as a continuing mechanism to gain access to Telecom's commercially sensitive information. Such

⁷³ Paragraphs 66 and 67 of TelstraClear's May submissions.

information would not be provided by one operator to another in the normal commercial process and the regulator should steer clear of distorting the commercial arena. TelstraClear highlights that it, as does any other member of the industry, uses the regulatory process as part of its commercial negotiating process. However, it should not be enabled to blur the regulatory and commercial processes and detrimentally unsettle the incentives on the parties.

G NON PRICE TERMS

G1 Retail/wholesale concurrency

162. Telecom has no further comments to make at this time.

G2 Operational support

Departure from the Commission's proposal

163. TelstraClear says that it "welcomes" the Commission's requirement that "Telecom provide a level of operational support to TelstraClear, whether manual or automated, such that there is no material difference in provisioning or fault repair in regard to the experience of retail customers whether retail services reliant on bitstream access are supplied to TelstraClear or Telecom"⁷⁴. However, TelstraClear is in fact proposing something quite different from what the Commission has proposed by raising an unfounded concern about the time it will take to develop an OSS solution in accordance with the Commission's proposal and tabling and requesting an new interim OSS solution. This interim OSS solution was not foreshadowed in TelstraClear's original application.

164. Given that TelstraClear's submissions depart so substantially from the draft determination, Telecom has not responded in full detail to all of TelstraClear's points. Should the Commission be minded to move away from the proposals in the draft determination and introduce new interim proposals, the parties should be further consulted with an adequate opportunity to respond. Telecom makes some high level comments on the relevant section of TelstraClear's submission below.

Market entry not hindered

165. TelstraClear's justification for an interim solution is that its entry into the market "could be significantly delayed" while OSS is being developed by the industry.⁷⁵ It asserts that the capability for the electronic exchange of data is "crucial to our ability to enter the market now".⁷⁶ Telecom is surprised by these claims and rejects them for the following reasons:

- (a) TelstraClear's assertion is not supported by what is actually happening in the market. The rest of the industry are in the market using the OSS and processes currently provided by Telecom and in the last broadband monitoring report make up 23% of all new connections.

⁷⁴ Paragraphs 95 and 96 of TelstraClear's May submissions.

⁷⁵ Paragraph 96 of TelstraClear's May submissions.

⁷⁶ Paragraphs 98-99 of TelstraClear's May submissions.

- (b) In Australia such electronic exchange of data has only occurred in the last few months. AAPT for example, was only able to implement electronic exchange of data for DSL products such as UBS in February 2005. For the four years prior to that data was posted to an extranet web page, similar to Telecom's eOR. TelstraClear's assertion that Australia's success is based on the availability of efficient electronic interfaces offered by Telstra Wholesale is therefore incorrect.
- (c) The current provisioning and delivery processes used by Telecom's wholesale customers are consistent with those that Telecom uses for its own retail customers. The substantive steps are identical and treated in the order in which they are received by both the wholesale provisioning team and service companies. As Telecom stated in para 386 of its 20 May submission, "Telecom's provisioning and delivery processes are "colourblind" as between retail and wholesale orders". There is a dedicated wholesale fault management centre for wholesale customers and, aside from this contact point, the handling of faults (retail or wholesale) are handled consistently. These processes combined with eOR as it exists now, comply with the Commission's proposal in the draft determination.

eOR is an adequate solution – no need for TelstraClear's interim solution

166. TelstraClear continues to pursue an OSS built specifically and only to meet the needs of TelstraClear at Telecom's expense. This is not technically and operationally feasible and is certainly not cost effective. TelstraClear continues to ignore these points, the fact that Telecom's business is an integrated one, the fact that the processes it is referring to are consistent between retail and wholesale and the Commission's draft determination. In doing so, TelstraClear seeks, again, to not only dictate *what* OSS is provided but *how* OSS is provided.
167. TelstraClear provide two diagrams, figures 8 and 9 in its 20 May submission showing the difference between "neutral OSS" as recommended by Schema and a "retail-prime OSS". In the following paragraph, TelstraClear attempts to draw on the Australian experience as evidence that "clear initial direction and oversight" from the regulator is required. In fact Australia's Wholesale OSS, the LinxOnline suite, closely follows the retail-prime OSS example, not the neutral OSS as clearly shown by Figure 26 under para 182 of TelstraClear's December 2004 submission. Activation, Faults and MACs in Australia use the same back-end OSS as retail while allowing Wholesale Service Providers to enter their information via a Web interface. This interface is called LOLO for activation and MACs and LOLS for faults.
168. Telecom submits that the "retail-prime OSS" is highly appropriate where there is a significant integration between retail and wholesale products and services, as there is in New Zealand, and where it would be uneconomic to create a "neutral OSS" whether specifically for one Wholesale Service Provider such as TelstraClear

or for the industry. Considered purely from a cost perspective, developing a neutral OSS is clearly considerably more expensive than a retail-prime OSS since it requires totally new systems for Wholesale. Telecom submitted extensively on this during the unbundling determination where extensive comparison was made of the costs incurred by BT for its Wholesale Line Rental (WLR) product, which Schema refers to in its report for TelstraClear's 20 May submission, and the cost per order such systems would incur should similar systems be developed for the New Zealand market.⁷⁷ Clearly, given Telstra Australia's adoption of the retail-prime OSS approach, the neutral OSS approach is too expensive even in a market at least six times larger than New Zealand.

169. As a further point of comparison, in Australia, following the "retail-prime OSS" approach, Telstra receive approximately 250,000 orders per month through LOLO, which offers a web extranet front-end similar to eOR, and 50,000 per month through LOLIG, which is the B2B interface AAPT adopted in February 2005. Telecom estimates at most 50,000 orders per month of all types (not just DSL) from all service providers (not just TelstraClear) will be received in approximately 18 months time i.e. 1/6th the volume received by Telstra.
170. As Telecom outlined in its May submission, an enhanced version of Telecom's electronic ordering system, "eOR for broadband", is likely to be available when the final determination is made. eOR for broadband is part of Telecom's continuing commitment to electronic OSS and automation where this is technically and operationally practicable and cost effective. It will provide a robust interim solution that will meet TelstraClear's request for automation of ordering and tracking, and will further improve the ability to efficiently process high volume interactions between Telecom and a wholesale customer.
171. eOR for Broadband is planned for initial customer release in June 2005 with full rollout three months later. eOR for Broadband integrates Telecom's backend systems to the Web interface provided to Service Providers and improves on the eOR system already in use at two Service Providers.
172. eOR overall continues to develop as set out in Annex E. To assist with comparisons Annex E includes a copy of the original table submitted by TelstraClear in its 16 December 2004 submission and a high level roadmap of additional eOR functionality that is not offered by LOLO/LOLIG.
173. TelstraClear, in its 16 December 2004 submission gave a comparison between Telstra Australia's LOLO system and eOR.⁷⁸ Telecom agrees that LOLO is more advanced than eOR, perhaps not unexpectedly given the 12 months development eOR has had compared to the 4 ½ years of development LOLO has had. Telecom

⁷⁷ Commerce Commission Conference on Unbundling, Telecom OSS Presentation – Mark Corbitt paragraph 13.

⁷⁸ Paragraph 186 of TelstraClear's 16 December 2004 submission.

expects that, within 18 months, eOR will be nearing the same level as LOLO and LOLIG (the B2B component of Telstra's Wholesale OSS), considerably less than the time it has taken LOLO to reach its present functional level.

174. Given the ongoing development of eOR, and additional functionality provided by eOR for broadband, as well as the commitment to consistency between retail and wholesale there is simply no need to move to the electronic data exchange process that TelstraClear has outlined in its submission. Whilst a direct electronic connection between Telecom's OSS and TelstraClear's backend systems is desirable for TelstraClear and is something that Telecom is working towards providing it is not crucial to the market today. Additionally, any interim OSS will delay the continued development of eOR and eOR for Broadband, creating delays for the overall industry.

International comparisons are of limited value

175. TelstraClear and its consultants, Schema draw heavily on the experience of OSS implementation in the UK and Australia to support the argument that automation is required.⁷⁹ Telecom is working towards more automation – so to that extent does not take issue with the Schema report. However, Telecom notes that the Schema report fails to take into account technical, operational or economic considerations which are required by the limits on the SAPs in the Act nor, in particular, the particular circumstances of the New Zealand market. While full B2B OSS may make economic sense in the UK where hundreds of thousands of new wholesale orders are placed each month, the position is completely different in New Zealand, where wholesale bitstream orders are likely to be around ten thousand per month.
176. Telecom's submission on OSS to the unbundling conference outlined some of the differences between Europe, the United States and New Zealand. TelstraClear's high level report from Schema on OSS is again attempting to cherry pick from other regimes in the name of "international best practice". Telecom reiterates the differences previously outlined rather than repeats those differences.⁸⁰

⁷⁹ Page 10 of the Schema report.

⁸⁰ Commerce Commission Conference on Unbundling, Telecom OSS Presentation – Mark Corbitt paragraphs 7-15, 25-26.

Assessment of OSS and the eOR solution

177. TelstraClear further submit that, based on a report for them by Deloitte, "eOR would substantially increase TelstraClear's costs in each of the main processes involved in connecting a customer to broadband services supplied by means of wholesale bitstream".
178. Firstly, Telecom considers that DeLoitte's representation of eOR must be read carefully bearing in mind that TelstraClear does not currently use eOR nor has the information referred to been provided by Telecom.
179. Secondly, Telecom submits that any wholesale bitstream connection process will incur costs to both Telecom and TelstraClear. Telecom has committed to providing the wholesale bitstream service in the same manner for both wholesale and retail. Those costs are the same for Telecom and TelstraClear and are borne by Telecom. Other costs might involve taking the customers call and entering the customer's details on to a system to allow continued contact with and management of that customer, as well as being able to bill them. Telecom bears its costs of managing its customers and expects TelstraClear to do the same for its customers. It would clearly be inappropriate for Telecom to provide the means for TelstraClear to manage its customers by means of OSS. Telecom provides the connection information necessary to do this, it is up to TelstraClear to provide the systems and people for its customers.
180. TelstraClear appears to be attempting to inflate its costs of business and to pass such costs on to Telecom, including for such processes as capturing order information and receiving and processing customer enquiries that Deloitte outline ,⁸¹ and which are a normal part of day to day business.
181. Deloitte have made many assumptions around eOR and its use. Telecom is unable to ascertain the validity of these assumptions or to provide appropriate comment because it is unaware of where Deloitte or TelstraClear sourced the information given their non-use of eOR.
182. Deloitte use their own IndustryPrint™ tool to represent best practice processes. Inasmuch as Deloitte do not provide telecommunications services, Telecom suggests that such best practice processes would be better represented using the Telemangement Forums eTOM model which has been adopted by many telecommunications companies worldwide, including Telecom and Telstra Australia. Neither Deloitte nor Schema mention the Telemangement Forum nor eTOM.

⁸¹ Page 3 of the Deloitte report.

Greater intervention of Commission in development of OSS

183. Although TelstraClear says that it endorses the Commission's proposal that implementation of OSS should either be agreed by the parties or dealt with by the TCF churn code, it requests that the Commission become involved in industry wide OSS development and monitoring and reporting. Telecom notes that the Churn Code is in the late stages of development and is somewhat surprised by TelstraClear's reference to it being in the early stages of development. Telecom is equally surprised at the statements made in paragraphs 107 and 108 of TelstraClear's May submissions. The project scope has the full support of the Forum and no party voted against it. The Churn Code working party is focusing on reducing invalid churn because this is where the need is and that is the purpose of the code.
184. Telecom considers that the Commission's proposal in the draft determination is preferable. The Commission envisages that the detail of implementation measures can be further discussed and negotiated between the parties. Any wider OSS issues can also be discussed between the parties and churn issues with the TCF and the churn code. Telecom considers that this is a sensible approach bearing in mind that OSS issues affect the industry as a whole across all services not just bitstream access services requested by TelstraClear, the latter being what the Commission is concerned with in these proceedings.
185. Should the Commission be minded to become involved as requested Telecom seeks the opportunity to make substantially more detailed comments both on the unrealistic requests made by TelstraClear and on the Commission's ability to deal with the detailed oversight of OSS solutions.
186. Telecom is prepared to negotiate with TelstraClear on OSS. However, this will not result in OSS specific to TelstraClear since, as has already been outlined, it is not cost effective to do so in the New Zealand market. Rather, an industry-wide solution has been adopted and will continue to be developed as has been outlined. Discussions have been held with TelstraClear previously, on B2B and, initially, on eOR. Discussions continue to be held with other Service Providers on eOR.

Costs

187. TelstraClear also submits that the Commission should make a determination that each party bears its own costs.⁸² Clearly it would be inappropriate for the Commission to deal with the costs of any matter on which the detail and substance has not been worked through.

⁸² Paragraphs 96(c) and 110 to 111. Notwithstanding this, Telecom does not agree that such a proposition is supported by the so called "equivalency provision". Refer to section B.

188. Telecom has borne the cost of developing eOR, and will continue to do so, but TelstraClear is trying to shift to Telecom the cost of integrating the wholesale OSS systems provided by Telecom with its own backend systems. These costs should be borne by TelstraClear. If Telecom was required to pay for this integration it would effectively be subsidising part of TelstraClear's commercial operations. As submitted above, customer management functions are part of normal day to day processes associated with any company and as such the costs and systems used to provide these functions for TelstraClear should be borne by TelstraClear.
189. As an example, Telstra in Australia have just provided the B2B system LOLIG (LinxOnline Interaction Gateway) to AAPT. In order to use LOLIG AAPT had to interface it with their own ordering and customer management systems at a cost, borne by AAPT, of approximately [] **TCNZRI**.

G3 Static IP addresses

190. Telecom has no further comments to make at this time.

G4 Future bitstream availability in new areas

191. TelstraClear has agreed with the Commission's proposal that Telecom notify TelstraClear of the expected completion of upgrading its network immediately the operational decision has been made to carry out the upgrade. TelstraClear proposes a second limb of "in any event, not later than the installation or testing of the DSLAM in the exchange."
192. Telecom has confirmed that the future availability of ADSL is available on the Wholesale JetStream & UBS LineCheck Toolkit⁸³. This will ensure that TelstraClear is aware of upgrades within the period between the operational decision and the installation or testing in the DSLAM in the exchange. Telecom has also offered to agree additional advance notice of upgrades to ADSL in a way which is consistent with retail⁸⁴. This would require some discussion with TelstraClear and should occur outside the regulatory process if it is sought.

