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COMMERCE COMMISSION

Final Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005

Determination under section 90 of the Telecommunications Act 2001 (the Act) of matters set out in section 92 of the Act in the matter of Telecommunications Service Obligations for Local Residential Service, for the period 1 July 2004 to 30 June 2005 being the financial year of the Telecommunications Provider 'TSP', Telecom New Zealand Limited.

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Date of Determination 10 September 2008

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF EQUATIONS

LIST OF TERMS AND ABBREVIATIONS

For the avoidance of doubt, the definitions in the Act or the TSO Deed, take precedence over the definitions outlined below where there is an inconsistency.

Abbreviation/ Term	Explanation
ACCC	Australian Competition and Consumer Commission
Access Network	the network that connects customers to their local telephone exchanges
ADSL	Asymmetric Digital Subscriber Line. A technology for transmitting digital information at high bandwidths on phone lines
CAPEX	capital expenditure
CAPM	Capital Asset Pricing Model
CCS 7, CCS#7, SS7 Common Channel Signalling Version 7	a network standard that transmits call-handling information for telecommunications calls over a separate channel than that taken by the calls
CDMA	a digital mobile phone technology known as Code Division Multiple Access
Cluster	a group of customers connected to the same feeder cabinet or directly to an exchange
CNVC	commercially non-viable customer – a Telecom residential customer in respect of whom the efficient incremental cost of providing the TSO services exceeds the standard residential line rental plus expected supplementary revenues.
Core Network	the network that connects the customer serving exchanges
CostProNZ	CostPro New Zealand Model is the application used to model the core network and transmission system costs
CT	Cable Terminal
Decision 497	means the determination dated 12 May 2003 made under section 27 of the Telecommunications Act 2001 in the matter of TelstraClear's application for determination for "wholesale" designated access services.

Abbreviation/ Term	Explanation
Decision 525	means the determination dated 14 June 2004 made under section 27 of the Telecommunications Act 2001 in the matter of TelstraClear's application for determination for "residential wholesale" designated access services
DLC	Digital Loop Carrier
DMR	fixed radio trunking technology known as Digital Microwave Radio
d-side	distribution side; the side of a cabinet and its network closest to the customer
DSLAM	Digital Subscriber Line Access Multiplexer. A device which takes a number of ADSL subscriber lines and concentrates these to a single ATM line
E1	a 2Mb cable link used for the transmission of telephone calls or data
Endogenous Optimisation	this optimisation involves the Commission using technologies already existing in the modelling process
Erlang	unit of telephone exchange capacity to handle concurrent calls
ESA	Exchange Service Area (also commonly referred to in the United States as a 'wire centre') – this is the exchange area along with its associated customers
Exogenous Optimisation	this optimisation involves the Commission introducing technologies that have not been effectively included in the into the Commission's modelling process in previous TSO determinations
FCC	The Federal Communications Commission is a United States government agency, charged with regulating interstate and international communications by radio, television, wire, satellite and cable
Feeder Cabinet	an enclosure used for the termination of cables, wiring and connection devices
FPDN	Fixed Public Data Network – a public data network using fixed (non radio) access technology

Abbreviation/ Term	Explanation
GSM	a digital mobile phone technology known as General System for Mobile
HAI	Hatfield Model – a core network model
HCPM	Hybrid Cost Proxy Model – an access network model
IN	Intelligent Network – a system for providing advanced telephony services such as toll free phone calls where the terminating party pays for the calls
IP	Internet Protocol – a data transmission protocol
IRR	Internal Rate of Return (the IRR is the annualised effective compounded rate of return that the TSP expects to earn on its incremental capital)
ISP	Internet Service Provider
LICA	Local Interconnect Calling Area – Interconnect calling area boundaries
LRIC	Long Run Incremental Cost – the additional costs incurred in the long run in supplying a defined increment of output
MAR	Multi-Access Radio – a wireless access technology
MDF	Main Distribution Frame – an interface between the line side of an exchange and the cables providing service to customers directly connected to the exchange
MEA	Modern Equivalent Asset is the equivalent item of equipment that would be used if an outdated asset in the network were to be replaced, given current best practice
MED	Ministry of Economic Development
MoE	Ministry of Education
MT	Mobile Technology radio cap
Net Cost	the unavoidable net incremental costs to an efficient service provider of providing the service required by the TSO instrument to commercially non-viable customers

Abbreviation/ Term	Explanation
NGN	Next Generation Network - the successor to the current circuit switched telephone network (PSTN). This network uses packet switched (IP) data
NSL	Network Strategies Limited
OFTEL	United Kingdom Office of Telecommunications, now merged into broader regulatory agency Ofcom
OPEX	Operational expenditure
ORC	Optimised Replacement Cost
PABX/PBX	Private Automatic Branch Exchange – a automated exchange normally used by a business
Probe	a Telecom database that has customer specific revenue information
Project PROBE/PROBE	Provincial Broadband Extension
PSTN	Public Switched Telephone Network is a dial-up telephone network used, or intended for use, in whole or in part, by the public for the purpose of providing telecommunication between telephone devices
Required Services	those services the TSP is explicitly required to provide to TSO customers under the terms of the TSO instrument
RLU	Remote Line Unit – a remote line concentrator without intra-calling capability
RMA	Resource Management Act
RoR Regulation	Rate-of-Return Regulation
SDH	Synchronous Digital Hierarchy – a method for communicating digital information using light over optical fibre
Simulation Period	This is a number internal to the TSO program showing the simulation period. (1=2001/2002, 2=2002/2003, 3=2003/2004 etc)
STP	Signalling Transfer Point - is a ‘router’ that relays SS7 messages between signalling end-points – this is similar to IP but is not the same technology

Abbreviation/ Term	Explanation
T1	A North American standard used to transmit 24 digitised voice grade signals
Telecom/TCNZ	Telecom New Zealand Limited / Telecom Corporation of New Zealand
Draft Determination	The Commission's "Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005" dated 9 July 2007
Revised Draft Determination	The Commission's "Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005" dated 13 May 2008
Tilt	the expected rate of change in the replacement price of network assets (an "increased tilt" results in a faster decline in the replacement cost of the asset)
TSLRIC	Total Service Long Run Incremental Cost, in relation to a telecommunications service, means: a) the forward-looking costs over the long run of the total quantity of the facilities and functions that are directly attributable to, or reasonably identifiable as incremental to, the service, taking into account the service provider's provision of other telecommunications services; and b) includes a reasonable allocation of forward-looking common costs.
TSO	the obligations prescribed by the Telecommunications Service Obligations Deed for Local Residential Telephone Service between Telecom and the Crown dated December 2001 (the 'TSO Deed')
TSO period	1 July 2004 to 30 June 2005, being the period to which this determination applies.
TSP	Telecommunications Service Provider, which is the entity that delivers the TSO. This is Telecom New Zealand Limited for the TSO period.
USA	United States of America
USO	Universal Service Obligation
USP	Universal Service Provider

Abbreviation/ Term	Explanation
VB	Visual Basic (a computer language)
VNZ	Vodafone New Zealand Limited
WACC	Weighted Average Cost of Capital

EXECUTIVE SUMMARY

Introduction

i.) The Telecommunications Act 2001 regulates the supply of telecommunication services in New Zealand.

ii.) Part 3 of the Act facilitates the supply of certain telecommunications services to groups of end-users within New Zealand who may not otherwise be supplied these services on a commercial basis, or at a price that the Minister considers to be affordable.

iii.) The Act requires the Commission to determine the unavoidable net incremental costs to an efficient service provider providing the service required by the TSO instrument to commercially non-viable customers.[1] It also requires the Commission to determine the allocation of this cost among liable persons in the telecommunications industry, and to assess Telecom's compliance with the TSO Deeds' quality standards.

iv.) Each year the Commission models the costs of an efficient service provider in delivering the TSO service (subject to the constraints of its "scorched node[2]" approach).

v.) The Commission has used its own cost models to calculate the net cost for the TSO period. The models use a 'bottom-up'[3] approach to design the network of an efficient service provider.

vi.) The viability of each cluster of residential customers is tested by comparing actual customer revenues to modelled costs for the TSO period. The Commission recognises those clusters generating less revenue than their incremental cost as being commercially non viable.

vii.) In previous years, the Commission has each year optimised the access network by introducing new technology to reflect the lowest cost technologies available for delivering the TSO service. The introduction of new technology can affect the return of capital invested by the TSP, by stranding the assets the TSP originally invested to provide the service.

viii.) Telecom argued in its submission that the price tilt and asset life parameters of the tilted annuity used by the Commission do not allow for new technology changes. It argued that the technology shocks introduced by the Commission in its modelling of costs resulted in the under compensation of the TSP, because the TSP can recover only a portion of its initial investment.

ix.) The Commission recognises that if it continues to introduce new technology in its cost model, it must take additional steps to avoid under-compensating the TSP for the cost of providing the TSO service by providing an offsetting compensation to ensure financial capital maintenance.

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[1] The provisions of the TSO Deed requires basic telephone access as widely available as it was at 20 December 2001; free local calling; dial up internet access; free listing in the White Pages; free genuine 111 emergency calls; and a monthly line rental no higher than the CPI adjusted price of the residential line rental charged at 1 November 1989.

[2] Scorched Node refers to a network modelling approach whereby a constrained optimisation has occurred which retains aspects of Telecom's original network design. This is in contrast to a "Scorched Earth" approach which would not have regard to Telecom's network design.

[3] A modelling approach progressing from small or subordinate units to a larger or more important unit.

x.) The Commission has concluded that the net effect of any offsetting compensation provided would be the same, in terms of the net cost of the TSO, as if no new technology was exogenously introduced into the model. The Commission has therefore decided to discontinue the introduction of further technology into the TSO costing model.

xi.) The Commission has modelled the use of fixed PSTN technologies in its determination. In instances where the same service can be provided more cost effectively the Commission has modelled the delivery of service via Multiple Access Radio (MAR) technology. MAR was technology used by the TSP and was modelled as providing TSO services in the original TSO Determination and is not classified as new technology for the purposes of this determination.

xii.) In previous determinations the Commission has allowed for competing technologies such as Mobile Technology (MT), Wireless Local Loop (WLL) and MAR to be included in the model. The Commission has determined that while it will continue performing an optimisation process, it will not longer introduce new competing access technologies into its modelling. As a consequence of the decision not to optimise further by including exogenous technologies, the Commission's model has been configured so that the MT and WLL technologies cannot be selected in the modelling process.

xiii.) The Commission in response to a submission that a correction is needed to the tilted annuity to account for a 6 month offset in the realisation of the annuity payments, has determined that no correction to the tilted annuity is needed. (refer "Appendix 8: Correction to the Tilted Annuity Formula")

Weighted Average Cost of Capital

xiv.) The cost of capital (WACC) and the asset tilts are important elements in estimating the cost of the TSO. The WACC and the tilts ensure that the TSP can expect to earn a normal rate of return on and of its incremental capital used to service CNVCs.

xv.) By discontinuing the introduction of new technologies in its TSO modelling, the Commission has reduced the systematic capital risk faced by the TSP, which leads to a corresponding decrease in the asset beta and the WACC.

xvi.) The Commission has revised the asset beta from 0.4 to 0.2 and determined a post-tax WACC of 5.7% for this period.

Liable Persons

xvii.) Telecom is the TSO provider and the liable persons are as follows:

- TelstraClear New Zealand Limited;
- Vodafone New Zealand Limited;
- Compass Communications Limited;
- CallPlus Limited;
- WorldxChange Communications Limited;
- TeamTalk Limited; and
- ihug Limited.

Net Cost Calculation

xviii.) For the TSO period, the total net revenues of liable persons and Telecom are $3.860 billion

xix.) The Commission's TSO net cost model, at a post-tax WACC of 5.7%, calculates the following cost for the TSO period:

TSO Net Cost	$52.0Million
Residential CNVCs	42,930

TSO Net Cost Apportionments

xx.) The TSO net cost is apportioned based on liable revenues as shown on the table below. This table satisfies the requirements of section 92 of the Act.

Table 1: Reported Carrier Liable Revenues and TSO Charge for Period 1/7/2004-30/6/2005

2004/2005	Liable Revenue ($)	% of total	TSO Charge ($)	Loss of use of money ($)	TSO charge Payable to Telecom ($)
Telecom	2,660,557,000	68.934%	35,854,787	[redacted]	
Vodafone	944,352,000	24.468%	12,726,485	3,279,605	16,006,090
TelstraClear	235,417,000	6.100%	3,172,579	817,571	3,990,150
WorldxChange	9,207,153	0.239%	124,079	31,975	156,055
Ihug	5,987,633	0.155%	80,692	20,794	101,486
CallPlus	2,595,816	0.067%	34,982	9,015	43,997
Teamtalk	816,085	0.021%	10,998	2,834	13,832
Compass	622,602	0.016%	8,390	2,162	10,553
Total	3,859,555,289	100.00%	52,012,993	4,163,956	20,322,162

Compliance with the TSO Deed's Requirements

xxi.) In accordance with section 80 of the Act, the Commission is required to make an annual assessment of Telecom's compliance with several basic quality-of-service standards specified in the TSO Deed. The Commission is satisfied that Telecom has complied in respect of the TSO period.

INTRODUCTION

1. This determination is in respect of the TSO Deed for Local Residential Telephone Service for the period from 1 July 2004 to 30 June 2005. The Telecommunications Act 2001[4], which regulates the supply of telecommunications services in New Zealand, was recently amended by the Telecommunications Amendment Act (No 2) 2006.

2. The transitional provision for TSO determinations in section 63 of the Telecommunications Amendment Act (No. 2) 2006 provided that "despite the amendments made by this Act to the principal Act, the principal Act continues to apply as if those amendments had not been made in respect of any TSO determinations that were commenced but not completed before the commencement of this act".

3. The TSO process for 2004/2005 commenced before the Amendment Act. Consequently for the purpose of this determination, the TSO provisions of Part 3 continue to apply as they were prior to the Amendment Act. The Commission has therefore released a single determination for the TSO period and applied Part 3 of the Act as if the Amendment Act had not changed Part 3.

4. Confidential information in this determination is subject to a confidentiality order made under section 15(i) of the Act and section 100 of the Commerce Act on 12 August 2005. The Order is available on the Commission's website (www.comcom.govt.nz).

5. The Order prohibits the disclosure of confidential information during the 2004/2005 TSO proceeding except where approved counsel and experts of interested parties have signed a deed of undertaking as to confidentiality and are approved to access the confidential information in accordance with the Order. Confidential information is referred to as Restricted Information under the Order (except where clause 4 applies and the information is granted Commission only status) and is identified by square brackets in the determination, ([ ]) or in the "comments" field of particular tables in the determination. All confidential information has been removed from the public version of the determination.

6. In some cases the Commission has redacted entire tables from the public version of the determination. Due to formatting difficulties, the Commission is unable to produce a version of the tables which identifies only the numbers as Restricted Information. Where the Commission has removed an entire table from the Determination, please note that the only information that is classified as Restricted Information under the Order is the numbers in those tables.

7. The Restricted Information in the determination includes a mixture of data which the Commission has received from interested parties to this determination, other third parties, and where possible, data derived by the Commission from data sourced from those parties. All Restricted Information in this determination is Commission Restricted Information (CCRI) except where the Commission has specifically identified beside the brackets ([ ]) that the information is party designated Restricted Information, for example, TelstraClear-designated Restricted Information (TCRI), Vodafone-designated Restricted Information (VNZRI), TeamTalk-designated

[4] All terms and phrases that are defined within the Telecommunications Act 2001 (the "Act") have the same meanings in this determination unless otherwise stated. All references to Parts, schedules and sections are to the Parts, schedules and sections of the Act.

Restricted Information (TTRI) or Telecom-designated Restricted Information (TCNZRI).

TSO PROCEEDINGS

8. Under Part 3 of the Act, the Commission is required to determine the net cost incurred for the supply of the services required by the declared TSO instruments, the allocation payable by all liable persons and the measurement of compliance to the specified standard.

Process

9. The Commission has undertaken the following process for the TSO period:

Consultation	Parties Involved
(1) Confidentially order issued (12 August 2005)	Telecom, TelstraClear, Vodafone, TeamTalk, Kordia,
(2) Commission Consult Pre Draft Over Net Liable Revenue (14 December 2006)	Telecom, TelstraClear, Vodafone
(3) Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005, (9 July 2007)	Commission
(4) Submissions on *Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*(August 2007)	Telecom, TelstraClear, Vodafone, Compass
(5) Paper on Commission's approach to modelling radio cap.(4 December 2007)	Commission
(6) Submissions on *Commission's approach to modelling radio cap* (January 2008)	Telecom, TelstraClear, Vodafone,
(7) TSO Mobile Conference (11 February 2008)	Commission, Telecom, TelstraClear, Vodafone,
(8) Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005 (13 May 2008)	Commission
(9) Submissions on *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005* (July 2008)	Telecom, TelstraClear, Vodafone,
(10) Final Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005	Commission

The TSO Deed for Local Residential Telephone Service

10. The Act requires the Commission to determine, on an annual basis, the net cost incurred by the TSP in providing the services required to meet its obligations under the TSO Deed for Telecom's local residential telephone service.

11. The TSO Deed requires Telecom, as the TSP, to:

- maintain a free local-calling option for all residential customers, for both voice and data calls;
- maintain, in real terms, the standard rental for residential customers at or below the level charged on 1 November 1989;
- charge residential customers in rural areas no more than the standard residential rental;
- continue to provide local residential telephone services as widely available as it was at December 2001;
- continue to provide directory assistance on the basis set out in the exchange of letters between the Crown and Telecom in 1997; and
- meet a number of service quality measures in areas including unsuccessful call attempts, complete switch downtime and the connection speed for standard dial up internet calls.

The Framework for the Determination

12. This section outlines the legislative framework for TSO instruments under Part 3 of the Act and the Commission's responsibilities with regard to these instruments.

13. Section 70(1) explains the purpose of the declaration of TSO instruments:

> The purpose of this section is to facilitate the supply of certain telecommunications services to groups of end-users within New Zealand to whom those telecommunications services may not otherwise be supplied on a commercial basis or at a price that is considered by the Minister to be affordable to those groups of end-users.

14. The TSO was deemed to be declared as a TSO instrument under section 70 by section 71 in 2001.

15. Subpart 2 of Part 3 of the Act prescribes the annual procedure for determining the net cost of the TSO and the amounts payable by liable persons to the telecommunications service provider (TSP) as a contribution towards this cost.

16. The Commission is required under section 80 to make an annual assessment of a TSP's compliance with a TSO instrument.

17. Section 81 requires that every liable person provide the financial and other information specified by the Commission. Section 83 requires the TSP to provide to the Commission a calculation of the net cost to it of complying with the TSO, along with an auditor's report confirming the calculation.

18. Section 84(1) requires that the Commission take the following matters into account in calculating the TSO net cost:

> (a) the range of direct and indirect revenues and associated benefits derived from providing telecommunications services to commercially non-viable customers, less the costs of providing those telecommunications services to those customers:
>
> (b) the provision of a reasonable return on the incremental capital employed in providing the services to those customers.

19. The 'net cost' (of the TSO) is defined in section 5 as:

> ... the unavoidable net incremental costs to an efficient service provider of providing the service required by the TSO instrument to commercially non-viable customers.

20. Section 84(2) states that in determining the net cost under section 92, the Commission:

    (a) may choose to not include profits from any new telecommunications services that involve significant capital investment and that offer capabilities not available from established telecommunications services; and

    (b) must not include any losses from telecommunications services other than services that the TSO instrument requires the TSP to provide; and

    (c) must consider the purpose set out in section 18.

21. The purpose described in section 18(1) is:

> …to promote competition in telecommunications markets for the long-term benefit of end-users of telecommunications services within New Zealand by regulating, and providing for the regulation of, the supply of certain telecommunications services between service providers.

22. Section 18(2) requires the Commission to consider efficiencies and states:

> In determining whether or not, or the extent to which, any act or omission will result, or will be likely to result, in competition in telecommunications markets for the long-term benefit of end-users of telecommunications services within New Zealand, the efficiencies that will result, or will be likely to result, from that act or omission must be considered.

23. Section 90 requires the Commission to make a final determination of the matters set out in section 92. As the TSO instrument does not specify the total amount payable by all liable persons to the TSP, the Commission is required to include all the relevant information outlined in section 92 in its final determination. Therefore, the final determination must include:

> (a) … (i) the net cost to the TSP of complying with the TSO instrument during the TSP's financial year and all material information that—
>
> (A) relates to the calculation of the net cost; and
>
> (B) would not, in the opinion of the Commission, be likely to unreasonably prejudice the commercial position of the TSP; and
>
> (ii) the amount of revenue determined in accordance with any prescribed methods that the TSP receives during the financial year from providing telecommunications services either by means of its PSTN or by means that rely primarily on the existence of the TSP's PSTN; and
>
> (b) … (i) the amount of revenue that each liable person in relation to the TSO instrument receives during the TSP's financial year from providing telecommunications services either by means of its PSTN or by means that rely primarily on the existence of the TSP's PSTN; and
>
> (ii) the amount (if any) by which the total amount that the TSP would receive from all liable persons in relation to the TSO instrument must be reduced because the TSP has not complied with the TSO instrument; and
>
> (c) a statement that identifies which revenue basis has been used under section 85(1) in respect of each amount of revenue to which the final determination applies; and
>
> (d) if a weighted revenue basis has been used for any amount of revenue, the particulars of the weighting attached to that amount of revenue; and
>
> (e) the revenue amounts that will be used for the purposes of calculating, under section 93, the amount payable by each liable person in relation to the TSO instrument; and
>
> (f) an amount payable by each liable person in relation to the TSO instrument to the TSP in respect of the financial year calculated in accordance with section 93; and
>
> (g) an amount payable by each liable person in relation to the TSO instrument to the TSP for the loss of use of the amount referred to in paragraph (f) calculated at the 90-day bank bill rate (as at the date of

the final determination) for the period commencing from the end of the TSP's financial year and ending with the date of the final determination.

DEFINING THE NET COST OF THE TSO

24. In order to determine the net cost of the TSO, the Commission must first interpret the components of the definition of net cost as set out in section 5:

> ... the unavoidable net incremental costs to an efficient service provider of providing the service required by the TSO instrument to commercially non-viable customers.

25. The Commission must interpret key terms, including:

- Unavoidable Net Incremental Cost;
- Commercially Non Viable Customers (CNVC); and
- Efficient Service Provider.

26. The Commission has also considered the following issues in relation to its consideration of section 84 and the TSO Deed:

- Telecom's Obligation to Serve Residential Customers;
- Intangible Benefits;
- Replacement Revenues;
- Revenue from Supplementary Services;
- Cost of Telephone Book Listing; and
- Cost of 111 Emergency Calling Service.

27. These terms and issues are discussed in this section in the context of Part 3 of the Act (including section 84 which sets out the mandatory considerations to be considered in determining the net cost under the Act).

28. The Commission notes that one of the two key issues identified by parties submitting in relation to the Revised Draft TSO Determination for 2004/2005 (Revised Draft Determination) was whether or not the new methodology employed by the Commission, where it no longer introduced new technology into its modelling, determined the net cost in accordance with Part 3 of the Act. (The other key issue was the whether or not it was appropriate to have a reduction in the asset beta. This issue is discussed under "TSO cost of capital" on page 50.)

Unavoidable Net Incremental Cost

29. The concept of incremental cost is well established in economics. It is the additional cost a firm would incur if it chose to serve an extra customer or group of customers, or provide an extra unit or tranche of output.[5] It is often useful to think of this in terms of the difference in a firm's costs 'with' and 'without' the additional customer(s) or unit of output. Incremental costs do not include common costs.

30. In the context of the TSO, the incremental cost of an obligation to provide services to commercially non-viable customers (CNVC) is, therefore, equal to the difference in the firm's total costs between the circumstances where it supplies those customers in conjunction with all its other customers, and where it does not.

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[5] See, for example, W. Baumol, and J.G. Sidak, *Toward Competition in Local Telephony*, 1994, MIT Press, p 57.

31. In respect of the access network, the relevant increment will be the access costs associated with serving CNVCs. In terms of the core network, the relevant increment will be the total tranche of calling costs associated with the CNVCs.

32. In estimating the net cost of the TSO, the Commission regards unavoidable net incremental costs as the difference between the long-run costs an efficient service provider would incur with and without the obligations imposed by the TSO instrument. This includes a return on incremental capital required to meet the obligations under the TSO instrument, as well as appropriate depreciation costs of those assets.

33. The unavoidable net incremental cost should be the long run incremental cost (LRIC). The long run is a period of time of sufficient duration for the firm to be able to alter all inputs to the service. This means that long-run costs include the costs of all the inputs used to provide the particular service. This includes providing a return on and of capital to an investor.

Commercially Non-Viable Customers

34. The TSO unavoidable net incremental cost is essentially the cost of providing TSO services to CNVCs.

35. CNVCs are those groups of customers in respect of whom the efficient incremental costs of providing the TSO services exceed the standard residential line rental plus expected supplementary revenue.

36. The Commission considers that Telecom would, in the absence of the TSO, have set residential access prices on an aggregated basis to groups of customers, and not on an individual basis.

37. The Commission considers that the smallest group of residential customers served by a fixed line access network to which costs ought to be attributed is a cluster; that is, the group of customers connected to the same feeder cabinet or directly to an exchange. The bulk of the costs of serving such customers are shared capital costs, such as trenching of distribution cables, and most of the cost sharing takes place between some or all of the customers in the same cluster. While it is arguable that Telecom would not price discriminate at so fine a geographic level, the Commission considers that this approach is consistent with Telecom's observed tendency to price discriminate at a level above the individual customer.

38. Traditionally empirical studies in developed countries have found that the demand for basic fixed line telephone access is highly inelastic.[6] It is therefore very unlikely that a material number of customers would voluntarily disconnect as a result of a rise in prices on a broad geographic basis. The Commission therefore considers that, in the absence of the TSO, there would be very few residential customers that would not be

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[6] Econometric analysis in the 1980s in a number of countries suggest that the demand for access to fixed line telecommunications services is relatively inelastic compared to the demand on fixed line calling products. In the United States, Perl found that for a flat access rate of $10 per month, the price elasticity of demand at an initial penetration rate of 93 per cent on the fixed line network was -0.038. (See L. Perl, "Residential demand for Telephone Service: Preliminary results of a New Model", in P. Mann and H. Trebing (eds.), *Changing Patterns in Regulation, Markets, and Technology: The Effect on Public Utility Pricing*, Proceedings of the Institute of Public Utilities Fifteenth Annual Conference, The institute of Public Utilities, Michigan State University.) Whilst for Canada, Bodnar, Dilworth and Iacono estimated that for a 1 per cent change in the 1985 residential access price, the elasticity of demand at an initial penetration rate of 98 per cent, was -0.009. (See J. Bodnar, P. Dilworth and S. Iacono, "Cross-sectional Analysis of Residential Telephone Subscription in Canada". *Information Economics and Policy* 3, 1988, pp 359-78.)

supplied, or would not take supply, at any plausible price above the TSO CPI indexed rental price cap.

39. In order to allow Telecom to earn a reasonable return on supplying service to CNVCs, as required by the Act, the Commission considers that the appropriate manner in which to identify CNVCs and calculate the amount Telecom should be able to recover is to assume that Telecom continues to serve all its customers, and to ask:

- If an efficient service provider was to provide service to all Telecom residential customers connected at 20 December 2001:
- for which clusters of residential customers would the incremental economic costs of providing the TSO services exceed the standard residential line rental plus expected supplementary revenue?; and
- by how much would that cost exceed that revenue?

40. CNVCs are identified and costed on a cluster basis. This means that each cluster generated by the cost modelling has been identified as either viable (able to be viably supplied at the cost cap) or non-viable (not able to be viably supplied at the cost cap). The sum of the net costs of all the non-viable clusters is the total TSO net cost.

Efficient Service Provider

41. The term "efficient service provider" is referred to in the definition of "net cost" as ... the unavoidable net incremental costs to an efficient service provider of providing the service required by the TSO instrument to commercially non-viable customers.

42. The term of "efficient service provider" is not defined in the Act. The Commission is required to ascertain the meaning of net cost (and including the term "efficient service provider") in the context of both the immediate context of Part 3 and the general legislative context of the Act, inclusion the purpose statement set out in section 18. The Commission has carefully considered these matters in conjunction with the parties' submissions in order to ascertain the meaning of "efficient service provider" under the definition of net cost.[7]

43. Any modelling undertaken by the Commission to determine unavoidable net incremental costs in this context must reflect the costs of an efficient service provider. The reference to an "efficient service provider" principle does not in itself produce a single definitive approach that is free of controversy. Submissions before the Commission in the TSO process have advocated contrasting approaches, for calculating the asset base for the TSP. This has ranged from use of the Telecom's actual historic costs as the key reference point, to disregarding all of these costs, and instead using the replacement costs incurred by a potential competitive entrant supplying the TSO.

44. An efficient service provider could be defined as one who produces a given quantity and quality of service for the lowest possible cost. The desirable level of efficiency could also be determined by reference to a competitive or contestable market standard, where incentives operate to ensure that costs are minimised. However, the Commission considers that imposing the highest standard of efficiency possible is unreasonable, particularly in the context of assessing the net cost of a social policy obligation.

[7] Section 5 of the Interpretation Act 1999 requires the meaning of an enactment to be ascertained from its text and in the light of its purpose

Context

45. The main purpose of the Act is to regulate the supply of telecommunication services.

46. Under section 70(1) of the Act, TSO instruments are declared to facilitate the supply of certain telecommunication services to groups of end-users within New Zealand to whom those telecommunications services may not otherwise be supplied on a commercial basis or at a price that is considered by the Minister to be affordable to those groups of end users.

47. The TSO Deed is primarily an instrument of social policy. It recognises that some customers have a high cost and that a basic social need (basic telephony and internet services at an affordable price) would not be met without a subsidy. The Commission determines the amount of that subsidy, and allocates its cost across Telecom and the liable persons.

48. While the TSO provisions of the Act are not designed primarily to have an effect on competition, the Commission must have regard to potential effects on competition. In determining the "net cost" of the TSO, the Commission is directed by section 84 to consider a number of matters, including the purpose set out in section 18 of the promotion of competition in telecommunications markets for the long-term benefit of end-users of telecommunications services within New Zealand. Section 18 also requires the Commission to consider efficiencies.

Efficiency

49. Efficiency must be considered not only through the efficient service provider provision but also under section 84(2)(c), where the Commission in determining the net cost, must consider the purpose set out in section 18.

50. The purpose described in section 18(1)

> is to promote competition in telecommunications markets for the long-term benefit of end-users of telecommunications services within New Zealand by regulating, and providing for the regulation of, the supply of certain telecommunication services between service providers.

51. Section 18(2) requires the Commission to consider efficiencies and states:

> In determining whether or not, or the extent to which, any act or omission will result, or will be likely to result, in competition in telecommunications markets for the long-term benefit of end-users of telecommunications services within New Zealand, the efficiencies that will result, or will be likely to result, from that act or omission must be considered.

52. There are three relevant types of efficiency relevant to assessing efficiency under Part 3 of the Act, they are:

Allocative efficiency – involves ensuring that resources are allocated to those producers and consumers who value them most highly. That is, the goods and services that are produced in the economy are the ones most valued by consumers and the distribution of production costs amongst firms within the industry minimises industry-wide costs. Allocative efficiency is achieved by setting prices equal to long-run marginal costs.

Productive efficiency – involves each firm combining its inputs or resources in such a way as to produce a given level of output of goods and services at a minimum cost to society.

Dynamic efficiency – is associated with ensuring that incentives are maintained for the infrastructure provider to undertake ongoing investment and innovation in the essential infrastructure over time. Dynamic efficiency has been defined as ensuring that the service provider still has incentives to undertake the investment at a socially optimal time, or where the net present value to society from the investment is maximised.

Further Considerations of Efficiency

53. In the context of the TSO, the Commission has developed principles on how to consider efficiency concepts in order to achieve a balance between assessing the long-term interests of end-users under section 18, and ensuring that the TSP can expect to earn a reasonable return on its investment. The following reflects how the Commission gives effect to the three types of efficiencies.

Allocative Efficiency

54. Aside from the difficulties in estimating marginal costs, the Commission recognises that, in practice, utility industries such as telecommunications experience significant economies of scale and scope. This means that long-run marginal cost-based prices set for access may not provide the supplier with a normal economic rate of return on, and of, its efficiently invested capital.

55. The Commission has therefore considered *allocative efficiency* by using a long-run incremental cost (LRIC) methodology. This is a proxy for the long run marginal cost, but as the increment is measured over the supply of the entire service, in practice it is equivalent to a long-run average cost of supply. As the Commission examines allocative efficiency in the long run, where all factors of production are variable, the costs measured include a return of, and on, capital.[8]

56. As the TSO is not a price setting regime, but designed to determine the net cost associated with delivery of the TSO service to commercially non-viable customers based on long run incremental cost, the achievement of *allocative efficiency* is a less directly relevant consideration of the scheme.

Productive Efficiency

57. Suppliers of services with market power are not subject to the same pressures to reduce production costs as firms in a more competitive market.[9] Further, economic theory suggests that when such firms are subject to regulation, they may have greater incentives to overstate costs or overcapitalise in its production.[10]

58. To avoid incentives for cost padding and to take into account *productive efficiency*, the Commission has used the historical costs of Telecom only to a limited extent. The

[8] In contrast, if a short run approach was taken, it would assumed that capital was a fixed factor of production and no return on or of capital would be explicitly required.

[9] When an industry has a monopoly structure, Leibenstein outlined that a firm will not be subject to the same pressures to decrease costs as in a competitive industry. This type of inefficiency due to such things as lax management, outdated production methods and inadequate cost control was referred to as "X-Efficiency". See H. Leibenstein, "Allocative vs. "X-Efficiency"', *American Economic Review* 56, 1966, pp 392-415.

[10] H. Averch and L.L. Johnson, "Behaviour of the Firm under Regulatory Constraint", *American Economic Review* 52, 1962, pp 1053-69, suggested that a monopoly subject to rate-of-return (RoR) regulation had incentives to over-capitalise in its supply of services. That is, for any given fair rate of return, by increasing the value of its capital asset base, it was shown that a RoR-regulated firm could increase the net operating profit that it was allowed to earn in each year. T.W. Kennedy, "The Regulated Firm with a Fixed Proportion Production Function", *American Economic Review* 67, 1977, pp 968-71, also showed that there was an incentive for the RoR-regulated monopoly to engage in "gold plating" of its network. Gold plating involves employing additional capital that is completely unproductive or even decreases the level of output, but allows the regulated firm to increases its overall level of profit.

Commission has employed a form of optimisation technique using replacement costs to determine the asset base, from which the normal rate of return on and of capital is calculated.

59. As Covec has noted,[11] the use of optimisation techniques combined with replacement costs became the standard valuation method for regulated telecommunications services in the USA and Australia throughout the 1990s. Using bottom-up engineering cost models, regulators have estimated not only the efficient TSO costs, but also the long-run (average) incremental cost-based access prices[12] for interconnection and last-mile access services such as the Unconditioned Copper Local Loop (UCLL) service.

60. Covec outlined that the conceptual rationale for the combination of optimisation and replacement costs used to estimate the TSO has been drawn from the theory of contestable markets.[13] This technique estimates the cost that either the incumbent would face if it were to have entered the industry at a later time, or that an efficient entrant would incur if competition and entry had been feasible in the industry.[14] One feature of this approach that was considered attractive was that regulators were able to place a reasonably objective valuation on a firm's assets without requiring information from the regulated firm. The regulated firm's costs were often based on the historical accounting costs of the network, which were considered unreliable and possibly overstated.