G5 Pro ration billing

193. The current JetStream billing system (IAF) does not permit pro rata billing. This issue is shared at retail and wholesale. The new billing system (Singleview) which Telecom is currently working towards will permit pro rata billing later this year. A determination which mandated pro rata billing before Singleview is in place, as TelstraClear requests, will be technically and operationally unworkable and inconsistent with the limits on the SAPs. Significant development work and cost

⁸³ Paragraph 399 Telecom's May submissions.

⁸⁴ This therefore deals with comments made by ihug and Callplus in their submissions on this point.

would be required to change the current technical limitation in IAF. This would not only be a wasteful exercise but is unlikely to bring the timeframe for pro ration any further forward.

194. Telecom disagrees with TelstraClear that section 30 would empower the Commission to regulate Telecom's retail relationship with its customer in line with previous submissions and section 18 of the Act.⁸⁵

G6 Rebates

195. Telecom agreed with the Commission's view on rebates.⁸⁶ TelstraClear has confirmed that its original request for rebates is effectively withdrawn.⁸⁷
196. TelstraClear however seeks to introduce a new request for rebates in relation to the sundry charges discussed in section F.⁸⁸ TelstraClear cannot introduce new requests at this late stage of the determination process and the Commission should therefore disregard the request.
197. In any event, Telecom disagrees with TelstraClear's proposals for an interim OSS or that Telecom's OSS is inadequate and there is no proper link with the sundry charges which are simply the cost of doing business. Both TelstraClear and the Commission have accepted that the sundry charges should be recovered by Telecom on that basis.
198. TelstraClear's request therefore is still a request that the Commission take on a role of penalising Telecom should it agree with TelstraClear's submissions that Telecom's OSS is inadequate. This is not a role that the Commission has under the Act. Telecom agrees with the Commission that any enforcement of terms of a determination are provided for by section 61.

G7 Other non price terms

199. TelstraClear's commercial team submitted a letter to Telecom's commercial team two days before the May submissions were due. On this basis, and on the basis that TelstraClear has never clarified in the regulatory proceedings what this request entailed, this part of the application should be treated as withdrawn. Telecom notes that TelstraClear's letter of 3 June 2005 notes the communication between the parties on this point.

⁸⁵ TelstraClear has previously stated in the mobile termination conference that the Act does not legally permit the Commission to set or influence a retail price. See pages 411 and 412 of the transcript from the mobile termination conference held 23 to 25 February 2005.

⁸⁶ Paragraph 299 of the draft determination and paragraph 405 of Telecom's submissions 20 May 2005

⁸⁷ Paragraph 122 of TelstraClear's May submissions.

⁸⁸ Paragraphs 123 to 126 of TelstraClear's May submissions.

G8 Term of the determination

200. Telecom encourages the Commission to liaise with the parties as to an appropriate implementation timeframe once it nears a final determination. This is necessary in order to avoid the Commission mandating requirements that cannot be met. Telecom has to date in submissions, endeavoured to provide preliminary views on timeframes.⁸⁹ However, until it is clear what is being mandated, it is difficult to provide detailed or firm forecasts.

⁸⁹ Paragraphs 408 to 410 of Telecom's May submissions.

H WORKABLE WAY FORWARD

201. Taking into account the Commission's views in the draft determination and extracting those parts that are not workable or not in the long term benefit of end-users, Telecom puts forward a fair and workable proposal with the following characteristics:
- (a) A selection of downstream speed options with a different price set for each within the residential and business areas. This is consistent with overseas practice (see Annexes B and E of Telecom's May submissions);
 - (b) The speed options would be 256 kbps, 1 Mbps, 2 Mbps and a "full speed" option for both residential and business;
 - (c) The "full speed" option would be to the maximum downstream speed that complies with the standard access principles and the purpose of the Act, and which can be supplied in a stable and sustainable way (See Section C of Telecom's May submission). The practical maximum is likely to be around 3 Mbps for the reasons detailed in this submission and would be a speed that is in line with high-end plans overseas;
 - (d) The options are L2TP (as confirmed by TelstraClear and the Commission);
 - (e) The uplink will be 128 kbps as in the designation;
 - (f) The retail minus approach mandated by the Act is approached as intended for each of the speed variants (Telecom would ensure that reference retail prices were available);
 - (g) A measurement and reporting regime will be implemented in order to report on consistency in line with the objectives set out in the draft report (but will, in the case of this proposal) be meaningful in terms of consistency;
 - (h) Telecom's industry proposal to set the churn fee at TSLRIC rather than incremental cost. (The churn fee was under review prior to the launch of the draft determination and has now been reduced to TSLRIC effective 30 May 2005); and
 - (i) A realistic timeframe is set to enable Telecom to deliver this proposal to TelstraClear and the industry in a similar timeframe.
202. This proposal is aimed at striking a reasonable balance between what is technically, operationally and economically achievable and the objectives of the Commission and the Act. It pushes the asymmetry boundary between the upstream and downstream speeds to the practical maximum that is workable. A menu of speeds as outlined is workable in terms of profiles, would enable retail and wholesale comparability and thus permit workable reporting on consistency. It will also resolve many of the difficulties with the proposal in the draft determination for which those difficulties largely outweigh any

perceived benefits. There will still be a number of mini DSLAMs (currently approximately 970) which will not support the "full speed" 3Mbps service due to backhaul limitations.

203. Telecom has provided preliminary views as to how a reporting mechanism might work should the Commission wish to mandate this. It is currently estimated that a baseline report could be prepared within 90 days after the final determination and a first audit report 30 days after that baseline report is finalised. Telecom would suggest a bi-annual reporting approach.
204. A revised methodology following the Commission's regression analysis (but correcting for errors) is submitted.
205. eOR for broadband ordering and tracking is to be available shortly to enhance the ordering experience of wholesale customers. Singleview implementation is also under way for later this year to resolve the pro-ration limitation. Other provisioning processes as outlined are consistent between wholesale and retail.

ANNEX A

Part A - Consistency Reporting – Non Workable Service Parameters

Telecom re-iterates that, subject to resolving issues around service comparability and the details of the parameters, it is willing to provide reporting to ensure consistency of service on the cost basis set out in paragraph 189 of its May submissions.

Telecom responds to some specific comments made by other submitters on Annex A of the draft determination below.

	The Commission’s proposals set out Annex A of the draft	Comments from TelstraClear	Comments from other parties	Telecom’s high level response
Contention Ratio	Definition: ‘The ratio of the number of end users of defined peak bandwidth (PIR) relative to the allocated bandwidth between the DSLAM and the first ATM switch during the peak busy hour of any day’.	...It is important to ensure...that if and when Telecom uses different contention ratios in its retail services, a matching approach is taken to wholesale bitstream services... (TelstraClear para 77)		Any change in the contention ratio of the regulated service will have an effect on the price of the service.
	Measurement Location: Between customer side of DSLAM and the network interconnection point. Indicated Rate: Nominal contention ratio of 50:1 for 95%	...TelstraClear suggests that the Indicated Rate be more accurately worded as: "For residential users a nominal contention ratio of <50:1 for more than 95% of the time. Measuring this contention shall occur over random 1 hour intervals on a daily basis and rolled up and reported quarterly highlighting		Contention ratio has no meaning in an unconstrained downstream service environment. By definition the contention ratio must relate to a defined peak information rate and as there is no such PIR defined the definition of contention ratio is not appropriate in this context.

	of the time.	samples failing the 95% requirement" (TelstraClear para 78)		
			...the definition of Contention Ratio should be redefined...to "The ratio of the sum of the end user access downstream bandwidth and the allocated bandwidth between the DSLAM and the network interconnection point (NNI) during the peak busy hour of any day". (CallPlus page 5)	With an unconstrained downstream, Telecom has no information on "the sum of the end user access downstream bandwidth," so the proposed definition cannot apply. If Telecom had this information, then what would be the point of having the unconstrained downstream service configuration. Telecom can only assume that the maximum is always applicable or some other average number which might be offered by the access seeker.
			"We are unsure of the difference and suggest clarification as to the distinction between the measurement location of "Network Connection Point" and "Network Interconnection Point" for the definitions of Contention Ratio, Jitter, Packet Loss and Latency" (CallPlus page 5)	Telecom references all measurement on a one way basis to the network interface on the first ATM switch.
			"We would like to see the following improvements...contention ratio no	A service with a contention ratio of 20:1 would bear no resemblance to Telecom's current retail Jetstream

			worse than 20:1... (Ihug page 3)	services and would have significant cost implications that would need to be factored in to the imputed price of the service.
Jitter/Delay Variation	<p>Definition: 'The difference in packet transfer time between the minimum absolute Packet Transfer Delay and the maximum absolute Packet Transfer Delay of any packet over a 1 minute measurement interval for a stream of packets that are all the same size bit'.</p> <p>Measurement Location: Checked by generated test traffic at the end-user's premises and measured at the Network Connection Point.</p> <p>Indicated Rate: One way delay variation of <500ms averaged over 1 minute interval for more than 95% of the time.</p>	<p>The Commission appears to have mistakenly quoted a 500ms figure in this parameter...a jitter factor of 500ms compared to the quoted "latency" would not be technically possible. (TelstraClear para 79)</p> <p>...TelstraClear suggest the Indicated Rate be more accurately worded as: "One way delay variation of <50ms averaged over a 1 minute interval for One way delay variation more than 95% of the time. Measuring one way delay variation shall occur over random 1 minute intervals on a hourly basis and be rolled up and reported quarterly." (TelstraClear para 80)</p>		<p>The Commission has correctly quoted a 500 ms figure. If the service being considered has a nominal contention ratio of 50:1 (subject to the comments above) then it is impossible to establish a jitter limit or delay variation limit of <50 ms as proposed by TelstraClear. Telecom or any other service provider could never comply with such a requirement, as explained at length at the workshop. If you have a contended service, packets will compete for bandwidth. There are only two options to deal with this (a) drop packets (this causes packet loss); or (b) delay packets (this causes delay variation). Usually a combination of delay variation and packet loss is applied with packet loss being used as a last resort, when buffers are overloaded. Hence peak one way delay variation could be as much as 500 ms on the</p>

				downstream with a 50:1 contended service. This peak would not occur for long periods of time but has a definite probability of occurrence.
			...the definition of Jitter should be redefined...to "The difference in packet transfer time between the minimum absolute Packet Transfer Delay and the maximum absolute Packet Transfer Delay of any packet of a range of fixed sized packet streams over a 1 minute measurement interval offered at the access rate of the direction". (CallPlus page 5)	The definition of jitter proposed by Callplus would be impossible to execute in a consistent manner as Telecom has no idea what "a range of fixed sized packet streams" actually is. This would need to be carefully defined and used consistently to be of any use. Telecom does in fact propose to use three packet sizes: 200 Byte, 600 Byte and 1472 Byte.
			"We would like to see the following improvements...jitter no worse than 100ms..." (Ihug page 3)	It will not be possible to achieve jitter no worse than 100 ms, simultaneously with a packet loss rate of <3% and a 50:1 contention ratio.
Packet loss	Definition: 'Packet loss ratio is the ratio of the total lost packet outcomes to the total transmitted IP packets in a population of interest'.	...there are two factors which should be incorporated into this parameter: (a) the effect that interleaving will have on this measure; and (b) what defines whether a packet is lost.		Agreed.

	<p>Measurement Location: Checked by generated test traffic at the end-user's premises and measured at the Network Connection Point.</p> <p>Indicated Rate: One way Packet Loss Ratio is <3% averaged over 1 minute intervals for more than 95% of the time.</p>	(TelstraClear para 81)		
		<p>...TelstraClear does not consider that interleaving being "on" or "off" for a particular customer is likely to impact on performance against the proposed parameter. (TelstraClear para 82)</p>		<p>Whether the interleaving is on or off will have a significant impact on both latency and packet loss. The one way latency for a 64 Byte packet will increase by around 20 ms with interleaving on vs interleaving off. This is highly predictable based on the DSL specifications. On the other hand, with interleaving off the packet loss performance will be highly unpredictable for many lines. This is because interleaving protects against impulse noise. Impulse noise arises from a large variety of sources, most of which Telecom has no control over (e.g. trolley bus arcing, customer premises wiring proximity to mains causing spikes, etc), and may:</p> <ul style="list-style-type: none"> • directly cause packet loss; and • indirectly cause packet loss due to resynchronisation of the modem. <p>The latter effect is much more damaging than the former, but both contribute to packet loss, in a</p>

				manner that cannot be controlled by Telecom.
		...TelstraClear proposes using the definition of packet loss in RFC 3393... (TelstraClear para 83)		At the workshop the parties agreed to use the ITU definitions for measures. The reference to RFC 3393 is appropriate only with careful interpretation when considering a contended service.
		TelstraClear suggests the Indicated Rate measurement be amended as: "one way packet loss ratio will be a maximum of 3% averaged over the total bit rate transfer (up and down) for all customers. Packet loss will be measured in random 1 minute samples of full rate, 1,500 byte packets every hour. Quarterly reporting will summarise daily, weekly and monthly samples highlighting samples exceeding 3%." (TelstraClear para 84)		The measurement proposed is internally inconsistent, in that it proposes measurement of a one way packet loss ratio with a 2 way average. Telecom considers that it would be more appropriate to use packets with a maximum size of 1472 byte for such measurements, as this would minimise the probability of packet fragmentation and therefore, result in more consistent measurements.
			"We would like to see the following improvements...jitter no worse than	It will not be possible to achieve packet loss rate of <3%, simultaneously with jitter no worse