61. The choice of the efficient service provider standard in setting the initial capital asset base in 2001/2002 was designed to limit the recovery of inefficient costs associated with historical monopoly provision of local access services. This mimics a process to provide incentives for the TSP to minimise costs and invest efficiently.

62. The Commission considered that it would be unreasonable to impose a standard of efficiency that completely disregarded the costs that Telecom experiences, and that doing so could in itself give rise to inefficiencies.

63. While it is appropriate to depart from the actual historical costs faced by Telecom, the Commission considers that the TSO costing exercise should still have some regard to these costs. Other efficiency considerations are also important in this context. If investments that appeared prudent at the time, cannot be recovered because of inappropriately restrictive regulatory settings this could create a strong disincentive for any future investment by the ESP.

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[11] Covec (Dr John Small and Dr Aaron Schiff), *New Technology in the TSO*, Prepared for Vodafone New Zealand, June 2008, p 8.

[12] In the USA, these access prices are based on what is referred to as the "Total Element Long-Run Incremental Cost (TELRIC)" method, which prices individual elements of the network. In Europe and Australia a similar methodology is used, however, the long run costs are calculated for regulated services rather than network elements. In Australia, the technique is referred to as total service long-run incremental cost (TSLRIC), whilst in Europe it is referred to as the long-run incremental cost (LRIC). The TSLRIC notation in Europe tends to be adopted where there is also some allowance for the recovery of non-attributable or common costs of the network.

[13] Covec (Dr John Small and Dr Aaron Schiff), *New Technology in the TSO*, Prepared for Vodafone New Zealand, June 2008, p 8.

[14] In the Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, this potential competitor entering in at the lowest possible costs, was referred to as the "hypothetical new entrant".

Dynamic Efficiency

64. The concept of *dynamic* efficiency tends to be the least well defined type of efficiency. It is the most important form of efficiency in practice, as it relates to ongoing investment and the supply of services to end users over the medium-to-long term. The Commission has to balance the need for efficiency in a given year (static efficiency) and efficiency over a number of years (dynamic efficiency).

65. The Commission has applied *dynamic efficiency* in the context of Part 3 by ensuring that the TSP *ex ante* has an expectation it will achieve a net present value (NPV) equal to zero on its efficiently invested capital. This provides the TSP with a return on and of its investment and is described in Economics as a "normal profit". The "NPV = 0" rule or Financial Capital Maintenance (FCM), is important where capital intensive sunk investments are being considered. An ESP that did not expect to achieve at least NPV = 0 would not be prepared to undertake such an investment.

66. The NPV = 0 rule also ensures that an ESP achieves a reasonable return on its investment in accordance with section 84(1)(b).

Conclusion on Giving Effect to Economic Efficiency in Practice

67. The Commission has recognised that in practice there may sometimes be trade-offs associated with the achievement of the three types of economic efficiencies. In particular, there are sometimes tensions between the achievement of static, *allocative* and *productive efficiency*, and the achievement of *dynamic efficiency*.

68. Where such tensions exist, the Commission has consistently taken the view that dynamic efficiency will generally better promote competition for the long-term benefit of end-users.[15] The rationale for this is that competition cannot be promoted for the long term benefits of end users in a market where the TSP is subject to a regime that does not provide it with the minimum conditions required to sustain the supply of services in the long run.

The TSO Revised Draft Determination 2004/2005

69. In the Revised Draft Determination the Commission separated its Optimisation into two separate classes:

- *Exogenous Optimisation* – this involves the Commission introducing new technologies into the TSO models in each year to calculate the net cost. For example, over the years there has been the introduction of various radio caps into the cost modelling exercise.
- *Endogenous Optimisation* – this involves that optimisation performed by the Commission's TSO models given demand and technology constraints. For example the Commission uses the geographical location of demand for network services customers; the estimates of customer revenue; and the costs of various telecommunications solutions to design and cost a virtual network that supplies a certain level of TSO service. For the elimination of doubt Endogenous Optimisation includes the MAR capping technology.

70. The 2004/2005 Revised Draft Determination noted that the introduction of new access technologies annually into the TSO through Exogenous Optimisation could result in

[15] For example, Commerce Commission, *UCLL decision 609*, p 54, para 207, the Commission stated that "where tensions exist between static efficiency and dynamic efficiency, it takes the view that dynamic efficiency will generally better promote competition for the long-term benefit of end users."

the asset base being decreased.[16] Under the *ex post* implementation of the scheme, the Commission noted that an expectation of a decrease in asset value, without any offsetting adjustment,[17] would mean the TSP would expect to be NPV < 0 on its sunk infrastructure. That is, the TSP faced an outcome where it could either earn an NPV = 0 on its efficient investment or an NPV < 0. As the Commission considered that there was a probability associated with these scenarios then the TSP could only have an expectation that it would earn NPV < 0 on its efficiently invested capital.

71. The Commission considered in the Revised Draft Determination that this asymmetry arising from Exogenous Optimisation could not be regarded as *dynamically efficient*. Subject to such an expectation, an incumbent TSP would never have the incentive to undertake the initial investment, and a potential TSP competitor with new technology would never have the incentive to enter such a market.[18]

72. Further, the Commission noted that the TSP would expect to earn an effective return on its incremental capital below the weighted average cost of capital (WACC) set by the regulator. The Commission considers that such a return would not be reasonable under Section 84(1)(b), as the TSP would not expect to achieve a return on and of the incremental capital employed to provide services to CNVC.[19]

73. On this basis, in the Revised Draft Determination the Commission considered that the ESP principle would be met if the Commission used only Endogenous Optimisation, and discontinued the practice of annually introducing new access technologies into the modelling process.

<u>Submissions on the Efficient Service Provider Principle in the Revised Draft Determination</u>

Telecom

74. Telecom[20] and CEG,[21] in a report on behalf of Telecom, noted that the approach to optimisation undertaken by the Commission prior to the Revised Draft Determination created an asymmetry that led to a TSP never having the opportunity to earn a reasonable return on its incremental capital. Telecom stated that:[22]

> 15 …The central problem with the past model was the optimisation process was one sided (i.e. asymmetric). The best that the TSP could hope for was to recover its investment in line with the tilted annuity, and no more.
>
> 16 In other words, when measured against expectations, the TSP could not "win" but there was a chance it could "lose". This meant the TSP would not expect to break even.

75. Telecom observed that the inability for the TSP to expect to earn a reasonable return on its investment was inconsistent with the outcome in a workably competitive market. It noted that:[23]

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[16] Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, p 93, para 425.
[17] ibid, Appendix 1.
[18] ibid, Appendix 2.
[19] ibid, Appendix 1.
[20] Telecom, *Cross-Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 1 July 2008.
[21] CEG (Dr Tom Hird), *New Technology in the TSO: Errors in the Covec Report for Vodafone*, A Report for Telecom New Zealand, 30 June 2008.
[22] Telecom, *Cross-Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 1 July 2008, p 5.
[23] ibid.

> 17 This is clearly at odds with outcomes in workably competitive markets. In workably competitive markets firms commit to investment on the basis of a certain set of expectation, and face the prospect of over-recovery as well as under-recovery. Importantly, the nature of competition ensures the investor has an expectation of earning the required cost of capital (otherwise the capital is not forthcoming).

76. The asymmetry that was created by new technologies, according to Telecom "defeats the TSP's legitimate expectations".[24] Further, Telecom stated that:[25]

> 28 …Telecom has consistently argued that the Commission has imposed an efficiency standard that is inconsistent with a good faith implementation of the compact between the Crown and Telecom for the delivery of rural services.
>
> 29 An approach consistent with the real world bargain between the Crown and Telecom is of the Commission to model costs that reflect Telecom's actual network, and not an optimised least cost network that was not open for Telecom to build in the real world.

77. In responding to Vodafone's submission on the need to create a new model in 2008, Telecom also referred to problems of "regulatory commitment" if such an exercise was engaged in by the Commission. It noted that:[26]

> Vodafone's essential position is that – regardless of understanding and investments at the time the TSO Deed was entered into – a highly optimised view starting from 2008 should now be imposed. Clearly there are several difficulties with this. This would undermine the regulatory commitment of the Commission, and the TSO framework generally. The only way to incentivise current and future TSP's to invest is to respect the expectation associated with existing prudent investments.

78. Telecom also noted that Vodafone in its submission in response to the Revised Draft Determination had confused the Commission's modelling exercise with what it described as "real world" effects. It highlighted that Telecom as a profit-maximising supplier of telecommunications services had ongoing incentives to lower costs to maximise it profits, and that in the real world, one technology simply did not displace another, especially where sunk costs were involved.[27]

79. CEG indicated that Covec's criticisms on behalf of Vodafone (about Telecom not having incentives to lower cost to CNVCs unless the TSP were subject to the least cost technology) were incorrect. It noted that the Commission's modelling approach where new technologies were not introduced created very strong incentives for Telecom to introduce these technologies in the real world, as it would allow them to lower costs, and this would increase the level of profits it could earn. CEG stated that:

> 65. Under the current regulatory framework Telecom's TSO revenues are set based on the Commission's hypothetical new entrant cost – without regard to the level of past and future expenditure undertaken by Telecom. Therefore, Telecom has a strong incentive to lower its costs by investing efficiently (because any such cost reductions are not reflected in lower prices). In this regard, Telecom is subject to a very high powered incentive scheme (and has as strong an incentive to invest efficiently as any unregulated firm.
>
> …
>
> 67. …removing optimisation on the basis of new technologies will make it more likely that Telecom will deploy those technologies not less. The only reasons that Telecom would have for

[24] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 9, para 35.

[25] Telecom, *Cross-Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 1 July 2008, p 7.

[26] ibid, p 11, para 56.

[27] ibid pp 8-9.

> not deploying an efficient new technology would be if it believed that the Commission would, on observing this deployment lower Telecom's revenues.

Liable Persons

80. Vodafone[28] and TelstraClear[29] both maintained that by not introducing new technologies in its modelling the Commission failed to properly give effect to the ESP principle under Part 3 of the Act, and the section 18 purpose of the Act.

81. Vodafone considered that by ignoring the introduction of new technologies in its Revised Draft Determination, the Commission did not "determine the net incremental costs to an efficient service provider in accordance with the Act."[30] Vodafone stated that:

> This approach ignores the behaviour of a hypothetical service provider of the TSO services acting efficiently. Such an operator would employ the most efficient technologies to provide those services.[31]

82. Further, Vodafone argued that it was inconsistent with promoting competition under section 18, as it neither maintained competitive neutrality nor ensured that incentives for investments were retained. Vodafone claimed that by compensating Telecom for the cost of its notional investment in a new network in 2001, Telecom's incentive to invest in ways that delivered the TSO more efficiently was removed, and Telecom was "over-compensated". It noted that:[32]

> …over-compensation results in a competitive imbalance in favour of Telecom at the expense of other service providers. This is clearly contrary to the legislative intent set out in s18 to foster competition in an efficient market and the Commission appears to have failed to consider this.

83. Vodafone acknowledged the difficulty in calculating a bottom-up long run incremental cost model, highlighting the "fiction" behind this approach, in that any network investment modelled was "hypothetical". On this basis, it questioned the approach in the Revised Draft Determination, where "Telecom receives full compensation for making investments in its hypothetical network."[33] This it maintained, had no regard for actual investments made by alternative service providers in new technologies, or the disincentives it created for potential competitors to invest in new technologies in the future. It also queried whether there was an asymmetry arising from the introduction of new technologies into the modelling, stating that:[34]

> Economic theory suggests no ex post compensation is required in circumstances where optimisation occurs.

84. The arguments made by Vodafone in relation to the ESP standard, the promotion of competition, and the lack of asymmetry from optimisation, led it to the conclusion that the Commission had made economic errors and that:[35]

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[28] Vodafone , *Submission on the Local Service TSO Revised Draft Determinations for the 2004/2005 and 2005/2006 Periods*, 24 June 2008.
[29] TelstraClear, *Local Service Telecommunications Service Obligation Revised Draft Determinations for 2004/05 and 2005/06*, 24 June 2008.
[30] Vodafone , *Submission on the Local Service TSO Revised Draft Determinations for the 2004/2005 and 2005/2006 Periods*, 24 June 2008, para 44.
[31] ibid.
[32] ibid, para 51.
[33] ibid, para 57.
[34] ibid, para 59.
[35] ibid, para 89.

> The economic errors identified in the Covec and NSL (Network Strategies Limited) reports are, as a consequence of the provisions of the Act, legal errors. It would be a breach of the Act for the Commission to allow these errors to be perpetuated in final determinations.

85. Both Vodafone and TelstraClear's arguments were supported by a report from Network Strategies Limited (NSL). NSL suggested that the network modelled was not productively efficient. According to its report, the Commission established a modern equivalent PSTN asset in 2001 that was configured such that it had "far greater capability than Telecom (or any other typical incumbent's) actual network, especially in rural areas." [36] Therefore, the Commission was using a network that had initially been "gold plated", and in 2004/2005 would have service capabilities well in excess of what would be needed to deliver the services required by the TSO deed. NSL stated that:[37]

> …the Commission's model does not represent an efficient TSO provider. Its wired/MAR model is a "gold plated" baseline with only 0.5% of lines provided using MAR, meaning that 99.5% of lines are constructed as relatively short copper loops connected to nodes with fibre backhaul. This implies that, with the addition of some DSLAMS and Ethernet equipment, the costs modelled for TSO service in 2004/2005 could provide ADSL2+ broadband capability

86. Further, NSL indicated that if no new technologies were introduced, the tilts in the tilted annuity depreciation would become irrelevant.[38]

87. Covec, on behalf of Vodafone, stated that the reason for the cost modelling engaged in by the Commission, was that:

> …the cost modelling exercise creates information which has to serve two basic purposes: (i) To generate a reasonable return on the TSP's actual historic investments, and (ii) To give the TSP correct incentives to make efficient investment and technology choices in future, for the benefits of consumers.[39]

88. Covec noted there was a tension between these two purposes, because "the TSP does not build a brand-new network every year, but makes investments that last for a long time, and inherited a network that was largely built long before the TSO cost modelling process was conceived."[40]

89. Covec considered that the Commission's removal of new technology from the modelling did not, however, achieve the requirements under the Act of promoting efficiency in the delivery of TSO service. It stated that the Commission's conclusions were: [41]

> ...not economically valid, created poor investment incentives and do not achieve the objectives required under the Telecommunications Act.

90. In terms of promoting incentives for efficient investment, Covec observed that:

> …removing alternative technologies from the cost modelling will only serve to weaken Telecom's incentive to invest in lower cost alternative technologies in future. As far as we can tell, the Commission has provided no analysis to distinguish this scenario of predictably low mobile costs and an inefficient decision by Telecom from the scenario where mobile costs have turned out to be unexpectedly low. Thus there is a real danger that the Commission's decision about the treatment

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[36] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and 2005/2006 Years*, 20 June 2008, Section 6, p 19.
[37] ibid, p 6.
[38] ibid, p ii.
[39] Covec (Dr John Small and Dr Aaron Schiff), *Comments on Telecom's Submission in respect of the Draft Determinations for the 2004/05 and 2005/06 TSOs*, Prepared for Vodafone New Zealand, 30 June 2008, p 2, para 2.
[40] ibid.
[41] Covec (Dr John Small and Dr Aaron Schiff), *New Technology in the TSO*, Prepared for Vodafone New Zealand, June 2008, p 4.

of new technologies will lock in and even reward past inefficiency in terms of Telecom's technology choices.

The Commission's View on the Efficient Service Provider

91. The Commission has always noted the potential problem of asset stranding. The TSP will not have the expectation of achieving NPV = 0 if this risk is unaccounted for ex ante. While the Commission did not believe it was necessary to provide ex ante compensation for such risk, the possibility of providing ex post compensation in response to stranding from new technologies was contemplated in the Commission's final determination in 2001/2002 where it stated that:[42]

> 334. In particular, reviewing the depreciation parameters on an annual basis effectively exposes the TSP to the risk of asset stranding only over the forthcoming year, that is, until the next review date. The risk of asset stranding in later years can be reduced by using new information (as time passes) to correctly identify in advance when this risk has increased and to accelerate the depreciation profile accordingly.

92. The absence of an expectation of NPV = 0 would have a negative impact on dynamic efficiency.

93. While the introduction of new technologies in each year may be consistent with achieving some measure of *productive efficiency*, the Commission considers that if repeated annual Exogenous Optimisation results in the incumbent TSP or a potential competitive entrant expecting to earn an NPV < 0 on its investment, it cannot be considered *dynamically efficient*. That is, neither an incumbent TSP nor any potential entrant with new technology would be prepared to invest in sunk infrastructure assets over the long run if they expect to be subject to repeated asset write-downs in the absence of compensation for these risks.

94. The Commission thus agrees with the general principle expressed by Covec, but considers that in the absence of compensation for the asset stranding risks associated with Exogenous Optimisation, a TSP would not have the correct incentives to make efficient investment and technology choices in future.

95. The Commission also maintains that even if no new technology is introduced into the modelling process in 2004/2005 onwards, static *productive efficiency* is still being achieved through the combined use of Endogenous Optimisation and replacement costs. That is, the 2004/2005 costs are still optimised given the technology used in 2003/2004, through the application of the Hybrid Cost Proxy Model (HCPM) and the CostProNZ model. Further, as the relevant tilts are being applied to the 2003/2004 modelled network assets, the asset base reflects a modern equivalent asset value of the 2003/2004 network technologies in 2004/2005. The removal of these tilts, as suggested by Network Strategies, would not reflect the modern equivalent asset value associated with the network, and would in effect ignore the requirements of productive efficiency.

96. With regard to incentives for investment in TSO-related services by Telecom and alternative providers, the Commission's view is that both CEG and Covec present valid views on what the incentives will be for Telecom and alternative providers when subject to the TSO regime that is in place. CEG considers a "carrot-based" regime appropriate, where outperforming the TSP benchmark through lower cost technologies will provide Telecom with profits. In contrast, Covec considers a "stick-based" regime appropriate, where Telecom is incentivised to decrease its costs down to the lowest cost technology in order to make a normal return. The Commission does

[42] ibid, p 78.

not believe that it needs to choose between these approaches as the fundamental issue for the Commission is whether or not the TSP or an efficient entrant would expect to be NPV = 0 on its investment if new technologies were to be introduced annually.

97. In previous Determinations, the Commission considered compensating the TSP for asset stranding risks in the cash flows, but did not do so because of an expectation that windfall losses would be offset by windfall gains. This expectation has not materialised because the lower costs of new access technologies has consistently resulted in re-valuation losses rather than gains.

98. As this expectation is no longer valid, the Commission considers that so long as Exogenous Optimisation continues it should compensate the TSP for this risk. However, there would be no practical value in Exogenous Optimisation of the network to achieve productive efficiency, while at the same time compensating the TSP for this process ex post. Over the asset life, the outcome from *ex post* compensation for the introduction of new technologies on the one hand no introduction of new technologies on the other hand is identical. On this basis, the Commission determined that it will not introduce any further new technology into the optimisation process, but will continue with Endogenous Optimisation.

99. The Commission's decision to remove the introduction of new technologies from the TSO modelling procedures for the purposes of its final determination of the net cost to the TSP:

- is consistent with promoting efficiencies under section 18 of the Act and the Efficient Service Provider principle in the definition of "Net Cost";
- is consistent with the principle that *dynamic efficiency* will generally better promote competition for the long-term benefit of end-users, whilst still promoting a level of *productive efficiency*. (The promotion of *allocative efficiency* has been achieved by basing the net cost associated with the scheme on the LRIC estimate derived from the Commission's cost model); and
- is consistent with the Commission providing the ESP with a reasonable return (i.e. an expectation of a rate of return that is equal to the WACC) on the incremental capital employed.

100. The Commission will accordingly for the purposes of the 2004/2005 TSO determination apply the same set of technology solutions that were in effect in the 2003/2004 TSO determination. As MAR was the only effective capping technology used in 2003/2004, it is the only capping technology that will be used in this TSO calculation.

Other issues

<u>Telecom's Obligation to Serve Residential Customers</u>

101. To calculate the net cost to Telecom of complying with the TSO Deed, the Commission must determine the nature of the obligations which the TSO Deed imposes on Telecom to serve new residential customers.

102. Section 70(4) requires a TSO instrument to specify various requirements, including the geographical area in which the service must be supplied.

103. Principle 3 of the TSO Deed states that "The line rental for local residential telephone service for Telecom residential customers in rural areas will be no higher than the standard residential rental and Telecom will continue to make local residential telephone service as 'widely available' as it is at the commencement date." The

Commission considers the requirement to make the service as widely available as it was at the commencement date as requiring that the TSO cost calculation be based on the customer demand for local residential telephone lines that existed at the time that the Deed was signed in December 2001. This demand has been used since the 2001/2002 determination.

Intangible Benefits

104. There may be benefits that accrue to Telecom as a result of being the TSP. These would constitute part of the range of direct and indirect revenues and associated benefits derived from providing telecommunications services to CNVCs which the Commission is required to take into account in making the TSO net cost calculation under section 84(1)(a). Such associated benefits can be described as intangible benefits.

105. Previous studies undertaken for telecommunications operators and regulatory bodies[43] have identified a number of potential sources of intangible benefits, the most important being:

- **Ubiquity benefits**: These are benefits arising from the TSP having a ubiquitous network. Two main sources are usually identified for ubiquity benefits:
    - customers moving from commercially non-viable to commercially viable areas where competition exists are more likely to choose the TSP than any of its competitors; and
    - the TSP is likely to attract customers who require services in both commercially viable and commercially non-viable areas and prefer to have a single supplier (e.g. businesses with a presence in commercially non-viable areas).
- **Life-cycle benefits**: These are benefits arising from the fact that customers who are currently commercially non-viable may at some future date become commercially viable, and may then choose the TSP over competitors;
- **Brand name and reputation benefits**: These are benefits arising from an enhancement of brand value and corporate reputation as a result of being the TSP;
- **Access to market information**: These are benefits arising from being able to collect information from a larger sample of customers and a wider range of areas; and
- **Volume discounts**: These are benefits related to the fact that being the TSP provider will generally increase its volumes and thus its bargaining power relative to, for example, equipment providers.

106. The Commission considers intangible benefits, such as those mentioned above, can arise only from the TSP providing service to those customers who would not have been provided with service if it were not for the TSO. As explained previously, the

[43] See, for example, Wissenschaftliches Institut für Kommunikationsdienste (October 1997), *Costing and financing universal service obligations in a competitive telecommunications environment in the European Union*; Wissenschaftliches Institut für Kommunikationsdienste (April 2000), *Study on the re-examination of the scope of universal service in the telecommunications sector of the European Union, in the context of the 1999 Review*; Oftel (July 1997), *Universal Telecommunications Services*; and Australian Communications Authority (January 2000), *Estimate of net universal service costs for 1998/99 and 1999/2000.*

Commission's view on this issue is that very few, if any, extra customers are provided with service because of the existence of the TSO. Accordingly, the intangible benefits Telecom receives from being the TSP must also be nil or very small, and immaterial in the context of the TSO net cost calculation.

107. The Commission's view is that the magnitude of intangible benefits is not significant in terms of the total TSO net cost, and that estimating the size of any intangible benefits the TSP receives is difficult, expensive and subject to error.

<u>Replacement Revenues</u>

108. Section 84(1)(a) requires that "all…associated benefits derived" be taken into account. The concept of replacement revenue is that in the absence of the TSO, the TSP may not supply particular residential households with a fixed line connection but may still earn some revenue from these households from, for example, calls from a mobile phone, a neighbour's landline or a phone box. In the calculation of the net TSO cost, this notional revenue could be used to reduce the supplementary revenue that the TSP earns from serving CNVCs.

109. However, as mentioned above, in the absence of the TSO it is assumed that almost all residential customers would still be provided with service. Under such assumptions there can be no replacement revenue. Even if a small number of CNVCs would have voluntarily disconnected, had there been no TSO, the consequential replacement revenues would be so small and uncertain as to be immaterial in the context of the net TSO cost calculation.

<u>Revenue from Supplementary Services</u>

110. Supplementary revenue is made up of revenue streams, other than the access rental, that depend on the existence of the residential access line. These revenue streams include but are not limited to those derived from: dial-up Internet access, tolls, and call charges.

111. Section 84(1)(a) requires net revenue derived from providing supplementary services to CNVCs to be included in the TSO net cost calculation. Supplementary revenue is the direct and indirect revenue derived from providing telecommunications services to CNVCs, less the costs of providing those services to those CNVCs. The costs to be subtracted from the supplementary revenue derived from CNVCs are those necessarily incurred in serving CNVCs. In other words, an incremental cost basis should be used and costs that would be incurred in providing those services to the entire customer base, such as advertising and billing system fixed costs, should not be deducted.

112. A similar principle applies to the return on incremental capital employed in providing services to CNVCs that also has to be taken into account under section 84(1)(b). Only the extra capital (if any) required to provide the services to CNVCs should be taken into account.

113. There are large fixed and common costs of owning and running the core network and other infrastructure used for providing supplementary services. As a result, a large portion of supplementary revenue could be expected to be an incremental benefit to Telecom. Since gross supplementary revenue is on average a significant amount, the method of calculation of net supplementary revenue is an important consideration.

114. However, in some cases the revenue may not exceed the cost of the provision of a service. Where this is the case, neither the cost nor the revenue associated with the non-profitable service should be taken into account.

115. The Commission received from Telecom, a list of revenue values by service type for each ESA. The Commission has compared these revenues against the cost of provision of these services and found that all of the types of supplementary service earn an economic profit. Telecom modelled the profitability of Telecom Mobile and Xtra, in each case reflecting a WACC supplied by the Commission. Both earned an economic profit. Accordingly, the costs and revenues of all these services are included in the model.

Cost of Telephone Book Listing

116. As part of its TSO obligations Telecom is required to supply a single standard listing of each Telecom residential customer's local telephone number in the telephone book, also known as the White Pages.[44]

117. The Commission considers that Telecom's listing of CNVCs in its White Pages is not a net cost to Telecom. If the costs of listing extra customers in the White Pages outweighed the benefits then it could be expected that Telecom would charge other suppliers for listing their customers in the White Pages.

118. The Commission considers there is a benefit to Telecom in listing the numbers of all CNVCs in its White Pages; otherwise the White Pages would lose its value as a universal PSTN directory. Since the White Pages are a Telecom-branded product, there is a benefit to Telecom to be the sole universal landline directory in New Zealand. This benefit is demonstrated by Telecom not charging either TelstraClear or resellers of access lines to list their customers in the White Pages.

Cost of 111 Emergency Calling Service

119. As part of its TSO obligations, Telecom supplies free genuine 111 calls to emergency service centres when they are dialled by Telecom residential customers.

120. The annualised capital cost of extra equipment needed in an ESA to support the provision of 111 calls is taken into account in the Commission's cost modelling. The incremental costs of providing the 111 service to CNVCs are the non switching-related variable costs of providing the 111 service. The only cost of this nature appears to be the call centre operator's volume related costs for genuine calls. From the figures previously supplied by Telecom to the Commission, the Commission considers that this cost is much less than one dollar per customer per year, and is therefore not material.

[44] The White Pages is now also available online.

NEW ACCESS TECHNOLOGIES, THE TILT, ASYMMETRY, AND THE “NPV = 0” RULE

121. In examining options to deal with the potential asymmetry created by the introduction of new technologies, the Commission in the Revised Draft Determination considered three options:

Option 1: The Commission continues to optimise by introducing new technology caps in the same manner that it did in previous years (i.e. the “Status Quo”);
Option 2a: The Commission ex post compensates for the introduction of new technologies (“Ex Post Compensation”); and
Option 2b: The Commission provides different tilts to new technologies and brings forward the timing of their introduction into the model (i.e. “A Change in the Timing of New Technology”).

122. The Commission rejected Option 1 in its Revised Draft Determination. It considered that there was uncertainty over whether or not the risks associated with asset stranding had been fully taken into account in the depreciation profiles. The Commission stated that:[45]

> 49. Although the Commission believes some asset stranding risks caused by new technologies have been included in the original tilt supplied by Telecom, the Commission is unclear about the extent to which these tilts capture the impact of alternative new technologies. The Commission’s preliminary view is that a TSO modelling approach employing the original tilts and introducing new technologies, may not fully provide an ESP with a reasonable return on its incremental capital.

123. Therefore, the 2004/2005 Revised Draft Determination considered that either “Option 2a: Ex Post Compensation” or “Option 2b: Changing the Tilt and Timing” should be implemented.[46] A summary of the two options and the Commission’s assessment regarding the relative merits of the two schemes are described below.

Option 2a: Ex Post Compensation

124. The Revised Draft Determination noted that if the asymmetry created by new technologies had not been accounted for, then one way of ensuring that a TSP achieved an NPV = 0, was through some form of ex post compensation via an annual lump sum payment. The level of compensation would then need to be set equal to the value of any asset stranding resulting from the new technology.

125. The Commission noted that the possibility of ex post compensation in response to stranding from new technologies was contemplated in its original final Determination in 2001/2002 where it stated that:

> 334. In particular, reviewing the depreciation parameters on an annual basis effectively exposes the TSP to the risk of asset stranding only over the forthcoming year, that is, until the next review date. The risk of asset stranding in later years can be reduced by using new information (as time passes) to correctly identify in advance when this risk has increased and to accelerate the depreciation profile accordingly.
>
> 335. Similarly, the depreciation profile can be slowed down in the event that asset stranding becomes less likely. In this case, where the tilt has in effect been over-estimated for the current period, the TSP would have received a “windfall gain”, although this could be corrected in respect of following periods through a reduction in the tilt.[47]
>
> ....

[45] ibid, p 27.
[46] ibid, pp 24-7.
[47] ibid, p 78.

> 352. The risks of asset stranding are best modelled in the cash flows. The Commission will take into account uncertainty with respect to the cost and timing of the introduction of new technology. Errors in estimating this uncertainty will be reduced by the Commission periodically reviewing its depreciation profile based on revised estimates of the expected economic life of the asset. On this basis, no provision for an increment to WACC appears to be justified.[48]

126. It was observed in the Revised Draft Determination that in economic terms, over the asset life, the outcome from *ex post* compensation for either the introduction of new technologies or that of no introduction of new technologies was identical. On this basis the Commission determined that it would remove the introduction of any further new technology from the optimisation process. It also considered that this would lessen the systematic capital risk, captured by the asset beta term used in the Capital Asset Pricing Model which would affect the WACC. The reduction in the asset beta value was consistent with previous statements made by the Commission about how it should adjust the beta term in light of any ex post compensation to the TSP.[49]

Option 2b: Changing the Tilt and Timing

127. The Revised Draft Determination noted that in order to resolve the asymmetry, Dr Tom Hird of NERA and then Competition Economists Group (CEG), in a report on behalf of Telecom[50] suggested that the Commission could adjust the tilts it applied. NERA's submission noted that in applying the increased tilts to take into account the new technologies, the Commission had to ensure that it also introduced the new technology at the "right time".

128. NERA used a simple stylised example, which is outlined in detail by the Commission in the Revised Draft Determination, Appendix 2, pages 82-96. This showed that the introduction of new technology at a time when its costs were lower than the optimised replacement cost (ORC) associated with the existing network, resulted in the existing supplier and potential entrant being unable to achieve an NPV = 0. To overcome this problem, NERA suggested a method whereby new access technologies should be introduced into the modelling at an earlier time, when the costs of the technologies were equal.

129. Figure 1 illustrates the approach proposed by NERA[51]. It shows that the new technology should be introduced at time t_1, where the cost of the new technology is lower than the replacement cost of the existing network (i.e. by distance EF), and the firm is able to earn only annual capital costs over time equal to BCGI. Such an annual capital cost recovery over time does not provide the firm with an expected NPV = 0 on its original investment.

130. Instead NERA proposed new technologies be introduced at time t_0, where the cost of the new technology and the replacement cost of the existing technology are equal (i.e. the ORC curves intersect at point A in Figure 1) and the firm earns annual capital costs over time equal to BCDGI. This in practice ensures that the asset base of the TSP is not being written down as a result of the new technology being introduced.

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[48] ibid, p 81.

[49] Commerce Commission, *Final Determination for TSO Instrument for Local Residential Service for period between 1 July 2003 and 30 June 2004*, 23 March 2007, p 32, para 103 and 105

[50] NERA (T. Hird and D. Young), "Application of Annuity Depreciation in the Presence of Competing Technologies II", Submission on behalf of Telecom New Zealand, 29 March 2006, and CEG (Dr Tom Hird appearing on behalf of Telecom New Zealand), *TSO Conference Mobile Technology Caps Transcript*, 11 February 2008, pp 52-3.

[51] This is the same diagram that appeared in the Revised Draft Determination on p 27.

This is consistent with the notion of dynamic efficiency as the ESP would earn an NPV = 0 regardless of whatever technology it chose to use.

131. Figure 1 also illustrates that by employing NERA's proposal an ESP could receive potentially large increases (or jumps) in the allowed annual capital cost recovery in the years where new technology was introduced into the model. For example, in Figure 1 at time t_0, the expected annual capital cost recovery increases by the amount CD.

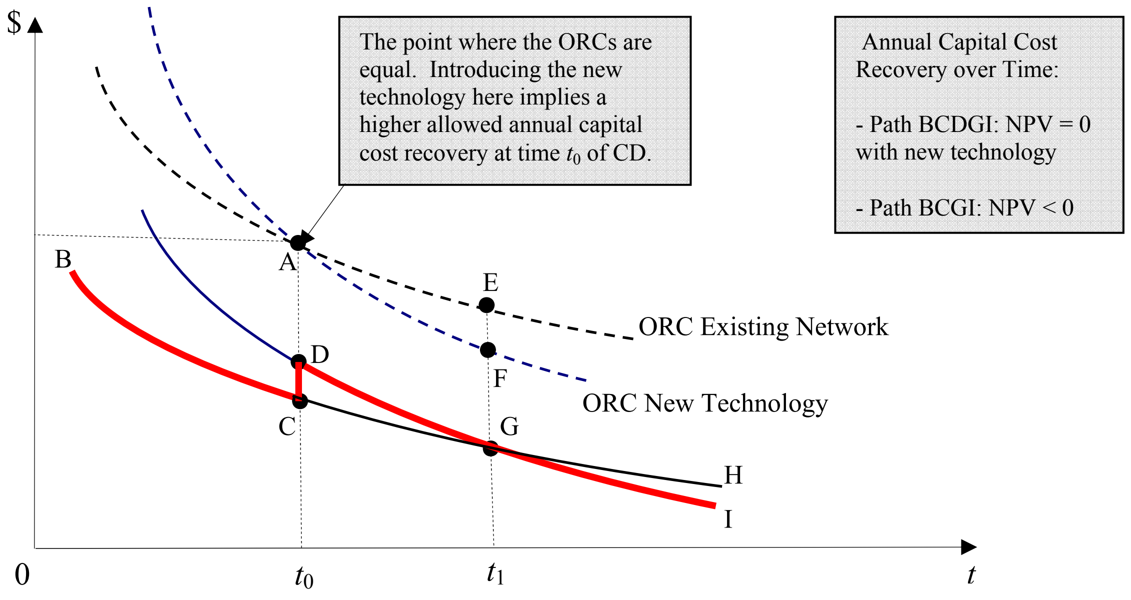

Figure 1: Introducing New Technology at the "Right Time"

<u>Commission's View in Revised Draft Determination</u>

132. The Commission agreed that the approach proposed by Dr Tom Hird of NERA and CEG, would in theory result in an outcome where the investor would earn NPV = 0 on its efficient investment undertaken in the initial period. However, the Commission considered that in practice, such an option would be difficult to implement, as it relied on the Commission being able to assess accurately when the replacement cost curves of new technologies would "cross over". (See Appendix 2). The 2004/2005 Revised Draft Determination stated that:[52]

> The Commission, in examining this option notes that:
>
> - to date when introducing new technologies into the TSO modelling, the Commission has done so at a time when these technologies are no longer considered speculative, and are established in the market as mature technologies. This is often well after the time when the ORC of the new technology is equal to the ORC of the existing technologies…;
> - given that the Commission is likely to be unable to introduce new technologies at the "right" time, under Option 2b, the Commission will effectively be placed in the position of continually having to compensate the TSP ex post…; and
> - while the Commission can extrapolate backwards to determine the point in time when the ORCs should have crossed over, this could occur at a time where the technology did not

[52] Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, p 28.

actually exist. For example, a satellite may not have been in the sky at the time where the ORC curves intersected…

133. Based on the practical difficulties associated with implementing Option 2b, the Commission adopted Option 2a in its Revised Draft Determination. It considered that the NPV = 0 rule, and thus *dynamic efficiency*, could be satisfied by simply halting the Exogenous Optimisation process.