			100ms... (Ihug page 3)	than 100 ms and a 50:1 contention ratio.
Latency	<p>Definition: 'The absolute time measured from the time the first bit of an IP packet is passed to the source (ingress) User Network Interface to the time the last bit of the packet is transmitted by the destination (egress) User Network Interface towards the user's equipment or the host'.</p> <p>Measurement Location: Checked by generated test traffic at the end-user's premises and measured at the Network Connection Point.</p> <p>Indicated Rate: <50ms using 64 byte packet for >95% of the time averaged over 1 minute interval with interleaving either on or off.</p>	<p>...the Indicated Rate for Latency should be more accurately worded as: "latency will be 50ms within the national network using 64kbyte packets averaged over 1 minute for more than 95% of the time. Measuring latency shall occur in random 1 minute samples each hour. Quarterly reporting will summarise daily, weekly and monthly samples, highlighting samples where the minimum requirement was not met." (TelstraClear para 85)</p>		<p>Telecom is not offering comparability of service over the national network. The determination relates to access from the customer to the first ATM switch. Furthermore, the definition of latency proposed is quite different to that discussed at the workshop. In this definition, latency includes delay variation. Telecom cannot achieve a latency under this definition of less than 50mS for a 64 byte packet with the sampling as defined. No service provider offering a nominal 50:1 contention ratio service could achieve this goal – see the comments in relation to jitter and contention ratio above.</p>
Maximum upstream throughput of 128	<p>Definition: Maximum upstream throughput of 128 kbps.</p> <p>Measurement Location:</p>	<p>...it is important to ensure that upstream availability is close to the 128 kbps limit as often as possible (TelstraClear para 86)</p>		<p>There is no requirement in the Act for the 128 kbps upstream limit to meet any requirement other than "maximum upstream throughput</p>

Limit (a)	Indicated Rate: Maximum upstream throughput of 128 kbps.	<p>...[TelstraClear] propose that the Indicated Rate be worded as follows: "128 kbps will have a minimum speed of 32 kbps at any given time and the percentage of time that the 128 kbps speed is not attained will be measured. Measurement will include sampling minute intervals at random intervals on an hourly basis. Quarterly reporting will summarise daily weekly and monthly samples compared directly with retail products with a nominal upchannel speed of 128 kbps meet or exceed that speed over the sample timeframe. Non discrimination between reference frames should exceed the 95% confidence interval." (TelstraClear para 87)</p>		<p>rate of 128 kbps".</p> <p>Any reference to 32 kbps minimum throughput applies to the downstream only and, as indicated in Telecom's May submissions, is dependent on the defined nominal contention ratio combined with the service PIR. If the downstream contention ratio is 50:1 then the upstream contention ratio will be of the same order (but typically less). TelstraClear's proposed wording would require a contention ratio of 4:1 which bears no relationship to any existing Telecom service.</p>
Downstream throughput no less than 32 kbps Limit (b)	Definition: Downstream throughput rate for data traffic sent to the end-user no less than 32 kbps. Measurement Location: TelstraClear propose 5 minute	<p>The second limitation on access principle...must be measured against retail positions and compared accordingly. In addition to the wording already provided by the Commission...we should further add: "Measurement will include sampling</p>		<p>Although averages may be able to be constrained within a 95% confidence limit with a reasonable number of samples, and hence measurement probes, it is unlikely that all measures will be capable of being constrained to this confidence</p>

	<p>average of those 1 minute measurements. Telecom agree with proposed sampling methodology.</p> <p>Indicated Rate: Downstream throughput rate for data traffic sent to the end-user no less than 32 kbps.</p>	<p>minute intervals over 5 minutes at random intervals on an hourly basis. Quarterly reporting will summarise daily, weekly and monthly samples compared directly with retail products over that sample timeframe. Non discrimination between the reference frames should exceed the 95% confidence interval." (TelstraClear para 88)</p>		<p>level without the implementation of a vast array of measurement probes. Telecom has engaged external experts to undertake formal analysis of the sampling methodology to determine the number of probes vs confidence levels relative to different measures.</p>
<p>No real time Limit (c)</p>	<p>Definition: Downstream throughput rate for data traffic sent to the end-user average not less than 256 kbps.</p> <p>Measurement Location: TelstraClear propose calculated as a 60 minute average of those 1 minute measurements. Telecom agree with proposed sampling methodology.</p> <p>Indicated Rate: Downstream throughput rate for data traffic sent to the end-user average not less than 256 kbps.</p>	<p>The third limitation on access principle...must be measured against retail services. In addition to the wording already provided by the Commission...we should further add: "Measurement will include sampling minute intervals over 60 minutes at random intervals on a daily basis. Quarterly reporting will summarise daily, weekly and monthly samples compared directly with retail products over that sample timeframe. Non-discrimination between the reference frames should exceed the 95% confidence interval." (TelstraClear para 89)</p>		<p>It is unclear what the following sentence is intended to mean:</p> <p>"Non-discrimination between the reference frames should exceed the 95% confidence interval".</p>

Interleaving	<p>Definition: Rearrangement of parts of the DSL line signal so that they alternate in a different known sequence so that when restored the line signal retains its integrity under conditions of injected line noise.</p> <p>Measurement Location:</p> <p>Indicated Rate: optional.</p>	<p>Paragraphs 115 and 116 of TelstraClear's May submissions discuss TelstraClear's views on the potential cost of an interleaving option but do not offer any comments as to the workability of an interleaving option.</p>		<p>The consequences of an interleaving option are unknown but indications as to potential adverse effects are set out in Telecom's May submissions⁹⁰.</p> <p>There is no consistency that can be reported between a wholesale service with interleaving off and Telecom's retail services with interleaving turned on.</p>
Service Availability	<p>Definition: Measured over a rolling 30 day period.</p> <p>Measurement Location:</p> <p>Indicated Rate: 99.3% (24 x 7)</p>	<p>...TelstraClear considers that Internet grade service availability is a maximum of 99.9% (8hours) and minimum of 99.5% (2 days) (TelstraClear para 90)</p>		<p>99.999% availability corresponds to 5 minutes of outage per year and is only ever applied to core parts of the network. The wholesale bitstream service is by definition an access product and so reference to such availability numbers is inappropriate and potentially misleading.</p> <p>Availability is determined by the accumulated impact of many factors, the most prominent of which is in access cable damage by an external contractor. Telecom can ensure that most cable faults are repaired within</p>

⁹⁰ See Section C2 of those submissions.

				24 hours. However, Telecom cannot control multiple incidences in a given year and hence offers availability of better than 99.3% for internet grade services. This figure is consistent with the Telecom retail services.
--	--	--	--	---

ANNEX A

Part B - High Level Critique of the Knossos Report

The Knossos report contains at least five fundamental errors:

- (a) The diagram of the wholesale bitstream service in paragraph 4 of the Knossos report is incorrect. This misunderstanding of how the wholesale bitstream service is configured is carried into a number of subsequent paragraphs;
- (b) As a result of the misunderstanding described in paragraph (a), the Knossos report confuses the backhaul service and the wholesale bitstream service;
- (c) The Knossos report has considered the various service parameters proposed by the Commission against IETF definitions, rather than the ITU definitions that were agreed at the Commission's workshop. As a result, the relevant parameters have been taken out of context;
- (d) The Knossos report does not take into account the inter-relationship between the various service parameters, such as contention ratio, packet loss and delay variation; and
- (e) The Knossos report also does not recognise that additional capability and flexibility have cost implications that will need to be reflected in the imputed price of the wholesale bitstream service.

Telecom sets out below some specific comments on various paragraphs in the Knossos report.

Section	Paragraph	Telecom's Comments
Unbundled Bitstream Service	4	The diagram in paragraph 4 is incorrect. The diagram assumes that the core network sits between the first ATM switch and the LAC (L2TP Access Concentrator) function. The LAC function is actually provided in association with the first ATM switch. The wholesale bitstream service would therefore be more accurately represented by showing the LAC function as being linked to the first ATM switch. This misunderstanding of how the wholesale bitstream service is configured is carried into a number of subsequent paragraphs.
	6	The reference to "dimensioning of the ATM virtual circuit at a rate of 24 kbps" in paragraph 6 is irrelevant, as this relates to the backhaul service rather than the wholesale bitstream service.
Network Performance Measures	9	Telecom disagrees that the reference to "network connection point" in the definitions of the service parameters in Annex A of the draft determination requires further clarification. It is clear from the description of the designated service in the Act that the relevant

		interface is on the trunk side of the first ATM switch.
"99.5% of the time"	11-12	The discussion in paragraphs 11 and 12 confuses the confidence intervals applied to the measurements of contention ratio, delay variation, packet loss and latency, with the service availability parameter. A confidence interval of 95% is applied to the measurement of the service parameters outlined in annex A of the draft determination because these service parameters are measured using a sample of all of the relevant wholesale services. By contrast, the service availability measure of 99.3% is measured on a per connection basis averaged over a year. (Availability of 99.3% allows for 2-3 cable cuts per year depending on repair times)
Contention Ratio	13 - 14	Telecom agrees that there are several problems with the definition of contention ratio in the draft determination and that an unconstrained service makes defining the peak bandwidth of a given ADSL line difficult without full knowledge of the actual line and the rate shaping within the Access Seeker's network.
	15	Telecom agrees that it is possible to attempt to define "peak bandwidth" in a number of different ways. However, the Knossos report fails to recognise that different definitions will have different cost, and therefore price, implications.
	16 -17	Paragraphs 16 and 17 confuse the backhaul service and the wholesale bitstream service.
	19	Paragraph 19 fails to recognise that any significant change in usage, that results in a change in the contention ratio, will have cost, and therefore price, implications.
	20-22	The discussion of gigabyte allowances in paragraphs 20-22 is irrelevant. Telecom only imposes such allowances on its retail products. It will not impose any form of cap or gigabyte allowance on the designated UBS service.
	24	Telecom's use of the word "nominal" in relation to contention ratio simply reflects the fact that during any particular measurement period on any particular DLSAM, there will be a statistical distribution associated with the contention ratio. At some times of the day, measurement of contention ratio may show at 1:1, whereas during the peak busy hour Telecom would expect to see a 50:1 contention ratio achieved on a regular basis.
	25	Telecom agrees that the Commission's intention is not to provide a constant bitrate service and notes that such a service is clearly

		outside of the scope of the designated bitstream service.
	26	Telecom agrees that it is difficult to define a contention ratio for an unconstrained service by reference to the PIR. Although it would be possible to define contention ratio in terms of minimum absolute bits per second, this would mean that all services would have the same throughput. (i.e a 2Mbps service would have the same throughput as a 256 kbps service). This would be inconsistent with reasonable customer expectations or international best practice.
	27	Knossos fails to consider issues of efficient use of the power spectrum within the copper cable sheath. If resources are allocated to the wholesale bitstream service relative to a nominal upstream throughput rate of 7Mbps this will waste the finite resource in the DLSAM and increase the noise in all cable sheaths as described in Telecom's May submission.
	28	Any requirement for Telecom to provision 62kbps per user of aggregated downstream bandwidth would have the implications identified in relation to paragraph 24 of the Knossos report above and have significant cost implications. For example, the cost of a 256 kbps service would increase by around 50%.
Packet Loss	30 - 37	The analysis in paragraphs 30-36 assumes that there is no contention. However, the results change dramatically if there is contention. For example, during peak periods, a service with a 6Mbps downstream speed and aggregated downstream bandwidth of 62 kbps per service (as proposed by Knossos) would experience an instantaneous packet loss of about 99%, unless some form of buffering is used. The approach taken by Knossos in paragraphs 30-36 is inconsistent with paragraph 25 of their report, where Knossos accepts that the service has to be contended. It also ignores the relationship between packet loss, latency and delay variation.
Latency	41	Telecom agrees that where there is heavy contention for the egress channel, packets or cells from one ingress channel may be queued for a considerable period while packets from other ingress channels are sent. This queuing is specifically intended to reduce packet loss. Again, this section of the Knossos report fails to recognise the relationship between packet loss, latency and delay variation.
	42	Telecom disagrees that latency is necessarily due to poor dimensioning or unusual traffic patterns. With contention, even if you have perfect dimensioning and typical traffic patterns you will end up with some delay caused by queuing.

	45	Telecom notes that Knossos have adopted an IETF definition of latency rather than the ITU definition agreed at the workshop. The ITU defines latency as the minimum packet transfer delay. The 50ms figure relates to this definition and is achieved with a 64 Byte packet when measured as per the ITU definition in both the up and down stream directions for all the services defined to date. To date neither Telecom nor the Commission have defined an average latency. However, when using a 64Byte packet it would be difficult to achieve an average latency in the context defined by Knossos for either the up or down stream directions which is "significantly" lower than 50 ms and have a service with a nominal contention ratio of 50:1.
Jitter	46 - 47	Telecom disagrees with the assertion that the 500 ms figure for jitter proposed by the Commission in the draft determination is incorrect. Again, this conclusion appears to reflect the fact that Knossos has adopted IETF rather than ITU definitions and is therefore misinterpreting the parameters proposed by the Commission. Using ITU definitions, with a contended service and packet loss >3% there will be a queuing delay as acknowledged in paragraph 41 of the Knossos report – that queuing delay could be in the order of 500 ms on top of the latency for small periods of time.
Upstream Throughput	48	Telecom notes that there is no requirement in the Act for the 128 kbps upstream channel limit to meet any requirement other than the maximum upstream throughput rate of 128 kbps.
Downstream Throughput	49	Telecom agrees that overall throughput is highly dependant on line quality, and may additionally be affected in short term bursts by radio frequency and electromagnetic interference and that such signal degradation may result in reduced throughput.
	50	Knossos appears to suggest that a different set of performance parameters should apply to those circuits that are terminated close to (e.g. less than 2km) the DSLAM. This suggestion ignores the issues around managing power spectral density in the copper cable network as discussed in section C1of Telecom's May submissions.
Equivalency of Service	51	Telecom disagrees that additional performance requirements are needed around OSS such as provisioning and fault responses. Telecom has addressed this point in sectionG2 of this submission.
Interleaving	53	Telecom notes the comment in paragraph 53 of the Knossos report that ISPs using Commercial UBS with whom interleaving was discussed indicated no particular desire to turn interleaving off, preferring to make the trade-off in favour of reliability rather than

		reduced latency. Telecom supports this trade-off and has a similar view of market expectations. Telecom discusses this point further in section C2 of this submission.
	54	Requiring Telecom to provide the access seeker with the ability to select from a menu of different interleaving configurations will add even further cost and complexity to the wholesale bitstream service. Each additional interleaving configuration would require an additional profile to be configured for each DSLAM. Telecom has previously provided the Commission with information on the number of profiles that can be support by its DSLAMs. Further Telecom does not have a sufficient understanding of the potential implications of turning off, or reducing, the amount of interleaving. Refer to section C2 of Telecom's May submissions.
Service Availability	55	Refer to the comments under the heading "99.5% of the time" above.
	57	Telecom disagrees with the assertion that the service availability figure for the core elements of the wholesale bitstream service should be 99.999%. Service availability of 99.999% is only ever used for core infrastructure. The UBS infrastructure is access infrastructure – not core infrastructure and hence this figure is not applicable.
Summary	55	Telecom disagrees with the assert that a "credible service" cannot be offered using a contention ratio of 50:1 and packet loss of >3%. Telstra, BT and Telecom all currently provide constrained services that meet these specifications and are considered to provide value in their respective markets.
	59 -60	Telecom notes that that additional capability and flexibility requested has cost implications that will need to be reflected in the imputed price of the wholesale bitstream service as these cost elements are not part of Telecom's current retail services.
	74	Telecom disagrees with the assertion that instability is likely to be caused by an absence of proper network engineering. It is possible to have a properly dimensioned network and still experience the DSLAM input buffer overloading described in Telecom's May submission.