<u>Submissions on Tilts and the Asymmetry in the Revised Draft Determination</u>

Telecom

134. Telecom's submission argued that irrespective of the tilt, the introduction of new access technologies by the Commission to the model would lead to a TSP having an expectation of being NPV < 0 on its initial investment. It stated that:[53]

> 35. …Whatever the tilt used in the fixed tilted annuity the compensation from the tilted annuity has, by definition, an NPV = 0. This means that the TSP investing in efficient fixed technology today can only ever receive compensation of:
>
> 35.1 NPV = 0 (in the event that the Commission switched to the mobile cap "at the right time" or the mobile cap always gave higher compensation than the fixed tilted annuity); or
>
> 35.2 NPV < 0 (in the event that the Commission switched to the mobile cap "too late").
>
> 36. The best that the TSP could hope for was to receive compensation exactly equal to its costs of investing in the efficient technology of the day. In the presence of any positive probability of the mobile cap being introduced "too late" then the TSP would expect to under-recover its efficient costs and would not be willing to make the investment. That is, the TSP's expected compensation would have an NPV < 0.

135. CEG, on behalf of Telecom, related the origin of the asymmetry to the tilts set for TSP, noting that:[54]

> 9. …It is clear that the Commission has reset asset values every year 'as if' those asset values had fallen at the same rate as predicted in the tilt. The effect of this is that:
>
> a. when technological change is slower than expected the TSP recovers exactly its efficiently incurred cost; but
>
> b. when technological change is faster than expected, the TSP recovers less than its efficiently incurred costs.
>
> 10. This creates the asymmetry that ensures that the expectation is that the TSP will under recover its efficiently incurred costs.

136. CEG highlighted that with the introduction of new mobile access technology into the Commission's modelling of the TSP, it would not be NPV = 0:

> 34. …Thus, the TSP investment in efficient fixed technology today can only ever receive compensation of:
>
> - NPV = 0 if optimisation does not occur (because the TSP always receives the fixed annuity which has an NPV = 0); or
> - NPV < 0 if optimisation occurs (because the TSP earns less than the fixed annuity.)

137. In responding to comments made by Covec that the NERA modelling was incorrect, and that an NPV = 0 would still be expected with introduction of new access technologies, CEG considered that Covec's analysis did not appreciate the sunk nature of the investments being contemplated.

[53] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 9.

[54] CEG (Dr Tom Hird), *New Technology in the TSO: Errors in the Covec Report for Vodafone*, A Report for Telecom New Zealand, 30 June 2008, pp 5-6.

> 44. …Covec does not understand the role that sunk (irreversible) investments play in the actual efficient operation of a telecommunications network (or any other business).

138. CEG disputed the claim that Telecom could protect itself against stranding by switching from fixed to mobile technology, and maintained that NERA and the Commission had made errors in modelling compensation, in perfectly contestable markets. It stated that:[55]

> 50…The NERA analysis does not assume no hypothetical fixed line competitor. Rather, the NERA analysis is driven by the existence of a hypothetical fixed line entrant that faces sunk costs if they enter. The Covec conclusion relies not on the existence of a hypothetical fixed line entrant but rather on the existence of a fixed line competitor and a fixed line technology that has zero sunk costs.

139. The CEG report outlined that neither a hypothetical fixed line operator, nor a hypothetical mobile operator would have an expectation of NPV = 0 under the type of regime outlined by Covec. Referring to the same diagram currently used by the Commission in Figure 1, CEG noted that between t_0 and t_1 this path of compensation BCGI would not allow for either a mobile or a fixed entrant to recover its costs. CEG stated that:[56]

> 56. For the fixed operator the path CGI is below their required compensation beyond time t_1. Therefore, they would not invest between t_0 and t_1 because, even though compensation during this period is equal to the fixed annuity, compensation after this period will be below the fixed annuity. For the mobile operator the opposite is true and the path CGI is below the mobile annuity between t_0 and t_1 and equal to it beyond t_1.
>
> 57. This means that no fixed line operator nor mobile operator would invest between t_0 and t_1 if compensation was expected to follow CGI. Clearly, the contestable market compensation must be above CG during the period t_0 to t_1.

140. Both Telecom and CEG also submitted that the asymmetry arising from the introduction of new technologies would still be realised regardless of how the tilts were originally specified, and irrespective of whether or not the tilts took into account the probability of new technologies.[57] Telecom noted that if the probability of new technologies was included in the tilts, this would only change the profile of cash flows that the TSP could earn over time, and would not prevent the asymmetry from arising. Telecom and CEG recognised that a lower tilt would exacerbate the problem created by the asymmetry, as the recovery of costs would have been pushed further out into the future.[58]

141. To demonstrate how the tilt in the tilted annuity formula operated, and the impact that new technologies had on the TSP, Telecom highlighted four separate options — titled Options A, B, C and D — that could be used to ensure an NPV = 0 outcome was maintained.

142. Telecom acknowledged that Options A, C and D were essentially similar to those options previously discussed by Telecom, and raised in the Revised Draft Determination under Options 2a and 2b.[59] Option B, which had not been raised by Telecom before, noted that a composite tilt accounting for all technologies could have been applied to the TSP. The problem with such a tilt is that it would be difficult to

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[55] ibid, p 16.
[56] ibid, p 18.
[57] ibid, p 12.
[58] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 9.
[59] ibid, p 8.

apply in practice, and did not solve the problem of asymmetry created by optimisation. It simply increased the front loading of the cash flows to the TSP.

143. Telecom claimed that Commission's reasoning and discussion of the tilt in the Revised Draft Determination demonstrated a failure to understand the nature of compensation provided by the tilts:

> 39. The assertion that the problems solely arises because of the nature of the tilt used in the past (see paragraphs 31, 49 and 410 of the draft determination) is wrong and shows an ongoing failure to grasp the nature of compensation provided by the tilted annuities in the Commission's model.[60]

144. Although considering the tilts irrelevant to the issue of asymmetry, Telecom still claimed that the tilts it supplied to the Commission for the purposes of establishing the costs of the TSP, did not account for the probability of technological obsolescence or stranding. It considered that suggestions made by the Commission, that stranding risks may have been incorporated, were unfounded and stated that:[61]

> 44. …Telecom has consistently informed the Commission that the price tilts supplied to the Commission were based on past price changes for the equipment in questions, and no allowance for the introduction of new technology was made.
>
> 45. …The point is made explicit in an email to Mike Harre dated 18 June 2003. It was also explicitly discussed with Dr Hamilton, and Dr Hamilton was supplied with the actual contract data on which the prices were calculated.
>
> 46. …If the Commission now has information that leads it to believe this data nevertheless incorporates expected technology change, then the Commission should disclose that information and seek comment on it before advancing the position in paragraph 49.

Liable Persons' Submissions on Tilts and Asymmetry

145. In relation to the tilts, TelstraClear and NSL asserted that:

> …the Commission implicitly assumes that the potential errors in the tilts would always lead to under-recovery of capital costs which is not necessarily the case.[62]

146. Vodafone and Covec submitted that the Commission was wrong to accept Telecom's argument that the tilts did not account for new technologies. Vodafone and Covec considered that if there were errors in the tilt, these were Telecom's errors, and that neither the Commission nor liable persons should be required to pay money to Telecom as consequence of this.[63] Further, both indicated that the historical record highlighted that Telecom was well aware of the way alternative technologies should be reflected in the tilt.

147. In highlighting that alternative technologies had been accounted for, Covec summarised statements made by Telecom and its advisors in the early stages of the TSO process about the tilted annuity:[64]

> PriceWaterhouseCoopers
>
> > "Our view is that the tilted annuity approach is the most appropriate approach to be used in the TSO calculation. Depreciation, in economic terms, can be defined as the change in

[60] ibid, p 9.
[61] ibid, p 10.
[62] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and 2005/2006 Years*, 20 June 2008, p 4 and TelstraClear, *Local Service Telecommunications Service Obligation Revised Draft Determinations for 2004/05 and 2005/06*, 24 June 2008. p 2.
[63] Covec (Dr John Small and Dr Aaron Schiff), *Comments on Telecom's Submission in respect of the Draft Determinations for the 2004/05 and 2005/06 TSOs*, Prepared for Vodafone New Zealand, 30 June 2008.
[64] ibid, p 17.

> value of an asset over a given period. The value of an asset may be influenced by a number of factors including:
>
> - its running costs and changes in running costs over its lifetime;
> - the value of its outputs and changes in value of outputs over its lifetime;
> - its productivity (in terms of the volume of outputs it can generate) and changes in productivity over its lifetime; and
> - the existence or expectation of a challenger asset (i.e. an alternative marque or technology) which threatens to redefine the modern equivalent asset."

Telecom -*Letter to the Commission on TSO Modelling*

> In this letter, Telecom cited the exact same list of factors as in the quote above from PriceWaterhouseCoopers.

148. Covec also examined the submission by NERA, which highlighted the problems associated with asymmetry. It suggested that both the Revised Draft Determination by the Commission and the report by NERA had made incorrect assumptions about how the hypothetical entrant worked in a contestable market setting. In particular, the type of "jump" observed in Figure 2 would not exist in a contestable market. It stated that:[65]

> Annual capital cost recovery for the fixed network in a contestable market will not follow the path BCDGI as NERA and the Commission appears to conclude. The reasons is that in a constable market, a hypothetical entrant always exists for both the fixed and mobile technologies….The Commission mistakenly assume that only a hypothetical mobile operator exists…Thus in a contestable market, realised annual capital cost recovery will follow the lower path BCGI.

149. On this basis the analysis by Covec considered that the while the path of cost recovery *ex post* was NPV < 0, in a contestable market the firm still expected to achieve an NPV equal to zero on its investment. According to Covec:

> The path BCDGI will give the existing network excess returns relative to what it would earn in a contestable market, once we recognise the existence of a hypothetical fixed entrant as well as a hypothetical mobile entrant.

<u>Conclusion</u>

150. The Commission considers that a TSP or new entrant would expect compensation for the risks associated with stranding due to Exogenous Optimisation. Without such compensation, either on an ex ante or ex post basis, the TSP or a new entrant would have an expectation of earning an NPV < 0 on its investment.

151. As the Commission has not taken into account the stranding risks associated with the introduction of new technologies in the original inputs set for the TSP, the TSP is subject to an expectation that its NPV < 0.

152. There are many possible ways that this asymmetry could be resolved. This includes the proposal by Dr Hird involving a complex change to the tilt and timing of the introduction of new technologies into the modelling. The Commission has determined that this approach is too difficult to adopt in practice.

153. In previous determinations, the Commission has indicated that if compensation is required, it should be done on an ex post basis through the cash flows. As ex post compensation for Exogenous Optimisation is in economic terms equivalent to the Commission no longer introducing any new technologies into its modelling, the Commission has discontinued Exogenous Optimisation. This is a simple and direct way of accounting for the asymmetry that would otherwise be created.

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[65] ibid, p 18.

154. The Commission has chosen the approach of no longer introducing new technologies into the TSO optimisation process, thus ensuring that the NPV = 0 outcome and dynamic efficiency will be achieved.

ASSET VALUATION

155. In order to determine the unavoidable net incremental cost of providing TSO services, the Commission must determine the value of the assets used to provide those services. The Commission's choice of asset valuation methodology reflects the interpretation of net cost under Part 3 of the Act.

156. Asset valuation is an important exercise in measuring the net cost of the TSO, as it forms the basis for determining capital-related costs. In an industry characterised by a high level of capital intensity such as telecommunications, both the return of capital (depreciation) and the return on capital are significant cost components.

157. Section 84(1)(b) of the Act states that the calculation of the net cost should take into account the provision of a reasonable return on the incremental capital employed in providing the services to CNVCs.

Choice of Valuation Methodology

158. The Commission considers that it is appropriate to value TSO assets on the basis of replacement cost. The use of replacement cost as an asset valuation methodology is consistent with the matters it is required to consider in determining the net cost of the TSO, and the requirements of the purpose statement set out in section 18.

159. The Commission has adopted a scorched node approach to the optimisation of the network. This involves optimising the network architecture around existing nodes, considering the range of best-in-use technologies that were available to the ESP in 2001.[66]

160. In terms of the assets themselves, the Commission has taken the position that within a forward-looking network, a modern equivalent asset (MEA) is the equivalent item of equipment that would be used if an outdated asset in the network were to be replaced with the same technology given current best practice.

161. Given the adoption of tilted annuity depreciation methodology discussed below, the Commission has valued TSO assets on the basis of optimised replacement cost (ORC).

Depreciation

162. The rate of depreciation determines the rate at which the costs of an investment are recovered over time. For example, if the TSP invests $10M in copper cable to provide services to TSO customers, the rate of depreciation determines the rate at which the $10M investment is recovered by the TSP. The rate of depreciation therefore determines the *rate of return of capital*.

163. The Commission must determine:

- the depreciation methodology; and
- the parameters necessary to implement that methodology (such as the asset lives).

<u>Determining the depreciation methodology</u>

164. In determining the depreciation methodology and the depreciation parameters (such as asset lives), the primary concern of the Commission is to select a methodology which

[66] Nodes, in this context, are the generally the points in Telecom's network where a switch or RLU was located at 20 December 2001

enables the TSP to recover the cost of its investment in providing the TSO, but no more than that amount.

165. The TSP's investments in infrastructure to provide the TSO are mostly long-lived and irreversible. In order to allow the TSP to recover the cost of prudent investment, the TSP must have the expectation of recovering the costs of such investment over the period in which the assets can be usefully used to generate revenues. This requires that the present value of expected net cash flows achieved from the infrastructure (i.e. revenues net of operating and other non-capital costs) must be sufficient for the TSP to recover the up-front cost of the investment. This has been referred to in this determination as the NPV = 0 rule.

166. The Commission has adopted a tilted annuity depreciation methodology. Under the tilted annuity approach, the capital costs are adjusted over time in line with the rate of increase or decrease of the Optimised Replacement Cost (ORC) of the capital equipment. If the replacement cost of the asset were declining over time, the capital costs would be higher early in the life of the asset and decline at the rate of decline of the replacement cost. The opposite would be the case if the replacement cost of the asset were rising over time.

167. The use of a tilted annuity also smoothes any 'jumps' that might occur when depreciation of a new asset commences at the end of the life of a previous asset.

<u>Determining the parameters of a tilted annuity</u>

168. In its first TSO determination in 2001/2002, the Commission examined the parameters of a tilted annuity, to determine:

- the lives of the capital equipment; and
- the rate of change of the replacement cost of the capital equipment.

Lives of capital equipment

169. Estimating the expected economic life of the asset is involves a degree of subjectivity. Although the engineering life can be used as a starting point, the difficulty is in determining how much the asset life should be shortened to avoid any expected stranding of assets that would otherwise occur as a result of technological change or changes in demand.

170. The Commission has used information provided by Telecom and TelstraClear to assess the most reasonable values for asset lives.

<u>Use of tilted annuities in the TSO</u>

171. An important component in determining the net cost of the TSO are the costs associated with the employment of capital. These capital costs include an appropriate return on capital employed (reflecting the opportunity cost of that capital), and a return of capital over time (depreciation).

172. In assessing the net cost of the TSO, the Commission has used a tilted annuity. An annuity is a mechanism for generating a series or profile of annual capital payments which combine a *return on capital* and a *return of capital* over time. The annuity can be tilted in order to allow recovery of invested capital in the face of changing real asset prices. For example, where asset prices are declining, the annuity profile can be "front-loaded" such that a higher proportion of capital is recovered earlier in the life of the asset.

173. Under a tilted annuity, the annual capital cost is given by:[67]

Equation 1: Annualised Capital Costs

$$V(1+\alpha)^{t-1}\frac{(r-\alpha)}{\left(1-\left(\frac{1+\alpha}{1+r}\right)^{N}\right)}$$

where V = the initial cost of the asset
$V(1+\alpha)^{t-1}$ = the ORC of the asset at time t
A = the nominal rate of change of the ORC of the asset
N = the economic life of the asset
r = the rate of return on capital
t = a particular year in the life of the asset

174. A tilted annuity adjusts the capital costs over time in line with the nominal rate of change in the ORC of the asset. An example of the stream of capital costs generated by a tilted annuity is given in Table 2 below where it is assumed that the rate of change in asset prices (α) is -5% p.a., the weighted average cost of capital (r) is 6.4%, the asset life is 10 years, and the initial capital investment is $100.

Table 2: Tilted Annuity

year	ORC (1)	Total Capital Cost (2)	Depreciated capital (3)	Return on Capital (4)	Return of Capital (5)
1	$100.00	$16.81		$6.40	$10.41
2	$95.00	$15.97	$89.59	$5.73	$10.24
3	$90.25	$15.17	$79.35	$5.08	$10.10
4	$85.74	$14.42	$69.25	$4.43	$9.98
5	$81.45	$13.69	$59.27	$3.79	$9.90
6	$77.38	$13.01	$49.37	$3.16	$9.85
7	$73.51	$12.36	$39.52	$2.53	$9.83
8	$69.83	$11.74	$29.69	$1.90	$9.84
9	$66.34	$11.15	$19.84	$1.27	$9.88
10	$63.02	$10.60	$9.96	$0.64	$9.96
NPV		$100.0			

175. In the context of the TSO, the initial $100 investment represents the capital employed in an efficient network designed to supply the TSO services. For example, in terms of the Commission's modelling of an efficient service provider, this would be the capital base associated with the scorched node network, with modern equivalent assets installed. The ORC is allowed to decline at the assumed rate of -5% p.a., as shown in column (1) of Table 2.

176. The total capital cost (column (2)) each year is calculated using the tilted annuity formula. The net present value of this stream of annual capital costs equals the initial investment. In other words, the TSP is expected to recover fully the costs of its initial investment in supplying the TSO services.

177. The total capital cost given in Table 2 can be broken down into the return on capital (column (4)) and the return of capital (column (5)).

[67] The tilted annuity used in the TSO model includes an additional term which reflects a "time to build" factor.

178. In summary, the above simple example considers an efficient initial investment of \$100 in supplying TSO services, and shows the annual capital costs that need to be funded in order for the TSP to be able to recover its initial investment.

Optimisation and Use of Tilted Annuities in the TSO Context

179. The original TSO model has been developed in a number of ways, including the introduction of a radio cap. The cap can result in copper based or MAR technologies being swapped into and out of the model, thus modelling the effect of clusters of customers being serviced with technology which at that time was more cost effective. MAR has been a feature of the Commission's models since the 2001/2002 Final Determination. It was a technology occasionally used by Telecom to deliver its PSTN services.

180. The operation of the radio cap can be characterised simply as follows. The initial TSO investment (V) is based on fixed technology. The TSO model designs an efficient network by taking certain network nodes and 'scorching'[68] the existing access network given the location of those nodes. This produces an initial asset base of \$100.[69]

181. Where it is cost effective to do so the TSO model effectively replaces the fixed line network technology with radio-based technology.[70] The model's mechanism for selecting the lowest cost technology is based on a comparison of the respective NPVs of the two technologies extended ad infinitum, then selecting the lesser of the two NPVs. The annualised capital cost reported from the tilted annuity is used in calculating the capital related yearly cost.

182. By testing the technology mix each year, the TSO model is in effect undertaking a degree of annual re-optimisation. This leads to a situation where some of the assets used to deliver the TSO services may be stranded as a result of the introduction of new technology.

183. Prior to the 2004/2005 TSO the Commission was exogenously introducing technology into the optimisation. As noted, the Commission will no longer introduce technologies not already actively deployed, so that in future the network topology and technology mix will be relatively stable. MAR has been retained as a capping technology due to it being an active part of the Commission's model over each of the previous determinations.

Competing Technology (Radio Cap) Optimisation Decision Rule

184. NERA submitted that the decision rule programmed into the TSO optimisation may be able to be improved. Specifically, NERA submitted that in selecting the lowest cost technology, the model should not compare annualised costs, but should instead compare the present value of future costs.

[68] Scorching is described at para 313.

[69] If instead the costs of the TSP's actual embedded network were modelled, this might have resulted in the initial V being \$150. Therefore, the concept of an 'efficient service provider' (as per the Act's definition of the net cost of the TSO) results in an efficiency adjustment of \$50 in the initial modelling. The effieicny adjustment reflects a desire of the regulator to avoid any "gold plating" of the asset base or what is otherwise known as capital waste. R. Sherman, *The Regulation of Monopoly*, Cambridge University Press, Cambridge, 1989, p 211, describes gold plating by the utlity as "the most serious departure from economic efficiency".

[70] Again this is a simplification. In reality, the radio cap only leads to new radio based technology (MAR) being introduced in certain areas (rather than wholesale replacement of the entire network).

185. In the 2003/2004 final determination, the Commission concluded that "the NERA proposal for identifying the lowest cost technology in the TSO model may represent a more robust approach in principle and is worthy of further study".[71]

186. The Commission's view is that the change identified by NERA provided a more robust principled approach to the calculation of the TSO cost. The Commission agrees with NERA over the principles raised concerning problems with the introduction of new technology into the modelling process.

187. The Commission has changed its modelling approach to reflect NERA's proposal of identifying the least cost technologies for the TSO period. On the basis that the Commission is continuing with the Endogenous Optimisation process, the principle of selecting technology based on the present value of future costs, has been implemented for the existing technologies of a copper based PSTN and MAR. The changes are detailed in "Appendix 1: TSO Model Inputs, Updates and Changes".

188. As the Commission is no longer engaging in Exogenous Optimisation,[72] the Commission has not had to consider how to implement the NERA proposal more generally.

189. In the final TSO determination for 2003/2004 the Radio Cap was characterised by a fixed cost per line. There were potentially three of these Radio Cap technologies. They were MT, WLL and MAR. Only MAR costs have had an impact on the 2003/2004 Determination. Two of these technologies, MT and WLL, are no longer applicable Radio Cap technologies as neither has been effective in the modelling process for 2003/2004.

190. The TSO program tests each non-viable cluster. Those with a per line cost that is greater than the radio cap threshold are capped i.e. costed as having service provided by MAR the cap technology. Conversely if the per line cost is not greater that the MAR radio cap threshold then the radio cap is not applied. An annualised cost was used for both the threshold test and the cost per customer.

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[71] Commerce Commission, *Final Determination for TSO Instrument for Local Residential Service for period between 1 July 2003 and 30 June 2004*, 27 March 2007, para 228.

[72] Refer to "Defining the net cost of the TSO" and "New access technologies, the tilt, asymmetry, and the "NPV = 0" rule"

TSO COST OF CAPITAL

Introduction

191. Section 84(1)(b) of the Act requires that the calculation of the TSO net cost allow the TSP a reasonable return on the incremental capital employed in providing the TSO services to CNVCs. The reasonable return is the opportunity cost of the funds invested in the network and non-network assets by an efficient service provider. It is the rate of return an investor would expect to achieve by investing in assets with a similar risk profile. If the ESP is not able to earn its cost of capital (i.e. its WACC), its incentives to invest in TSO assets will be undermined.

192. In its previous determinations of the net cost of the TSO, the Commission set out its detailed views on the cost of capital in relation to the TSO. In terms of the current determination of the net cost of the TSO, this section builds upon the position taken in the Commission's previous TSO determinations, and reviews the various components of the cost of capital. Where appropriate, estimates have been updated to reflect the different period under consideration and any relevant information that has emerged since the previous determination.

193. Submissions made in response to the Revised Draft Determination noted that one of the two key issues raised by submitters on the cost of capital was related to the asset beta. (The other key issue raised was related to the ESP principle and has been discussed earlier in this Determination.)[73] In particular, Telecom and the Liable Persons made submissions on whether or not it was appropriate for the Commission, in response to changing its methodology, to adjust the asset beta value downwards from 0.4 to 0.2.

Overview of the Approach

194. Firms are typically funded by a combination of debt and equity. A firm's cost of capital therefore represents the weighted average cost of equity and debt, with the latter net of the corporate tax deduction. The weighted average cost of capital, WACC, is calculated using Equation 2:

Equation 2: Post Corporate Tax WACC

$$WACC = k_e(1-L) + k_d(1-T_c)L$$

where: k_e is the cost of equity capital,
k_d is the cost of debt,
T_c is the corporate tax rate
L is the financial leverage ratio (i.e. debt to total capital).

195. Consistent with its approach in the previous TSO determinations and in other regulatory contexts, the Commission has again adopted this equation to estimate the WACC of the TSO.

Cost of Debt

196. The cost of debt, k_d, measures the cost to the firm of borrowing funds. It represents the interest rate required by investors to hold the firm's debt, given the risks they bear. It can in some cases be observed directly as the yield on debt issued by a company (e.g., a bond issue with a specified return), or the cost of banks' lending to borrowers.

[73] Refer to the "Efficient Service Provider" on p 22.

However, typically it is estimated as the sum of the risk-free rate (R_f) and a premium (p) to reflect marketability and risk of default. Thus, the cost of debt is defined as:

Equation 3: Cost of Debt

$$k_d = R_f + p$$

Cost of Equity

197. The cost of equity is the rate of return required by investors on equity that compensates them for the risk they bear. It represents the opportunity cost of the funds they have invested. In accordance with previous TSO determination and its established practice, the Commission has used the simplified version of the Brennan-Lally capital asset pricing model, CAPM. The simplified Brennan-Lally CAPM is expressed as follows:

Equation 4: Cost of Equity under the Brennan-Lally CAPM

$$k_e = R_f(1 - T_I) + \beta_e MRP$$

where: β_e = equity beta

MRP = market risk premium

T_I = is the average (across equity investors) of their marginal tax rates on ordinary income

198. The definition of the MRP consistent with the simplified Brennan-Lally model is given by Equation 5:

Equation 5: Market Risk Premium

$$MRP = k_m - R_f(1 - T_I)$$

where: k_m = expected rate of return on the market portfolio

199. The Commission uses the simplified Brennan-Lally CAPM to determine the TSO cost of capital for the TSO period.

The Asset Beta

200. Beta measures the sensitivity of an investment's return to the market return. Risk relates to the possibility that returns may deviate from expected returns. The total risk of an asset or business is made up of both systematic and unsystematic risk.

201. Unsystematic risk (or diversifiable risk) is specific to the asset or firm, and may be eliminated by diversification. The risks associated with technology obsolescence, increasing competition, patent approval, antitrust legislation, management styles and geographic location are all examples of diversifiable risks.

202. Systematic risk (on non-diversifiable risk) is market risk, not unique to the firm. Such risk cannot be eliminated by diversification. It is related to, and dependent on, the state of the economy as a whole. The sources of systematic risk include changes in real GDP, inflation, currency movements and the long-term real interest rate.

203. Systematic risk is common to all firms. When the stock market falls (e.g., because of an increase in the world price of oil), all stocks are systematically affected by the same risk, although some to a greater or lesser extent. The beta seeks to capture the exposure of a particular asset to systematic risk by measuring the sensitivity of the asset's returns to market returns.

204. Only systematic risk is relevant in determining a firm's cost of equity within the CAPM framework. Investors are not compensated through the CAPM for diversifiable or unsystematic risk since the assumptions of the model imply that investors only hold a combination of two assets, the market portfolio of risky assets and a risk-free asset, which eliminates diversifiable risk.

205. Equity betas take into account the entity's leverage.[74] Financial risk is the incremental risk (difference between the equity and asset betas) that arises when a firm takes on debt. Other things being equal, an increase in financial leverage will lead to an increase in the equity beta since a higher level of leverage implies a higher volatility of returns to shareholders. In other words, because obligated payments on debt do not vary with the level of revenues, and debt holders have a priority call on cash flows, financial leverage magnifies the systematic risk of the cash flows distributable to equity holders. The asset beta (β_a) measures the sensitivity of a firm's returns relative to market returns when the firm has no debt.

206. The relationship between equity beta and asset beta is given by the following formula:[75]

Equation 6: Calculation of the Equity Beta

$$\beta_e = \beta_a\left[1 + \frac{L}{1-L}\right]$$

where β_a is the asset beta, i.e., the equity beta in the absence of debt.

207. If a firm has no debt (i.e., it is entirely financed by equity and hence $L = 0$) then its asset and equity betas are identical. For otherwise identical investments, a company with more debt in its capital structure will have a higher equity beta and a higher required rate of return on equity than a company with less debt.

208. Previous determinations have used information from a range of sources to assist in determining the appropriate asset beta for investments in the provision of the TSO. This has included:

- consideration of the factors influencing asset betas;
- direct estimation of a firm's asset beta from market data; and
- estimates of asset betas of comparable firms in New Zealand or other countries (including TSO/USO providers in other countries).

209. These various approaches are not considered to be mutually exclusive alternatives, in the sense that any one should be relied upon in isolation from the others. Each of these approaches has advantages and disadvantages, and can best be thought of as determining a range within which the asset beta lies.

The Revised Draft Determination - The ESP, Optimisation, and the Asset Beta

210. In calculating the "net cost" of the TSO, section 84(1)(b) of the Act requires the Commission to take into account the provision of a reasonable return on the

[74] Crighton Seed and Associates, *Weighted Average Cost of Capital for Christchurch International Airport*, June 1999, p 8.

[75] The first formula of this type was developed by Hamada. (See R.S. Hamada, "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks", *Journal of* Finance 27, 1972, pp 435-452.) The specification of the relationship between equity and asset beta shown above assumes that debt is tax neutral and that debt has a zero beta.

incremental capital employed in supplying services to those commercially non-viable customers.

211. To determine the net costs as described in the Act the Commission has used an engineering cost model. This calculates the costs of a hypothetical efficient service provider in each year by replacing certain components of the network and engaging in a process called "optimisation".

212. As noted earlier the optimisation that the Commission has used in its modelling from 2001/2002 to 2003/2004 can be divided into two parts:[76]

- the optimisation resulting from the introduction of exogenous technologies (Exogenous Optimisation); and
- that optimisation performed by the Commission's models given demand and technology constraints (Endogenous Optimisation).

213. The Exogenous Optimisation involves the Commission introducing new technologies into the model that are used to calculate the efficient costs of supplying telecommunications service in each year. For example, over the years there has been the introduction of various radio caps into the cost modelling exercise.

214. The Endogenous Optimisation in contrast considers the location of demand of customers; the estimates of revenue from these customers; and the costs of various telecommunications solutions based on the technologies introduced; to design and cost a virtual network that supplies a certain level of telecommunications service.

215. In the Revised Draft Determination, the Commission opted to no longer introduce new technologies (Exogenous Optimisation) in modelling the efficient costs of the TSO. This led it to conclude that the systematic capital risk associated with the asset had been decreased. Due to the significance of technology risk in telecommunications, the removal of this risk was in the Commission's view likely to have a significant impact on the appropriate beta value used in the cost of capital determination.

216. In previous TSO determinations, where there was both Exogenous and Endogenous Optimisation occurring, the Commission had undertaken extensive analysis, to derive an asset beta of 0.4. This analysis involved a direct estimate of Telecom's beta, use of domestic and overseas comparators, and the assessment of influences and risks relating to the TSO.

217. In the Revised Draft Determination the Commission considered that if it were to discontinue the entire optimisation process, i.e. remove both the Exogenous and Endogenous Optimisation, then the TSP would be likely to be subject to virtually no risk and the revised asset beta value should be 0.

218. Further using the previously derived figure of 0.4 as an upper bound and 0 as a lower bound, the Commission considered that with the removal of Exogenous Optimisation, it was appropriate to apply an asset beta of 0.2 for the TSP. The Commission noted that reduction in the asset beta due to a change in the risk profile was consistent with the Commission's position in the 2003/2004 determination, where it stated that:[77]

[76] Refer paragraph 69.

[77] Commerce Commission, *Final Determination for TSO Instrument for Local Residential Service for period between 1 July 2003 and 30 June 2004*, 23 March 2007, para 105.

…. that an ex-post guarantee, …, is likely to justify a reduction in the asset beta of the TSP. While such a reduction may not be to zero, any positive value would need to be based on the residual risks faced by the TSP.

Telecom's Submissions on the Asset Beta

219. Telecom submitted that the Commission's decision to reduce the asset beta value from 0.4 to 0.2, as a result of removal of Exogenous Optimisation in the 2004/2005 Revised Draft Determination was incorrect, and inconsistent with previous reasoning and decisions made by the Commission.

220. In particular, Telecom submitted that it was inappropriate to decrease the beta as a result of the removal of the introduction of new technologies, and stated that:[78]

68.1 the Commission has repeatedly and clearly enunciated the views that technology change has no impact on systematic risk; and

68.2 consequently, the Commission has clearly stated that technology change has not been included in the Commission's previously estimated 0.4 asset beta.

221. Telecom submitted quoting a number of passages from the Final TSO Determination 2001/2002 that "technology risk" was never accounted for in the systematic capital risk,[79] This was combined with statements by the Commission that recognised technological obsolescence was a type of unsystematic risk that was asset specific.

222. Telecom indicated that in relation to the asset beta value, it also had process concerns[80] about the 2004/2005 Revised Draft Determination. It used the following subheadings to categorise and highlight these concerns which are summarised below:

- *A Reversal of Principle* - According to Telecom, previous statements by the Commission articulated a principle that the TSP's asset beta does not compensate for technology change;
- *Adjusting the Quantum of the Asset Beta* - According to Telecom the nature of the change in the Asset Beta should have been "more fully explained".[81] In addition, Telecom raised the following points:
    - reliance on the ACA asset beta of 0.1 was inappropriate;
    - the TSP model continues to face revaluation and optimisation risk;
    - the Commission needs to establish the proportion of the unexpected technology change that it believes is systematic and current reasoning "falls well short of the appropriate standard of analytical rigour, and consultation, required in this context"[82];
    - the CAPM fails at low beta values; and
    - the low risk comparator used by the Commission is unrealistic in any market;

[78] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 16.
[79] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 16.
[80] ibid pp 18-25.
[81] ibid p 19, para 84.
[82] ibid p 22, para 95.