ANNEX B

RESPONSE TO TELSTRACLEAR'S COMMENTS ON

THE UTILITY OF THE PROPOSED UNCONSTRAINED SERVICE WITH AN INTERLEAVING OPTION⁹¹

TelstraClear's view on Telecom service development focus	TelstraClear's view on Telecom's current UBS service	TelstraClear's view on Commission's unrate shaped service with interleaving off	Telecom's response
Streaming video (news, weather, sport, entertainment)	<p>Only limited streaming video over the current solution provided by Telecom.</p> <p>Some sorts of video ('talking heads' reading the weather or news) could utilise 1.5 Mbps downchannel capacity at approximate 'TV broadcast' quality, live action. However sports and entertainment require 3.5-4 Mbps with current technology.</p> <p>The new MPEG4 standard allows equivalent</p>	<p>The difference between unrate-shaping and rate-shaping is essentially the amount of data that can be broadcast at any point in time given minimum contention and use within the network.</p> <p>By providing an unrate-shaped service TelstraClear will be able to stream video content with better surety that traffic will be received by our customers and less jitter/delay and buffering is required by</p>	<p>Unconstrained Service: The difference between the performance of an unrate shaped service, and a service with a downstream speed rate limited to about 3mbps for streaming video will be negligible, assuming an appropriate video codec is utilised. If higher rate codecs are used then the number of customers able to take advantage of the marginal increase in quality will be limited. For example, Telecom noted in its May submissions that less than</p>

⁹¹ As detailed in Figure 6 of TelstraClear's May submissions.

	<p>quality with 1.5-2 Mbps downchannel capacity, but the processing power required to support this CODEC is beyond the capacity of practically all current personal computers.</p> <p>Because the 2 Mbps restriction imposed by Telecom, bit rate delivery may hinder some video streams when network use is high and/or significantly over-subscribed. Streaming video quality will suffer if other applications, such as the web, are attempted simultaneously.</p> <p>Lower eroded streaming will be more feasible – particularly content streaming as available today from the Xtra web site for news stories and reports. The effect of lower encoded streams is that they are grainy at full screen resolution and sometimes only play in small windows (screen within screen).</p>	<p>customers.</p> <p>Essentially this leads to better network and traffic efficiency, as customers are able to view services and cancel if they do not want to view further. In the case where buffering and download is required this will require traffic usage from the network and customer end.</p>	<p>50% of lines will achieve 4 Mbps.</p> <p>Interleaving Off: Turning interleaving off will not improve the end user experience for customers downloading streaming video. In fact, turning interleaving off may actually have a detrimental impact on the end user experience, as increased packet loss may cause buffer exhaustion. If this occurs the video will freeze while the buffer is refilled.</p>
<p>Music streaming, music downloads, music vending machines for songs, ring tones, ring back tones and music identification</p>	<p>Streaming music will generally be deliverable to reasonable quality levels with a 192 kbps downchannel due to the low encoding rates.</p> <p>However, the effect of interleaving with high over-subscription (affecting contention) is that some streaming may be delayed when</p>	<p>The unrate-shaped service will allow TelstraClear to better cope with contention and over-subscription of the music download services to maintain better service levels and less service interruption.</p> <p>The availability of unrate-shaped services means that vending machines could</p>	<p>Unconstrained Service: An unconstrained service will not improve the end user experience for customers downloading streaming music.</p> <p>Interleaving Off: Turning interleaving off will not improve the end user experience for customers downloading streaming music. More</p>

	<p>network use is very high.</p> <p>A 2 Mbps downchannel may limit the amount stored in a music vending machine – typically it would only be possible to download to the vendor 90 tunes per day given low contention (no over-subscription) on the network.</p>	<p>download potentially up to 4 times more than with a 2 Mbps rate-limited service making them more useful to vendors.</p>	<p>likely it will cause deterioration of the music quality due to packet loss and occasionally line resynchronisation events.</p>
<p>Multiplayer games environment</p>	<p>There are a number of effects that the 2 Mbps service speed limitation, and interleaving and contention (along with over-subscription) will have on the games environment.</p> <p>Firstly, many games require low trigger responses (responses from networks whereby latency and jitter are minimised).</p> <p>Interleaving decreases the packet loss within the network but by doing so increases the delay. Within the Telecom environment interleaving adds at least 40 ms one way to gaming services that translates to a significant trigger delay (especially when added to other hops and network delay within the Telecom environment). There are instances where players in Australia playing on New Zealand gaming services have less overall trigger delay than New Zealand gamers: that is a direct result of the Telecom</p>	<p>TelstraClear believes that we can offer additional levels of service and differentiation of services with the ability to turn interleaving on or off.</p> <p>We believe that by offering this service we will enable a wider spectrum of games audience and will be providing value added services to match this expectation.</p> <p>As multi-player games increase, we expect to extend our platforms further so that we can keep up with information exchange and bandwidth needs. An unrate-shaped service would allow TelstraClear to craft bandwidth required services at a pace that suites both our end users and core server requirements in shorter time-frames without having to rely on the incumbent to release progressively faster versions of its bitstream service, leading to more</p>	<p>Unconstrained Service: An unconstrained service will not improve the end user experience for gamers, using games available on the market today. Future games may operate better with higher downstream bandwidth but are unlikely to need more than 3 Mbps in the foreseeable future as this aligns with maximum rates available in many global markets.</p> <p>Interleaving Off: If all customers have interleaving on, or if all customers have interleaving off, then all customers will have the same gaming experience. Turning interleaving off will only be an advantage for games that require low trigger responses and if those games and the gamers playing them are hosted in Australasia. Turning interleaving off will not assist gamers using sites outside of Australasia as the 20-28 ms of latency gained by turning interleaving off will have a negligible effect</p>

	<p>network configuration and interleaving.</p> <p>Generally the bit-rate requirement is a function of the bit-rate requirement from the game. Typical current games are tolerant with the 256 kbps services but can be heavily affected by contention and network over-subscription. This current extends to the 2 Mbps UBS services because of these 2 factors.</p>	<p>innovation and a more dynamic market.</p>	<p>compared with the 150+ms of latency associated with a packet travelling outside of Australasia (note that most gaming sites are located in the US). In addition, turning interleaving off may actually have a detrimental effect on the end user experience if the service becomes unstable as a result of increased packet loss.</p> <p>Note that the maximum one way delay introduced by interleaving is <30 ms as compared to the 40 ms claimed by TelstraClear. It is typically in the range of 20-25 ms.</p>
--	--	--	---

ANNEX C

Annex on Crosstalk and Spectrum Management

By Lee Garth, Ph.D.

1. Introduction

Over the past fifteen years, the so-called Communications Revolution, driven by the wide-scale adoption of the Internet and telecommunication services such as wireless cellular telephones, has changed the modern lifestyle in industrialized countries. Consumer desire for a ubiquitous broadband network to facilitate activities including communicating with friends, entertainment, and shopping has been motivation for telecommunication service providers to drastically modify and extend their existing networks. As more and more high-bandwidth fibre optic cable has been laid to create the backbone of the telecommunications network, one of the last “bottlenecks” in creating a broadband network to the home is the portion of the network lying between the local switch or central office (CO) and the home or customer premises (CP). As shown in Fig. 1, this portion of the network generally consists of twenty-five copper twisted-pair wires bundled together in distribution or trunk cables (on the telephone poles or buried under the street) leading to splicing units or distribution boxes and copper drop cables which connect the house to the trunk cable. (Figure 2 shows the cross-section of a typical New Zealand distribution cable.) The physical characteristics of this crucial last portion of the network, often called the “Last Mile”, is the subject of this annex.

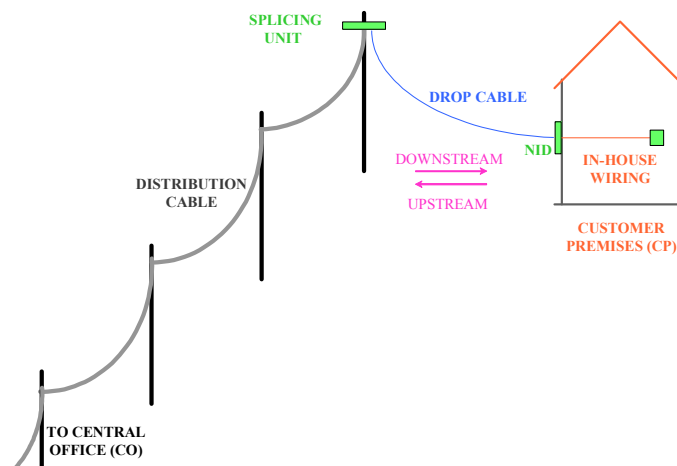


Figure 1: The “Last Mile” Network Configuration

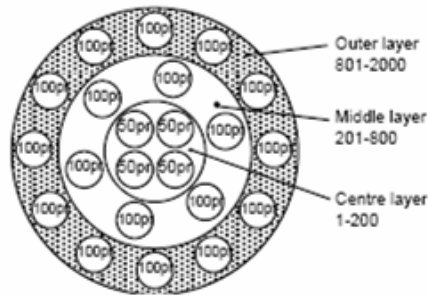


Figure 2: Cross-section of Typical New Zealand Distribution Cable

The telephone network was originally engineered for voice communications at frequencies below 4 kHz. However, with the advent of modern digital computers, over the past thirty years the network has been retrofitted to accommodate communications between computers, first using voiceband modems, which allow the network to treat the computer-generated data signals as analogue voice signals, and then using Digital Subscriber Line (xDSL) modems to utilize the full bandwidth of the copper cables connected to the customer premises. As shown in Fig. 3, conventional voiceband modems use the plain-old-telephone service (POTS) frequencies below 4 kHz. At these frequencies, very little coupling happens between the copper wires in the distribution cables. On the other hand, Asymmetric Digital Subscriber Line (ADSL) modems often use frequencies all the way up to 1 MHz. As detailed in the next section, at these frequencies coupling occurs between the parallel pairs in the distribution cables, leading to increased noise and crosstalk. As more and more high bit rate ADSL subscribers are added to the network, if these impairments are not managed properly, they can lead to severe performance degradation of the “Last Mile” network. Either the achievable user bit rates for a given loop length or the achievable reach of the network for given bit rates will suffer.

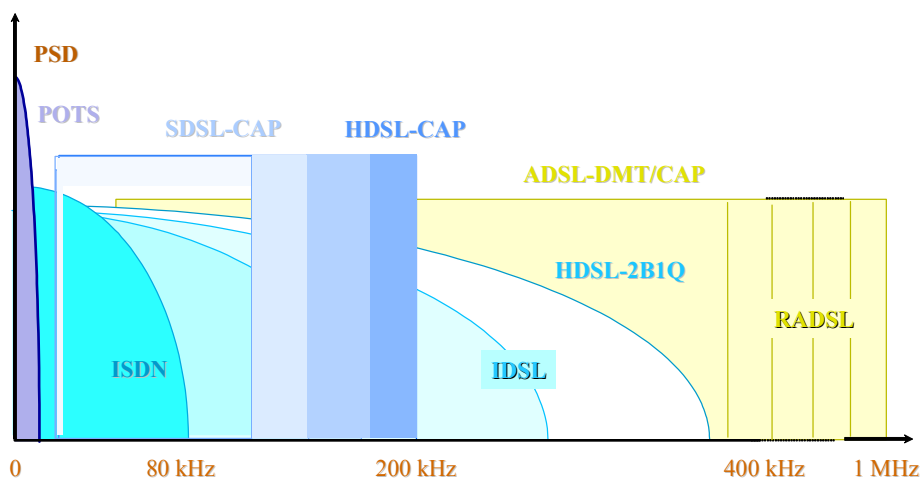


Figure 3: Spectra of Typical xDSL Services

In this annex we give a brief technical overview of crosstalk and the modulation scheme used by ADSL modems. Then, we compare two crosstalk mitigation strategies

for first generation ADSL modems, the conservative spectral mask-based strategy presently used in Australia and the more dynamic “copper rate limiting” strategy presently used by Telecom New Zealand. We explain the many advantages of the latter strategy over the former. We conclude this annex by looking toward the future and the next generation crosstalk mitigation techniques which will be rolled out for second- and third-generation ADSL services over the next decade.

2. Background

In this section we give a brief technical overview of crosstalk and introduce the discrete multi-tone modulation (DMT) scheme used by ADSL modems. With this background we will then be able to compare various crosstalk mitigation strategies.

a. Overview of Crosstalk

If two conductors are placed parallel to each other in close proximity and a time-varying voltage or current is sent over one of the conductors, then a voltage or current will be induced in the other conductor, even though it is not physically connected to the first conductor. This property follows from basic physical laws (Maxwell’s equations for electromagnetism). In the context of transmission lines, this effect is called *crosstalk*. As shown in Fig. 4, crosstalk comes in two forms. Near-end crosstalk (NEXT) is the induced interference at the receiver due to other transmitters located at the *same* end of the cable as the receiver, whereas far-end crosstalk (FEXT) is the received interference due to transmitters located at the *opposite* end of the cable. If the upstream and downstream channels in a communication system share the same frequency spectrum, then NEXT tends to be the dominating impairment. If the upstream and downstream channels use separate frequency ranges, then FEXT usually dominates.