- *The Final 2003/04 TSO Determination* - According to Telecom the Commission has relied upon this, but it does "not provide a foundation for the Commission to now make significant changes to the role and quantum of the asset beta with only cursory consultation"[83]; and
- *Fair Consultation* - According to Telecom the consultation by the Commission has not been fair and real. "For consultation to be fair and real, the Commission must first put forward a sufficient level of reasoning and evidence such that interested parties know what they are responding to."[84] Telecom claims that the Commission "does not acknowledge, let along explain, the reversal on a key point of principle, and simply selects the middle of an arbitrary range. Telecom point to expert opinions from Professor Guthrie and PwC, which highlights that "to arrive at a robust conclusion the Commission would have to carry out a thorough theoretical and empirical analysis, which is not present in the revised draft."[85]

223. Finally, in Telecom's cross submission in response to Professor Bowman's paper that supported the Commission's position and reasoning that there should be a 0.2 reduction in the asset beta as a result of the removal of new technologies from the optimisation process, Telecom maintained that because previous statements by the Commission suggested that the technology risk was never accounted for in the asset beta provided to the TSP:

> …then the logic in the submissions by Vodafone and Professor Bowman, a TSP asset beta of 0.6 should have been used by the Commission in its previous TSO cost calculations.[86]

Liable Persons' Submissions on the Asset Beta

224. While considering that new technologies should continue to be introduced to meet the efficiency requirements of the Act, Vodafone[87] and TelstraClear[88] indicated that, if the Commission did not engage in Exogenous Optimisation in the future, it was correct for it to make a downward adjustment in the value of the asset beta. TelstraClear stated that "the Commission has appropriately identified how the removal of new technology risks will reduce the TSP's systematic capital risk."[89]

225. The submission by Vodafone considered that there was a clear relationship between risk and the required rate of return on an investment, so when determining the rate of return to allow for an investment, it was important to understand the risk associated with that investment. According to Vodafone:[90]

> 14. The flaw in the reasoning within Telecom's submission, however, is that it fails to recognise the fundamental and very large reduction of risk that the Commission's change in modelling approach involves. The removal of the possibility of optimising the modelled network to

[83] ibid, p 24, para 103.
[84] ibid, p 24, para 107.
[85] ibid, p 24, para 108.
[86] Telecom, *Cross-Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 1 July 2008, p 10.
[87] Vodafone , *Submission on the Local Service TSO Revised Draft Determinations for the 2004/2005 and 2005/2006 Periods*, 24 June 2008; and Vodafone, *Local Service TSO Revised Draft Determinations for 2004/2005 and 2005/2006*, 1 July 2008.
[88] TelstraClear, *Local Service Telecommunications Service Obligation Revised Draft Determinations for 2004/05 and 2005/06*, 24 June 2008.
[89] ibid, para 6.
[90] Vodafone, *Local Service TSO Revised Draft Determinations for 2004/2005 and 2005/2006*, 1 July 2008, para 14.

> account for new technologies clearly reduces the risk an investor would have had *sic* it ever made the hypothetical investment the Commission is modelling.

226. Vodafone contrasted the outcome in normal competitive markets with that in the TSO modelling. It noted that in competitive markets, telecommunications networks may not be able to recover costs either due to new technologies emerging after an investment was made, or demand not materialising due to increased competition, a recession or war. Under the TSO modelling implemented by the Commission in the Revised Draft Determination such risks were largely removed. Vodafone also highlighted the artificial nature of the TSO regime, outlining that any loss in revenue was fully compensated through the TSO, and changes in technology and demand simply led to changes in the level of net cost incurred. It stated that:[91]

> 26. In reality, therefore, even if Telecom had made the notional investment modelled by the Commission, it would have certainty that the costs it incurred in making this investment would be recovered, irrespective of what happens to technology change or demand. In this sense, it has hard to see that Telecom incurs either of the systematic or unsystematic risks that Telecom so carefully explains in its submissions.

227. Based upon the approach adopted in the Revised Draft Determination, Vodafone therefore maintained that as a result of the Commission no longer introducing new technologies, an asset beta of zero was more appropriate to apply to the TSP. It claimed that:[92]

> 27. The network investment modelled by the Commission is, therefore, the perfect investment. It is one that is not subject to any risk. Any private investor would love to make such an investment. It never has the threat of being made obsolete by new technology. And if competition comes along and customers no longer wish to use the network, full returns on the investment are still guaranteed as any reduction in revenue is recovered via the consequent increase in net cost.
>
> …
>
> 29. The reality is that the hypothetical investment modelled by the Commission is unlike any other investment that could occur in a competitive market. It is not subject to any form of market risk and so the returns on the investment don't need to reflect any such risk.
>
> 30. This contrasts greatly with what Telecom is asking the Commission to provide it with. Not only does it want to have the risk of technological change generating new and more efficient technologies removed from the equation so that the efficient cost of providing the TSO can't be optimised (and therefore reduced), it now puts its hand out and asks to be compensated for imaginary risks associated with its hypothetical network. Vodafone struggles to see how any of the risks it claims to exist are relevant in the highly stylised model within which the Commission is operating.

228. On behalf of Vodafone and TelstraClear, Network Strategies Limited (NSL) also argued that with the removal of Exogenous Optimisation, the asset beta may be closer to zero.[93]

> The Commission acknowledges the reduction in risk inherent in its new approach by reducing the asset beta value from 0.4 to 0.2 on the basis that, absent new technologies, systematic capital risk will decline. While this does seem to be consistent with the Commission's view of the nature of the constituents of the asset beta for the TSO business, it is arguable that the asset beta should be reduced closer to zero, since systematic cashflow risk is already negligible and systematic capital risk may have been eliminated under the new approach.

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[91] ibid, p 7.
[92] ibid para 27.
[93] Network Strategies, *Report on TSO Revised Draft Determinations for the 2004/2005 and 2005/2006 periods*, Report for TelstraClear and Vodafone, 20 June 2008, p 10.

229. Covec, on behalf of Vodafone, noted that removing technology change from the model led to a lower-risk situation in respect of these investments than when technological change was possible. It stated that: [94]

> ...while we believe that technology change should not be ignored, if it is then an adjustment for the reduction in risks that the TSP faces is appropriate.

230. Professor Bowman,[95] provided a report on behalf of both TelstraClear and Vodafone, which concluded that the Commission's reduction of 0.2 in the asset beta of the TSO was reasonable taking into account the elimination of systematic capital risk associated with the Exogenous Optimisation process. Professor Bowman stated that:[96]

> 38 The Commission has taken the position that the appropriate asset beta for the TSP will be greater than zero but less than its previous determination of 0.4. It has settled on an estimate of 0.2 for the asset beta, reflecting a halving of the systematic risk of the TSO.
>
> 39 I have not been asked to estimate the appropriate asset beta for the TSO, and I have not conducted a study to that end. However, based on my experience, I believe a reduction of 0.2 in the asset beta of the TSO to reflect the removal of the risk of loss from the introduction of new technology is reasonable.
>
> 40 As the asset beta is reduced, the WACC of the TSO is commensurately reduced, which is appropriate.

231. Vodafone, Covec and NSL all indicated that based upon the current reduction in the asset beta to 0.2, contributors to the TSO must have previously been overcharged. They suggested that the Commission should consider the magnitude of this overcharging in its current determinations. Vodafone claimed that:[97]

> …Network strategies suggests that this past error of the Commission has likely led to Telecom being over-compensated by as much as 30 per cent in previous TSO determinations. Given the Commission has estimated a combined net cost of $155.3 million for its previous TSO determinations for periods prior to 2004/05, a 30 per cent over payment would amount to approximately $46.5 million.

<u>The Commission's view</u>

232. The Commission recognises that its thinking has developed over the course of the TSO determinations. It has however always done its analysis under an umbrella of a consistent set of principles.

Risks Captured by the Asset Beta

233. In all previous TSO determinations there has been extensive discussion by the Commission about the relevant risks captured by the asset beta term used in the capital asset pricing model (CAPM) to calculate the cost of equity capital. The Commission has consistently recognised that while the total risks associated with an asset comprise both systematic and unsystematic risks, the asset beta only compensates investors for those systematic (i.e. non-diversifiable) risks. The Commission has maintained that the risks associated with expected depreciation of the asset can be covered via the cash flows through the tilted annuity formulation.

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[94] Covec (Dr John Small and Dr Aaron Schiff), *Comments on Telecom's Submission in respect of the Draft Determinations for the 2004/05 and 2005/06 TSOs*, Prepared for Vodafone New Zealand, 30 June 2008, p 2, para 2.

[95] Professor R.G. Bowman, *Report on the Appropriate Weighted Average Cost of Capital*, Prepared for TelstraClear and Vodafone NZ, June 2007.

[96] ibid, pp 6-7.

[97] Vodafone, *Submission on the Local Service TSO Revised Draft Determinations for the 2004/2005 and 2005/2006 Periods*, 24 June 2008, para 74.

234. The distinction between unsystematic risk and systematic risk has been acknowledged in all previous determinations and is repeated in this determination in paragraphs 201-204.[98]

235. The Commission has openly acknowledged and consistently maintained that technological obsolescence is an unsystematic risk, as it is specific to the asset.

236. Nevertheless, there will be systematic capital risk associated with new technologies. This point was highlighted in the report by Professor Bowman, who noted that:[99]

> 36 In my opinion, the investment in research and development that might lead to new technology will be related to the state of the economy. Further, decisions on introducing new technology will also be related to the state of the economy.
>
> 37 Therefore, I believe the risk of new technology to the TSP includes a systematic component. Elimination of risk of loss from the introduction of new technology would decrease the appropriate asset beta for the TSP.

237. The Commission has consistently outlined in its analysis the difficulties in estimating the appropriate asset beta for the TSO given the unobservable nature of the entity (the ESP being a hypothetical construct) and the ex post nature of the regime. As the asset beta for a TSP cannot be directly estimated from listed companies, and there are difficulties finding comparable companies, the Commission outlined that the estimate will invariably involve an element of judgement.[100]

Exogenous Optimisation and Technology Change

TSO Final Determination 2001/2002

238. Telecom's submission that the Commission should not have decreased the asset beta term from 0.4 to 0.2 in response to the removal of Exogenous Optimisation, relies on the following passage it quotes from the 2001/2002 Final Determination:[101]

> 226. In summary, the Commission is not satisfied that the systematic component of the risk of asset optimisation and the risk of asset stranding warrant any increment to the TSO beta compared to assets valued with reference to historical cost.[102]

239. Based upon this quote Telecom concludes that,[103]

> It is clear that the asset beta the Commission has used in the TSO decision so far does not include compensation for this …risk.

240. To assess appropriately what the Commission was referring to, in paragraph 226, it is important to examine the context in which the Commission's statement in paragraph 226 of the 2001/2002 Final Determination was made.[104]

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[98] Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, p 45, paras 169-171.

[99] Professor R.G. Bowman, *Report on the Appropriate Weighted Average Cost of Capital*, Prepared for TelstraClear and Vodafone NZ, June 2007, p 6, paras 36 and 37.

[100] For example, see Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2002 and 30 June* 2003, 24 March 2005, p 41 and p 52.

[101] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 16.

[102] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001 and 30 June* 2002, 17 December 2003, p 60.

[103] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 16.

[104] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001 and 30 June* 2002, 17 December 2003, p 60.

241. In setting the asset beta in the TSO Final Determination 2001/2002, the Commission considered that an asset beta of 0.40 was appropriate. To arrive at this determination the Commission used a benchmarking methodology that placed weight on the beta estimates from overseas telecommunications companies and rate-of-return (RoR) regulated USA electric utilities. In particular, the Commission focused upon the ACCC estimate of the asset beta for Telstra's PSTN of 0.5,[105] and Lally's estimate of an asset beta of 0.3 for the USA electricity utilities.[106] On this basis the Commission concluded that:[107]

> The Commission considers that US electricity utilities subject to rate of return regulation are likely to be a good proxy to the TSO beta as they are subject to annual resetting of prices. A number of submissions argued that regulation is not the only important factor, but that an industry effect should also be considered. The Commission accepts that differences in the characteristics of the electricity and telecommunications industries should be reflected in beta.

242. PwC and CRA argued for Telecom that as the Commission used optimised replacement costs to value the TSO assets, whilst RoR-regulated electricity utilities from which the benchmark was taken were based on historical cost regulation, the Commission should provide an increment to its benchmarked asset beta value of 0.4 to reflect this difference. The Commission stated in its decision that:[108]

> …only the systematic component of the risk arising from the revaluation of the TSO's network assets and asset stranding should be taken into account in determining the TSO asset beta under the CAPM framework. In this regard, both PWC and CRA argue that systematic capital risk will be significant (high) when assets are valued using optimised replacement cost.

243. The Commission in making this statement in the TSO Final Determination for 2001/2002 was therefore considering whether or not an additional amount or increment was required over and above its benchmarked beta value of 0.4. It was not, as Telecom appears to have suggested in its submission, assessing whether or not the systematic capital risk associated with Exogenous Optimisation or new technologies was in the asset beta value of 0.4. Further, a precise breakdown of the systematic risks associated with asset beta for the TSP was only explored in greater detail by the Commission in its 2002/2003 Final TSO Determination.

TSO Final Determination 2002/2003

244. In response to criticism by Telecom about the comparators used in the benchmarking procedure employed in the Final Determination 2001/2002, the Commission adopted an alternative approach for estimating the asset beta in the TSO Final Determination 2002/2003. As suggested by CRA, on behalf of Telecom, the Commission decomposed the asset beta of Telecom's PSTN into the systematic cash flow risks and the systematic capital risks.

245. As defined by CRA, the *systematic cash flow risk* comprised the risk of an inadequate return on capital, while the *systematic capital risk* comprised the risk of an inadequate return of capital. The Commission noted that the distinction reflected "two important features of the regulatory framework: the TSO cost sharing mechanism, which

[105] ibid, p 56.
[106] M. Lally, "Revision Frequency and Systematic Risk for Regulated Companies", Working Paper, Victoria University, Wellington, 2002.
[107] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001 and 30 June* 2002, 17 December 2003, p 61, para 233.
[108] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001 and 30 June* 2002, 17 December 2003, p 59, para 219.

mitigates cash flow, but not capital risk, and periodic asset optimisation which "sheets home" capital risk to the TSP."[109]

246. The Commission outlined that the systematic capital risks faced by the TSP represented,

> …the risks of unexpected economic depreciation of the TSO assets over the period, i.e. the risk that actual economic depreciation deviated from expected economic depreciation over the period.

247. The Final Determination for 2002/2003 observed that the systematic capital risk was affected by the optimisation process, and if the asset base was not subject to optimisation, (e.g. such as those associated with new technologies), the TSP would be entitled to a guaranteed return of capital and bear almost no capital risk.[110]

> 176. … the TSP bears capital risk because the asset base is periodically re-optimised by the regulator in an attempt to mimic a competitive market. Accordingly the underlying sources of capital risk include not just demand, technology and cost shocks (which competitive firms face), but also possible errors by the regulator in implementing the optimisation process.
>
> 177. If instead the existing asset based was not subject to optimisation and new capital expenditure was automatically included into the asset base at cost then, given the TSO cost sharing mechanism, the TSP would be entitled to a guaranteed return of capital subject only to the default risk of liable persons and the risk of change in the regulatory framework. In this case, the TSP would bear almost no capital risk.

248. Based upon this analysis, the Commission assessed the PwC estimate for the asset beta of Telecom's fixed line PSTN business, which was estimated at 0.8. It was established that, in the context of Telecom's PSTN's business, the 0.8 reflected both the capital and cash flow risk. As the TSO was considered to have no cash flow risk, in order to compare the TSP and PSTN assets, the Commission isolated the impact of the capital risk associated with the PSTN asset beta. This led to an estimate for a range of TSO asset beta of between 0.3-0.59.

249. The Commission concluded that this outcome was consistent with the Final Determination 2001/2002, and 0.4 therefore represented an appropriate point estimate of the asset beta for the TSO. In reaching this estimate the Commission observed that:[111]

> …the Commission believes that the PWC approach regarding reconciliation of asset betas for different lines of business has merit. However, in practice the difficulty stems from the fact that the TSP is an unobservable entity and therefore it is virtually impossible to quantify the extent to which any estimation errors associated with one methodology differ from any estimation errors associated with another methodology. While different point estimates of the TSO asset beta clearly have different cash flow implications to the various interested parties, the high likelihood of (unobservable) estimation errors suggest than an expectation of a *complete* reconciliation of two different point estimates is unreasonable.

TSO Final Determination 2003/2004

250. In the 2003/2004 determination the Commission considered submissions by NERA, on behalf of Telecom, that the TSO determination should generate annual capital costs that allow for a NPV = 0 on the asset.

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[109] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 1 July 2002 and 30 June 2003*, 24 March 2005, p 46, para 175.

[110] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 1 July 2002 and 30 June* 2003, 24 March 2005, pp 46-7.

[111] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 1 July 2002 and 30 June 2003, 24 March 2005*, 24 March 2005 p 52.

251. NERA indicated that the NPV = 0 outcome could be achieved by the Commission, if it committed to introducing new technologies at a certain time in its modelling and used an adjusted tilted annuity formula. NERA proposed a simpler way for the Commission to ensure the same outcome would be for it to select the least-cost technology today and apply the tilted annuity to that technology in perpetuity. The Commission has subsequently referred to the process of applying a tilted annuity in perpetuity to a least cost technology as the removal of Exogenous Optimisation.[112]

252. The Commission considered that NERA's proposal to halt Exogenous Optimisation was likely to remove much of the uncertainty, and without any downward adjustment to the beta, there was likely to be over-compensation to the TSP. Further, NERA itself acknowledged that its approach could eliminate risk. The Commission stated that:[113]

> 102. …the Commission considers that there would be important implications of the NERA approach for the WACC used in the TSO model. Specifically, such an approach would over-compensate the TSP by pricing in the capital risk twice, once in the form of the asset beta, and again in the form of the cash-flow adjustments.
>
> 103. In its subsequent submission, NERA accept that to the extent that an ex-post approach eliminates all risks faced by the TSP, the appropriate asset beta would be close to zero. However, NERA disputes whether all such risks would be eliminated under such an approach. NERA could not identify any regulatory precedent for such a conclusion (i.e. an asset beta equal to or close to zero), and further notes that firms could still face risks associated with variations in expenditures or future regulators reneging on commitments.
>
> …
>
> 105. The Commission re-iterates its view that an ex-post guarantee, as implicit in NERA's proposal, is likely to justify a reduction in the asset beta of the TSP. While such a reduction may not be to zero, any positive value would need to be based on the residual risks faced by the TSP.

TSO Revised Draft Determination 2004/2005

253. In the 2004/2005 Revised Draft Determination, the Commission discussed the impact that the removal of the Exogenous Optimisation process would have on the systematic capital risk associated with the TSP.[114]

> 43. As systematic technology risk is an important consideration in telecommunications compared to many other industries, it is likely to represent a substantial component of the systematic capital risk faced by the TSP. Therefore, the removal of the introduction of any further new technology in the optimisation process by the Commission means that there should be a corresponding reduction in the asset beta.
>
> …
>
> 58. As a consequence of the removal of the introduction of new technologies in the optimisation process the systematic capital risk associated with the asset has reduced, leading to a subsequent decrease in the asset beta value employed in the TSO modelling.
>
> 59. The Commission notes that this reduction in the asset beta value is consistent with previous statements made by the Commission about how it should adjust the beta in light of any ex post compensation on the TSP.

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[112] Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, pp 46-7.
[113] Commerce Commission, *Final Determination for TSO Instrument for Local Residential Service for period between 1 July 2003 and 30 June 2004,* 23 March 2007, p 32.
[114] Commerce Commission, Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005, 13 May 2008, pp27-8.

254. The Commission outlined that in previous TSO Final Determinations the Commission had engaged in extensive analysis, exploring methodologies to determine appropriate asset beta values for the TSO. It had used not only benchmarked comparators from utility industries, but in response to shortcomings alleged by Telecom with these comparators, more direct estimates which involved using Telecom's PSTN asset beta. The Commission established that on this basis 0.4 represented an appropriate estimate.

255. In assessing the appropriate asset beta value the Commission referenced the methodology used in the Final Determination 2002/2003, which partitioned the relevant risks associated with the asset beta into the systematic cash flow risk and the systematic capital risk. The Commission noted the systematic cash flow risk had been considered negligible and referred to the ACA decision which indicated that 0.1 could be used to capture the relevant cash flow risk. The Commission then assessed the impact of the removal of the Exogenous Optimisation process on the systematic capital risk and the appropriate asset beta value:[115]

> 189. If the Commission were to discontinue the entire optimisation process, i.e. remove both the Exogenous and Endogenous Optimisation, then the TSP would be subject to virtually no cashflow risk, and virtually no capital risk. The revised asset beta value should then arguably lie between a lower bound of 0, where there is no risk associated with the asset, and an upper bound of 0.4, the value previously used in the TSO calculations where optimisation took place.
>
> 190. Based upon there being some residual level of optimisation retained in the calculation, (through the Endogenous Optimisation process), and to balance the possible overestimation with underestimation, the Commission considers that in response to the possibility of new technologies being removed, it is appropriate to apply an asset beta of 0.2 for the TSP.

Other Asset Beta Issues

256. In relation to a number of other claims made by submitting parties on behalf of Telecom in relation to the asset beta, the Commission makes the following observations:

- Telecom appeared to suggest that the Commission acted in reliance on the ACA asset beta of 0.1 for the final figure of 0.2 that it estimated, this is not correct. The ACA asset beta of 0.1 was simply mentioned by the Commission in light of the observation that the cash flow risks associated with TSO schemes was considered negligible due to the funding arrangements. As was stated in the Revised Draft Determination by the Commission:[116]

  > The systematic cash flow risk in the TSO has generally been considered negligible due to the industry funded nature of the scheme. In the 2003/2004 TSO determination the Commission outlined that the ACA in Australia had considered the relevant asset beta for a similar scheme in Australia should be 0.1. **This figure was based on there being some small risk of payment default to contributors to the fund.** (Emphasis added)

- Telecom noted that the Commission had stated in its 2001/2002 Final Determination that "reliable asset beta estimates of 0.2 or less for firms are rarely observed in practice."[117]

[115] Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, p 48.
[116] Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, p 47.
[117] Telecom, *Submission in respect of the Commerce Commission's Revised Draft Determination for the TSO Instrument for Local Residential Telephone Service for the period between 1 July 2004 and 30 June 2005, and the Draft Determination for the 1 July 2005 to 30 June 2006 period*, 13 June 2008, p 22.

The Commission considers that there are difficulties in estimating appropriate beta values for the TSP, given the nature of the TSO asset, which is an unobservable entity that is regulated on an *ex post* basis.

In reality, no business is likely to be subject to the type of *ex post* compensation that exists to ensure NPV = 0 is maintained in each period, so the systematic capital risks sheeted home to the TSP will be minimal. The unique nature of the TSO modelling process has been alluded to by Vodafone, and has been recognised by Telecom's consultant CEG, which state in relation to the outcome under the Commission's new approach that:[118]

> 60 To the extent that Covec is right that the results conflict with 'basic intuition' this is the result of attempting to model as 'hypothetically contestable' a service that is clearly not contestable (i.e., a monopoly service with large up-front sunk assets with long lives). One should not be surprised if one does not derive 'intuitive' competitive results when one attempts to shoehorn a monopoly regulated service into a model of perfect competition/contestability. Nonetheless, this 'counter intuitive' result is required if the present value of expected future compensation is to be sufficient to recover the costs of the most efficient technology in each year.

The Commission notes that changes once the Exogenous Optimisation process is removed from the modelling will be marginal, not substantive. Using current model parameters for tilts and asset unit prices, the variable factors in the model when there is only Endogenous Optimisation will be limited to the following:

- *Changing Traffic Levels* – This is an ex post figure which is based on actual levels of traffic experienced by the TSP over the year. Due to economies of scale in the supply of the service, changes in demand will result in different unit costs for carrying traffic in the core network. Under the Endogenous Optimisation process this will result in instances where the MAR solution will replace the copper-PSTN based solution and vice-versa;
- *Changing Revenue Levels* – This is an ex post figure which is based on actual levels of revenues that accrue over the year. The impact of different revenues, is that different ESA clusters will be profitable which affects the TSO cost, but not the technologies employed; and
- *Changing WACC* – This is a figure that is based on the cost of capital over the year, and reflects a forward-looking measure of capital costs. The parameter will affect the TSO cost and the ESA clusters that are profitable, but it will not affect the technical solutions that are chosen in the modelling.

257. The Commission therefore considers that an asset beta of 0.2, though unusual in practice, is appropriate due to the hypothetical nature of the TSP asset. The asset beta of 0.2 captures the residual risks remaining from the Endogenous Optimisation process.

258. The Commission further notes that Professor Bowman, and Professor Guthrie (LECG) are both experts who have extensive experience dealing with cost of capital regulatory issues. Professor Guthrie suggests that the impact of new technologies,

[118] CEG (Dr Tom Hird), *New Technology in the TSO: Errors in the Covec Report for Vodafone*, A Report for Telecom New Zealand, 30 June 2008, p 19.

such as wireless on systematic capital risks is uncertain, and could lead to a higher or lower asset beta. Professor Bowman who has extensive experience as an expert witness on cost of capital matters in regulatory proceedings, argued that new technologies have a systematic component, and stated that:[119]

> 39 …based on my experience, I believe a reduction of 0.2 in the asset beta of the TSO to reflect the removal of the risk of loss from the introduction of new technology is reasonable.
>
> …
>
> 41 The approach taken by the Commission in considering the implications on asset beta and WACC of the TSP of removing optimisation risk was appropriate for the task and was thorough. I believe its analysis was carefully done, and that the determination with respect to asset beta and WACC were well supported.

259. The Commission therefore considers that the reduction in the asset beta from 0.4 to 0.2 as a result of the removal of Exogenous Optimisation is appropriate.

260. Finally, the Commission rejects the argument made by Vodafone, NSL and Covec that some form of payment should be made to the liable persons on the basis that the current asset beta of 0.2 indicates that the Commission previously overestimated this parameter. Even if the payment was permitted by the Act, which it is not, economic grounds would not warrant such a payment.

261. In each previous Final Determination, regardless of whether or not the new technologies were effective in lowering the cost, the Exogenous Optimisation process was applied, and the systematic capital risk associated with new technologies was present. On this basis it was entirely appropriate in past Determinations for the Commission to have adopted an asset beta of 0.4. It has only been in the 2004/2005 TSO Determination, where these risks have been removed by no longer engaging in Exogenous Optimisation, that it has become appropriate to reduce the asset beta to 0.2.

Conclusion

262. The only difference between this Determination and previous TSO determinations are that the circumstances surrounding the optimisation process used have changed. The Commission has accounted for this in a manner that is consistent with its previous determinations. The difference in outcome in this case is due to a consistent application of well-stated principles to a different set of facts.

Estimation of the Other Model Parameters

Risk-free Rate

263. The risk-free rate is used in calculating both the cost of debt and the cost of equity. The risk-free rate is the interest rate that an investor would require to invest in a risk less asset. The risk-free rate is proxied by the yield to maturity on government bonds.

264. The major issue in determining the risk-free rate is which maturity of government bonds to use. The other issue is the period of averaging of observed returns.

Appropriate maturity

265. The CAPM is a single period model which provides no guidance as to the appropriate maturity of government bonds to use for the risk-free rate. In accordance with its past determinations on the cost of capital, the Commission uses a risk-free rate of a

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[119] Professor R.G. Bowman, *Report on the Appropriate Weighted Average Cost of Capital*, Prepared for TelstraClear and Vodafone NZ, June 2007, pp 6-7.

maturity matching the regulatory period. This approach ensures that firms earn a reasonable return (i.e. their incremental cost of capital), and recover the initial cost of investment, but no more.

266. The one-month arithmetic average of the annualised 12-month government stock rate prior to 1 July 2004 results in a risk-free rate of 6.0%.

Market Risk Premium

267. The MRP measures the additional expected return over and above the risk-free rate required to compensate investors for holding the market portfolio. It therefore represents the premium investors can expect to earn for bearing only systematic (common) risk. As such, the MRP is not a firm-specific parameter, but rather, is common to all assets in the economy.

268. The various approaches that can be used to estimate the MRP can be classified into two broad categories: ex post or historical methods; and ex ante methods. There is continuing debate over the appropriate methodology to use to estimate the MRP, and its size. All the different methodologies have advantages and disadvantages, and they all help to inform the estimation of the MRP. The Commission therefore estimates the MRP based on estimates produced by both ex post and ex ante approaches, rather than preferring some approaches over others.

269. The TSO determination for 2002/2003 discussed the issue of the MRP, and in particular, the question of consistency of risk-free interest rate terms within the CAPM. The Commission concluded that, on balance, an assumption that the MRP is invariant across different time horizons is reasonable and practicable.

270. The Commission considers that the appropriate point estimate of the MRP for the TSO period is 7% within a 5.5% to 8.5% range,[120] and uses a point estimate of 7% for this determination.

Leverage

271. Leverage represents the level of gearing or the ratio of debt to total capital, i.e. debt plus equity. Under the simplified Brennan-Lally CAPM, the WACC is not materially affected by small changes to the leverage ratio.

272. In previous TSO determinations, the Commission concluded that an optimal leverage ratio should be used, and is best based on observations of the average leverage amongst relevant firms. Taking account of evidence of Telecom's current and past gearing, gearing of other telecommunication firms and the gearing for regulated telecommunication firms, the Commission adopted a leverage ratio of 30%.

273. A leverage ratio of 30% has been used for this determination.

Debt premium

274. The cost of debt is the promised yield on debt, i.e. the interest rate required by investors to lend funds to or to hold bonds of the firm.[121] The debt premium reflects the marketability of corporate bonds and the risk of default. Investors providing debt to firms are exposed to greater risk of default than when they hold government bonds.

[120] Commerce Commission, *Draft Guidelines, The Commerce Commission's Approach to Estimating the Cost of Capital*, November 2005.

[121] Strictly speaking, in the context of valuation where only expected returns are relevant, the cost of debt should be defined as the expected yield on debt. However, in most cases, the difference between the expected and promised yield on debt is slight and unlikely to be significant. Furthermore, the promised yield or contractual yield is easily observed, whereas the use of the expected yield would involve significant difficulties.

If the TSP's debt level and leverage increase, then the debt premium might also be expected to increase.

275. In the previous TSO determinations, the Commission considered the risk of the TSO business to be lower than that of Telecom as a whole. This is reflected in a lower asset beta for the TSO business, and may lead to a lower debt premium. For the TSP, the Commission concluded that a debt premium (including facilities fees and debt issuance costs) of 1.5% was reasonable.

276. A debt premium of 1.5% has been used for this determination.

Tax Rates

277. There are two tax rates used in the WACC model: the investor tax rate in the simplified version of the Brennan-Lally model, and the corporate tax rate in the cost of debt.

278. The investor tax rate is the marginal ordinary tax rate on investor income, which may include interest, dividends and capital gains. Under the simplified version of the Brennan-Lally model it is assumed that capital gains taxes are zero, firms attach maximum imputation credits to their dividends, and shareholders can fully utilise their credits.

279. In previous TSO determinations, the Commission used an investor tax rate of 33%, consistent with the simple Brennan-Lally model.

280. For the reasons set out in the previous TSO determinations, the Commission considers that an investor tax rate of 33% remains appropriate. In particular, using a version of the Brennan-Lally CAPM model which allows for varying treatment of imputation credits does not appear to have a material impact on WACC.[122]

281. The corporate tax rate of 33% is the tax rate of the TSO business.

282. For the purposes of this determination, the Commission has used a corporate tax rate of 33%.

Bias in Government Bonds

283. The return on government bonds is used to establish the risk-free rate that is an important input to the CAPM model and the WACC use in the TSO calculation.

284. Telecom has submitted that:[123]

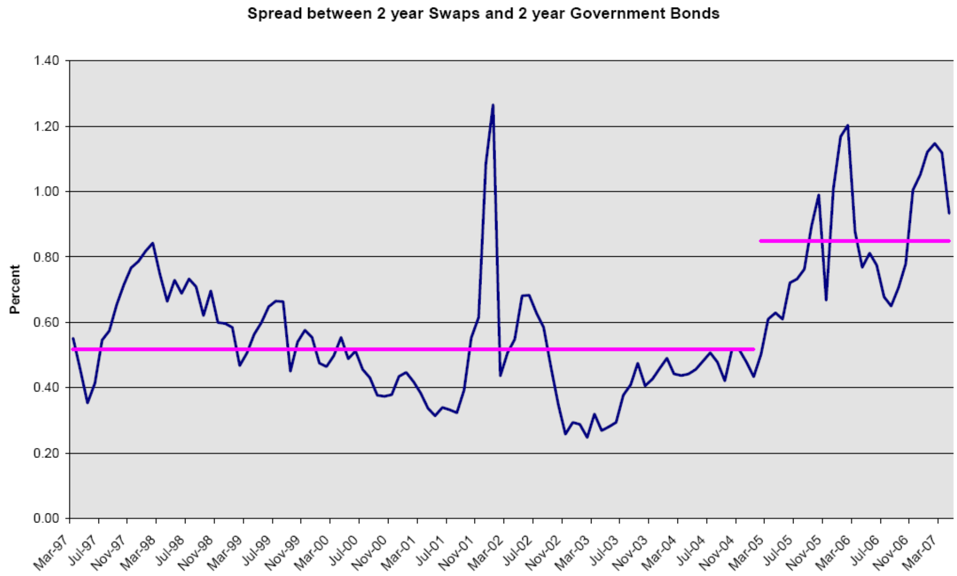
> 57 … an important new issue that relates to recent developments in Government bond markets both in New Zealand and in Australia. In both countries the Reserve Bank has commented that Government bond yields are artificially suppressed by low levels of supply.
>
> Most recently the RBNZ has stated:
>
> *"Despite overall volatility in the swaps market remaining low, swap spreads (the difference between swap rates and bond yields) have widened recently. A large part of this is due to continued offshore interest in NZD assets, including domestic government bonds, which has helped keep bond yields at relatively low levels. Spreads between swap rates and bond yields have widened most at long-dated maturities, with a considerable increase since late February.*
>
> *"While a widening in swap spreads could indicate investors demanding return for taking on a greater level of perceived credit risk, the current wide level in swap spreads appears to be largely due to a continued shortage of supply in the government bond market. Despite the proportion of*

[122] See 2001-02 TSO Determination, para 295-299.

[123] Telecom, *Telecom New Zealand Submission on the TSO 04-05 and 05-06 Draft Determinations,* 6 August 2007, Para 57-59.

all government securities held by non-residents easing from the highs reached late last year, it is still at historically high levels"

58 This increase in the spread between Government bond yields and swap yields is illustrated by the following figure. This shows that the yield on 2 year Government bonds has fallen relative to the 2 year swap rate and is currently at unprecedentedly low levels (relative to the swap rate).



59 This graph illustrates that since the beginning of 2005 the difference between 2 year swap rates and 2 year government bonds has been around 64% higher than the average in the preceding 7 years. It is now well accepted in the finance literature that swap rate is a better proxy for the true risk free rate than the Government bond rate. Professor Grundy and Dr Tom Hird survey this literature in their report for the Energy Networks Association in Australia. One of the articles that they survey is Blanco, Brennan, and Marsh (The Journal of Finance, 2005). Importantly, in the current context the authors note:

"…it is well known that government bonds are no longer an ideal proxy for the unobservable risk free rate"

285. Telecom has also submitted that:[124]

65 In the context of the TSO decision, we believe that the Commerce Commission should explicitly include a provision to retrospectively revisit the calculations based on consideration of this issue by the expert cost of capital panel. Telecom contends that any resulting increase in compensation should be capitalised and recovered in future years.

286. The Commission's view is that it is not empowered to reopen previous TSO calculations and recalculate the TSO net cost on a retrospective basis under Part 3 of the Telecommunications Act 2001.

287. The Commission has reviewed Telecom's submission and believes there is some market evidence to suggest swap rates are used as the basis for pricing the risk-free rate. However, the Commission considers that in respect of the 2004/05 TSO determination there is insufficient long term evidence to support the proposition that the swap rate forms the basis of the risk-free rate used for calculating corporate costs of capital.

288. In particular, the Commission does not believe that the quote from the Blanco, Brennan and Marsh[125] cited by Telecom and NERA,[126] supports the claim by NERA

[124] Telecom, *Telecom New Zealand Submission on the TSO 04-05 and 05-06 Draft Determinations,* 6 August 2007, Para 65.
[125]NERA (B. Grundy and T. Hird), *Bias in Indexed CGS Yields as a Proxy for the CAPM Risk Free Rate*, March, 2007.

that the swap rate is well accepted as a better proxy for the true risk-free rate than the government bond for the purposes of the CAPM. The Commission notes that the Blanco, Brennan and Marsh paper when referring to the government bond rate no longer being an ideal proxy for the risk-free rate makes no reference to the CAPM or any other form of asset pricing model.

289. In determining an appropriate proxy for the risk-free rate, the purpose to which the rate is being used is an important consideration that needs to be taken into account. A risk-free rate implied from a fixed income derivative market, is clearly relevant for derivative pricing purposes, but may not necessarily be relevant for corporate cost of capital purposes. For example, Hull, Predescu and White note that:[127]

> Bond traders tend to regard the Treasury zero curve as the risk free zero curve and measures corporate bond yields as the spread of the corporate bond yield over the yield on a similar government bond. By contrast, derivative traders working for large financial institutions tend to use the swap zero curve…as the risk free zero curve in their pricing models because they consider *swap* rates to correspond closely to their opportunity cost of capital. (The term in italics has been added by the Commission).

290. For the Commission to adopt the swap rate as the basis for its risk-free rate, it would need to be satisfied that there is a long term trend indicating that the swap rate is a better proxy for the risk-free rate than the government bond rate.

291. In the absence of this long term trend and for the reasons outlined above, the Commission considers that the government bond rate remains the appropriate proxy for the risk-free rate.

Overall TSO WACC for 2004/2005

292. In reviewing the TSO WACC for the TSO period, the Commission has considered which of the parameters used in the previous TSO determinations need to be re-estimated. The risk-free rate for the TSO period is 6.0%.

293. Table 3, sets out the parameters of the cost of capital of the TSP business for the TSO periods.

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[126] R. Blanco, S. Brennan and I.W. Marsh, "An Empirical Analysis of the Dynamic Relation between Investment Grade Bonds and Credit Default Swaps", *Journal of Finance* 60, 2005, pp 2255-81.

[127] J. Hull, M. Predescu and A.White, "The Relationship between Credit Default Swaps Spreads, Bond Yields and Credit Rating Announcements", *Journal of Banking and Finance* 28, 2004, pp 2789-811.

Table 3: TSO Cost of Capital Parameters for 2004/2005

	Low	**High**	**Commission's Point Estimate**	**Telecom**[128]
Risk-free Rate	6.0%	6.0%	6.02%	6.4%
Market Risk Premium	5.5%	8.5%	7.0%	7.5%
Equity Beta	0.0	0.571	0.286	1.14
Asset Beta	0.0	0.40	0.2	0.80
Cost of Equity	4.03%	8.89%	6.03%	13.18%
Debt Premium	1.2%	1.8%	1.50%	1.6%
Cost of Debt (pre-tax)	7.22%	7.82%	7.52%	8.00%
Gearing	30%	30%	30%	30%
Corporate Tax Rate	33%	33%	33%	33%
Investor Tax Rate	33%	33%	33%	28%
Post-Tax Nominal Cost of Capital or WACC	**4.27%**	**7.79%**	**5.73%**	**10.8%**

294. The post-tax nominal cost of capital (WACC) for the TSO period is in the range of 4.27% to 7.79%, with a point determination of 5.73%

[128] Telecom's TSO cost calculation for 2004/2005 does not include a specific cost of capital estimate. Instead, Telecom refers to its previous submissions. The figures included in the above table under "Telecom" are based on the PWC submission on behalf of Telecom for 2003/2004 (PWC, 17 September 2004). The one exception is the risk-free rate, which according to Telecom should be based on long-run government bond rates. The PWC submission referred to above estimates the average ten-year government bond rate applicable to the period 2003/2004. The Commission has estimated the corresponding average applicable to 2004/2005 to be 6.4%.

TELECOM'S COST MODELLING

295. For the 2001/2002 TSO period, Telecom used its own cost model to calculate the TSO net cost. The Commission analysed this model and concluded that it had various disadvantages that limited its utility in calculating TSO net costs and, therefore, that the results from Telecom's model were not suitable for use by the Commission in determining the TSO net cost.[129]

296. Accordingly, the Commission undertook its own cost modelling exercise using the CostProNZ and HCPM cost models to determine the TSO net cost. The Commission has continued to use its own cost modelling to assess the TSO net cost.

Requirements for 2004/2005

297. The Commission instructed Telecom to use the Commission's cost models and input data to calculate the TSO net cost for the TSO period.

298. Telecom was instructed to:

- use the Commission's CostProNZ and HCPM models as they were used for the Commission's TSO determination for 2002/2003;
- use the input data for CostProNZ and HCPM models that was used in the Commission's TSO determination for 2002/2003, but:
- update revenue and traffic information to 2004/2005;
- use a WACC of 10.5% for Telecom Mobile;
- use a WACC of 14% for Xtra; and otherwise
- use a WACC of 7.1%.

299. Telecom has complied with the above instructions but submitted that:

- section 83 does not allow the Commission to provide binding directions on the cost of capital and that the Commission may only issue binding requirements in relation to section 84(2) matters; and
- the cost of capital of 7.1% is considered unreasonable and is not appropriate for the TSO period.

300. Telecom has submitted that it does not agree with the use of the same WACC (5.7%) for the TSO local calling service and non-TSO calling services. Telecom is of the view that the WACC for non-TSO calling services should reflect the fact that the market for these services is highly competitive.[130]

301. The Commission appreciates that the products and services of Telecom do not have a homogenous WACC. The difficulty is one of how to disaggregate the various WACCs.

302. In aggregate, the WACC for 'core' TSO services has been assessed as being 5.7%. If services such as access lines and local calls should be accorded a lower beta and the other products a higher beta, then to a large extent the effects would net out.

303. Accordingly, it is the Commission's view that the suggested changes would create extra complexity without improving the modelling of the TSO costs.

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[129] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001 and 30 June 2002*, December 2003, pp 83-97.

[130] Telecom, *Submission on the TSO 04-05 and 05-06 Draft Determinations*, 6 August 2007, p 21, para 68.

Telecom's TSO Net Cost Calculation

304. As required by the Act Telecom provided the Commission with its calculation of the net cost for the TSO period. That calculation was made using the Commission's models, and assumptions specified by the Commission, resulting in a TSO cost of $63 million, excluding an adjustment for the Chatham Islands.

305. Since that calculation was made, the Commission has issued the 2003/2004 determination. That determination incorporated changes to the costing model used by Telecom. The Commission has also instituted a number of changes to the 2004/2005 TSO model. These changes in modelling assumptions have contributed to the result that the Telecom calculation is higher than the Commission's calculation in this determination.

COMMISSION'S COST MODELLING

Modelling Issues

306. The cost of the TSO arises from the possibility that revenues from some residential telephone customers do not cover the economic costs of providing the TSO services. Such customers may be, for example, groups of remote rural customers who are served using expensive infrastructure.

307. To determine the net cost, it is necessary to identify commercially non-viable customers or groups of customers, and to calculate the unavoidable net incremental costs to an efficient service provider of serving these individuals/areas. This requires modelling of the efficient costs and revenues of customers and groups of customers in New Zealand. Some of the principles to be followed in modelling costs and revenues for the TSO net cost calculation were discussed in "Defining the net cost of the TSO" on page 21.

308. Following on from these principles are a number of issues that need to be considered when building a model of a telephone network in order to determine the cost of serving residential customers. Some of these issues are generic issues common to most kinds of network modelling, and others are more specific to the modelling required to calculate the TSO net cost.

309. The model design supports the delivery of the TSO services to all CNVCs in conformity with the service standards in the TSO Deed. Where design decisions are required on elements of those standards beyond matters expressly dealt with in the TSO Deed, the Commission has had regard to the service outcomes experienced by most customers.

Top-down vs. Bottom-up

310. Networks are generally modelled on a top-down or a bottom-up basis. A top-down model typically starts with engineering data and accounting information from a real network and makes various adjustments to the inputs with the intention of estimating the costs to an efficient network operator of providing the relevant service. A bottom-up model, on the other hand, builds a theoretical model of a forward-looking efficient network from the ground up, and uses this to calculate costs.

311. A bottom-up modelling approach (rather than a top-down modelling approach) is most likely to provide a reliable determination of the net cost of the TSO, and is most consistent with the requirements of the Act. Bottom-up modelling:

- more directly estimates the costs of an efficient service provider in delivering the services required under the TSO deed;
- is likely to be better at identifying and estimating the unavoidable net incremental costs of providing the services to groups of customers within a particular area;
- allows for a more transparent modelling process; and
- provides the Commission with more control over the modelling process.[131]

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[131] Commerce Commission, *TSO Position Paper*, 30 September 2002, Section 3.1.

Degree of Optimisation

312. The degree of optimisation refers to how efficient the modelled network design is compared to technology and architecture currently existing in the network. The efficiency of a network depends on the routing of the traffic, the number of exchanges and the type of equipment used. A fully optimised network would probably use a completely new network topology with the most efficient routing, optimal number of exchanges and the latest technology to connect all customers.

313. When a network design is not bound by the location of existing exchanges, the approach is known as scorched earth. However, the modelling approach generally adopted by regulators assumes that the locations of at least some existing exchanges remain and the network is redesigned around them. This is known as the 'scorched node' approach.

314. The Commission considers that some degree of optimisation in its cost modelling is necessary to maintain strong incentives for the TSP to invest efficiently, while also acknowledging that the evolution of an efficient network depends on past decisions. Therefore the Commission has adopted a scorched node approach, optimising the network architecture around existing nodes, considering the range of best-in-use technologies. 'Nodes' are the points in Telecom's network where a switch or a RLU was located at 20 December 2001.

315. The Commission has used a model designed so that:

- equipment in the network between the network termination point (customer's premises) and the first node in Telecom's current network may be optimised, including equipment, technology and layout;
- equipment at nodes can be optimised (e.g. replace a switch with a RLU); and
- some nodes with a small number of lines can be removed.

316. The model largely retains Telecom's network design beyond the nodes, back into the core network. Any optimisation proposed by the parties must be consistent with these assumptions.

Trade-off between Operational Costs and Capital Costs

317. The design of a telephony network, its age and type of equipment affect its operational costs. Cheaper equipment often has higher maintenance costs, so savings in capital costs by using such equipment may be offset by these higher operational costs. Older networks (with a lower value) also tend to have higher operational costs than newer, higher value networks.

318. A network cost model may, therefore, overstate overall costs by combining capital costs using the price of new, good quality equipment and operational costs, such as maintenance, using actual network expenditures from a network with a significant amount of older, lower quality equipment.

319. The Commission has determined operational costs using actual reported operational costs from Telecom and has not attempted to make any allowance for the fact that Telecom's equipment is older than equipment assumed to be used in the modelled network.

Impact of Business Customers

320. Telecom serves business customers in higher cost, rural areas at standard prices even though it is not obliged to do so under the TSO. When modelled, the cost of serving some of these business customers may be higher than the revenue received.

321. For TSO cost modelling, it would not be fair to attribute the various costs of serving unprofitable business customers to the cost of serving residential customers. However, since business and residential customers share the same network, many costs will inevitably be shared between business and residential customers. Such shared costs are difficult to separate.

322. If the TSO did not exist, it is likely that Telecom would continue to serve its business customers. The prices charged to these businesses may rise to make servicing them economic, but this is unlikely to cause those customers to disconnect because the demand from businesses for basic telephone services is generally considered to be highly inelastic. Ideally this means that the TSO cost modelling should recognise the infrastructure put in place (or that an efficient provider would put in place) to serve business customers, and only the incremental cost imposed by adding residential users to this infrastructure should be counted in the net TSO cost. Alternatively, an economic cost allocation scheme would allocate most of the common cost to the inelastic business demand. However, such a modelling approach would be complicated to implement.

323. Trenching is the main cost in the access network, and trenches are shared between lines going to businesses and lines going to residential customers. The trenching costs used in the TSO net cost calculation should be reduced to take account of such sharing, as suggested above. Otherwise, the cost of business customers is treated as incremental to residential customers, which effectively amounts to residential customers subsidising business customers. The Commission notes that Telecom's consultants recognise that the TSO effectively makes it cheaper to serve business customers, because:

> Both TSO and non-TSO customers benefit from the availability of universal access resulting from the TSO deed requirement on Telecom to provide nationwide service for residential users.[132]

324. The Commission has taken a conservative approach to modelling the impact of business customers. To prevent the costs of unprofitable business customers from contributing to the TSO net cost at a cluster level, the model tests whether the average cost of any business lines in each commercially non-viable cluster exceeds the average income per line within the cluster. If average business costs exceed revenues, both the revenues and costs attributable to business lines are removed from the calculation of cluster net cost.

Model Implementation

325. The Commission is aware that network cost modelling exercises are generally resource-intensive and costly. In balancing this consideration against the benefits of a bottom-up model to the Commission's process, the Commission proceeded with a two-stage model implementation:

- CostPro New Zealand (CostProNZ) purpose built model for design and costing of switching and transport components; and

[132] Commerce Commission, *TSO Position Paper*, 30 September 2002, Section 3.1.

- Hybrid Cost Proxy Model (HCPM) a public domain model for optimisation and costing of access network components.

326. The Commission considers that this approach provides a sophisticated model with significant cost benefits, transparency of process and flexibility for upgrade and re-use of model components.

Specific Modelling Approach

327. The specific modelling approach adopted for the TSO period has been driven by, and is consistent with, the Commission's positions on the key modelling options above. This approach involves the choice of architectures and technologies consistent with likely investment decisions of an efficient service provider during the TSO period.

Switching and Transport

328. The switching network model is based on conventional PSTN technology configured into a four-tiered architecture of nodes as follows:

    - remote multiplexer/transmission sites providing MDF, line card and transport services across feeder links to local exchanges;
    - RLUs which provide MDF, line card and traffic concentration services and are hosted by local exchanges;
    - Local Exchanges (LX) providing MDF, line card, traffic concentration, RLU hosting, local switching and CCS #7 signalling; and
    - Tandem and Gateway switches, which provide inter-region and international switching of traffic.

329. In addition, the architecture includes special purpose and service specific nodes including Intelligent Network (IN) and Signalling Transfer Points (STPs).

330. The Commission considers that conventional PSTN switching constitutes the best 'in-use technology' choice consistent with the Commission's modelling approach and the timing of this determination.

331. The transport network architecture is based on Synchronous Digital Hierarchy (SDH) fibre optic rings providing the linking and route diversity between switching network nodes. Some smaller nodes or remote multiplexer/transmission systems are linked to rings by individual 'spur' fibre cables that lack route diversity. Some linking to remote and offshore sites is provided using Digital Microwave Radio (DMR) systems. Access, Distribution and Feeder Radio Technology Cost Cap.

332. The modelling of the wire-line access network is based on a three-tier architecture consisting of:

    - drop cables (copper), which link the customer premises to a Drop Terminal/Cable Terminal (CT). This is normally a short cable run from house to road;
    - distribution cables (copper), which link the CT to either the node MDF or to a Feeder Cabinet; and
    - feeder cables (fibre and copper), which link the Feeder Cabinet to the node.

Radio Caps

333. The Commission has used WLL, GSM, WLL radio caps in the 2003/2004 final determination. In response to considerations relating to the introduction of

technology only MAR is used in this determination. These considerations are discussed in "New access technologies, the tilt, asymmetry, and the "NPV = 0" rule" on page 37 while the MAR parameters are described in "Appendix 2: MAR Radio Cap".

334. As a consequence of the Commission's approach to net cost in this Determination, further development of the radio caps including WLL and MT has not been pursued.

335. As a practical consideration, to ensure that they do not affect the calculation, the previous cap implementations related to the WLL and MT caps have been set to a large nominal value that is sufficiently high to ensure that these caps remain ineffective.

TSO NET COST CALCULATION

Modelling Update

336. The Commission's TSO net cost calculation tool has been updated to version 7.01.04. This update incorporates the changes to input values and methodology described in 'Appendix 1: TSO Model Inputs, Updates and Changes' and 'Appendix 8: Correction to the Tilted Annuity Formula'.

337. In summary, the key updates from the 2003/2004 final determination are:

- choices between competing technologies are based on selecting the proposition with the lowest NPV;
- β, WACC updated;
- update of the tilted annuity formula to ($t = 4$);
- update of MAR;
- effective elimination of the WLL and MT caps; and
- update of revenue and traffic information.

338. The overall operation of the model is consistent with the previous versions.

Model Input Specifications

339. For the purposes of calculating the TSO net cost, the Commission has used the following versions of models and inputs:

- CostProNZ: Version v2.2d and 'HCPM0405v22' scenario; and
- HCPM: 7.01.04 of the Commission's model and 'V7_0 hcpm_current_inputs.xls' providing the input values to many of the HCPM parameters.

340. In addition to the HCPM input spreadsheet, HCPM now integrates incremental per customer capacity costs by ESA and direct ESA costs generated by CostProNZ.

TSO Net Cost

341. The Commission's determination of the annual net cost is based on the Commission's TSO net cost model. This model calculates the TSO net inclusive of the cost for serving the Chatham Islands, for which complete modelling information is not available.

342. The Commission's TSO net cost model, operated according to the input specifications detailed above, at a post-tax WACC of 5.7%, and with 'Distribution Network' optimisation set to '500' calculates the following cost for the TSO period:

Table 4: TSO Net Cost Model Calculation: Annual Period Beginning 1 July for TSO 2004/2005

Annual TSO Net Cost	$ 52.0M
Residential CNVCs	42,930

343. The commercially non-viable customers constitute 3.5% of the 1.210 million residential customer lines modelled.

Chatham Islands Adjustment

344. Cost modelling for the Chatham Islands is detailed in 'Appendix 5: Chatham Island Adjustment'. This modelling identifies the following additional annual costs associated with providing TSO services to the islands:

Factor	Per Annum Cost
Additional Radio Lines	$[ ] CCRI
Earth Station & Space Segment	$[ ] CCRI
Total Adjustment	$696,451

345. This adjustment is provided as a user adjustable input to the Commission's TSO model i.e. it does not have to be added to the models reported loss calculation.

Price Path Adjustments

346. A number of changes have been applied between the 2003/2004 Final Determination dated 23 March 2007 and this Determination, including:[133]

- MAR Radio Cap annuity from $[ ] CCRI to $[ ] CCRI;
- WLL Radio Cap annuity from $[ ] CCRI to $9,999;
- MT Radio Cap annuity from $[ ] CCRI to $9,999; and
- NPVinfinity for the MAR, WLL and MT caps has been calculated as $[ ] CCRI, $99,999 and $99,999 respectively.

347. These changes have been explored via a 'cost path' showing the effect of many of the individual changes between the final 2003/2004 determination and this determination. The 'cost path' could be traversed in a number of ways. The order that has been chosen was selected to illuminate the effect of global changes.

348. The factors below have been progressively introduced into the loss calculation giving an idea of the contribution that each factor makes to the overall TSO loss. These factors are shown on both Table 5 and Figure 2 below.

Table 5: Cost Path Analysis of TSO Cost Including Chatham Adjustment

Incremental Change	TSO Cost Assessment $M
Final Cost Calculation 2003/2004	63.7
+Draft 2004/2005	71.4
+Revised Draft 2004/2005	57.3
+Back out the time to build correction	52.2
+Add the Project PROBE Correction	52.0
=Final Cost 2004/2005	52.0

[133] The costs identified as $9,999 and $99,999 are nominal values ensuring that the WLL and MT caps do not participate in the model.

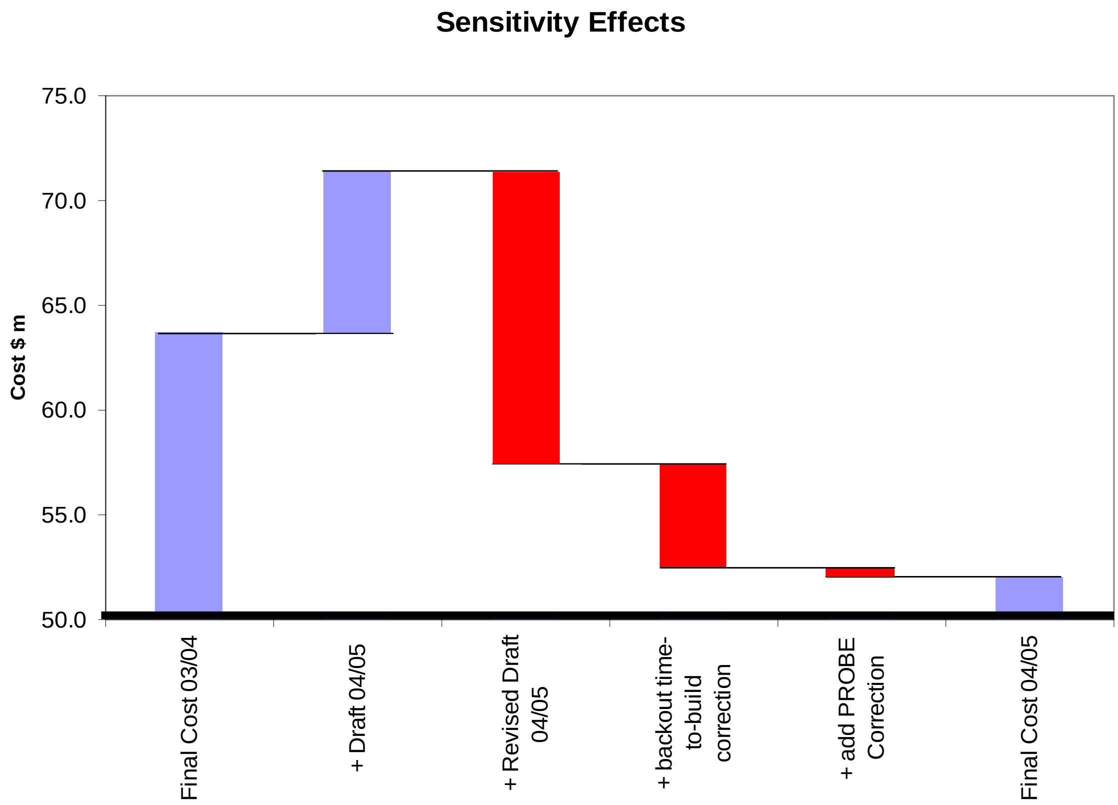

Figure 2: Effect of Progressive Implementation of updates on the TSO Cost

Overall Modelling Outcomes

349. The TSO Net Cost Calculation Tool produces a diagnostic file. This is the 'national.csv' file located in the appropriate directory in 'c:\hcpm\tso\wk_lib'. The file has been analysed to produce contextual information.

350. The following information has been summarised from the file:

- Cluster CNV – this is a count of all the clusters that are CNV;
- Cluster – this is a count of all the clusters;
- Res Access Lines – this is a count of all the Residential Access Lines;
- Res CNVC Access Lines – this is a count of all the Residential CNVC Access Lines; and
- Total CNVC Cost – this is the TSO cost for this period exclusive of the Chatham Islands Cost.

351. The information that has been summarised from the 'national.csv' file has been analysed to produce three overarching metrics. They are:

- the percent of clusters that are CNV;
- the percent of residential access lines that are CNV; and
- the total CNV cost per Residential Access lines.

Table 6: Modelling Outcomes (NZ excl. Chatham Is.)

	2003/2004 Final Determination	2004/2005 Draft Determination	2004/2005 Revised Draft Determination	2004/2005 Final Determination
WACC	6.4%	7.1%	5.7%	5.7%
Cluster Total	3509	3509	3509	3509
Cluster CNV	2,003	1892	1753	1738
% Clusters CNV	57.1%	53.9%	49.9%	49.5%
Res Access Lines	1,210,448	1,210,448	1,210,448	1,210,448
Res CNV Access Lines	60,960	53,215	43,700	42,930
% Res Access Lines CNV	5.0%	4.4%	3.6%	3.5%
Total CNV Cost	$63,082,338.01	$70,667,594	$56,591,418	$51,316,542
Total CNV Lines	60,960	53,215	43,700	42,930
Total CNV Cost/CNV Line	$1,034.82	$1,327.96	$1,295.00	$1,195.35

352. The TSO loss for 2003/2004 was calculated as the total of the annuities where each annualised cost was negative. The approach was changed for 2004/2005 to the sum of the annualised cost where the NPV of the forecast annuities was negative – refer to paragraph 410. The WACC used in the Revised Draft is less than that used in both the previous TSO year and the Draft Determination. This lowered WACC has decreased the overall economic cost of the supporting network. The final determination has removed a time to build adjustment that had been used for the Revised Draft determination. Refer to "Correction to the tilted annuity formula caused by a 6 month offset in the TSO commencement date" on page 97.

TSO Technologies

353. The TSO Cost Calculation Tool used for the 2004/2005 period models the use of two different types of technology. They are: Wired and Multi Access Radio. The ESA cluster take up of this technology is shown on Table 7 below and is compared with previous determinations..

Table 7: Incidence of Technology used by the TSO Model (NZ excl Chatham Is.)

	Profitable				CNV			
Period (WACC)	Wired	Multi Access Radio	WLL	Mobile Technology	Wired	Multi Access Radio	WLL	Mobile Technology
2002/2003 (7.1%)	1430	0	45	na	529	1194	311	na
2003/2004 (6.4%)	1506	0	0	0	1103	900	0	0
2004/2005 (7.1%) draft	1615	2	0	0	1093	799	0	0
2004/2005 (5.7%) revised draft	1755	1	0	0	1016	737	0	0
2004/2005 (5.7%) final	1768	3	0	0	1003	735	0	0

Summary

354. This Determination demonstrates the effect of the introduction of optimisation based on minimising NPV and shifts away from the introduction of exogenous technology with a consequential reduction review of the modelled WACC.

ALLOCATION OF TSO COST TO LIABLE PERSONS

355. The net TSO cost, once calculated, is allocated amongst liable persons and Telecom as the TSP.

The Definition of 'Liable Person'

356. Section 5 of the Act defines a 'liable person' as follows:

> Liable person, in relation to a TSO instrument, means (except when they are the TSP),-
>
> (a) Telecom; and
>
> (b) a person -
>
> (i) whose network is interconnected with a fixed PSTN operated by Telecom; and
> (ii) who provides a telecommunications service in New Zealand to end-users by means of some component of a PSTN that is operated by the person.

357. Telecom is the TSP but also contributes to the net cost of this TSO service.

'A person whose network'

358. The definition of 'liable person' requires a network to be interconnected with a fixed PSTN operated by Telecom. A 'network' means a system comprising telecommunications links to permit telecommunication. It is not a requirement that a liable person must own the network it uses to supply services to end-users. It is sufficient that there is a network which is operated by a liable person and which is interconnected with a fixed PSTN operated by Telecom. The network operator will generally own or lease the network or otherwise have that network under its control.

'Is interconnected with a fixed PSTN operated by Telecom'

359. The term 'interconnection' is not defined under the Act. Accordingly, the term will instead take its meaning from the context in which it is used.

360. TSO instruments are created in order to facilitate the supply of basic telecommunications services to groups of end-users within New Zealand to whom those services may not otherwise be supplied on a commercial basis or at a price that is regarded as affordable. The TSO instrument must define the service, identify the end-users to whom it is to be supplied, define the geographical area within which the service is to be supplied, specify the retail price at, or below which, the service must be supplied , and any service criteria standards.

361. Given this context, the Commission believes that liable persons are required to contribute towards the net cost of providing TSO services because those persons benefit from the network externality arising from the fact that Telecom provides service to commercially non-viable customers at less than economic cost.

362. This suggests that the focus is on carriers with networks that are directly interconnected with Telecom's fixed PSTN and that therefore are able to exchange originating and terminating traffic with Telecom.

363. The Commission accordingly considers that networks are 'interconnected with a fixed PSTN operated by Telecom' when there is a direct linkage between the originating

and terminating networks enabling the direct exchange of interconnect traffic with Telecom's fixed PSTN. Interconnect traffic is directly exchanged between carriers.

364. Customer-facing interfaces, such as ISP modem banks and PABX, do not exchange originating and terminating traffic with Telecom in a manner that requires a formal interconnection agreement with Telecom and therefore are not networks that are 'interconnected with Telecom's fixed PSTN'.

'Who provides a telecommunications services in New Zealand to end-users'

365. The Commission considers that a carrier whose network is interconnected with a fixed PSTN operated by Telecom qualifies as a liable person under the second limb of the definition by providing end-users with a retail telecommunications service or by providing a wholesale service on which the end-user retail service depends.

366. The extension limb of the definition of end-user ('… or of another service whose provision is dependent on that service') is meaningful only on the basis that the first service and the dependent service are supplied by different parties in a chain of supply. If the same person were the supplier of the dependent service and the retail service, the extension limb would be redundant.

367. The Commission has considered the scenario in which carrier Netco owns and operates a network which is directly interconnected with the Telecom PSTN, but has no retail customers, while carrier Servco acquires wholesale services from carrier Netco to provide its retail services. As Netco supplies a service used by Servco to supply its retail services, Netco's network is being used to provide telecommunications services to end-users and Netco is therefore a liable person. Netco is assessed for TSO purposes on its wholesale revenue received from Servco. In contrast, Servco is not a liable person because it is not interconnected with Telecom's fixed PSTN.

'By means of some component of a PSTN that is operated by the person'

368. In Decisions 497[134] and 525[135], the Commission considered the meaning to be given to the words 'by means of'. The context in those Decisions was the interpretation of these words as they appear in Part 2 of Schedule 1 of the Act within the description of "retail services offered by Telecom to end-users 'by means of its fixed telecommunications network' ". The Commission adopts the same interpretation for the purposes of the 'liable persons' definition. Accordingly, 'by means of' is to be understood as requiring a meaningful or not insignificant participation by some component of a PSTN operated by that person in the provision of the service.

369. A defining feature of a 'PSTN' is dial-up capability. Under the Act, a PSTN is 'a dial-up telephone network used, or intended for use, in whole or in part, by the public for the purposes of providing telecommunication between telephone devices'. The Commission therefore considers that a relevant component of a PSTN must provide dial-up capability.

370. Accordingly, the Commission concludes that a liable person for the purposes of this determination is any person, in addition to Telecom:

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[134] Commerce Commission, determination dated 12 May 2003 made under section 27 of the Telecommunications Act 2001 in the matter of TelstraClear's application for determination for "wholesale" designated access services

[135] Commerce Commission, determination dated 14 June 2004 made under section 27 of the Telecommunications Act 2001 in the matter of TelstraClear's application for determination for "residential wholesale" designated access services.

(a) Who owns or operates a telecommunications network that is directly interconnected (as defined above) with Telecom's fixed PSTN; and

(b) Who provides a telecommunications service in New Zealand either as a retail service to end-users or as a wholesale service to another carrier that is used by that carrier to provide another telecommunications service in New Zealand to end-users; and

(c) In either case referred to in (b) above, the telecommunications service is provided by means of some component of a PSTN providing dial-up capability and operated by that person**.**

371. The persons listed below were parties to interconnection agreements with Telecom during all or part of the TSO period. The networks of those persons were therefore directly interconnected with Telecom's fixed PSTN. The Commission is satisfied that each of these companies meets all of the conditions.

372. Those persons are:

- TelstraClear New Zealand Limited;
- Vodafone New Zealand Limited;
- Compass Communications Limited;
- CallPlus Limited;
- WorldxChange Communications Limited;
- TeamTalk Limited; and
- ihug Limited.

373. Although there is a physical connection between Kordia's[136] Extend network and Telecom's fixed PSTN, Kordia was not directly interconnected with Telecom's fixed PSTN during the TSO period nor did Kordia provide a PSTN service to end-users. Accordingly, Kordia is not a liable person for the purposes of this determination.

<u>Vector Communications Limited (Vector)</u>

374. Vector owned a telecommunications network during the TSO period. However, that network was not directly interconnected with Telecom's fixed PSTN. Accordingly, Vector is not a liable person.

<u>Woosh Wireless Limited (Woosh)</u>

375. Woosh owns a telecommunications network and was directly interconnected with Telecom's fixed PSTN during the TSO period. However, Woosh was not using its interconnection to Telecom to provide, directly or indirectly, a telecommunications service to end-users during the TSO period. Woosh is not therefore a liable person for the purposes of this determination.

<u>Internet Service Providers</u>

376. Some network operators provide ISP services in conjunction with voice telephony services. Others however do not provide voice services (except by way of resale) and rely on modem banks for the purposes of terminating data calls which have been provided across a PSTN infrastructure. Though ISPs operate ISP modem banks, they are not considered to be interconnected with Telecom's fixed PSTN.

[136] Kordia was known as Broadcast Communications Limited (BCL).

<u>Vodafone New Zealand Limited (Vodafone)</u>

377. Vodafone submitted that its use of Telecom's PSTN fell about 35% over the period from March 2003 to March 2007, and that its contribution to the TSO cost has risen by in excess of 60% over this period.[137]

378. As per section 70(1) of the Act, the TSO was created to "facilitate the supply of certain telecommunications services to groups of end-users within New Zealand to whom those telecommunications services may not otherwise be supplied on a commercial basis or at a price that is considered by the Minister to be affordable to those groups of end-users".

379. The Commission's view is that the TSO does not recognise any utility that Vodafone may or may not receive from access to Telecom's PSTN. It is more in the nature of a collective social responsibility for the telecommunications industry. Its basis of allocation is defined in the section beginning at paragraph 383.

<u>Liable Persons Summary</u>

380. The liable persons for the purposes of this determination are:

- TelstraClear New Zealand Limited;
- Vodafone New Zealand Limited;
- Compass Communications Limited;
- CallPlus Limited;
- WorldxChange Communications Limited;
- TeamTalk Limited; and
- ihug Limited.

381. The calculation of the amount payable by each liable person in relation to the TSO instrument is in accordance with the formula set out in section 93. In the case of the TSO Deed the formula requires the quantification of the amount of the liable revenue of each liable person; and the liable revenue of the TSP (in this instance, Telecom).

Audit Reports

382. In its liable revenue instructions the Commission required that liable persons provide a report prepared by a qualified auditor that includes a statement of whether or not all the information provided complies with all the Commission's requirements. In order to provide more assurance when liable persons have significant liable revenue and the resources to pay for a more thorough audit, the Commission required Telecom and liable persons that are listed companies to provide a 'long form audit engagement report'. All other liable persons were requested to provide, as a minimum, an 'audit engagement report'.

Liable Revenue

383. In relation to liable persons, section 92(b)(i) requires the final determination to include the amount of revenue that each liable person in relation to the TSO instrument receives during the TSP's financial year from providing telecommunications services either by means of its PSTN or by means that rely primarily on the existence of the TSP's PSTN.

[137] Vodafone, *Submission on 04/05 and 05/06 Draft TSO determinations*, 27 July 2007, p 3, para 14

384. In relation to the TSP section 92(a)(ii) requires the final determination to determine the amount of revenue determined in accordance with any prescribed methods that the TSP receives during the financial year from providing telecommunications services either by means of its PSTN or by means that rely primarily on the existence of the TSP's PSTN.

385. The Act does not define "revenue" in either section 92(b)(i) or section 92(a)(ii).

386. For the reasons set out in the 2002/2003 TSO Determination, the Commission considers that the net revenues interpretation best gives effect to the purpose set out in section 18. It is superior to the retail revenue approach because it minimises the risk of deterring the resale of retail services. The net revenue approach is therefore most likely to promote competition in telecommunications markets for the long-term benefit of end-users within New Zealand. The Commission acknowledges that the net revenue approach may raise the costs of vertically integrated infrastructure providers in comparison to the retail revenue alternative. The Commission has weighed these competing effects, and on balance concludes that the net revenue approach should be adopted.