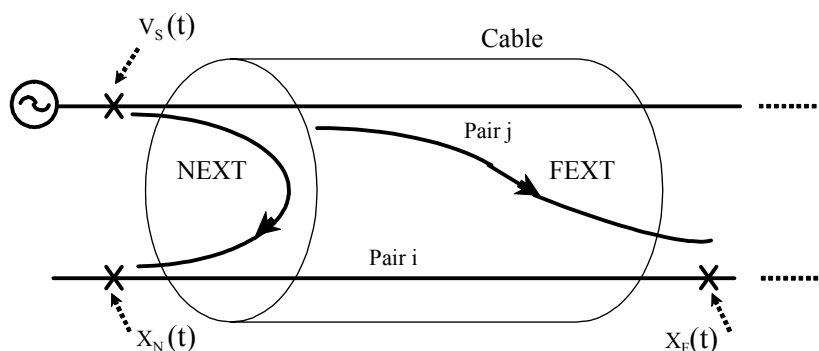


Figure 4: Two Types of Crosstalk from [1]

Based on physical measurements of distribution cables, various empirical crosstalk models have been proposed. Figures 5 and 6 show laboratory measurements of pair-wise self-NEXT and self-FEXT losses for a typical U.S. distribution cable [2]. In the ADSL standard [3, p. 171], the downstream FEXT loss is modelled as

$$|H_{\text{FEXT}}(f)|^2 = |H_{\text{channel}}(f)|^2 \times k \times l \times f^2 \quad (1)$$

where $H_{\text{channel}}(f)$ is the channel transfer function, coupling constant $k = 8 \times 10^{-20} \times (n/49)^{0.6}$ for $n < 50$ where n is the number of crosstalkers, l is the coupling path length in feet, and frequency f is in Hz. The power spectral density of the FEXT then has the form

$$\text{PSD}_{\text{ADSL-FEXT}} = \text{PSD}_{\text{ADSL-Disturber}} \times |H_{\text{FEXT}}(f)|^2 \quad (2)$$

where $\text{PSD}_{\text{ADSL-Disturber}}$ is the power spectral density of the typical crosstalker. From (1) we see that the FEXT interference increases with frequency f , the shared path length l , and the number of coexisting signals in the cable n . Similarly, the power spectral density of ADSL NEXT from the downstream into the upstream channel can be modelled as

$$\text{PSD}_{\text{ADSL-NEXT}} = \text{PSD}_{\text{ADSL-Disturber}} \times (x_n \times f^{3/2}) \quad (3)$$

where $x_n = 8.818 \times 10^{-14} \times (n/49)^{0.6}$. Again, the NEXT interference increases with frequency and the number of coexisting signals.

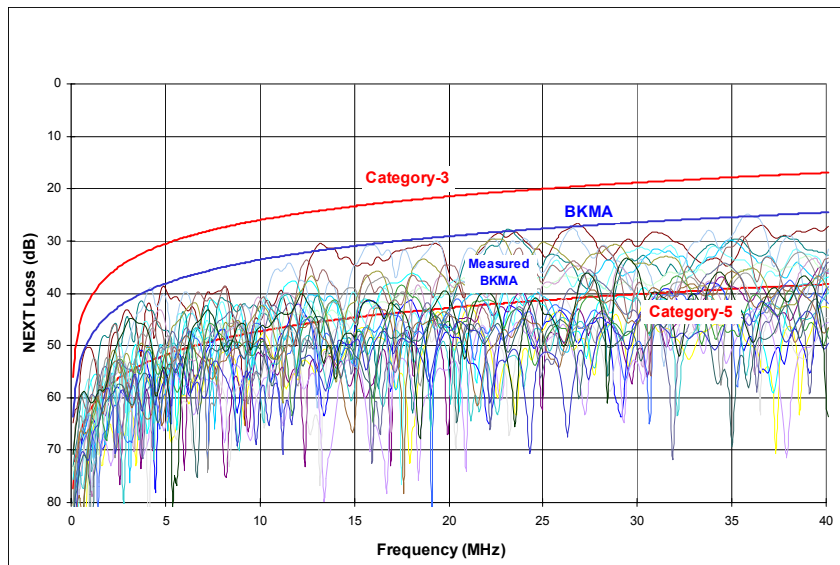


Figure 5: Measured Pair-to-Pair NEXT Losses of BKMA Cable from [2]

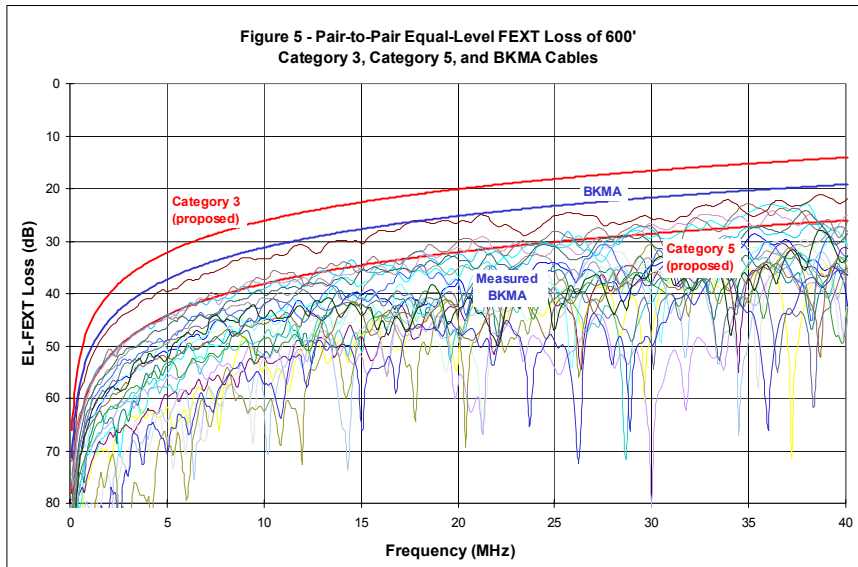


Figure 6: Measured Pair-to-Pair Equal-Level FEXT Losses of 600' BKMA Cable from [2]

For voiceband modems, due to the low frequencies involved, crosstalk is not a significant impairment. On the other hand, for ADSL, due to the large frequency range, we see from (1)-(3) that crosstalk can cause significant performance degradation due to increased noise levels. As the number of high bit rate users increases in a cable, the crosstalk increases, either reducing the achievable bit rates for the various users in the cable or the possible reach of the ADSL service. For example, Fig. 7 shows the achievable data rates per user for two different loop lengths as a function of the number of full bit rate users in the distribution cable.⁹² As the number of users increases, we see that the bit rate decreases.

Another important point is that increasing the transmit power of all the users does not help in a crosstalk-limited channel. Rather, it boosts the interference due to the crosstalk paths along with the desired signal along the direct path. Therefore, alternative crosstalk reduction strategies need to be considered as broadband penetration in the local loop increases. To understand the possible strategies, we need to understand the ADSL modulation scheme.

b. Introduction to DMT and Bit Loading

Orthogonal frequency division multiplexing (OFDM) divides a wideband channel into L parallel narrowband channels (see Fig. 8). Instead of sending a single high bit rate stream as conventional single-carrier systems do, an OFDM system transmits L

⁹² See Table 1 in Section 3 and the Appendix for the simulation parameters and algorithm used to generate these calculations.

parallel low bit rate streams. With the advances in digital computing power and the invention of the Fast Fourier Transform (FFT), practical implementations of OFDM systems have been developed in the past twenty years. ADSL modems have been the first application and large-scale deployment of this powerful communication scheme in the world.

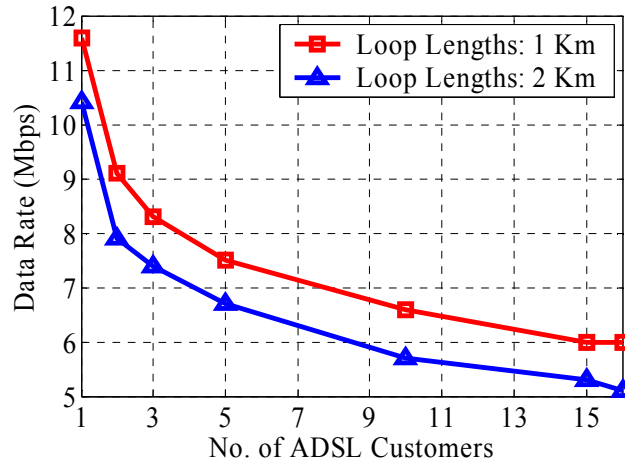


Figure 7: Data Rate vs. Number of Users for Downstream ADSL

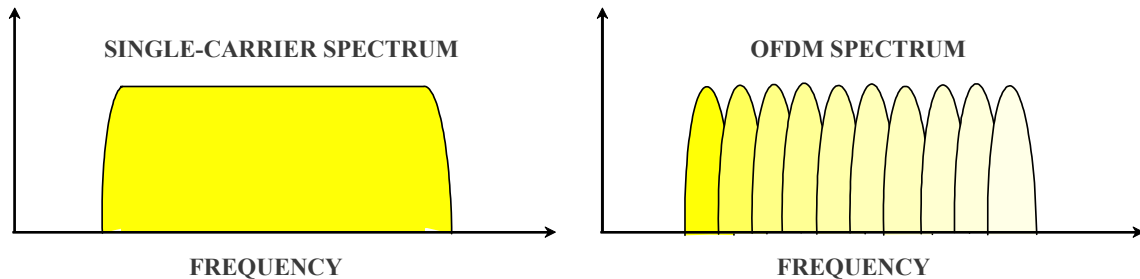


Figure 8: Single-Carrier vs. OFDM Spectra

One of the key advantages of an OFDM system is the ability to send more bits (information) down good portions of the channel frequency spectrum and fewer bits down poor portions of the channel spectrum.⁹³ This scheme is known as “water-filling” and can be shown to be optimal using Information Theory. For a given signal power, more bits can be sent by using a larger-sized signal constellation. In ADSL, this water-filled version of OFDM is called Discrete Multi-Tone (DMT) modulation.

⁹³ To determine the good portions of the channel, a series of tones at different frequencies are transmitted down the channel, and the received signal power / noise power, known as the signal-to-noise ratio (SNR), is measured at each frequency. At a given frequency, the larger the SNR is, the better the channel is.

Figure 9 shows two different signal constellations for an SNR of 30 dB with an average signal power of 1. By selecting a symbol from the 16-point constellation, four bits of information can be sent per symbol, whereas by selecting a symbol from the 64-point constellation, six bits of information can be sent. To be able to properly detect the transmitted symbol, the receiver needs to be able to distinguish between the signal constellation points. The greater the Euclidean distance between the constellation points, the better the receiver will perform (correctly deciding which symbol was sent). Figure 10 shows the signal constellations for a lower SNR (15 dB). Now, because the spacing between the noisy “balls” in the 64-point constellation is too small, the receiver can no longer correctly distinguish between the points. We can still see distinct balls for the 16-point constellation, which has better noise immunity. These figures illustrate the general principle of water-filling. If there is high SNR for a particular frequency, a large signal constellation with little Euclidean distance between points is used. On the other hand, if there is low SNR, a small signal constellation with a large distance between points is used.

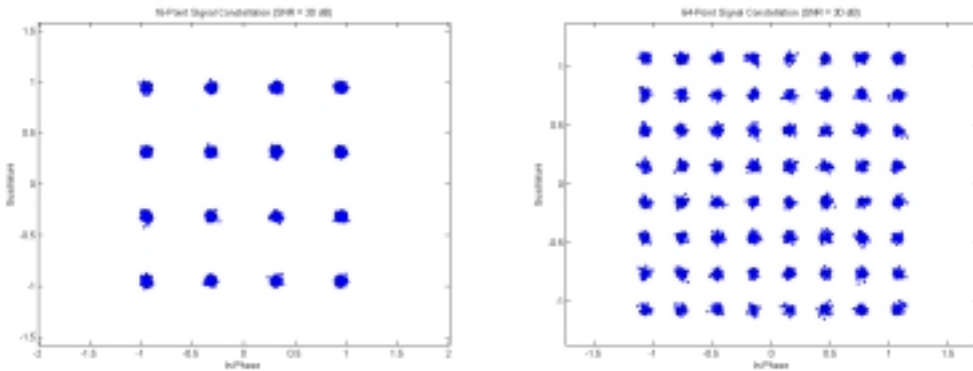


Figure 9: 16- and 64-Point Signal Constellations for SNR = 30dB

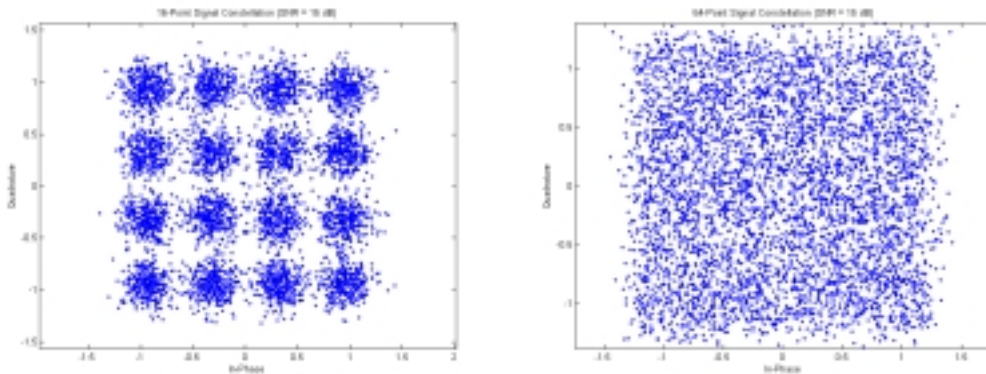


Figure 10: 16- and 64-Point Signal Constellations for SNR = 15 dB

In a DMT system the process of deciding the size of signal constellation to use for each frequency tone, given a particular transmission power level, is derived from

Shannon's equation for the channel capacity and is called *bit-loading*. For a particular tone m , the number of transmitted bits per DMT symbol b_m has the form

$$b_m = \log_2 \left(1 + \frac{\varepsilon_m h_m}{\Gamma \sigma_m^2} \right) \quad (4)$$

where, for tone m , ε_m is the transmit energy, h_m is the channel gain, and σ_m^2 is the noise power. We use gap Γ to quantify the effective loss in SNR with respect to the capacity for a practical DMT system with a given fixed probability of symbol error. The total bit rate over the L parallel channels is then

$$r_{\text{Tot}} = f_s \sum_{m=1}^L b_m \quad (5)$$

where f_s is the DMT symbol rate. Given a fixed total energy $\varepsilon_{\text{Tot}} = \sum_{m=1}^L \varepsilon_m$, we can show that r_{Tot} is maximised by the so-called water-filling solution

$$\varepsilon_m + \frac{\Gamma \sigma_m^2}{h_m} = K. \quad (6)$$

In other words, the sum of the transmitted energy and the noise normalized by the channel gain scaled by the gap remains constant ($= K$) across all the frequency bins. As shown in Fig. 11, this can be visualized using the noise-to-signal ratio curve, where the signal energy is poured like water on top of the curve. The total amount of water poured corresponds to the total signal energy ε_{Tot} to be distributed among the bins, and the resting water level is K in (6).

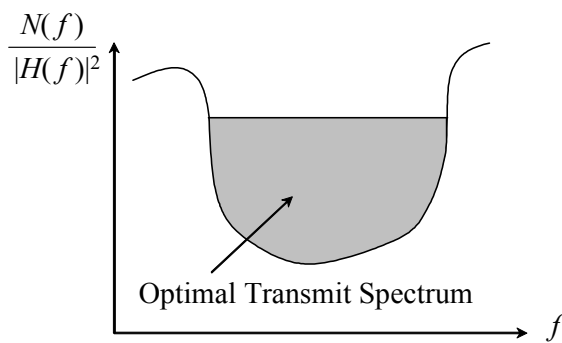


Figure 11: Water-filling Spectrum

To implement the optimization in a reasonable number of computations, various iterative water-filling algorithms have been proposed. See [4, Ch. 7] for a brief overview of some of these algorithms. As shown in [5], the water-filling energy distribution $\{\varepsilon_m, m = 1, \dots, L\}$ can be approximated by an equal-power distribution ($\varepsilon_m = \varepsilon_{\text{Avg}}$) with negligible performance loss. This equal-power distribution (with different constellation sizes) is used in practical ADSL modems.

Note that in Fig. 11, as the crosstalk level rises due to an increased number of high bit rate users, the noise-to-signal ratio curve will shift upwards, mandating an increased level K and transmit power \square_{Avg} to maintain the same system performance (capacity or reach). To reduce the overall system degradation due to crosstalk, given first generation ADSL modems, we have two possible options, described in the next section.

3. First Generation Crosstalk Mitigation Techniques

To combat crosstalk effectively, coordination among the xDSL transmitters and receivers is required. As we will discuss in Section 4 on next generation mitigation strategies, the higher the level of coordination, the greater is the crosstalk mitigation that can be achieved. Unfortunately, first generation ADSL modems do not contain an explicit coordination mechanism for modems operating over a common distribution cable. Two primitive strategies are either to perform bit loading based on a worst-case spectral mask or to use bit rate limiting to reduce the transmitted power for the low bit rate users in a distribution cable. We now discuss these two strategies in detail.

a. Strategy A: Worst-Case Spectral Mask (WCSM)

This strategy engineers the ADSL modems to withstand the highest possible number of crosstalkers (i.e., 24 in a 25 pair cable) of the worst possible source type in a cable with worst-case crosstalk couplings. To limit crosstalk and guarantee a reliable minimum bit rate for all of the ADSL users in the presence of crosstalk, the transmitting power spectral density (PSD) of the DSL systems is upper-bounded. Restrictive masks on the transmitted PSD of the ADSL system are defined, identifying the maximum allowed PSD in each frequency. The masks are computed assuming 100% penetration of the highest bit rate service and the worst crosstalk couplings. Figure 12 shows example ANSI (U.S.) and ACIF (Australian) standard PSD masks [6].

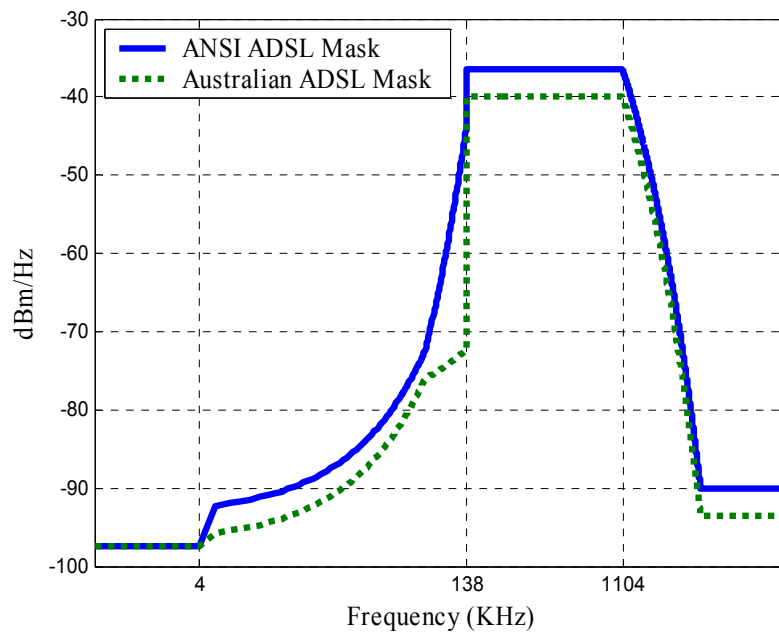


Figure 12: Two Typical Spectral Masks for Downstream ADSL

The PSD compliant mask must be observed by users even if there are no other DSL services present in the binder or even if the actual crosstalk couplings of the channel are much smaller than those of the worst case. As a result, this conservative approach limits the data rate and access loop length of ADSL systems to guarantee a minimum quality of service for all ADSL users. Using this strategy, the maximum bit rate of each user is determined based on its distance from the CO regardless of the loop plant geometry, the existence or absence of other crosstalkers, etc. This scheme is prudent when different DSL service providers are sharing the loop plant and the customers are located relatively close to the CO. This strategy is presently used in Australia.

b. Strategy B: Bit Rate Limiting (BRL)

In this scheme each user is allocated a particular bit rate, depending on the subscription fees. Using standard bit-loading when the service is first established, the ADSL modem uses only the power / bandwidth required to achieve the specified bit rate. The maximum bit rate that can be offered to a particular customer depends on the distance from the CP to the CO and the bit rate of the other ADSL customers already present in the distribution cable. Due to the parsimonious use of spectrum and transmitted power by all of the rate-limited users, this value is typically higher than the maximum bit rates that can be achieved under the WCSM scheme. In practice, none of the pessimistic WCSM assumptions, including 100% penetration of the highest bit rate service and the worst crosstalk couplings, are correct. The typical access loop length of the ADSL customers is also considerably higher than that obtained under the WCSM scheme, because the customers far from the CO with very high channel attenuation are able to transmit higher power levels, as the conservative PSD mask is not present in this scheme.

Moreover, more than 80% of DSL services in a typical New Zealand binder are low bit rate 256 Kbps ADSL links. These services require less transmitting signal power, which reduces the crosstalk levels, either increasing the capacity for high bit rate services or extending the reach of lower bit rate services. Unlike the WCSM strategy, the bit rate limiting scheme is adaptive to the crosstalk environment of a particular binder and provides a more efficient use of power and / or bandwidth resources. This “copper rate limiting” strategy has been implemented successfully within New Zealand in the past year.

c. Advantages of BRL over WCSM Strategy

To verify our reasoning, we have run computer simulations based on standard loop models. Using these simulations, we have found that the BRL strategy makes a more efficient use of bandwidth and power than the WCSM strategy. In particular, the BRL strategy is capable of reaching larger loop lengths, which results in significant cost reductions in providing reliable home ADSL service, particularly for far (e.g. rural) customers. Figure 13 gives representative data rates that are achieved using BRL compared to benchmark bit rates for WCSM as in [6]. Our simulation parameters are listed in Table I and our simulation algorithm is outlined in the Appendix. The dotted

line shows the maximum bit rates that can be achieved by the BRL scheme in a crosstalk free environment. The dashed line illustrates similar bit rates when 24 crosstalkers with 2 Km loop lengths are present in the binder. We see that, by removing the conservative PSD mask, the BRL scheme allows a user located within 2.5 Km from the CO to achieve a much higher bit rate than the WCSM scheme. Similarly, the loop access length is increased by about 2 Km compared to the WCSM scheme for low data rates, enabling the provision of ADSL service for users as far as 7 Km away from the CO.

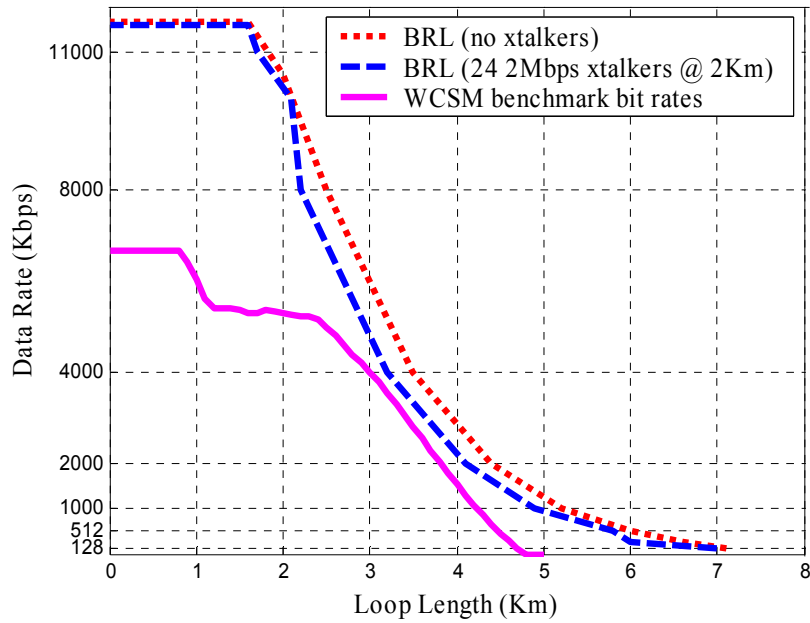


Figure 13: Achievable Data Rate vs. Loop Length for a Single ADSL User under BRL and WCSM Schemes (Downstream)

Table I. SIMULATION PARAMETERS

Transmit power as in [7]	20.4 dBm
Noise margin	12 dB
Bit error rate	$< 10^{-7}$
SNR gap (Γ)	18.9 dB
Noise power	-140 dBm/Hz
Total no. of channels	256

Downstream channels	33 – 256
Bandwidth of each channel	4312.5 Hz
DMT symbol rate	4000 Hz
b_{\max}	15

In Figure 14 we compare the performance of the BRL scheme to the WCSM scheme for large loop lengths. In our BRL simulations we assume that all of the users are transmitting at the same rate. As it can be observed, the BRL scheme increases the loop access length by approximately 2 Km. In particular, the loop length for a typical data rate of 256 Kbps increases from 4.7 Km to 6.5 Km. In summary, the BRL scheme uses bandwidth and power much more efficiently and achieves much higher bit rates and loop access lengths than the WCSM scheme. A final advantage of the BRL scheme is that the lack of hard spectral masks makes it more compatible with next generation crosstalk mitigation schemes, which we now introduce.

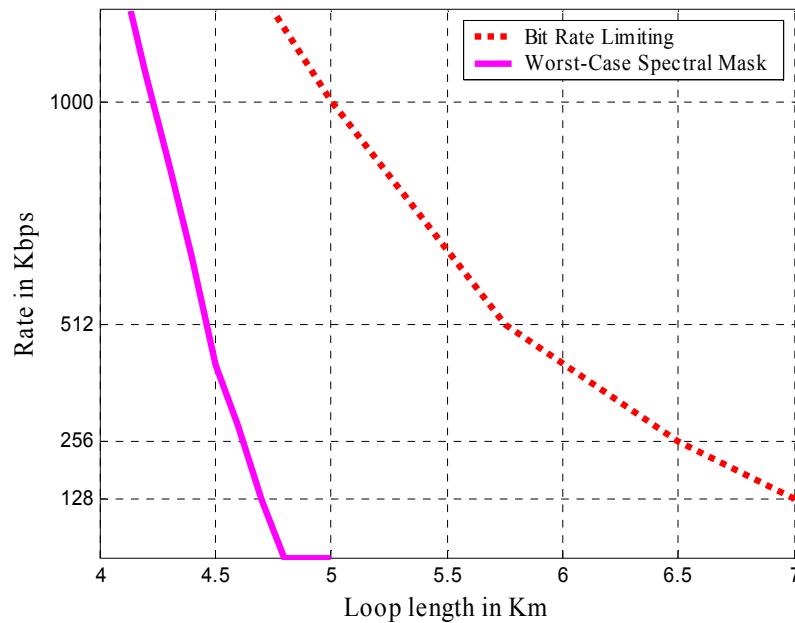


Figure 14: Data Rate Achieved by BRL Compared to WCSM Benchmark Bit Rates (Downstream)

4. Next Generation Crosstalk Mitigation Techniques

In first generation crosstalk mitigation techniques, it is assumed that the transceivers modems do not have coordination with each other in order to cancel crosstalk. This results in minimal implementation complexity. On the other hand, the performance of crosstalk mitigation techniques depends considerably on the degree of

coordination among the users. To remove the crosstalk much more effectively, in second and third generation crosstalk mitigation techniques the transceiver modems operating over a common distribution loop actively coordinate their data transmissions. These next generation coordination strategies are called *dynamic spectrum management*.

In second generation crosstalk mitigation techniques or *PSD*-level coordinated crosstalk mitigation techniques, the transmit PSDs of the users are determined jointly, considering the target data rate of each user and the crosstalk channel conditions (loop lengths, crosstalk couplings, etc.) to reduce the mutual crosstalk among the users and to increase the bit rates. For example, in commercially available ADSL2+ modems [8], spectral shaping, such as turning off those tones under management system control, is used.⁹⁴

Third generation crosstalk mitigation techniques are based on *signal*-level coordination among users. Using signal-level coordination, perfect crosstalk cancellation is possible using multiple-input multiple-output (MIMO) vector coding schemes, allowing each user to transmit over the equivalent of a crosstalk-free channel, leading to significant performance gains. Unfortunately, these third generation techniques have a high implementation complexity that is beyond the scope of current modems [9]. These techniques involve sharing timing and symbol information among transmitters and receivers. In practice, one of the biggest obstacles in implementing advanced crosstalk cancellation techniques is that the coordination of modems in unbundled loops with several competing service providers is very difficult [10].

One final note is that for these next generation techniques to operate correctly, hard worst-case spectral masks such as the WCSM scheme will have to be removed. As the BRL scheme does not have these masks, it will facilitate an easier migration from first generation systems to next generation ones.