<u>Deduction of payments to non-liable persons</u>

387. The net revenue approach eliminates liable revenue generated from intra-industry sales, by deducting from gross revenue any amounts payable to other carriers for the provision of services that are telecommunications services. However, this does not necessarily mean that all payments to other carriers for telecommunications services are deductible. Deductibility needs to be considered in the context of the pool of industry revenue that the Commission is attempting to measure. For TSO purposes, the relevant pool of revenue is that generated by liable persons from supplying telecommunications services to anyone who is not a liable person. Only amounts payable to other liable persons for telecommunications services should, therefore, be deductible.

388. In some instances, telecommunications services are purchased from a non-liable person acting as an intermediary between a liable upstream provider and a liable downstream provider. In prior TSO determinations, the Commission allowed deductibility for all payments to non-liable persons for the provision of services that are telecommunications services provided by means of that entity's PSTN or by means that primarily rely on the existence of Telecom's PSTN. On further consideration the Commission has decided that this approach is too broad and that the rule should be more specific. The Commission also understands that the opportunity to use refile type arrangements to reduce costs has largely gone.

389. The Commission has allowed a deduction for amounts payable to non-liable persons for the purchase of telecommunications services when the services are provided by means of another liable person's PSTN or by means that rely primarily on Telecom's PSTN and which means that the non-liable person has purchased the service from a liable person or from Telecom.

<u>Weighted revenues</u>

390. Under section 85(1), the Commission, may use a weighted revenue basis to determine the amount payable by a liable person towards the TSO net cost. Section 85(3) states that a weighted revenue basis involves the following steps:

(a) identifying categories of telecommunications services that are likely to have the same market elasticity of demand;

(b) estimating the market elasticity of demand for each category of telecommunications services by using a recognised econometric method or other recognised estimation method.

391. The Commission considered and rejected the use of a weighted revenue basis, while noting that the issue could be reconsidered in future determinations if sufficiently robust and reliable data became available. The Commission is not aware of any new data on demand elasticities that would allow the Commission to adopt a weighted revenue approach.

Consistency of revenue information

392. To qualify as liable revenue under section 92(b)(i), the revenue must be received by the liable person from providing telecommunications services either by means of its PSTN or by means that rely primarily on the existence of Telecom's PSTN.

393. The Commission considered the meaning to be given to the words 'by means of' in Decisions 497 and 525,[138] and concluded that 'by means of' requires a meaningful or not insignificant participation by some component of a PSTN operated by that person in provision of the service. Liable revenue accordingly includes revenue received by a liable person from providing telecommunications services through a meaningful or not insignificant participation of a component of a PSTN operated by that person in providing the service.

394. Liable revenue also includes revenue received by a liable person from providing telecommunications services by means that rely primarily on the existence of Telecom's PSTN.

Calling card revenue

395. The Commission considers that liable revenue includes calling card revenue from calls which are not switched by a liable person. Such revenue is received by the liable person from providing telecommunications services that rely primarily on the existence of Telecom's PSTN and the fixed network ubiquity arising from the extensive and near universal nature of Telecom's PSTN.

Inbound roaming revenue

396. The Commission considers that revenue from roaming of overseas mobiles on New Zealand mobile networks is liable revenue because it is a telecommunications service provided by means of the New Zealand mobile carriers' PSTN.

Confiscated prepay credits

397. Prepay mobile calling is a telecommunications service that is provided by means of a mobile operator's PSTN. The operator sells this service by selling fixed amounts of prepay credits that have an expiry date, and the value of the credit sold must be counted as liable revenue. The Commission considers that there should not be a deduction on the basis that some of the credit remains unused by the end-user before its expiry date.

Cost of handsets

398. Revenue from the sale of a mobile handset, which is not recovered through mobile access and calling charges, is not liable revenue as it does not satisfy the tests in

[138] Paragraph 84 of Decision 525, Determination on the TelstraClear Application for Determination for 'Residential Wholesale' Designated Access Service.

section 92(b)(i) relating to the provision of telecommunication services by means of a liable person's PSTN or by means that rely primarily on the existence of Telecom's PSTN.

399. The access and calling revenue received by a mobile operator is liable revenue as it is revenue received from providing telecommunication services by means of the operator's PSTN. Whether the operator treats some portion of its access and calling revenue as attributable to the cost of handsets is not relevant and does not alter the nature of the revenue for the purposes of section 92(b)(i). This is consistent with the Commission's net revenue approach which only eliminates revenue generated from intra-industry sales, and does not exclude other costs that are recovered through mobile calling or subscription charges.

TSO Charge Payable by Liable Persons

400. Section 92 of the Act, which is set out in the section entitled "The Framework for the Determination", requires the TSO final determination to include a number of matters. The following table summarises the matters that must be included in the determination as set out in section 92. In particular, this table shows the liable revenue amounts determined by the Commission from the information provided by liable persons and Telecom as at the date of determination, and the resulting allocation of the TSO net cost.

Table 8: Reported Carrier Liable Revenues and TSO Charge for Period 1/7/2004-30/6/2005

2004/2005	Liable Revenue ($)	% of total	TSO Charge ($)	Loss of use of money ($)	TSO charge Payable to Telecom ($)
Telecom	2,660,557,000	68.934%	35,854,787		
Vodafone	944,352,000	24.468%	12,726,485	3,279,605	16,006,090
TelstraClear	235,417,000	6.100%	3,172,579	817,571	3,990,150
WorldxChange	9,207,153	0.239%	124,079	31,975	156,055
Ihug	5,987,633	0.155%	80,692	20,794	101,486
CallPlus	2,595,816	0.067%	34,982	9,015	43,997
Teamtalk	816,085	0.021%	10,998	2,834	13,832
Compass	622,602	0.016%	8,390	2,162	10,553
Total	3,859,555,289	100.00%	52,012,993	4,163,956	20,322,162

TSO COMPLIANCE

401. The Commission is required under section 80 to make an annual assessment of the TSP's compliance with the TSO instrument. Section 80 of the Act provides that:

> Not later than 60 working days after the end of each financial year of a TSP under a TSO instrument, the Commission must—
>
> (a) assess the TSP's compliance with the TSO instrument during that financial year in accordance with any process set out in the TSO instrument; and
>
> (b) notify the TSP and the Minister in writing of any non-compliance by the TSP with the TSO instrument.

402. Clause 21 of the TSO Deed requires Telecom to:

> 21.1.1 report to the Crown and (pursuant to the Act) the Commerce Commission at least annually on its performance against the local residential telephone service quality measures;
>
> 21.1.2 disclose to the Crown and (pursuant to the Act) the Commerce Commission the methodology (including proxy sampling methods), the relevant calculations and reasonable supporting information for the relevant calculations;
>
> 21.1.3 have that methodology and its implementations audited for its appropriateness to achieve a sensible and pragmatic, but robust, analysis of performance against the local residential telephone service quality measures; and
>
> 21.1.4 disclose that audit report to the Crown and (pursuant to the Act) the Commerce Commission.

403. Telecom has provided sufficient information to demonstrate its compliance against TSO service quality measures (the 'Service Quality Measure Report') for the TSO period.

404. The Commission noted that Telecom's measurement methodology involved sampling and approximations. While accepting that compliance had been demonstrated, the Commission continues to reserve its position on the appropriate measurement methodology for future periods.

405. The Commission has notified Telecom and the Minister of Communications that the Commission accepts that the TSO service quality measures were met for the TSO period.

DATED this 10 September 2008

Dr Ross Patterson
Telecommunications Commissioner

APPENDICES

APPENDIX 1: TSO MODEL INPUTS, UPDATES AND CHANGES

Model Architecture

406. The TSO model is an aggregate of models and processes, this is shown on Figure 3: TSO System Drawing.

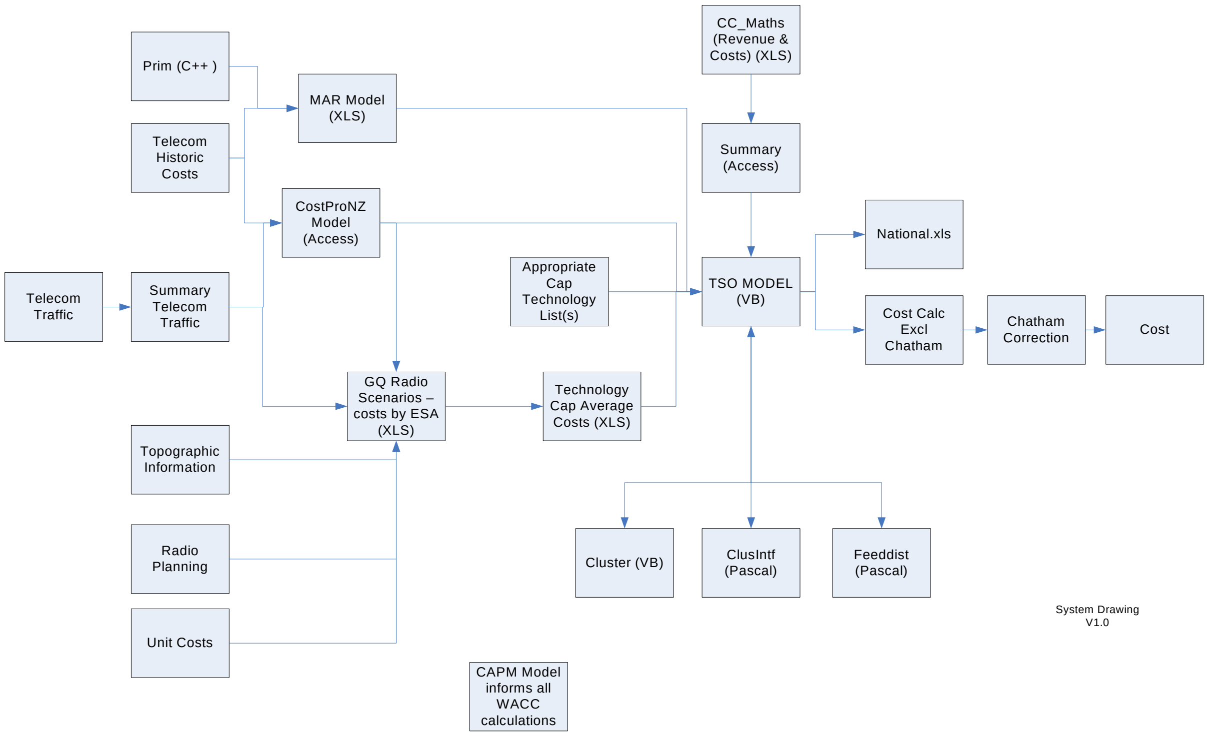

Figure 3: TSO System Drawing

407. Description of the main models:

- CAPM - Capital Asset Pricing Model
- Clusinf – cluster interface – this program was sourced from the FCC -it interfaces between the data requirements of the cluster program and the feeddist program (model source location 'C:\hcpm\model_lib\fcc hcpm code').
- Cluster – this program was sourced from the FCC – it assembles clusters of customers for processing by the HCPM system (model source location 'C:\hcpm\model_lib\fcc hcpm code').
- CostProNZ model – this model uses PSTN unit costs, a network topology to calculate the costs of carrying traffic (model source location 'c:\hcpm\model_lib\Cost_Pro_NZ').
- Feeddist – feeder and distribution design and cost calculation this program was sourced from the FCC (model source location 'C:\hcpm\model_lib\fcc hcpm code').
- MAR Model – Multiple Access Radio – this model takes simple information and produces a tilted annuity cost (model source location 'c:\hcpm\model_lib\MAR_model').

- Prim – this model calculates a Prim distance placing a limit on the distribution cabling cost for the distribution side of the MAR model (model source location 'c:\hcpm\model_lib\prim')
- Technology Cap Average Costs MAR – this model takes various costing scenarios and provides an average cost to be used in the TSO model 'c:\hcpm\model_lib\MAR_model'.
- TSO model – this model is the heart of the system. It calls on PSTN design information and can cap the traditional PSTN design with the radio caps. The model assesses the minimum avoidable cost 'c:\hcpm\model_lib\TSO_optomisation'.

Update of the TSO 2003/2004 program Optimisation Algorithm

408. In the 2003/2004 TSO determination, the Commission considered a submission by NERA that the technology with the lowest replacement costs should be selected, rather than the technology with the lowest annualised cost.

409. A comparison of competing technologies on the basis of their upfront capital costs (ORCs) is valid only if all other features of the two technologies are assumed to be the same, or at least to be reasonably similar. These include the expected lives of the assets, the expected operating costs over the life of the assets, and the expected quantity and quality of service. These conditions were not explored in the examples given in the NERA submission. If these conditions are not met, then a comparison based on ORCs alone will be incomplete and will require an appropriate adjustment to be made. For example, if there is a material difference in operating costs then the comparison should be based on the present value of the sum of the (upfront) capital and ongoing operating costs. If there is a material difference in the economic lives of the assets, then the standard approach is to compare the present values of the technologies assuming they are repeated until a common terminal date is reached. This common terminal date concept is demonstrated on Figure 4.

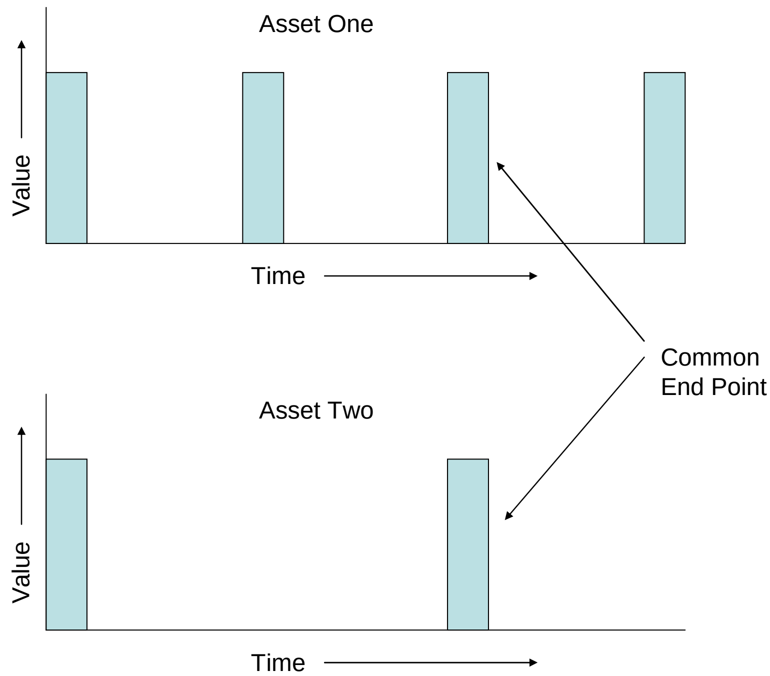

Figure 4: Two Investments with a Common Terminal Date

410. The Commission has modelled telecommunication assets using the parameters in 'Table 36: HCPM Model Technologies Asset Economic Profile Information'. These have been used in the HCPM model, the model that simulates Telecom's access network usage costs.

411. A complicating factor in comparing baskets of technologies e.g. the HCPM or the MAR models is that each technology is in itself composed of technologies. Each of these lower level technologies has its own characteristic life time. In the case of the HCPM model the lifetimes of the technologies are [ ], [ ], [ ], [ ], [ ], [ ], [ ], [ ] and [ ] years. The common end point of this time series is at 7,490,700 years i.e. after this time all the technologies will have their first common period when they are all at the end of their respective life periods.

412. The NPV formula is presented below for a series of investments V_0 with a tilt of α.

Equation 7: NPV Formula Evaluated over a Set Number of Lifetimes

$$NPV = \sum_{t=0}^{life\_times} \frac{V_0 * (1+\alpha)^{t*N}}{(1+r)^{t*N}}$$

Where:

α	=	nominal tilt
life_times	=	number of PV terms to be added, each representing a technology life time of 'N' years
N	=	period of a life time (years)
NPV	=	Net Present Value
V_0	=	year 0 ORC
r	=	WACC (Weighted Average Cost of Capital)
t	=	counter of lifetimes

413. The NPV is a numerical series involving the summation of a number of present value terms. Computationally the calculation of NPV for a large number of terms is inefficient. As the number of terms included in the summation is made arbitrarily large then the NPV summation will asymptote to a final value, referred to as "NPV∞".

414. Recognising the tilted NPV as a geometric series and summing over all the terms from 0 to infinity is mathematically equivalent to:

Equation 8: NPV over an Infinite Number of Lifetimes

$$NPV\infty = \frac{V_0}{1-\left(\frac{1+\alpha}{1+r}\right)^N}$$

Where:

α	=	nominal tilt
N	=	period of a life time (years)
$NPV\infty$	=	Net Present Value of a series extended to infinity
V_0	=	initial ORC
r	=	WACC (Weighted Average Cost of Capital)

415. This is both computationally efficient and is not troubled by the concept of endpoints. It provides a consistent basis to compare the NPV of different technologies.

Abbreviations

416. The use of the following abbreviations is restricted to this section as they have not been noted in the document's list of abbreviations:

dist	Distribution – cabling from a central cabinet to customers
ugd	Plant involving ducts and manholes
bur	Direct buried cable
cop	Copper cable
aer	Aerial cable
struc	Structural costs e.g. digging the hole for place cable underground or erecting the poles to carry aerial cable
term	Terminal
t1	A PSTN transport mechanism whereby multiple PSTN voice circuits are aggregated into a larger multiplexed 'pipe'.

Model Architecture

417. Pictorially the model architecture used in the TSO 2003/2004 determinations may be viewed as Figure 5 below.

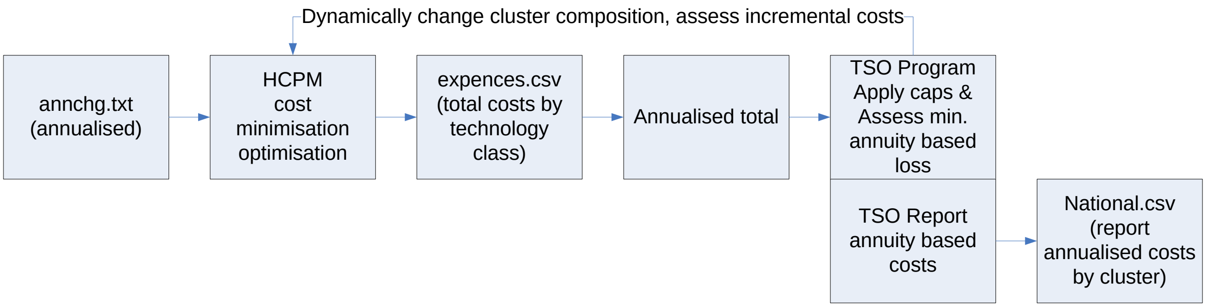

Figure 5: TSO/HCPM model as used in TSO 2003/2004

418. Prior to the TSO 2004/2005 the 'annchg.txt'[139] file was populated with weightings allowing the HCPM model to report in 'expense.csv' and 'exptot.csv' on the annualised expenses. The TSO program would then act to minimise the total annualised cost of the network.

419. The 'annchg.txt' input was updated for TSO 2004/2005 with weightings to cause the HCPM system to report on NPV, the TSO program would then act to minimise the total NPV. Other system inputs such as the HCPM costs, net revenue and the radio cap values were augmented to provide both the annualised and the equivalent NPV∞ cost. The MAR radio cap was updated based on the caps cost drivers including tilt and asset lives, while the other inputs such as the net revenue used were assumed to be constant in nominal terms (i.e. to stay at the same nominal level into the future).

420. The updated architecture is shown below.

[139] A brief description of this file's function and of other similar files is held in 'Table 39: HCPM Default Inputs'.

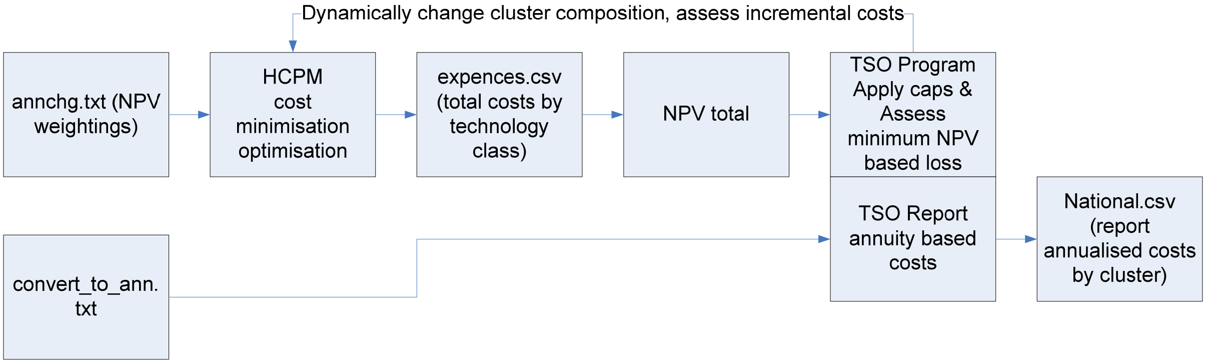

Figure 6: TSO/HCPM model Architecture TSO 2004/2005

421. Internally the update in the TSO Visual Basic (VB) code has been accomplished by making the variables dealing with costs carry two values; one dealing with NPV, and the other its equivalent annualised cost. Any decision made as part of the optimisation would only be informed by NPV, while any calculation of the TSO cost would only be informed by the annualised cost. This has the effect of minimising the NPV but reporting the associated annualised cost.

Annuity, NPV Coefficients & Converting from NPV to Annuity

422. By changing the 'annchg.txt' coefficients the system can be relatively easily converted to reporting NPV∞ costs. The TSO software has been designed to minimise the NPV costs. This has met part of the upgrade requirement but does not allow reporting of the annualised costs. The cost report from the HCPM model is now composed of the NPV costs of 18 different asset classes. Due to different characteristics such as tilt and asset lifetimes it is not possible to reverse engineer the total NPV to report the annualised costs. It is however possible to reverse engineer each of the 27 different NPV cost items in 18 different asset classes to establish their annualised cost. This is developed in Equation 9 to Equation 11 below.

Equation 9: Annualised Cost of Capital Coefficient

$$\left(\frac{1+r}{1+\alpha}\right)^{u}\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^{N}}$$

Where:

α = Nominal rate of change of the optimised replacement cost of the asset
u = time to build in years
r = rate of return on capital
t = particular year in the economic cost of the asset
N = economic life of the asset

423. An asset's ORC is multiplied by a NPV factor such as is given by Equation 10 below, to derive its NPV. This equation is used to populate 'annchg.txt'.

Equation 10: NPV Summed to Infinity Coefficient

$$\frac{1}{1-(\frac{1+\alpha}{1+r})^{N}}$$

Where:

α = Nominal tilt

N	=	The period of a life time (years)
r	=	WACC (Weighted Average Cost of Capital)

424. Given the individual NPV cost for each of the 27 technologies on Table 9 it is possible to reverse engineer the cost quantity and to obtain the corresponding annuity. This is achieved as follows:

Equation 11: Conversion of HCPM NPV Output to an Annuity

$$Annuity_i = NPV\infty_i \times (Annuity\ Coefficent_i / NPV\infty\_Coefficent_i)$$

Where:

i	=	Technology class i
Annuity Coefficient	=	The factor multiplying the original value V (refer to Equation 14)
NPV∞_ Coefficient	=	The factor multiplying the original value V (refer to Equation 10)

425. The individual costs are able to be reverse engineered to establish their annualised costs. The term $(Annuity Coefficient_i / NPV\infty\_Coefficient_i)$ has been calculated and is stored in 'convert_to_ann.txt'. This term is available to convert the NPV totals presented in 'expense.csv' to annualised quantities. These are in turn used by the program to report on the annualised cost of the investment.

426. The program suite has previously had to deal with a single concept that of a tilted annuity. The suite minimised this cost and also reported using this cost. This update meant that the program has to simultaneously manage both NPV concepts and yet retain the equivalent amount representing the annuity.

427. This "bilingual" property has been achieved through the use of a 'type' variable. Where previously any cost information would have involved an annuity it now has two "properties" that of annuity and NPV. The required quantities have been promulgated throughout the program. Where required for optimisation, NPV has been used to make decisions. Where required for costing the TSO the annuity has been used.

428. The program has been updated by using Table 10 and substituting the weightings in 'annchg.txt' from those of Equation 9 to those of Equation 10. The NPV and annuity inputs from the radio cap have been entered directly. The system at this stage will minimise NPV and report on this minimised NPV.

429. This updating of the 'annchg.txt' file has converted the system to optimising by minimising the NPV. At this point and without further modification all the expense reporting would be in terms of NPV. This is not useful for reporting an annualised expense. It is now necessary to change the system allowing it to report on annualized costs.

430. The system comprising the TSO & HCPM programs needs look up tables to calculate the NPV∞ and the corresponding annuity. The HCPM system uses the weightings in 'annchg.txt' to produce NPV∞ which is reported in 'expense.csv'. The TSO program read the NPV information in 'expense.csv' and uses the coefficients in 'convert_to_ann.txt' to produce annuities.

Correction to the tilted annuity formula caused by a 6 month offset in the TSO commencement date

431. The tilted annuity as shown in Equation 9 includes a time parameter. This parameter takes on integer values from $t = 1$ to $t = \mathrm{N}$.

432. The TSO Deed came into effect on 20 December 2001. The annuity commenced from this point but does not align with the financial years by which the TSO cost is calculated.

433. The TSO cost for the 2000/2001 financial year was calculated by taking the full year cost and prorating the portion of the year covered. The adjustment factor was calculated as the number of days in the period 20 December 2001/Number of days in year.

434. Telecom has submitted that in subsequent years the offset in the tilted annuity calculation is causing an incorrect calculation of the TSO loss. Telecom submitted that the impact of the appropriate adjustment would be significant (add approximately $1m) and could be done easily.[140]

435. Telecom in their response to the 2004/2005 draft determination provided an approximation on how the calculation may be performed.

436. Network Strategies in their response to the 2004/2005 draft determination has submitted that the Commission's approach was reasonable, and allows the tilted annuity formula to operate as it was intended for the following determination periods.[141]

437. The Commission had proposed an adjustment to the time-to-build factor in the tilted annuity formula used in the revised draft.[142]

438. NSL has submitted in response to the proposed adjustment that:[143]

> While we do not necessarily agree with Telecom's proposed correction methodology, the Commission has neither implemented either of Telecom's recommendations nor implemented a solution that could be considered correct:
>
> - The Commission has increased the time to build by six months (in many instances, by increasing it to one year from six months). This does not achieve what Telecom has requested. It simply commits the investor's capital six months earlier than the previous version, a solution which varies the base case annuity by a factor dependent on both WACC and tilt. Telecom's solution involves correcting the equipment prices, and uses a factor that only depends on the equipment tilt.
> - Telecom noted that the effect of correcting the 'error' would add less than an additional one million dollars to the TSO cost. The Commission's solution has added $4.9 million.
>
> Network Strategies submits that the Commission has incorrectly committed the capital required to build the modelled network at least six months too early, leading to significant additional costs which are unrelated to any adjustment required to allow for the price tilt issue alleged by Telecom. In addition, the Commission's new approach to optimisation means that there is no technology risk and the tilts in the tilted annuity depreciation are now irrelevant (as there is no need to compensate for the risk of technology obsolescence).

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[140] Telecom, *Submission on the TSO 04-05 and 05-06 Draft Determinations*, 6 August 2007, p 6, para 8.
[141] Network Strategies Limited, *Review of submissions to the 2004/2005 and 2005/2006 TSO Draft Determinations*, 20 August 2007, p 2.
[142] Commerce Commission, *Revised Draft Determination for TSO Instrument for Local Residential Telephone Service for period between 1 July 2004 and 30 June 2005*, 13 May 2008, Appendix 10.
[143] Network Strategies Limited, Report *on TSO Revised Draft Determinations for 2004/2005 and 2005/2006 periods*, 20 June 2008, section 4.2.

> We recommend that the Commission revert to the original time to build settings and review the need for the continued use of tilted annuities.

Commission View

439. The Commission has revised the adjustment to the tilted annuity as is discussed in "Appendix 8: Correction to the Tilted Annuity Formula". This appendix concludes that there are two countering effects: the early commitment of capital and the modelled phasing of payments. These effects correct for one another to the extent that no net adjustment is needed.

Errors in the estimation of the tilt (α) parameter

440. The alpha (α) parameter in Equation 9 models the nominal rate at which the MEA is changing. Some are positive, indicating that the MEA cost is increasing in nominal terms, while the bulk of the plant items have a negative alpha indicating that the cost is decreasing.

441. Ex ante tilts have been used. These tilts were constructed using the best available information. Telecom has observed that while the tilt of copper based cable is negative, indicating an expectation that the cost will decrease, in reality the cost of copper has increased.

442. Telecom has submitted:[144]

> Calculation of tilts inevitably involves errors. The Commission can not be expected to accurately forecast future prices. Neither can the Commission be expected to accurately forecast the impact of new technologies that are still being developed. Even in a market based setting, where financial rewards for accurate predictions are very high, predictions are often inaccurate. Given the inherent uncertainties involved, the Commission is simply not close enough, and does not have the market based incentives, to accurately predict these events. Hence, whatever tilts the Commission settles on now, it will always be faced with the issue sometime in the future – what to do when the tilts have turned out to be wrong.

443. The Commission's view is that the TSP is being funded for the initial capital investment. The copper cost has indicated that the ORC has increased in a way that was not anticipated when the parameters were originally stated. The Commission's view is that there are many interdependent assumptions that constitute the model. If some of these parameters were to be examined then it would be necessary to review the other engineering assumptions such as the use of PSTN technology and possible replacement of copper with fibre. The Commission's position is that it is currently unnecessary to review the engineering and financial assumptions underpinning the TSO's models.

Reporting via 'expense.csv'

444. The HCPM model's main expense information is written to 'expense.csv'. A summary is also written to 'exptot.csv'. File 'exptot.csv' is populated with the total expense of a cluster network. Previously the 'exptot.csv' file was a main output from the HCPM model to the TSO model. The expense quantities output are determined by the nature of the weightings in 'annchg.txt'. If the weightings are annuity based then the output costs are in terms of annuities; if they are NPV based then the output quantities are NPV.

445. Post the modification the 'exptot.csv' file is still produced by the HCPM program. It is a NPV, and is the sum total of 27 cost items. The total is a single figure that cannot

[144] Telecom, *Telecom New Zealand Submission On The Tso 04-05 and 05-06 Draft Determinations,* 6 August 2007, para 19.

be reverse engineered to deduce either the individual ORC or an equivalent annuity. The total could be used in the optimisation but is not able to be used to provide information on annuities. The expense file is however, able to be used. The 'expense.csv' file in this configuration lists 27 HCPM expense items on Table 9, and also identified their asset profiles.

Table 9: HCPM 'expense.csv' Items

ref	HCPM Expense Items	Asset Profile
0	dist ugd cable	ac_ugd_cop
1	dist bur cable	ac_bur_cop
2	dist aer_cable	ac_aer_cop
3	dist ugd structure	ac_ugd_struc
4	dist manhole cost	ac_manhole
5	dist aer structure	ac_aer_struc
6	dist bur structure	ac_bur_struc
7	Fiber terminal cost	ac_fib_term
8	t1 terminal cost	ac_t1_term
9	t1 repeater cost	ac_repeater
10	secondary tterm cost	ac_t1_term
11	interface cost	ac_fdi
12	drop_cost	ac_drop
13	drop terminal cost	ac_drop_term
14	nid_cost	ac_nid
15	per line cost (lines)	ac_nid
16	feed ugd cable	ac_ugd_cop
17	feed bur cable	ac_bur_cop
18	feed aer cable	ac_aer_cop
19	feed ugd fiber	ac_ugd_fib
20	feed bur fiber	ac_bur_fib
21	feed aer fiber	ac_aer_fib
22	feed ugd structure	ac_ugd_struc
23	feed manhole cost	ac_manhole
24	feed_bur_structure	ac_bur_struc
25	feed aer structure	ac_aer_struc
26	feed splice cost	ac_fib_splice

446. Each of the 27 NPV cost items are able to be read from 'expense.csv' and their total is provided as a total NPV. (This is the same total as the 'exptot.csv' file.) Each of the NPV is able to be reverse engineered to form an annuity. The total of these annuities is then calculated and used to inform the TSO models annualised output.

447. The parameters in 'annchg.txt' are derived using Equation 10 plus the asset profile information on Table 10. These parameters are also used when using Equation 11 to populate 'convert_to_ann.txt'. They are directly used when producing the NPV, annuity or the reverse engineered weightings.

Table 10: HCPM Asset Profiles

ref	Asset Profile	Asset life (yr)	Time to Build (yr)	Nominal price tilt (%)
0	ac_ugd_cop	[ ]	0.5	[ ]
1	ac_bur_cop	[ ]	0.5	[ ]
2	ac_aer_cop	[ ]	0.5	[ ]
3	ac_ugd_fib	[ ]	0.5	[ ]
4	ac_bur_fib	[ ]	0.5	[ ]
5	ac_aer_fib	[ ]	0.5	[ ]
6	ac_ugd_struc	[ ]	0.5	[ ]
7	ac_bur_struc	[ ]	0.5	[ ]
8	ac_aer_struc	[ ]	0.5	[ ]
9	ac_manhole	[ ]	0.5	[ ]
10	ac_t1_term	[ ]	0.5	[ ]
11	ac_fib_term	[ ]	0.5	[ ]
12	ac_fdi	[ ]	0.5	[ ]
13	ac_fib_splice	[ ]	0.5	[ ]
14	ac_drop	[ ]	0.5	[ ]
15	ac_drop_term	[ ]	0.5	[ ]
16	ac_nid	[ ]	0.5	[ ]
17	ac_repeater	[ ]	0.5	[ ]

The restricted information in the above table is CCRI.

Net PSTN Revenues

448. The Commission’s modelling approach relies on using net supplementary revenues only if the net total is positive. If the margin is negative (loss making) then the loss is not to be included as a TSO loss.

449. Network Strategies have submitted:

> … average PSTN revenue per line is declining over the periods of the current Draft Determinations. As line rental is fixed or increasing, this decline must be in terms of calling and supplementary services which contribute to TSO revenues.
>
> In the same way that ADSL revenues only contribute if the service is profitable in an ESA, the Commission must now begin to re-test contributing PSTN services in each ESA to ensure that aggressive pricing has not reduced revenues to below the modelled costs. If individual services are found to be unprofitable in an ESA, their costs and revenues must be removed from the TSO net cost calculation.

450. The Commission’s view is that the net revenues for each supplementary service form a basket. This basket is made up of all the national charged calls for that ESA. If per chance a call scenario were to exist which in itself had a revenue less than modelled cost then as long as the total basket of these calls has revenue greater than modelled costs then the total should count as supplementary revenue. The Commission has examined the net costs and the net revenues for the CNVCs and has found that the revenue is in excess of the cost.

Update of the TSO model to use ADSL net revenues

451. The Commission’s models have been updated to include ADSL net revenue as a ‘supplementary’ revenue stream. Supplementary revenues are discussed under “Revenue from Supplementary Services” on page 35.

452. Telecom has provided a model and data to calculate the net revenue by ESA from their ADSL service. The model is based on two sub models: the first models Telecom’s ADSL access network; the second models Telecom’s core network. The

model was presented to the Commission using WACCs of 14% and 8.8% respectively.

453. The Telecom ADSL net revenue model is available in ‘C:\cc_tso_net_cost_tree’.

454. Supplementary revenues net of their associated costs qualify as customer revenues. If the net quantity is positive then this will increase the average per customer revenues in particular ESAs. If the net quantity is negative i.e. loss making then the loss is *not* taken into the TSO.