5. Summary

In summary, ADSL is a proven technology to bridge the Last Mile to the home. However, unless care is taken in allocating spectrum and power among the users, crosstalk between users has the potential to reduce significantly the overall performance of the telephone network. Among first generation crosstalk mitigation techniques we recommend using the BRL scheme over the WCSM scheme to maximize the performance to the network. Our computer simulations have backed our theoretical assertions.

Appendix: Calculation of Achievable Data Rates for the Bit Rate Limiting Strategy

In this appendix, we outline the algorithm we have used to test if a set of target data rates is achievable using the BRL scheme. In our simulations we assume the modems work in the following way:

⁹⁴ Note that, if the user bit rate is not specified, then the number of lower frequency tones that can be safely turned off by the modem cannot be determined.

1. The users perform autonomously with no coordination among the modems (no exchange of timing information, etc.).
2. To achieve a desired bit rate, the modems run the water-filling algorithm with a 12 dB noise margin against their own direct loop channel and the sum power of the noise and crosstalk.
3. The modems test their noise margin continually. If their noise margin goes below 0 dB in any of their L channels, they reallocate power by water-filling with a 12 dB noise margin. If their noise margin gets too large, they also reallocate power to reduce the transmission power and the crosstalk to the other users.

A set of target bit rates is called *achievable* if the bit rate of the users converges to the set after a few iterations (say, i_{\max} iterations) and the resultant noise margin of all users is greater than 0 dB on all channels. Considering the above definitions, we have proposed an algorithm to test the achievable target rates under the BLR strategy. The algorithm is summarized as a flowchart in Fig. 15.

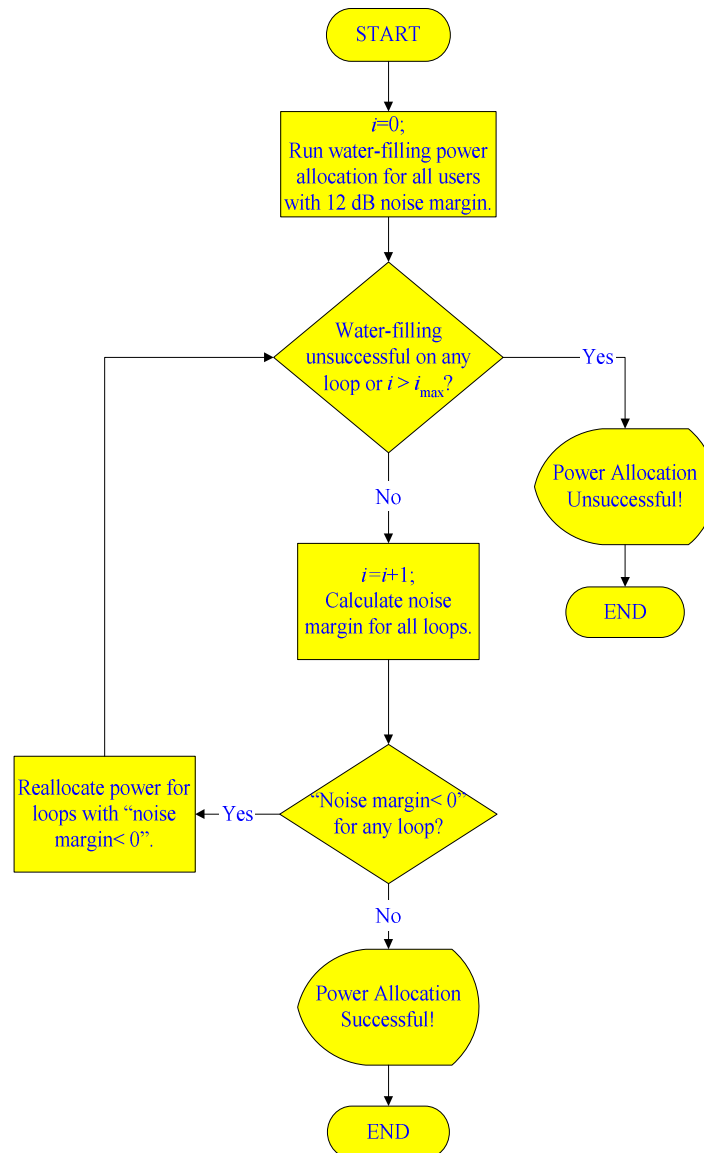


Figure 15: Flowchart of the Algorithm to Test the Data Rates Achievable by BRL

References

- [1] L. M. Garth, G. Huang, and J.-J. Werner, "Crosstalk mitigation for xDSL channels," *IEEE Circuits and Systems Society Newsletter*, vol. 10, p. 3ff., March/April 1999.
- [2] G. Huang and J.-J. Werner, "Cable characteristics," ANSI Standards Contribution T1E1.4/97-169, May 12-16, 1997.
- [3] *Network and Customer Installation Interfaces – Asymmetric Digital Subscriber Line (ADSL) Metallic Interface*, ANSI Standard T1.413-1998, Nov. 11, 1998.
- [4] T. Starr, J. M. Cioffi, and P. J. Silverman, *Understanding Digital Subscriber Line Technology*, Prentice-Hall, Upper Saddle River, NJ, 1999.

- [5] P. S. Chow, "Bandwidth Optimized Digital Transmission Techniques for Spectrally Shaped Channels with Impulse Noise," Ph.D. thesis, Stanford University, May 1993.
- [6] *ACIF C559:2005 Part 3; Requirements for Deployment Class Systems*, Australian Communications Industry Forum Limited, 2005.
- [7] *Asymmetrical Digital Subscriber Line Transceivers 2 (ADSL2)*, ITU Std. G.992.2, 2002.
- [8] *Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2+)*, ITU Std. G.992.5, 2003.
- [9] A. R. Forouzan and L. M. Garth, "Computationally efficient partial FEXT cancellation in fast time-varying DSL crosstalk environments," *Submitted to EURASIP J. Applied Signal Processing*, Dec. 2004.
- [10] A. R. Forouzan and L. M. Garth, "Generalized iterative spectrum balancing and grouped vectoring for maximal throughput of digital subscriber lines." *Submitted to IEEE Global Commun. Conf. 2005*.

Biography

Lee M. Garth received the B.S.E. degree (magna cum laude) from Princeton University, Princeton, NJ, in 1987 and the M.S. and PhD degrees from the University of Illinois at Urbana-Champaign, in 1989 and 1996, respectively. From 1990 to 1996 he was a Senior Engineer at Techno-Sciences, Inc., in Urbana, Illinois, working on sonar detection problems for the U.S. Navy. In 1996 he joined the Advanced Data Communications Group at Bell Laboratories (Lucent Technologies), Holmdel, New Jersey. Originally founded by Dr. Robert Lucky, the world famous research group was one of the key pioneering groups in voiceband modem technology. In the 1990s, the group led by Dr. Jean-Jacques Werner had moved on to high bandwidth twisted pair communications, leading the international standards efforts for both ADSL and VDSL. During his time with the group, Dr. Garth developed novel blind equalization techniques for VDSL applications, leading to an international patent, and contributed to international standards bodies (ETSI, ANSI). In 2000, he joined the Electrical and Computer Engineering Department at the University of Canterbury where he is now a Senior Lecturer. His research interests include digital subscriber lines and statistical signal processing with applications to wireless and wireline communications systems. Dr. Garth is a Senior Member of the IEEE and a Member of Tau Beta Pi. He is presently chair of the IEEE New Zealand Council.

The author wishes to acknowledge the able assistance of Dr. Amir Forouzan in running the computer simulations in this annex.

ANNEX D

Response to TelstraClear Submission

Jerry Hausman, MIT

June 2, 2005

I. Use of the LBTE as the Regulatory Goal

1. Telecom has asked me to respond to certain aspects of TelstraClear's (TC's) submission. I note that TC agrees that the CC's approach should be "to promote competition in telecommunications markets for the long-term benefits of end-users." (TC Submission, Annex 2, p. 59) However, TC nowhere in its submission analyzes the LTBE. The correct approach to regulatory policy is to analyze the LTBE rather than protecting competitors. In my academic research I have emphasized that an explicit approach to consumer welfare and social welfare provides the best approach to regulation of telecommunications.⁹⁵ The use of an LTBE criterion is an example of this approach.
2. In the US the Federal Communications Commission (FCC) has been over-ruled by the DC Court of Appeals three times because the FCC continued to try to keep alive by regulation AT&T and MCI, the two major long distance companies that have no technological or economic rationale for their continued existence. Recently, the FCC has recognized that it cannot attempt to continue its misguided policy, and AT&T and MCI have been acquired by local exchange companies. However, during the 9 year period that the FCC followed its misguided policy it cost consumers tens of billions of dollars.⁹⁶ I recommend to the CC that it strictly adhere to the LTBE standard. Otherwise, the CC has no established policy goal to guide its regulation of telecommunications.

⁹⁵ See e.g. J. Hausman, "Economic Welfare and Telecommunications Welfare: The E-Rate Policy for Universal Service Subsidies," Yale Journal on Regulation, 16, 1999; "A Consumer-Welfare Approach to the Mandatory Unbundling of Telecommunications Networks," Yale Law Journal, 1999; and "Regulated Costs and Prices in Telecommunications," in G. Madden ed. International Handbook of Telecommunications, 2003.

⁹⁶ This estimate is based on J. Hausman et. al., "Does Bell Company Entry into Long-Distance Telecommunications Benefit Consumers?," Antitrust Law Journal, 70, 2002.

II. Price Regulation in the Wholesale Market

3. Telecom has asked me to consider the issue of a uniform wholesale price addressed by TC in ¶ 39-43 of its submission. While the CC found in its draft determination that separate wholesale bitstream access prices for residential and business customers is appropriate, TC now states that it wants a single wholesale price (¶ 40-41). TC claims that a distortion will arise, but TC does no analysis regarding a single wholesale price and the LTBE.
4. I will assume that the costs are the same for similar speeds of DSL provided to residential customers and SMEs. As I demonstrated in my previous submission, the LTBE will increase in the presence of price discrimination because a greater variety of speed/caps offerings will exist in the market. TC never considers the consumer welfare effect of greater variety, but TC instead claims a "distortion" will exist because of Telecom's retail customer categories. (¶ 41) TC wants the "flexibility to define our own downstream retail customer categories (or not to have any)." (¶ 41) Thus, TC has advanced its own interests in terms of "flexibility" rather than considering the effect on the LTBE. Telecom has made the investment in its network in terms of upgrading the fiber component to offer higher quality DSL. This sunk cost investment may not be recovered given the rapid pace of technological change in telecommunications and increasing competition, e.g. WiMax supporters claim it will provide 40 Mbps service by 2006.⁹⁷
5. A basic principle of economics states that the company who takes the investment risk should not be required to give a "free option" to its competitors, or investment incentives will be adversely affected.⁹⁸ TC can gain the flexibility it desires by making its own investment in facilities to provide DSL, either a wireline network or a fixed wireless network. However, if the CC allows TC to arbitrage away consumer benefits by regulatory intervention to allow TC to have "flexibility", future investment incentives for Telecom will be adversely affected and the LTBE for consumers will be decreased. Thus, the primary question in terms of LTBE is that price discrimination serves the LTBE, but TC wants the ability to arbitrage the price discrimination so it can have "flexibility."
6. TC also states that the CC has found that a separate wholesale market for residential and business customers does not exist so that the regulatory

⁹⁷ See <http://www.wimaxforum.org/about>.

⁹⁸ I have explained this principle to the CC at previous hearings. For an explanation see e.g. J. Hausman, "Regulated Costs and Prices in Telecommunications," in G. Madden ed. International Handbook of Telecommunications, 2003.

framework should not recognize different prices for residential and business customers. (¶ 42) Even if the CC decides that only a single wholesale market exists, again the question in terms of the LTBE is whether price discrimination will be permitted to exist or whether regulatory arbitrage will eliminate it. Since prices differ for residential and business customers in the highly competitive US and Canadian broadband markets as I demonstrated in my previous submission, different price elasticities exist for residential and business customers. Different price elasticities between residential and business customers also exist in NZ given market data on Telecom prices for broadband access. It is the existence of these differing price elasticities and differing preferences for broadband speed, even if considered within the context of a large overall market, which permits the offering of different speed broadband services that increases consumer welfare and the LTBE.

7. In my previous submission I considered a single market and demonstrated that price discrimination would lead to an increase in LTBE because additional variety, e.g. different speeds, would be offered. In this situation consumers choose their most favored service given a variety of services to choose from. However, sometimes consumers are not given an unrestricted opportunity to choose their most favored service. Customers may be restricted from choosing among the complete array of choices offered, e.g. business customers are not permitted to choose a service designed for residential customers. In the current situation price discrimination leading to different speeds increases the LTBE relative to a uniform price, but the question arises whether segmenting the market into residential and business segments leads to a further increase in the LTBE.
8. Thus, the question would be whether the CC should permit arbitrage across business and residential markets so that for a given speed/caps package an access seeker could choose the lower price service between the business and residential offerings and supply it to both business and residential customers. I would expect, of course, for only the lower price service to be demanded.⁹⁹ I note that in the extremely competitive US and Canadian markets that I discussed in my first submission (¶ 4-7) market evidence demonstrates a significant degree of price discrimination across residential and business markets by both cable companies and by the telephone companies.
9. No definite theoretical answer exists to the question posed above because the combination of both types of price discrimination has not been analyzed together, probably because of the analytical complexity. For the question posed above, a necessary (but not sufficient) condition for a welfare improvement is

⁹⁹ See e.g. the Internet NZ submission in which they state the price should be set at the level of the residential bitstream service. (¶ 5.3)

that the combination of both types of price discrimination leads to greater quantity demanded than permitting different speeds/caps considered alone.

10. If business and consumer preferences differed greatly, e.g. business customers primarily preferred high speed service and residential customers preferred lower speed services, then I conjecture that only speed/caps discrimination would be preferred. However, market evidence in New Zealand demonstrates that customer preferences across both speed and monthly data allowances are quite mixed among residential and business customers.
11. Data in Table 1 demonstrate that [] TCNZRI [] COI of residential customers have chosen the slow speed broadband service (256 kbps) while [] TCNZRI [] COI have chosen 1 Mbps or higher plans. Business customers choose high speed plans more with [] TCNZRI [] COI of business customers choosing slow speed plans. However, Telecom only began offering slow speed plans to business customers in September 2004 and take up has been [] TCNZRI. In the 6 months from October 2004-March 2005 the proportion of business customers choosing slow speed plans has [] TCNZRI [] COI.