455. In 2003/2004 there were 553 ESAs with at least 1 CNVC cluster. The 2004/2005 ADSL data indicated that [ ]CCRI of these ESAs had a positive revenue contribution. This contribution is an average of $[ ]CCRI per line per year.

Modelling

456. The modelling is performed by two main program suites. The HCPM suite is a public domain program to design an efficient PSTN access network. The TSO is an optimisation program which investigates the possibility of providing service using a technology that is not available in the HCPM model. The HCPM model then determines clusters of customers that are incrementally non profitable.

<u>HCPM Modelling</u>

457. The HCPM program uses 18 different asset classes refer to Table 10: HCPM Asset Profiles. These range from copper to fibre cables to manholes and duct lines. The unit cost for these technologies is calculated using inputs from: ‘annchg.txt’; and various ORC costs directly entered from various tables.

458. The net cost for any particular solution is calculated by:

$$Cost = \sum_{i=1}^{n} w_i * n_i * ORC_i$$

Where:

$Cost$	=	the cost of the solution (NPV or annuity)
w_i	=	a weighting to convert an ORC based cost to either a NPV or to an annuity
n_i	=	a measure of quantity recording the number of units of a technology that are deployed
ORC_i	=	the Optimised Replacement Cost for a unit of technology i

<u>Net Revenue</u>

Weighting of Quarterly Revenue

459. Network Strategies has submitted on Telecom’s weighting of quarterly revenue:[145]

> We have previously noted that the method for the calculation of annual revenue per line data from the quarterly data has never been explicitly specified, and so we have not in the past been able to comment on this factor.
>
> The calculation, as implemented in the spreadsheet, is as follows (note this excludes the addition of ADSL revenue):

$$arevline = \frac{\sum_i (revline_i \times lines_i)}{\sum_i (lines_i)} * 4$$

[145] Network Strategies Limited, *TSO revenue for 2004/05 and 2005/06: a review of the data*, 19 January 2007, section 4.1.

> where arevline is annual revenue per line, $revline_i$ is revenue per line for quarter i and $lines_i$ is the weighted line count for quarter *i*.
>
> The weighted line count for each quarter is the number of 'line days' (days in which a line was active) divided by the number of days within the quarter. It is effectively a weighted average.
>
> Given Telecom's precision in weighting the line count over the days in which individual lines were active, it would be preferable if the calculation of the annual revenue per line used a level of accuracy that matches that of the source data.
>
> Currently, by dividing the sum of the quarterly line counts by four, the calculation assumes that all quarters have equal number of days. In fact, there are very slight differences:
>
> • March quarter – 90 days, weighting of 90/365 = 0.2466
>
> • June quarter – 91 days, weighting of 91/365 = 0.2493
>
> • September quarter – 92 days, weighting of 92/365 = 0.2521
>
> • December quarter – 92 days, weighting of 92/365 = 0.2521.

460. A large component of the annual revenue is the monthly rental. The monthly revenue is correctly treated using a weighting of ¼. The proposed weightings would be incorrect for rental revenues. If the number of days in each quarter were equal then the weighting would be ¼ or 0.25. The modified weightings suggested are very close to the weightings that are currently used. It is the Commission's view that this development does not materially alter the TSO calculation and as such is unnecessary.

Trends in Weighted Line Counts

461. The TSO model is informed by an estimate of the average revenue per customer and the number of customers. The product of these two quantities provides an estimate of the total revenue in an ESA or a cluster. The customer numbers are held static, they are taken from the geographical distribution of customers as they were in the 20 December 2001 at the time the TSO deed was signed. The average revenue per customer is established as the total revenue reported by customers by ESA per a weighted line count of customers in that ESA in that period.

462. Network Strategies has submitted that:[146]

> Line counts in ESAs do change over time, as new lines are connected or existing lines cancelled. However, we would expect that the residential line count would not be subject to major fluctuations, unless there was some factor such as a boundary change, or completion of a new housing development, which would explain dramatic shifts in the data.
>
> More variability would be expected in business line counts, due to the greater volatility of the business environment.
>
> To assess variation in the line counts, we have examined the coefficient of variation. This statistic has been calculated from the weighted line counts – we did not use moving averages in this instance as we believe that there would be a lower level of seasonal fluctuation than for the revenue data.
>
> Note that in ESAs with very few lines, even small changes in the line count will result in a high variability.
>
> The ESAs with the highest variation tended to exhibit either a step change from Q10 to Q11, similar to that of the residential examples above, or had very few lines, so that the addition or cancellation of just one or two lines had a major impact on the total line count. An exception to this was the ESA [ ]TNZRI, where the line count dropped from [ ]TNZRI in Q6 to [ ]TNZRI in Q7, remaining at around that level through to the end of 2005/2006.

[146] ibid, p 5.

> Net impact on TSO revenue: uncertain – it is possible that some of these large fluctuations in line count may have a significant effect on revenue at the ESA level, however there may be a valid reason for the change. Further information is required to confirm.

463. Telecom has submitted that:[147]

> Trends in the weighted line counts raise other issues. As NSL note, the main change occurs between Q10 and Q11. This is as a result of Telecom changing the way this calculation is made. This was outlined in 'TSO Revenue and Line Data 04/05, Revised Extraction Process – An Explanation (July 2005)'. This is an improvement over the previous method.
>
> NSL also note a very large change in the number of business lines in MID between Q6 and Q7. Telecom has acknowledged in the past that there was a particular issue with this ESA and an adjacent one, SFD. For the period up to Q6, no lines were recorded for SFD and those lines were in MID (and possibly others). In Q7 this error was resolved.

464. The Commission's view is that the average revenue is calculated as follows $\frac{total\_revenue}{weighted\_count\_lines}$. If both the numerator and denominator consist of information from the same population then the resultant average will be constant and characteristic of this population. (By example, if the lines had halved and their reported revenue had halved then the average revenue per line would not have changed.) The Commission's view is that these changes which are a result of dealing with real world data have not materially affected the calculation of the average revenue per customer nor the TSO loss calculation.

Adjustment for bad debts

465. Network Strategies has submitted that Telecom has omitted an adjustment for bad debts:[148]

> The Telecom PROBE total revenue data for Q15, Q17 and Q18 has been adjusted for bad debts. This adjustment comprises a decrease of [ ]TZNRI – calculated from the ratio of [ ]TNZRI in bad debts out of SAP total revenue of [ ]TNZRI – applied to both business and residential total revenue.
>
> This adjustment does not appear to have been applied to other quarters for the years 2004/05 and 2005/06, namely Q11–Q14 and Q16.
>
> Net impact on TSO revenue: if 2004/05 and Q16 revenues were also adjusted for bad debt, TSO revenue would fall by up to [ ]TNZRI,– TSO net cost would increase very slightly, but the increase is unlikely to be significant

466. Telecom has submitted:[149]

> NSL is correct that this adjustment was not made in Q11-14 and Q16. The Bad Debt adjustment was only started in Q15, which is why it was not included in prior quarters. That it was not recorded in Q16 was due to an oversight.
>
> Telecom wishes to advise that there are two further slight errors in the bad debt calculation. The first is that it incorrectly includes bad debts associated with Telecom Directories Ltd. The second is that the denominator used to calculate the bad debt percentage inadvertently excluded wholesale revenues. Both these will reduce the bad debt percentage.
>
> Given that these errors are likely to cancel each other out, Telecom does not propose to revise the data.

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[147] Telecom, *Telecom New Zealand Response to the Network Strategies Report on TSO Revenue for 2004/5 and 2005/6*, 19 February 2007, para 14 and para 18.
[148] Network Strategies Limited, *TSO revenue for 2004/05 and 2005/06: a review of the data*, 19 January 2007, section 4.2.
[149] Telecom, *Telecom New Zealand Response to the Network Strategies Report on TSO Revenue For 2004/5 And 2005/6*, para 22.

467. The Commission's view is that the magnitude of the errors identified by NSL and Telecom are low and that they have tended to cancel each other. While it is unfortunate that these errors happen they have not materially affected the TSO cost.

Processing of Xtra Revenue

468. Network Strategies has submitted that there is a possibility of ADSL revenue being doubly counted:[150]

> The Telecom total revenue used to calculate revenue per line includes a component labelled "Xtra Net Revenue". It is unclear whether this component includes ADSL revenue or whether it relates only to non-ADSL Xtra products.
>
> If it does include ADSL revenue, then there is a potential for double counting as ADSL revenue is added separately to the revenue per line data.
>
> It is unclear why different figures should be used, but we note that in the spreadsheets for 2005/06, the 2004/05 annual figure is given to be that as used for Q13 and Q14. Revising Q11 and Q12 data to use this figure also will increase TSO net revenue slightly, but will not have a significant effect on the outcome.
>
> We also noted an extraordinary fall in the annual figure from 2004/05 to 2005/06. Business net revenue fell by 13% while residential net revenue fell by 26% (based on the annual data specified for Q13 and Q14). Further information on this revenue component is required to help us to assess these movements.
>
> Net impact on TSO revenue: uncertain, but there is a possibility that this factor may be significant – further information required.

469. Telecom has submitted:[151]

> Confirming that these data are for Xtra dial-up net revenues only, and excludes net revenues associated with ADSL.
>
> NSL noted an error in the net revenues for Q11 and Q12. We agree there is an error here and the numbers used for Q13 and Q14 should be used instead. Telecom does not propose to revise the data to include the adjustment as we agree with NSL that the impact would be marginal. However, if the Commission would like us to correct for this we would be more than willing to do so.
>
> NSL note changes in (net) revenues for Xtra dial up between 2004/05 and 2005/06. While NSL suggest this is "extraordinary", this largely reflects a decline in dial-up customers as customers switched to broadband over the period. This switch has been noted publicly by Telecom on a number of occasions.
>
> That this revenue stream is declining sharply is fortunate as it is becoming increasingly difficult to separate out dial-up costs from other internet related costs in Telecom's cost data. As in previous years we have produced separate reports and tables for this revenue stream to assist the auditors. NSL have seen these in the past. We would be happy to provide the report for 05/06 if that would be helpful. We are as yet undecided how this calculation will be made for 06/07, but it will probably be considerably simplified on the cost side. This is not a large revenue stream and any simplification is unlikely to have a significant impact on the TSO.

470. The Commission considers that while there may be occasional records that are incorrect, there is no better source of information that is available. Since the evidenced rate of unexplained anomalies is very low, the present information should be accepted in its current state.

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[150] Network Strategies Limited, *TSO Revenue for 2004/05 and 2005/06: a Review of the Data*,, 19 January 2007, section 4.3.

[151] Telecom, *Telecom New Zealand Response to the Network Strategies Report on TSO Revenue for 2004/05 and 2005/06*, para 26,27,28.

Apparent Revenue Anomalies

Residential revenue per line

471. NSL has found that, in general, there was very little variation in the moving average data: the median coefficient of variation was just 2.5%, and only 47 ESAs had a coefficient of variation of at least 5%:

- o two ESAs had a coefficient of variation of at least 10%
- o nine ESAs had a coefficient of variation of at least 7% and less than 10%
- o 36 ESAs had a coefficient of variation of at least 5% and less than 7%.

472. Telecom submitted that:

> NSL examine residential revenues by ESA over time and highlight a number of ESAs where unusual things have happened. They focus on two particular ESAs. Each is discussed in turn.
>
> NSL highlight higher than normal revenues per line in [ ]TCNZRI in Q16. This is due to higher than normal national call revenues. These high revenues are matched by unusually high call volumes in our call record data base. In other words they are real. We do not know why one or more customers in this ESA changed their normal behaviour over this period.
>
> NSL note a change in the pattern of the revenue data in [ ]TCNZRI especially between Q14 and Q15. Again this decline is mainly in the national call revenues and is matched by a similar decline in our call records. Hence we believe that the decline is real, though why it occurred then we do not know.

Business Revenue per Line

473. NSL has found more fluctuation in business revenue per line, as usage tends to vary more with businesses. NSL also discovered the median coefficient of variation of the moving average data was 5.4% and 436 ESAs had a coefficient of variation of at least 5%:

- o nine ESAs had a coefficient of variation of at least 30%
- o 18 ESAs had a coefficient of variation of at least 20% but less than 30%
- o 99 ESAs had a coefficient of variation of at least 10% but less than 20%
- o 310 ESAs had a coefficient of variation of at least 5% but less than 10%

474. Telecom submits:[152]

> NSL examine business revenues by ESA over time and highlight a number of ESAs where unusual things have happened. Each is discussed below.
>
> The business revenue per line for [ ]TNZRI, [ ]TNZRI, [ ]TNZRI and [ ]TNZRI exhibit a step reduction between Q10 and Q11. The change occurred at the time when Telecom revised the TSO revenue extract process to improve the revenue classification and ESA line allocation. [ ]TNZRI and [ ]TNZRI show a drop in call revenue (national, international, local and FTM) but their line counts are virtually unchanged while [ ]TNZRI and [ ]TNZRI show both call revenue and line count drops. We believe these are discontinuities which are typical of what we might have expected when the data processes were changed. The revised data is the more accurate.
>
> [ ]TNZRI business revenue per line peaks in Q16, Q17. This reflects higher than normal high national call traffic volumes for these quarters. [ ]TNZRI exhibits a peak in Q7/Q8 reflecting higher than normal local call volumes for these quarters. We note that the final determination covering Q7 and Q8 has already been made.

475. Telecom has submitted that:[153]

[152] Network Strategies Limited, *TSO Revenue for 2004/05 and 2005/06: a Review of the Data*, 19 January 2007, section 5.2.

[153] Telecom, *Cross Submission on the TSO 05-05 and 05-06 Draft Determinations*, 20 August 2007, para 38.

> 38 Some of NSL's concerns on the ADSL net revenue modelling for 04/05 are shared by Telecom, as indicated in Telecom's response to NSL's earlier submissions on the ADSL modelling. These have been addressed in the 05/06 net revenue modelling, but have not been backdated to 04/05. Telecom continues to believe that ADSL net revenues should not be included in the modelling in the 04/05 determination as per section 84 (2) (a).

476. Telecom has further submitted that:[154]

> Telecom considers that no changes are required to the PSTN revenue numbers. All NSL's concerns are capable of being explained and so do not require any changes to the data being used in these draft determinations.

Commission view apparent data anomalies

477. The Commission has to consider whether this data anomaly is indicative of a problem or whether it is due to genuine customer behaviour. Telecom has advised the Commission that these information sources are reconciled to Telecom's general ledger. Previous, apparent anomalies have been able to be explained by Telecom as real customer behaviour or as timing differences in the various flows of money. However, upon examining data against previous years' information, the Commission has found similar patterns where random anomalies were detected. The consistency of these anomalies leads the Commission to form the view that this is the way the data behaves in reflecting the operations of Telecom and its customer behaviour.

<u>ESAs with Data Peculiarities</u>

478. Network Strategies has submitted that:[155]

- The ESA [ ]TNZRI in Q13 had residential revenue per line of [ ]TNZRI when the typical value in other quarters was around [ ]TNZRI. This appears to be due to a large amount of revenue assigned to the category 'unrecognised' in that quarter.
- There is a note associated with the 2004/05 and 2005/06 revenue data for the ESA [ ]TNZRI that previous year's revenue data be used as data for these years were not available. This means that the ESA uses revenue per line data from 2003/04 for the following two years. More information concerning the reason for the lack of data may suggest a better assumption.
- The ESA [ ]TNZRI had a large negative value for business revenue per line in Q17, namely [ ]TNZRI. This is caused by a large negative value, ([ ]TNZRI), for access rental revenue in that quarter. There are [ ]TNZRI business lines in [ ]TNZRI for Q17. [ ]TNZRI has CNV clusters in 2003/04, so the negative revenue will increase TSO net cost in the ESA by approximately [ ]TNZRI.

479. Telecom has submitted that:[156]

> NSL are correct that the revenue per line in [ ]TCNZRI in Q13 was much higher than expected due to an increase in 'unrecognised' revenues. These are revenues from new GL codes that we haven't yet assigned TSO product codes. We call them "unrecognised" or "FD" and included them in their entirety in the TSO runs for that year. In subsequent years, as we source the correct GL codes, these revenues are allocated to their correct categories.
>
> Prior to 04/05, OPA had its own identity, line count and revenue. However in 04/05 it was incorporated into WHT. The decision to use OPA 03/04 rev/line for 04/05 and 05/06 is the Commission's. An alternative is to use the WHT rev/line for OPA.
>
> [ ]TCNZRI has a large negative value for business revenue per line in Q17 because a large credit for a business line was made in that period.

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[154] Telecom, *Telecom New Zealand Cross Submission on the TSO 04-05 and 05-06 Draft Determinations, 20 August 2007*, para 37.
[155] Network Strategies Limited, *TSO Revenue for 2004/05 and 2005/06: a Review of the Data,* section 4.4
[156] Telecom, *Telecom New Zealand Response to the Network Strategies Report on TSO Revenue for 2004/05 and 2005/06*, 19 February 2007, para 30-32.

480. The Commission's view is that when dealing with "live data" that there will always be apparent anomalies. In this case: some unrecognised revenue was incorrectly coded to the correct revenue stream but nevertheless it was credited as revenue; an ESA was amalgamated into another, the Commission has imputed a revenue; and there has been an issue of timing for a revenue stream, where the initial charge and the refund happened in different quarters creating an apparent issue. The Commission has accepted Telecom's explanation of the issues and is of the view that it is a more fundamentally rigorous approach to impute previous revenue.

ADSL Modelling

481. Telecom has provided data and models of their ADSL costs and revenues at an exchange level. These models are available on the distribution disk at 'C:\cc_tso_net_cost_tree\0405' and at 'C:\cc_tso_net_cost_tree\0506'. These net revenues have been treated as a revenue stream and have been aggregated on 'C:\cc_tso_net_cost_tree \ revenue_lines_all_q_all_esa.xls'

482. Liable Persons have been invited to comment on Telecom's ADSL model and statement of net revenue[157]. These comments were provided to Telecom. Parties comments and Telecom's response is now appended to the ADSL model. They are physically located on the distribution disk[158] and are provided as part of Telecom's ADSL model and net revenue. Liable parties (& Telecom) having already reviewed the ADSL model and having the benefit of Telecom's response to their questions should gain a greater appreciation of the ADSL model and net revenue information.

483. Network Strategies has submitted that:[159]

> From our examination of Telecom's ADSL Access Cost Model and the calculation of ADSL net revenues, we have identified a number of problems which are likely to overstate ADSL-related costs significantly, and subsequently understate ADSL net revenues. We therefore recommend that the Commission assigns the highest priority to:
>
> - review the calculation of backhaul costs with particular emphasis on the problem of mixing a historical configuration with a theoretical transport network, and including assumptions relating to sharing
> - remove inefficiencies of the historical model
> - update the model so that modern equivalent assets are used
> - avoid Telecom being reimbursed twice in areas where ADSL infrastructure has been subsidised by Project PROBE, and hence ADSL costs should take into account the impact of the subsidy and this should flow through to higher ADSL revenues

484. The Commission's view is that in 2004/2005 ADSL was a relatively new product, its penetration was increasing and so were its revenues. Many of the modelling improvement opportunities identified by Network Strategies have been included in the 2005/2006 models. The Commission has not required that the 2004/2005 issues be addressed because of the relatively low importance of ADSL revenues in this period in the CNVC geographical areas.

485. Project PROBE (Provincial Broadband Extension) was developed jointly by the Ministry of Education (MoE) and the Ministry of Economic Development (MED) to roll out broadband Internet access to all schools and provincial communities throughout New Zealand. This project involved funding infrastructure providers to

[157] Commerce Commission, *Update on Local Calling TSO 2004/05 and 2005/06,* letter 13 December 2006
[158] C:\cc_tso_net_cost_tree\RequestElaborations.
[159] Network Strategies Limited, *Report on the TSO Draft Determinations for the 2004/2005 and 2005/2006 Periods*, 6 August 2007, p 33.

provide broadband service. The infrastructure that has been funded with Telecom has been incorporated into its fixed asset base.

486. The Commission's view is that Telecom's ownership of the asset has at least in part been funded by the Project PROBE project. The Commission anticipates that there will be difficulty in unbundling the Project PROBE funding and allocating it to particular ESA and clusters of customers. Accordingly the Commission proposes to ascertain the total funding provided through the project by determining a corresponding annuity then pro rata this as a residential per ADSL line subsidy in the form of additional revenue in the ESA to which this funding has applied.

487. The Commission has provided an additional excel model '*correct_revenue_lines with cc_assemble_tilted_cost.xls*' to provide a tilted annualised model of the Probe Capital Contribution that Telecom has received for the provision of ADSL revenues. This model calculates the net cost per residential customer inclusive of the ADSL annuity. The change in the TSO net cost due to this inclusion is discussed on Table 5 on page 78.

Incorrect allocation of ADSL Revenue

488. NSL has submitted:

> … that the ADSL net revenue covers more ESAs than are listed for the TSO net revenue. These additional ESAs are all denoted by codes such as XXXn, where XXX is the ESA code and n is a number, for example RNF1. These additional ESAs do not have any associated ADSL costs or revenues, and thus there is no effect on TSO net revenue.

489. The Commission's view is that the ADSL revenue is recorded against a code such as XXX[160]. This is taken from the *revenue_lines_all_q_all_esa.xls* file as code 'PTA'. The TSO VB program using information from '*esamapping.csv*' remaps 'PTA' to 'RNF1'. Thus any ADSL revenue benefit that is applied to PTA is credited to RNF1[161].

Scaling of Costs

490. NSL has submitted that:[162]

> The 2005–06 model combines the 2004–05 costs (with t incremented to *t* = 2) with the 2005-06 revenue. A serious error is introduced when the model tries to reconcile the different number of customers between the two years.
>
> The total annual cost (column Y of the ESA_summary sheet) is the sum of various costs presented on a per-line basis multiplied by the number of lines.
>
> The costs are determined using the 2004–05 cost model, dividing the total cost for each DSLAM by the number of lines (or ports); because this model only allows working costs to be selected, the number of ports is the number actually in use. The total cost consists of component costs that come from a variety of equipment with different capacities – including the DSLAM base equipment with a large capacity (and hence is effectively a fixed cost for the number of lines being considered) and the highly port-dependent costs of ADSL line card equipment.
>
> However multiplying the cost per line by a new number of lines is not a valid method of calculating the total cost because many of the costs do not increase as the number of lines increase (for the numbers of lines assumed). By multiplying all per-line costs by the number of 2005–06 lines, the total costs are frequently overstated, and for some ESAs – such as [ ]TNZRI – are significantly overstated.

491. Telecom has submitted that:

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160 In this case the XXX represents three letters.
161 Table 13: Mapping between Telecom Standard ESAs and HCPM Supplementary ESAs.
162 Network Strategies Limited, *ADSL net Revenue: a Review of the Telecom Model*, 5 February 2007, p 18.

> NSL appear to suggest that the only DSLAM cost that should be included is the line card cost. This appears to be in line with the general proposition they have advanced in relation to TSO costs – that the only costs which should be included in the TSO are the true marginal costs.
>
> If this is what NSL are suggesting, then we note that the Commission has consistently rejected this submission in the past. The Commission considers, and Telecom agrees, that the appropriate costs are long run incremental, where incremental is defined in terms of increments of customers (and is therefore different from, for example, the TSLRIC definition of an increment).
>
> In Telecom's view this requires all the DSLAM cost to be included. The demand for DSLAMs is sensitive to customer numbers, both in the short and long run. In the long run the numbers of DSLAMs in the market is dependent on the number of customers – the more customers with broadband, the more DSLAMs. Even in the short run, DLSAM numbers reflect customer numbers and their location, and multiple DSLAMs could well be installed simultaneously in exchanges where growth is strong. Telecom does accept however that there are other costs, like marketing or management systems, which are not variable with respect to customer numbers. These are excluded from the ADSL costs.

492. The Commission's view in this regard is that it is inappropriate to use a cost that does not capture the long term incremental cost (LRIC). The use of LRIC costs in the TSO modelling process is discussed under "Unavoidable Net Incremental Cost" on page 21.

Use of Legacy Equipment

493. Telecom when constructing their ADSL cost model has used their actual equipment costs as opposed to the ORC (Optimised Replacement Costs).

494. NSL has submitted that:[163]

> The most significant problem with this model is that it uses Telecom's actual, historical configuration – characterised by the use of remote DSLAMs with particular parent exchanges and their corresponding technologies – but at the same time uses the theoretical transport network generated by the CostPro model to calculate the model's backhaul costs (particularly SDH).
>
> This approach is inappropriate because the CostPro transport network was not designed or structured to provide efficient backhaul for Telecom's current DSLAMs: CostPro backhaul often specifies multiple SDH rings between remote DSLAMs and their parents, whereas in efficient networks only one ring would be used. Furthermore, the Commission specifies efficient forward-looking (MEA) networks should be used, rather than historical models such as the one that Telecom has provided.
>
> Recommendation: remove inefficiencies of the historical model and implement MEA approach.
>
> Recommendation: Telecom should verify that HCPM calculates the most efficient, forward-looking solution for cabinet backhaul.

495. The Commission's view is that the costs modelled for supplementary revenues such as Telecom Cellular and ADSL should reflect the actual costs that Telecom faces. As such it is inappropriate to require Telecom to use a MEA cost and topology.

Time to Build

496. The time to build parameter in "Equation 14: Annualized Cost of Capital" on page 128 has a time to build parameter *u*.

497. NSL has submitted that:[164]

> The model uses [ ]TNZRI years as the time to build for DSLAMs and other equipment. This appears to be a very long time and may be the period between delivery and the deployment of the equipment. However we would expect that most vendors would not receive payment on delivery and in fact, depending on the contract Telecom has with its vendors, we would not be surprised if

[163] Network Strategies Limited, *ADSL net Revenue: a Review of the Telecom Model*, 5 February 2007,p2.
[164] Network Strategies Limited, *ADSL Net Revenue: a Review of the Telecom Model*, 5 February 2007, p 12.

the vendors received payment after the equipment was switched on – effectively a negative time to build.

498. Telecom has submitted that:[165]

> The 'time to build' parameters are consistent with those the Commission has used elsewhere. Time to build reflects the gap between the time the equipment is installed and paid for and the point at which revenues are achieved. This value is a reasonable estimate in the ADSL context – particularly in the small rural areas where there is a net TSO cost.
>
> 38 NSL suggest that Telecom might pay its vendors after the equipment was switched on. That certainly may happen in some instances due to delivery and billing cycles etc. The key issue here however is the difference in timing between payment and revenue streams, not when the equipment is installed as such.

499. The Commission's view is that the time to build parameter provides an allowance for the changes in the 'optimised replacement cost of an asset' and the 'rate of return on capital' that occur over the period between when the capital is committed and the time that the investment is revenue earning.

Detailed Modelling Questions

500. Numerous issues have been identified by Network Strategies and responded to by Telecom. The Commission has reviewed the detail of these questions and is comfortable that no major or systematic issues have occurred in the modelling. The net ADSL revenue at least for the CNVC customers is slight or negligible. The Commission expects Telecom's modelling accuracy to improve over time.

Terrain Related Inputs

501. HCPM terrain information has been derived from ESA trenching difficulty analyses supplied by Telecom. This data has been collected from Telecom's regional outside plant contractors and is used as an averaged structure cost multiplier for each ESA in Telecom's TSO cost model.

502. For each ESA, terrain information is in the form:

Table 11: Sample ESA Terrain Information

ESA	I/T Hard	I/T Med	I/T Easy	O/T Hard	O/T Med	O/T Easy	Rural ind	I/T	O/T
[ ]	0.05	0.95	0	0.1	0.3	0.6	1	0.3	0.7
[ ]	0.2	0.8	0	0.2	0.6	0.2	0	0.81	0.19
[ ]	0.05	0.95	0	0.1	0.3	0.6	1	0.05	0.95
[ ]	0.05	0.95	0	0.35	0.35	0.3	0	0.4	0.6
[ ]	0	0	0	0.2	0.4	0.4	1	0	1
[ ]	0	0	0	0.1	0.2	0.7	1	0	1
[ ]	0.05	0.95	0	0.15	0.4	0.45	1	0.05	0.95
[ ]	0	1	0	0.2	0.3	0.5	1	0.05	0.95
[ ]	1	0	0	0	0	0	0	1	0

503. The Telecom contractor information is interpreted as follows:

- I/T Hard, I/T Med and I/T Easy are the probabilities of striking hard medium or easy conditions for trenching/cable laying in the 'In Town' component of each ESA

[165] Telecom, *Telecom New Zealand Response to the Network Strategies Report on ADSL Net Revenues,* 19 February 2007 ,para 37.

- O/T Hard, O/T Med and O/T Easy are the probabilities of striking hard medium or easy conditions for trenching/cable laying in the 'Out of Town' component of each ESA
- Rural ind is an indicator for principally rural ESAs (1 for rural, 0 for urban)
- I/T O/T are the In Town and Out of Town network weightings for each ESA

504. The Telecom terrain categories are defined:

- Easy – areas where it is possible to mole-plough
- Medium - includes trenching of footpath (small to medium back hoe or chain digger), directional drilling or 'prerip' with mole-plough in medium traffic areas.
- Hard - includes trenching roadway (large back hoe), difficult terrain (rock saw) and CBD/high traffic areas

505. The corresponding three sets of HCPM structure costs are:

- Normal
- Soft
- Hard

506. As discussed in the 2002/2003 TSO determination[166], the Commission does not use the FCC geophysical parameters to determine trenching difficulty. The FCC approach is not appropriate for New Zealand, where road reserve and road berm access conditions have proven to be the key trenching cost drivers.

507. For the purposes of TSO modelling, the Commission has mapped Telecom's easy, medium and hard terrain categories onto HCPM normal, soft and hard categories respectively. The mapping is achieved by manipulating specific cluster terrain parameters:

- Bedrock Depth
- Rock Hardness
- Soil Consistency
- Water Table Depth
- Minimum Slope, and
- Maximum Slope

508. Each cluster is forced to use a particular set of structure costs by setting its terrain parameters:

[166] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for Period between 1 July 2002 and 30 June 2003*, March 2005, para 281, 2002/2003 Terrain Approach.

Table 12: Cluster Terrain Parameters

Costs	Bedrock	Hardness	Soil	Water Table	Min Slope	Max Slope
Normal (Easy)	60	Normal	0	5	1	1
Soft (Medium)	10	Soft	1	5	1	1
Hard (Hard)	10	Hard	1	5	1	1

509. Water table and slope triggers are not used explicitly, but combined into the definitions of Easy Medium and Hard.

Terrain Modelling Approach

510. For the 2002/2003 TSO Determination TelstraClear engaged experts Dr David Bell and Mr Ranald Ducat to undertake a terrain and trenching difficulty analysis of several high TSO cost ESAs. In that determination the Commission considered the results and recommendations arising from the Bell-Ducat survey in some detail.[167]

511. The Commission recognised that the Bell-Ducat methodology has usefully identified the key trenching cost drivers in rural New Zealand and makes progress towards defining a framework for the objective characterisation of trenching conditions in road reserves.

512. In that year the methodology had been tested on a subset of high TSO cost ESAs and does not yet provide a comprehensive database of results for New Zealand.

513. The Commission remains of the view that the Telecom Contractor information remains the only comprehensive and consistently applied database of terrain for all ESAs. The Commission considers that Bell-Ducat assessment of high TSO cost ESAs is not sufficiently robust to replace the terrain profiles or costs adopted for the 2001/2002 TSO Determination and subsequently for the 2004/2005 TSO determinations.

514. The Commission has continued to use the terrain data as was used in the 2002/2003 determination. If any party were to provide a national database providing demonstratively improved modelling outcomes then the Commission would consider the benefits of using this data to recalibrate the Commission model.

Terrain Allocation

515. Telecom trenching difficulty information is used to sub-divide allocation of terrain into the four categories:

- Rural In Town
- Rural Out of Town
- Urban In Town
- Urban Out of Town

516. Each category is treated separately for the purposes of HCPM cluster terrain allocation.

[167] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for Period between 1 July 2002 and 30 June 2003* March 2005, Appendix 7.

Rural In Town

517. Telecom trenching difficulty information indicates that the 'Easy' classification is not used for any 'In Town' network clusters (i.e. probability of 'Easy' = 0 in all cases). Using the definitions supplied by Telecom, this implies that 'mole-plough' cable laying techniques cannot be used for rural 'In Town' areas, requiring in all instances more expensive laying techniques.

518. Cluster #1 of an HCPM rural ESA is mapped to 'Rural In Town' trenching probabilities. In many instances, this cluster includes areas which could be reticulated using modern mole-plough laying techniques. This issue is addressed by adjusting HCPM trenching cost estimates for rural Medium (HCPM Soft) areas to allow for less expensive laying techniques (see trenching rate inputs below).

519. Rural In Town cluster terrain classification is set to HCPM Soft unless the probability of Hard exceeds the probability of Soft.

Rural out of Town

520. Rural Out of Town clusters (2 to n) are assigned terrain classifications based on Out of Town trenching difficulty probabilities as follows:

- Number of Normal (Easy) Clusters (N) is calculated by rounding up (OTEasy * (n-1))
- Number of Soft (Medium) Clusters (S) = Round((OTMed / (OTMed + OTHard)) * (n – 1 – N), 0)
- Number of Hard Clusters = n – 1 – N – S

Urban

521. Terrain classification for urban ESAs uses the rural procedure if average line density is less than 650 lines per square mile. If density is above this value, cluster terrain classification is set to Medium (HCPM Soft) unless the 'In Town' probability of Hard exceeds probability Medium. This process ensures that metro areas such as Auckland central and Wellington central retain an overall Hard classification. The following table provides statistics on terrain allocation to clusters:

Terrain Type	HCPM Hard	HCPM Soft	HCPM Normal
% Allocation	14	48	38

Engineering Inputs

Access Network Sharing

522. The Commission's estimate of access network sharing is stratified by customer density as follows:

Density	Sharing
Metro	15.30%
Urban/Suburban	4.19%
Rural	3.51%

523. Although sharing percentages are available on an ESA by ESA basis, these are difficult to apply in modelling, especially in rural ESAs where a single business location may be responsible for all non-PSTN circuit ends. Where rural non-PSTN circuits form a large percentage of total circuit ends, the high level of sharing

indicated may not occur in practice due to the non-PSTN circuits being concentrated within a single cluster.

524. For this reason the Commission has adopted average sharing figures by customer densities, which are applied as cost reduction factors on the appropriate trenching costs.

Clustering Process Inputs

525. Cluster inputs are geocoded customer/demand information and control options and settings for the process of grouping customer locations into serving areas.

526. The HCPM ESA input files differ from Telecom's standard list of ESAs as listed in the following table:

Table 13: Mapping between Telecom Standard ESAs and HCPM Supplementary ESAs

ESA	Description
AKCE	CTY ESA is renamed AKCE - Auckland Central
AO1	AO1 is western Akaroa - former radio site
BM1	Blenheim 1 and 2 - remote coastal areas
BM2	
DRF1	Darfield 1 - Arthurs Pass area
HBN1	Hastings 1, hill area south of Otamauri
KHO1	Kaikohe 1, area west of Taheke,
MKB	Millbrook ESA Missing from Telecom geo-data input, very small area included in Arrowtown - AW ESA
MUS	Manutuke South 20km south of MKE: Manutuke combined with MKE
OAU1	Otautau1, ex radio area north of Orawia
OTI	Otira - geocoded information not available, 20 lines north of AHP on state highway - use scaled AHP costs
PHA1	PAHIATUA 1, coastal Wairarapa adjacent to Alfredton
RNF1	RANFURLY 1, hill area south of Patearoa
RRR	RRR Ruatoria Rural combined with RUT Ruatoria
TG1	Motiti Island, off Tauranga coast - DMR. Use TG per line revenues
TSQ	TSQ Te Puia Springs West combined with TPS Te Puia Springs
WI1	Waipawa 1, coastal area south of Omakere
WR1	Whangarei 1, Pipiwai region
WTG	Waitangi, Chatham Island – partially modelled
WWS	Wairoa West, combined with Wairoa, WA

527. ESAs with a numerical qualifier (AO1, BM1 etc) are additional to Telecom's ESA list. These consist of small numbers of lines in remote areas which are assigned average revenues consistent with neighbouring ESAs for which Telecom has provided data.