Table 1: Residential and SME Broadband Service Plans

Residential Plans			March 2005
Download Speed	Monthly data allowance	Monthly charge ¹⁰⁰	% on each plan
256kbps	1GB	\$39.95	[] COI
1Mbps	1GB	\$44.95	[] COI
256kbps	3GB	\$49.95	[] COI
2Mbps	10GB	\$69.95	[] COI
2Mbps ¹⁰¹	10GB	\$69.95	[] COI

¹⁰⁰ Monthly charge for Telecom home line customers. Non-customers pay an additional \$10 per month.

¹⁰¹ Excess usage charge above the cap applies to this service.

SME Plans

Download Speed	Monthly data allowance	Monthly charge	% on each plan
256kbps	1GB	\$59.95	[] COI
256kbps	3GB	\$79.95	[] COI
256kbps	10GB	\$99.95	[] COI
Full Speed ¹⁰²	0.6GB	\$69.11	[] COI
Full Speed	1.2GB	\$137.78	[] COI
Full Speed	1.8GB	\$193.78	[] COI
Full Speed	3GB	\$309.78	[] COI
Full Speed	5GB	\$475.78	[] COI
Full Speed	10GB	\$905.78	[] COI
Full Speed	20GB	\$1,617.78	[] COI
Full Speed	30GB	\$2,417.78	[] COI

Different preferences or monthly data allowances also exist among residential and business customers. A [] **TCNZRI** of residential customers ([] **COI**) and business customers ([] **COI**) choose plans with month data allowances of 3GB or higher. An interesting finding is that business customers tend to [] **TCNZRI** than residential customers.¹⁰³

¹⁰² Full Speed is a download speed of 2-8 Mbps and an upload speed of 600kbs.

¹⁰³ This finding is subject to the qualification, discussed above, that slow speed plans have only recently been offered to business customers. I hypothesize that the outcome may be similar to the US where, as in NZ, residential customers are not charged for local calls and thus are not typically concerned about local telephone usage while businesses in both countries are charged for local calls.

12. Market data in New Zealand demonstrate that a significant proportion of residential customers choose high speed services and a significant proportion of business customers choose low speed services. Preferences for monthly data allowances also overlap among the two groups of customers. In this situation demand for broadband is likely to be greater with business and residential customer segmentation because higher elasticity residential customers will pay lower prices than business customers who have lower elasticities.¹⁰⁴
13. If the residential and business markets are combined because of regulation, the prices to residential consumers will be higher than otherwise so they will demand fewer broadband services and government policy to encourage residential broadband usage will be frustrated.¹⁰⁵ If the residential and business markets are not combined, business will pay higher prices for DSL, but overall DSL demand is likely to be higher because of the significantly lower elasticity of business customers compared to residential customers.
14. While overall broadband demand is thus likely to be higher with separate residential and business market segments as the CC recommended in its Draft Determination, the higher prices to businesses could more than offset the lower prices to residential customers so that an increase in the LTBE does not occur. However, I do not think this outcome is the more probable outcome given the increased amount of competition for business customers from the presence of the TC network and other competing networks such as Woosh. Thus, I recommend that the CC follow its Draft Determination and have separate prices for business and residential customers, and the CC set prices in these separate markets based on retail minus for each service, rather than taking an average price, for reasons I discussed in my first submission. This policy is most likely to increase the LTBE.
15. Another favorable outcome in terms of an increase in the LTBE is the likely increased variety of other services offered with broadband. In the highly competitive US and Canadian markets that I discussed in my first submission, competitors offer both a large variety of speeds and charge different prices to residential and business customers. The competitors also offer value added services such as static IP addresses for businesses.¹⁰⁶ For residential customers competitors bundle home networking so multiple competitors and other devices

¹⁰⁴ I note that residential prices in NZ are less in NZ than Bell South as the prices in my first submission demonstrate. While no monthly data allowances exist in the US, the large majority of US residential broadband customers do not have high monthly data download usage.

¹⁰⁵ The submission by InternetNZ that recommends a single price for both residential and business customers (¶ 5.3) completely fails to recognize this outcome. Thus, InternetNZ's recommendation contradicts their mission to "promote the internet in New Zealand" (¶ 1.1) because higher prices to residential consumers will lead to lower residential broadband internet usage in NZ.

¹⁰⁶ For example Cox includes a static IP address and 5 email accounts with its broadband internet services for business customers.

can be connected using a wireless home network.¹⁰⁷ Numerous services are also bundled together with broadband access where the total price of the bundles is significantly less expensive than the sum of the prices of the individual services. These types of innovative services and bundles offered to consumers are the outcome of a competitive process. If CC regulation creates a single wholesale price, these types of feature and bundled competition are likely to decrease because competitors will not be able to differentiate their products along as many dimension and profit opportunities will decrease.¹⁰⁸

16. Since the LTBE depends on outcomes in retail markets where consumers actually purchase telecommunications services, the CC should establish a regulatory framework that leads to a maximum LTBE based on results in retail markets. If regulatory policy in wholesale marketers decreases the LTBE in retail markets, the regulatory policy is misguided. Thus, the CC cannot consider wholesale markets in isolation. Instead, the CC should recognize that its regulatory policy in wholesale markets will have a direct effect on outcomes in retail markets and attempt to create a regulatory framework that leads to the maximum LTBE and economic efficiency.¹⁰⁹

III. TC's Other Claims

17. TC claims that while the Ministry for Economic Development found that residential broadband prices compare well with the OECD average that business broadband prices are higher than the comparable OECD prices. (¶ 46) TC goes on to claim that the CC can use international benchmarking to require lower wholesale prices without any analysis or demonstration that Telecom is earning economic returns that are excessive. (¶ 48-49) Thus, TC claims that the inclusion of all of the business Jetstream prices will lead to too high an average price. (¶ 49) If the CC follows my recommendation and sets individual wholesale

¹⁰⁷ For example Comcast permits up to 5 computers to be online at the same time on a home wireless network.

¹⁰⁸ See J. Hausman, "Sources of Bias and Solutions to Bias in the CPI", Journal of Economic Perspectives, 2003, where I discuss how the "invisible hand of imperfect competition" leads firms to introduce new products and services in an attempt to increase profits and as a result leads to significant consumer benefits. However, if regulatory arbitrage increases the price elasticities, firms will have a decreased profit incentive to introduce new products and services.

¹⁰⁹ I note that in the US with the spread of broadband internet access for residential customers, ISPs have a diminished competitive role. For example AOL, the leading narrowband ISP, has suffered significant subscriber losses and financial problems as consumers have shifted to broadband. AOL lost approximately 10% of its subscriber between Q1 2004 and Q1 2005, <http://ir.timewarner.com/downloads/Slides050405.pdf>. Microsoft's MSN suffered a 28% decrease in internet access revenue and a 35% loss in internet access subscribers in the year ending in (calendar) Q1 2005; <http://www.microsoft.com/msft/default.mspx>. Microsoft reports this decrease arose from migration of MSN subscribers to broadband. Firms such as Yahoo and Google provide significant value added services to consumers while it is unclear what extra value ISPs can provide beyond these services given higher speed broadband access that permits rapid web access and searches. Thus, the CC should be extremely careful not to design regulation to "protect" ISPs who may have an important business role in a narrowband environment, but who may have a diminished competitive role in a broadband environment.

- prices as retail minus for each individual business service, this problem does not arise because no average will be used in setting regulated prices.
18. I note that no demonstration has been made that Telecom's prices are "too high" in terms of Telecom earning excessive economic returns on its provision of broadband services. Indeed, TC's actions demonstrate the opposite. Telstra, TC's corporate parent, is among the largest companies in the Southern Hemisphere with a market capitalization exceeding A\$60 billion. Telstra has returned dividends exceeding A\$6.7 billion over the past two years. In FY 2005 alone Telstra returned A\$4.9 billion in cash to its shareholders and expects to return equal amounts in FY06 and FY07.¹¹⁰ Further, Telstra has recently raised A\$1.88 in a Eurobond offering.¹¹¹ Also, the demand for broadband is growing in NZ.
 19. Given that its corporate parent has no capital constraint and cannot find sufficiently high return investments so its has returned excess cash to its shareholders, if Telecom were earning "monopoly rents" on broadband, I would expect TC to increase significantly the geographical scope of its network in NZ to capture some of the excessive rents that Telecom would be earning. The investment in increased geographic scope of its network would be expected to lead to high enough returns to TC and Telstra to justify the investment.
 20. Instead, TC has only marginally expanded its network over the past 3 years since telecommunications regulation began in NZ. As is well known among economists, investment in regulation is much less costly and less risky than investment in sunk cost network facilities.
 21. If the CC were to follow TC's recommendation and further lower the wholesale price below retail minus avoidable costs, the effect would be to effectively regulate Telecom's retail and wholesale prices of broadband. Thus, the entire regulatory approach of retail minus avoidable costs would be eliminated since the CC would be choosing the level of prices in the market. This approach is equivalent to the discredited "rate of return" (ROR) regulation that was used in the US and Canada until the early 1990s when it was replaced by price cap regulation.¹¹² Under ROR regulation, regulators chose the "correct" prices for each service offered by telephone companies.
 22. When ROR regulation was used in the US lengthy regulatory hearings were required to "allocate" the capital cost of jointly used network facilities to particular services. Such allocations are always inherently arbitrary in a network

¹¹⁰ Data from presentation of John Stanhope, Telstra Chief Financial Officer, May 19, 2005 at ABN AMRO Communications Conference.

¹¹¹ <http://au.biz.yahoo.com/050518/19/4qgg.html>. Telstra has also issued two "special dividends" during this period.

¹¹² See e.g. J. Hausman, "Regulated Costs and Prices in Telecommunications," in G. Madden ed. International Handbook of Telecommunications, 2003 for a recent discussion.

that produces multiple services. Further, while ROR worked reasonably well in a world of monopoly (AT&T) provision of telecommunications, when competition arose the procedure had severe distortionary effects that led to reduced investment, reduced innovation, and billions of dollars in consumer harm.¹¹³ The LTBE of US consumers was harmed by large amounts. Thus, the CC would destroy the regulatory framework in which Telecom is encouraged to place additional fiber in its network and provide higher quality broadband services, if the CC decides to use a "rate of return" type regulation rather than either a "retail minus" or price cap based regulatory framework that are widely recognized to have reduced economic distortions compared to ROR regulation.

23. TC raises the possibility of a "price squeeze" given the CC's recommended pricing policy. (¶ 11). Thus, TC is claiming that it would earn a negative margin given regulated wholesale prices if it is required to compete with Telecom at retail.¹¹⁴ Since the differential between retail prices and wholesale prices is based on avoided costs, TC is claiming either that (1) the CC has calculated avoided costs to be too low or (2) that TC is less efficient than Telecom so that its retail costs are too high to earn a positive margin.¹¹⁵ TC has provided no analysis that the CC's calculation of avoided costs is too low leading to a possible price squeeze so that possibility (1) is not explained.
24. If possibility (2) is the reason for a price squeeze, then TC should not participate in the broadband market in NZ using the Telecom network because it would lower economic efficiency since TC is not productively efficient. A waste of economic resources would occur and the most important principle of economics is that the economy should be as close to productive efficiency as possible.¹¹⁶ Thus, it would not be in the LTBE for a non-productively efficient firm to participate in a market where its participation arises only because of misguided regulation.

¹¹³ See J. Hausman, "Valuation and the Effect of Regulation on New Services in Telecommunications," Brookings Papers on Economic Activity: Microeconomics, 1997. I quantify the lost consumer welfare from the delayed introduction of voice mail and other network based services.

¹¹⁴ A negative margin is the usual economic definition of a price squeeze.

¹¹⁵ I note that TC never discusses a price squeeze subsequently in its submission so it does not explain why a price squeeze could occur. Nor does TC provide any data to substantiate its claim.

¹¹⁶ See P. Samuelson and W. Nordhaus, "Efficiency is a central (perhaps *the* central) concern in economics. Efficiency means there is no waste." (Economics, 12th ed., 1985, p. 28)

ANNEX E

eOR/eOR for Broadband and LOLO (Australia) Comparison

The table below builds on that presented by TelstraClear in their 16 December submission (under para 186). Added to it are the dates when Telecom expects to provide this functionality.

Function	eOR/eOR for Broadband		LOLO/LOLS	
	Online	B2B	Online	B2B
Ordering				
Pre-order service qualification (is the line DSL capable)	Q3 05	Q3 05	√	√
Initial order	√	√	√	√
Variation of order	√	Tbd	√	√
Tracking of order	√	Q3/4 05*	√	√
Reassignment back to incumbent retail arm (assignment reversed)	2006	Tbd	√	√
Reassignment between two service providers	2006	Tbd	√	√
Service visit enquiry and appointment booking	2006	Tbd	√	√
Order fulfilment	Q3/4 05*	Q3/4 05*	√	√
Order cancellation	√	2006	√	√
Service changes				
Orders for moves, adds and changes	√		√	√
Service visit inquiry and booking of appointment for MACs	Tbd	Tbd	√	√

Faults				
Fault logging	Q4 05 **	x	√	x
Online fault testing (e.g. line testing of fixed lines)	Q3 05	x	√	x
Fault tracking	Tbd	x	√	x
Service visit inquiry and booking appointments for faults	Tbd	x	√	x
Notification of fault clearance	Tbd	x	√	x
Modification of fault details	Tbd	x	√	

* Like LOLO B2B this will initially be for DSL broadband products only

** Proving to be more difficult than anticipated due to legacy system constraints

Those items marked Tbd are not yet under consideration. There may also be economic reasons why they are not considered

Functions not included in the LOLO comparison table provided by TelstraClear that will be provided by or that are under consideration for eOR include:

Function	Stage	Planned Date
Residential reassignments	Business case	Q4 05
Usability enhancements	Some underway, some in business requirements	Q3 & Q4 05
Upgraded product database	Business requirements	Q4 05
Integration with pricebooks (no LOLO equivalent)	Feasibility	Q2 06 (assuming feasible)
Addition of zoning tool (no LOLO equivalent)	Feasibility	Q2 06
Service level reporting	Business requirements	Q4 05 or Q1 06
Active notification	Feasibility	Tbd
Jeopardy management	Feasibility	Tbd