528. Shaded ESAs in the table are removed from Telecom's standard ESA list due to lack of geocoding information or because they are very small nodes physically adjacent to a parent.

529. The physical ESA cluster files are slightly modified for this determination from those provided previously with the TSO model and databases. The Commission has added an additional character to the cluster information lines within the '*.clu' files as illustrated in bold:

Previously:

```
WC_code, Swx, Swy, CenX, Ceny, Company,,,,,,
AAI,173.256282369,-35.050691054,173.256282369,-35.050691054,TCNZ,,,,,,
Number of Lines (including special access):  998
Number of Clusters:  7
Run-time in Minutes:  0.0047

Cluster, X, Y, Lines, X1, Y1, X2, Y2, Bedrock, Hardness, Soil, WaterTbl, MinSlope,
MaxSlope, CB Number
1,0,0,373,546,-324,-2586,6912,10,SOFT,1,5,1,1,000dummyCB
2,21537,52795,86,29416,45736,11585,61712,10,HARD,1,5,1,1,000dummyCB
3,-18371,8938,141,-18393,8822,-15270,25240,10,SOFT,1,5,1,1,000dummyCB
4,23726,569,73,22403,1566,36201,-8830,60,NORMAL,0,5,1,1,000dummyCB
5,10906,10281,50,13309,8811,4745,11693,60,NORMAL,0,5,1,1,000dummyCB
6,35902,23703,85,36024,23785,25627,16780,60,NORMAL,0,5,1,1,000dummyCB
7,36567,62520,190,36532,62455,43154,74906,60,NORMAL,0,5,1,1,000dummyCB

X, Y, Cluster, Res, Bus

-1430,7891,1,1,0
19,923,1,1,0
-1108,-412,1,1,0
```

Modified:

```
WC_code, Swx, Swy, CenX, Ceny, Company,,,,,,
AAI,173.256282369,-35.050691054,173.256282369,-35.050691054,TCNZ,,,,,,
Number of Lines (including special access):  998
Number of Clusters:  7
Run-time in Minutes:  0.0047

Cluster, X, Y, Lines, X1, Y1, X2, Y2, Bedrock, Hardness, Soil, WaterTbl, MinSlope,
MaxSlope, CB Number
1,0,0,373,546,-324,-2586,6912,10,SOFT,1,5,1,1,000dummyCB,1
2,21537,52795,86,29416,45736,11585,61712,10,HARD,1,5,1,1,000dummyCB,2
3,-18371,8938,141,-18393,8822,-15270,25240,10,SOFT,1,5,1,1,000dummyCB,3
4,23726,569,73,22403,1566,36201,-8830,60,NORMAL,0,5,1,1,000dummyCB,4
5,10906,10281,50,13309,8811,4745,11693,60,NORMAL,0,5,1,1,000dummyCB,5
6,35902,23703,85,36024,23785,25627,16780,60,NORMAL,0,5,1,1,000dummyCB,6
7,36567,62520,190,36532,62455,43154,74906,60,NORMAL,0,5,1,1,000dummyCB,7

X, Y, Cluster, Res, Bus

-1430,7891,1,1,0
19,923,1,1,0
-1108,-412,1,1,0
```

530. The extra character has been added to record in the ‘comments’ field of the record the initial cluster that the record belongs to. The cluster files are dynamically created as the program executes. The addition of this extra piece of information allows the program to keep track of the original cluster reference number of a cluster which at the termination of the program run allows reporting of the CNVC clusters.

531. Each cluster information line is now tagged with its original cluster number as the final character on the line. This does not impact the operation of HCPM, but enables tracking of original cluster numbers for improved reporting from the model. <u>Note that use by the TSO program of cluster files without this modification will result in incomplete reporting of TSO costs.</u>

532. The key engineering inputs to the clustering process are:

- Copper distance limit for distribution cable, set to 7km (22,300 feet) for 0.63mm diameter cable. This figure is industry standard for delivery of telephony services, although it is sometimes exceeded with some accepted

degradation of service quality in rural areas.
Limit the number of lines ordinarily assigned to a single cabinet, to a maximum of 1800 lines. In particularly dense areas this limit may be exceeded.

533. The clustering inputs, with descriptions are summarised in:

Table 14: Cluster Inputs

Values	Description	Comments
150	Raster_Size	Micro-grid size for locating customers before clustering
22300	Distance_Limit	feet - maximum reach with 0.63mm cable = 7km
1800	Line_Limit	Nominal max number of lines per cabinet
80	Line_Fill	Determines cluster size before optimisation
5	Lines_per_Business	Used only with Census block input data
1	Cluster_Algorithm	Use the Divisive option
4	Optimisation_Method	Auto-select optimal approach
1000	Maximum_populated_cells	Initial value for rasterisation process
0	Use_hcpm.mdb	Alternative ESA database format, not used
0	True-up_line_counts	Update demand for annual runs, not used
1	Lines_per_Residence	Used only with Census block input data
0	make_plot	Run time option – used only in interactive mode

Copper Cable

534. There are many interrelated features in the Commission's model. These include, but are not necessarily limited to:

- Tilt;
- Asset beta;
- Scorched node assumption; and
- Unit prices.

535. Telecom has submitted that copper prices have changed considerably from those used in the TSO modelling.[168] This has pointed to the tilt being incorrectly set.

536. The Commission's view is that the changes in the unit prices of copper cannot be managed in isolation of other trends that have been occurring. These other changes include the upcoming adoption of NGN technology and changes in the price of fibre.

537. If the TSO design were to be reviewed in the future then it would include more fibre and would start eliminating the more expensive and lower capability copper technology.

538. The MEA copper price could only be adopted in an MEA design which had optimised its use of copper. The Commission's view is that these quantities will not be revisited until such a time as the whole modelling approach is revisited.

539. Costs in the tables below include material, placing, splicing and engineering. Entries in black are direct data values supplied by parties. The source is noted in the "Comments area" of the Table. The input values are unchanged from the 2001/2002 determination, but modelled capital charges track the tilt value for Copper Cable through use of $t = 4$ in the annualisation formula.

[168] Telecom, *Submission on the TSO 04-05 and 05-06 Draft Determinations*, 6 August 2007, p 11, para 32

540. Where parties do not use a particular size of cable, the cost value (in **blue**) has been interpolated or extrapolated from supplied data. This approach is consistent with parties' estimation of cable jointing/splicing costs and scales placement and engineering costs, particularly for the larger cable sizes.

541. The Commission notes that cables above 1200 pair capacity are unlikely to be used in modelling for a New Zealand network outside of metro and highly dense urban environments.

Table 15: Cost of 0.63mm (24 Gauge) Copper Cable

Size	UG	Buried	Aerial	Comments
4200	$[ ]	$[ ]	$[ ]	Price per foot for underground, buried and aerial copper
3600	$[ ]	$[ ]	$[ ]	0.63mm cable prices NZ
3000	$[ ]	$[ ]	$[ ]	
2400	$[ ]	$[ ]	$[ ]	
2100	$[ ]	$[ ]	$[ ]	
1800	$[ ]	$[ ]	$[ ]	
1200	$[ ]	$[ ]	$[ ]	UG TCNZRI
900	$[ ]	$[ ]	$[ ]	
600	$[ ]	$[ ]	$[ ]	
400	$[ ]	$[ ]	$[ ]	UG TCNZRI
300	$[ ]	$[ ]	$[ ]	UG TCNZRI
200	$[ ]	$[ ]	$[ ]	UG TCNZRI, B mod TNZRI, A TCRI
100	$[ ]	$[ ]	$[ ]	UG TCRI, B mod TCNZRI, A TCRI
50	$[ ]	$[ ]	$[ ]	UG TCRI, B mod TCNZRI, A TCRI
25	$[ ]	$[ ]	$[ ]	UG TCRI, B mod TCNZRI, A TCRI
18	$[ ]	$[ ]	$[ ]	
12	$[ ]	$[ ]	$[ ]	
6	$[ ]	$[ ]	$[ ]	B mod TCNZRI 7pr
1	$[ ]	$[ ]	$[ ]	

Table 16: Cost of 0.4mm (26 Gauge) Copper Cable

Size	UG	Buried	Aerial	Comments
4200	$[ ]	$[ ]	$[ ]	Price per foot for underground, buried and aerial copper
3600	$[ ]	$[ ]	$[ ]	0.4mm NZ
3000	$[ ]	$[ ]	$[ ]	Used the 24 Gauge aerial as no data for 0.4mm
2400	$[ ]	$[ ]	$[ ]	
2100	$[ ]	$[ ]	$[ ]	
1800	$[ ]	$[ ]	$[ ]	
1200	$[ ]	$[ ]	$[ ]	UG TCNZRI
900	$[ ]	$[ ]	$[ ]	
600	$[ ]	$[ ]	$[ ]	
400	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI update, A TCRI
300	$[ ]	$[ ]	$[ ]	
200	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI update, A TCRI
100	$[ ]	$[ ]	$[ ]	UG TCRI, B TCNZRI update, A TCRI
50	$[ ]	$[ ]	$[ ]	UG TCRI, B TCRI, A TCRI
25	$[ ]	$[ ]	$[ ]	
18	$[ ]	$[ ]	$[ ]	
12	$[ ]	$[ ]	$[ ]	
6	$[ ]	$[ ]	$[ ]	
1	$[ ]	$[ ]	$[ ]	

Feeder/Distribution Inputs

542. The feeder/distribution inputs, with descriptions are summarised below:

Table 17: Feeder / Distribution Inputs

Value	Variable Name	Comments
[ ]TCNZRI	max_drop_length	Kilofeet – maximum distance from CT to customer premises
0.5	user_lambda	Used to locate customer on lot, 1= centre, 0= edge
12	copper_gauge_xover	Kilofeet – decision point for use of 0.4mm or 0.63mm cable
22.3	max_copper_distance	Kilofeet – maximum reach for copper cable
1.25	MaxCopperPenalty	Cost penalty multiplier if copper cable in cluster > length limit
12	copper_t1_xover	Kilofeet – unused
0	t1_fiber_xover	kilofeet; - Set this value to zero to turn off T1 technology for switched services
1.25	t1_redundancy_factor	- unused
24	copper_placement_depth	Inches – burial depth, has terrain factor dependencies if changed
36	fiber_placement_depth	Inches – burial depth, has terrain factor dependencies if changed
3	CriticalWaterDepth	Feet – unused, has terrain factor dependencies if changed
1.3	WaterFactor	Multiplier – unused
12	MinSlopeTrigger	Unused – has terrain factor dependencies if changed
1.10	MinSlopeFactor	Unused – has terrain factor dependencies if changed
30	MaxSlopeTrigger	Unused – has terrain factor dependencies if changed
1.05	MaxSlopeFactor	Unused – has terrain factor dependencies if changed
1.20	CombSlopeFactor	Unused – has terrain factor dependencies if changed
0%	pct_ds1	% of business lines terminated on T1 – unused
0%	pct_lsa	% of special access lines carried by DS1 or DS3 – unused
24	ChannelsPerT1System	Unused
2	PairsPerT1System	Unused
4	FibersPerTerminal	
2016	CapacityF2016	Capacities of Fibre terminals
1344	CapacityF1344	
672	CapacityF672	
96	CapacityF96	
60	CapacityF24	60 channel minimum unit
96	CapacityT96	
24	CapacityT24	
10	Lines_per_bus	For use with Census Block input information – unused
1.00	DistRoadFactor	Use rectilinear distances rather than road factor
1.00	FiberFillFactor	1 = 100%
1	DistanceType	1 = rectilinear, 2 = airline
1	FeederRoadFactor	Use rectilinear distances rather than road factor
1	Max_SAIs	Maximum number of cabinets placed in a cluster
0%	DefaultSpclAccessRatio	No special access lines costed
12	RepeaterSpacing (Kf)	For T1 feeder systems - unused
0	European indicator	Cable placing option for some European regulators: 0 = unused
500	European cutoff density	Unused

Fibre Cable

543. Costs in the tables below include material, placing, splicing and engineering. Fleeting costs are proportional to trenching difficulty factors and are included as averages within structure costs. Entries in black are direct data values supplied by parties. The source is noted in the Comments area of the Table. The input values are unchanged from the 2001/2002 determination, but modelled capital charges track the tilt value for Fibre Cable through use of $t = 4$ in the annualisation formula.

544. Where parties do not use a particular size of cable, the cost value (in **blue**) has been interpolated or extrapolated from supplied data. This approach is consistent with parties' estimation of cable jointing/splicing costs and scales placement and engineering costs, particularly for the larger cable sizes.

Table 18: Fibre Cable Costs

Size	UG	Buried	Aerial	Comments
288	$[ ]	$[ ]	$[ ]	
144	$[ ]	$[ ]	$[ ]	
96	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI, A TCRI
72	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI, A TCRI
60	$[ ]	$[ ]	$[ ]	
48	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI, A TCNZRI
36	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI, A TCNZRI
24	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI, A TCNZRI
18	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI, A TCNZRI
12	$[ ]	$[ ]	$[ ]	UG TCNZRI, B TCNZRI, A TCNZRI
1	$[ ]	$[ ]	$[ ]	

<u>T1 Feeder</u>

545. The T1 feeder capability is not used.

<u>Plant Mix</u>

546. The relative proportions of aerial, buried and underground plant vary by density zone according to the following tables. The entries represent minimum placement percentages for underground, buried and aerial respectively. When they sum to less than 100%, HCPM selects the residual placement to minimise cost for the particular terrain type and density.

547. Percentages of buried infrastructure are maintained above 0% to take account of sharing with the core network and areas in which aerial is not practical. Telecom inputs have been selected for densities greater than 650 as these are more likely to reflect requirements for serving a mix of higher density residential and business areas.

Table 19: Distribution Plant Mix

Density	UG	Buried	Aerial	Comments
0	0.00%	30.00%	0.00%	Minimum placement percentages
5	0.00%	30.00%	0.00%	
100	0.00%	30.00%	0.00%	
200	0.00%	30.00%	2.00%	
650	0.00%	30.00%	2.00%	
850	10.00%	88.00%	2.00%	Force Buried/UG in suburban and more
2550	27.00%	72.00%	1.00%	dense areas, based on TNZ values
5000	27.00%	72.00%	1.00%	
10000	40.00%	59.00%	1.00%	

Table 20: Copper Feeder Plant Mix

Density	UG	Buried	Aerial	Comments
0	0.00%	30.00%	0.00%	Minimum placement percentages.
5	0.00%	30.00%	0.00%	
100	0.00%	50.00%	0.00%	
200	0.00%	50.00%	0.00%	
650	0.00%	50.00%	0.00%	
850	60.00%	40.00%	0.00%	
2550	75.00%	25.00%	0.00%	
5000	90.00%	10.00%	0.00%	
10000	95.00%	5.00%	0.00%	NZ

Table 21: Fibre Feeder Plant Mix

Density	UG	Buried	Aerial	Comments
0	0.00%	30.00%	0.00%	Minimum placement percentages.
5	0.00%	30.00%	0.00%	
100	0.00%	50.00%	0.00%	
200	0.00%	50.00%	0.00%	
650	0.00%	50.00%	0.00%	
850	60.00%	40.00%	0.00%	
2550	75.00%	25.00%	0.00%	
5000	90.00%	10.00%	0.00%	
10000	95.00%	5.00%	0.00%	NZ

Drop Terminal

548. Drop Terminals are equivalent to Cable Terminals (CTs) in Telecom's network. The costs include the terminal hardware, the cable tail, which connects into the distribution cable, jointing into the distribution cable and termination of the tail into the terminal.

549. Telecom and TelstraClear continue to provide widely differing costs for Drop Terminals. TelstraClear suggest that Telecom costs are higher than those experienced in a mass network rollout as they 'indicate rollout on a casual terminal-by-terminal basis'.

Table 22: Cost Estimates for Buried Drop Terminals

Buried	**5 pair**	**10 pair**	**15 pair**	**Remark**
Terminal	$160	$180	$330	'Quiet Front' Terminal
Tail	$45	$45	$45	Assume 15m @ $3/m
Joint to main	$205	$205	$205	See Joint table below
Terminate	$50	$50	$50	
Total	**$460**	**$480**	**$630**	

Table 23: Combination Cost Estimates of Drop Terminals

Joint Table	**Cost**	**Remark**
Dig and Back Fill	$75	2 hours inc travel
Joint	$50	
Materials	$80	

Table 24: Cost Estimates for Aerial Drop Terminals

Aerial	**5 pair**	**10 pair**	**15 pair**	**Remark**
Terminal	$160	$180	$330	'Quiet Front' Terminal
Tail	$10	$10	$10	
Joint to main	$130	$130	$130	
Terminate	$50	$50	$50	
Total	**$350**	**$370**	**$520**	

550. Note that costings have been made using a 'Quiet Front' terminal which is consistent with reduction of total life time costs for Drop Terminals. Drop terminal costs provided by the Commission are entered in red in the following table. Cost values provided by parties are entered in black and extrapolated values beyond the ranges provided are entered in blue.

551. For terminal sizes larger than 25 the values in this table reflect the cost of an indoor termination frame. The extrapolated costs are based on Telecom 400 pair frame costs. TelstraClear values provided for indoor frames do not appear to account for full installation costs.

552. The input values are unchanged from the 2001/2002 TSO Determination, but modelled capital charges track the tilt value for Drop Terminals through use of $t = 4$ in the annualisation formula.

Table 25: Drop Terminal Costs

Size	Buried	Aerial	UG	Comments
1	$[ ]	$[ ]	$[ ]	UG – TCNZRI
6	$[ ]	$[ ]	$[ ]	UG – TCNZRI
12	$[ ]	$[ ]	$[ ]	UG – TCNZRI
25	$[ ]	$[ ]	$[ ]	A-TCNZRI
50	$[ ]	$[ ]	$[ ]	TCNZRI
100	$[ ]	$[ ]	$[ ]	
200	$[ ]	$[ ]	$[ ]	
400	$[ ]	$[ ]	$[ ]	UG – TCNZRI
600	$[ ]	$[ ]	$[ ]	
900	$[ ]	$[ ]	$[ ]	
1200	$[ ]	$[ ]	$[ ]	
1800	$[ ]	$[ ]	$[ ]	
2400	$[ ]	$[ ]	$[ ]	
3600	$[ ]	$[ ]	$[ ]	
5400	$[ ]	$[ ]	$[ ]	
7200	$[ ]	$[ ]	$[ ]	NZ

FDI – Feeder cabinet costs

553. Outdoor cabinet costs are based on Telecom 400 and 1400 port cabinets. The costings are fully installed. Note that HCPM determines costs for cabinets with greater than 7200 lines by summing the input values for two or more cabinets with less than 7200 lines.

554. The input values are unchanged from the 2001/2002 determination, but modelled capital charges track the tilt value for FDI through use of $t = 4$ in the annualisation formula.

555. See Drop Terminal costing above for indoor cost analysis.

Table 26: Feeder Distribution Interface Costs

Lines	Outdoor	Indoor	Comments
1	$[ ]	$[ ]	Costs of Outdoor and Indoor feeder/distribution
50	$[ ]	$[ ]	interface devices
100	$[ ]	$[ ]	
200	$[ ]	$[ ]	
400	$[ ]	$[ ]	Outdoor, TNZ 400 port cabinet
600	$[ ]	$[ ]	Outdoor, TNZ 1400 universal cab (fully costed)
900	$[ ]	$[ ]	
1200	$[ ]	$[ ]	
1800	$[ ]	$[ ]	
2400	$[ ]	$[ ]	
3600	$[ ]	$[ ]	Costs for SAIs with greater than 7200 lines
5400	$[ ]	$[ ]	are determined by summing the input values
7200	$[ ]	$[ ]	for two or more SAIs with less than 7200 lines
9000	$[ ]	$[ ]	
10800	$[ ]	$[ ]	
12600	$[ ]	$[ ]	
14400	$[ ]	$[ ]	
16200	$[ ]	$[ ]	
18000	$[ ]	$[ ]	
19800	$[ ]	$[ ]	
21600	$[ ]	$[ ]	
23400	$[ ]	$[ ]	
25200	$[ ]	$[ ]	
27000	$[ ]	$[ ]	
28800	$[ ]	$[ ]	NZ Cabinets and building frames

<u>Fill Factors</u>

556. Fill factors are commonly quoted in the context of design rules for initial network installation, typical utilisation or the trigger point at which relief is required. Fill Factor is defined as:

Fill Factor = (demand + intact lines + faulty lines)/total capacity

557. The Commission has adjusted the factors for rural areas to 60% for Feeder Cable and 40% for Distribution Cable. Although this may be common practice, modelling in HCPM creates unrealistic costs on low density feeder routes by provisioning up-front all of the systems and electronics (line cards) to meet the demand growth being allowed for. This aspect of the HCPM model may be adjusted in future versions, but for the purposes of this determination, rural feeder fill factor is re-adjusted to 80% to correct for over provisioning.

Table 27: Fill Factors

Density	Feeder	Distr	Comments
0	80.0%	40.0%	Utilization factors for feeder and distribution plant
5	80.0%	40.0%	These are for copper
100	80.0%	40.0%	
200	80.0%	40.0%	
650	80.0%	60.0%	
850	80.0%	60.0%	
2550	80.0%	60.0%	
5000	80.0%	60.0%	
10000	80.0%	60.0%	NZ

Structure Costs

558. Outside Plant 'Structure' in HCPM refers to the set of facilities that support, house, guide or otherwise protect distribution and feeder plant as follows:

- Aerial, which includes telephone poles and associated hardware such as anchors and guys
- Buried, which consists of trenches
- Underground, which includes trenches, conduit and manholes

559. Structure costs include the initial capital outlay for physical material associated with outside plant structure (including trenches, poles etc); the capitalised costs for supplies, delivery, provisioning, right of way, resource consent and any other capitalised cost directly attributable to these assets; and the capitalised cost for the labour, engineering and materials required to install the materials. For example, buried and underground structures include costs for capitalised labour, engineering and material costs for activities such as ploughing, trenching, backfilling, boring, concrete/asphalt cutting etc.

560. Structure costs are dependent on area type, defined within HCPM in terms of line density. Table 28: Areas by Line Density defines the areas by line density:

Table 28: Areas by Line Density

Area Type	Density in line/square mile	Density in line/km^2
Rural	0	0
Rural	5	2
Rural	100	39
Rural	200	78
Suburban	650	254
Suburban	850	332
Urban	2550	996
Urban	5000	1953
Metro	10000	3906

561. The specific HCPM structure input tables follow:

Table 29: Normal / Easy Terrain Costs

	Normal Terrain Costs $/ft						
	Underground		Buried		Aerial		
Density	Feeder	Distr.	Feeder	Distr.	Feeder	Distr.	Comments
0	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	Placement costs for easy terrain
5	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
100	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
200	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
650	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
850	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
2550	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
5000	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
10000	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	NZ

562. In the case of Normal terrain, 'medium' rural trench rates have been adopted for the underground category, recognising the likely trenching techniques required.

Table 30: Soft Rock / Medium Terrain Costs

	Soft Rock Costs $/ft						
	Underground		Buried		Aerial		
Density	**Feeder**	**Distr.**	**Feeder**	**Distr.**	**Feeder**	**Distr.**	**Comments**
0	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	Placement costs for medium terrain`
5	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
100	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
200	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
650	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
850	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
2550	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
5000	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
10000	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	NZ

Table 31: Hard Rock / Hard and Rock Terrain Costs

	Hard Rock Costs $/ft						
	Underground		Buried		Aerial		
Density	**Feeder**	**Distr.**	**Feeder**	**Distr.**	**Feeder**	**Distr.**	**Comments**
0	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	Placement costs for hard terrain
5	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
100	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
200	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
650	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
850	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
2550	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
5000	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	
10000	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	NZ

<u>Manhole Costs</u>

563. The following costs are Commission estimates based on weighted averages of Telecom's contractor data. Hard Rock information is an average of weighted averages (by cable pair kilometres) of installation and material costs from CBD and concrete/high traffic areas. Similarly, Soft rock is derived from sealed road/medium traffic areas and Normal from suburban/grass berm.

564. The input values are unchanged from the 2001/2002 TSO Determination, but modelled capital charges track the tilt value for Manholes through use of $t = 4$ in the annualisation formula

Table 32: Manhole Costs

Duct Capacity	Normal	Soft Rock	Hard Rock	Comments
2	$[ ]	$[ ]	$[ ]	Installed Cost for Manholes
4	$[ ]	$[ ]	$[ ]	
9	$[ ]	$[ ]	$[ ]	
99	$[ ]	$[ ]	$[ ]	NZ

Manhole Spacing

565. Manhole spacing is based on Telecom supplied data.

Table 33: Manhole Spacing

Density	Spacing(ft)	Comments
0	[ ]TCNZRI	
5	[ ]TCNZRI	
100	[ ]TCNZRI	
200	[ ]TCNZRI	
650	[ ]TCNZRI	
850	[ ]TCNZRI	
2550	[ ]TCNZRI	
5000	[ ]TCNZRI	
10000	[ ]TCNZRI	

Infrastructure Sharing

Table 34: Infrastructure Sharing

Density	Buried	UG	Aerial	Comments
0	100.00%	100.00%	100.00%	Percentage of underground, buried and aerial structure used by telco
5	100.00%	100.00%	100.00%	i.e. 100% means fully owned by telco, 50% means half shared with
100	100.00%	100.00%	100.00%	other utility/telco
200	100.00%	100.00%	50.00%	
650	100.00%	100.00%	50.00%	
850	100.00%	70.00%	50.00%	
2550	100.00%	70.00%	50.00%	
5000	100.00%	70.00%	50.00%	
10000	100.00%	55.00%	35.00%	NZ

Fibre Distribution and Miscellaneous Constants

566. HCPM utilises American sizing for fibre distribution systems. Telecom has provided costs for some systems up to 360 lines. It is necessary at this time to extrapolate these figures to estimate costs for larger systems. The smallest system has been reset to 60 channels to correspond to Telecom's 8Mb/s PDH cabinet – see fibre systems capacity in Feeder/Distribution inputs sheet.

Table 35: Fibre Distribution and Miscellaneous Constants

Value	Variable	Comments
$[ ]	cost_per_drop_kf	Units are in kilofeet
$[ ]	nid_cost	[ ]
$[ ]	duct_cost_per_kf	Units are in kilofeet
$[ ]	a2016	Fixed cost of size 2016 fibre terminal
$[ ]	b2016	Variable cost of size 2016 fibre terminal
$[ ]	a1344	
$[ ]	b1344	
$[ ]	a672	
$[ ]	b672	
$[ ]	a96	
$[ ]	b96	
$[ ]	a24	60 channel system minimum
$[ ]	b24	
$[ ]	ac96	Fixed cost of size 96 T1 (or HDSL) terminal
$[ ]	bc96	Variable cost of size 96 T1 (or HDSL) terminal
$[ ]	ac24	T1 is unused
$[ ]	bc24	
$[ ]	site_prep_cost	Telecom
$[ ]	Fiber_splice_cost	NZ

Financial Inputs

567. The input values are unchanged from the 2001/2002 TSO Determination. However, adoption of 12% of capital cost as a means of accounting for direct operating and maintenance costs will scale resulting capital charge factors by 1.12.

568. The original price tilt information supplied by Telecom was real and has been treated as nominal. This is discussed in the text following paragraph 582. The corrected price tilts are shown under 'Nominal price tilt'.

Table 36: HCPM Model Technologies Asset Economic Profile Information

Category	Asset life (yr)	Real Price tilt (%)	Nominal price tilt (%)	Time to Build (yr)
ac_ugd_cop	[ ]	[ ]	[ ]	0.5
ac_bur_cop	[ ]	[ ]	[ ]	0.5
ac_aer_cop	[ ]	[ ]	[ ]	0.5
ac_ugd_fib	[ ]	[ ]	[ ]	0.5
ac_bur_fib	[ ]	[ ]	[ ]	0.5
ac_aer_fib	[ ]	[ ]	[ ]	0.5
ac_ugd_struc	[ ]	[ ]	[ ]	0.5
ac_bur_struc	[ ]	[ ]	[ ]	0.5
ac_aer_struc	[ ]	[ ]	[ ]	0.5
ac_manhole	[ ]	[ ]	[ ]	0.5
ac_t1_term	[ ]	[ ]	[ ]	0.5
ac_fib_term	[ ]	[ ]	[ ]	0.5
ac_fdi	[ ]	[ ]	[ ]	0.5
ac_fib_splice	[ ]	[ ]	[ ]	0.5
ac_drop	[ ]	[ ]	[ ]	0.5
ac_drop_term	[ ]	[ ]	[ ]	0.5
ac_nid	[ ]	[ ]	[ ]	0.5
ac_repeater	[ ]	[ ]	[ ]	0.5

All real and nominal price tilt information in the above table is TCNZRI

Xtra and Telecom Mobile WACC

569. The Commission has used a WACC of 14% for Telecom Xtra and 10.5% for Telecom Mobile.

Financial Considerations

570. When asset prices are declining, the tilted annuity approach to calculation of annual charge factors adopted by the Commission for TSO modelling creates a declining profile of nominal annual capital charges as the year *t* is advanced in the formula:

Equation 12: Tilted Annuity

$$\frac{V[1+\alpha]^{t-1}[r-\alpha]}{1-\left(\frac{1+\alpha}{1+r}\right)^{N}}$$

Where:

r	=	the rate of return on capital
α	=	the nominal rate of change of the optimised replacement cost of the asset
t	=	a particular year in the economic life of the asset
N	=	the economic life of the asset
V	=	the optimised replacement cost of the asset.

571. The practical implementation of the formula in the HCPM, and CostProNZ models also includes a factor to allow for a time to build of *u*:

Equation 13: Tilted Annuity Correction for Time to Build

$$((1+r)/(1+\alpha))^{u}$$

572. The annualised cost of capital with the time to build adjustment is given byEquation 14: Annualized Cost of Capital with a Time to Build Adjustment

Equation 14: Annualized Cost of Capital with a Time to Build Adjustment

$$V\left(\frac{1+r}{1+\alpha}\right)^{u}\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^{N}}$$

573. Where:

α	=	the nominal rate of change of the optimised replacement cost of the asset
u	=	the time to build in years
r	=	the rate of return on capital
t	=	the particular year in the economic cost of the asset
N	=	the economic life of the asset
V	=	the optimised replacement cost of the asset

RMA Costs

574. The Resource Management Act 1991 (RMA) is New Zealand's legislation that "promotes the sustainable management of natural and physical resources"[169].

[169] Section 5 of the Resource Management Act 1991.

Developments affecting the environment can be subject to cost increases due to the compliance costs associated with the RMA.

575. Any network deployment on as large a scale as the scenarios modelled by this TSO would incur considerable delays and costs. Delays would be part of the project planning for this undertaking. There would be periods when the delay would be less than the average time, conversely there would be periods when the delay is greater than the average. The Commission expects that these delays would average so that there would be no net delay. There would be direct compliance costs caused by the RMA. These costs would be difficult to separate and to identify as belonging to a particular site. Most of the costs would be common as part of a nationwide pool of these costs. As such they are not TSO costs.

<u>Operating Costs</u>

576. For the purposes of this determination, the Commission has adopted the following operating cost factors:

a. $[ ] TCNZRI per line per annum service cost for residential lines
b. $[ ] TCNZRI per line per annum service cost for business lines
c. 12% of capital cost per annum for direct network operating and maintenance costs

<u>Line Rental Cap</u>

577. For the first three TSO determinations, Telecom has raised its residential rental prices to recover the CPI movement. The Commission has used actual standard (undiscounted) Telecom line rentals rather than CPI based maximums in this determination.

578. Telecom did not raise its residential line rental in the 2004/2005 period. Given the Commission considers annual price increases are reasonable, Telecom was advised that the standard residential line rental to be used in the provision of 2004/2005 TSO revenue was deemed to have increased to $36.31 ($40.85 including GST) as at 1 January 2005, in line with a 2.5 percent increase in the CPI in the year since its 2003/2004 price increase was calculated.

579. The CPI adjustment can be observed on the distribution disk in file 'CC_REV_Q13.xls', 'CC_REV_Q14.xls' and a summary in 'revenue_lines_all_q_all_esa.xls'.

Modelling Imputation

580. OPA (Opito Bay) has no revenue recorded against its [ ] TCNZRI business and residential lines. The Commission has imputed the revenue by using the revenue from the 2003/2004 period.

<u>Processing of Revenue Data</u>

581. In response to TelstraClear's request for greater transparency in the conversion of Telecom revenue data to average per line revenues for each ESA, the following files have been generated and are used as input's to the Commission's net cost calculation tool (contained in subdirectories under 'c:\hcpm\TSO\wk_lib\').

File	Description
grossrevs.csv	Contains average revenue per line calculated directly from Telecom's figures provided in the files of the form 'ccmathsq#_ESAs.xls'. The revenue figures for each ESA are based on standard line rental (for the particular quarter) plus average supplementary revenue per line net of Vodafone fixed to mobile and other interconnect costs. The 4 quarterly averages are added to form an annual figure (quarterly approach required to account for changing effective ESA line counts). The Commission has scaled up the resultant average revenues in line with the additional unallocated revenues identified by Telecom.
mobilevols.csv	Contains the average per line fixed to Telecom Mobile traffic volume for each ESA (seconds/line). Per minute TSO fixed to mobile termination costs are determined by Telecom's modelling at $[ ] TCNZRI per minute (10.5% WACC). This figure forms the default input to 7.01.04 of the Commission's net cost calculation tool, and can be changed as a variable on the tool's input screen. ESA per line fixed to mobile costs are deducted from gross revenues during the calculation of annual charge factors process.
incomingvols.csv	Contains average ESA per line incoming local and national call volumes. Incoming call costs for each call type are calculated by CostProNZ (CPNZ) and retrieved from the CPNZ scenario database by the net cost calculation tool. Calculated costs are deducted from gross average revenues for each ESA (which include incoming local and national call revenues).
revbyline.csv	The file of average net revenues per line by ESA (used in the net cost calculation tool) is now created and placed in the sub directories under 'C:\HCPM\TSO\wk_lib' directory each time annual charge factors are changed in the net cost calculation tool. Specifically, revenue figures are calculated by netting calculated mobile and incoming traffic costs. In addition, revbyline.csv now holds average per line calling costs for each ESA. This is a change from previous versions of the net cost calculation tool which used average calling costs by area density type. Calling costs are automatically updated from the CPNZ scenario database when annual charge factors are changed.
esacosts.csv	This file is unchanged from previous versions of the net cost calculation tool, except that the direct cost associated with each ESA is automatically updated from the CPNZ database each time the annual charge factors are changed.
wcap.csv	New file which holds the information used to calculate the Wireless Technology Cost Cap when annual charge factors are changed in the net cost calculation tool
esamapping.csv	Mapping of ESA names for interworking of various Telecom and Commission adopted lists of ESAs. Note that 'grossrevs.csv', 'mobilevols.csv' and 'incomingvols.csv' use a Telecom ESA listing as they are derived directly from the Telecom revenue information.

Tilt Adjustment

582. The tilt represents an determination of the rate of change of the replacement cost of capital equipment. In the first TSO determination, the Commission adopted tilts based on information submitted by Telecom.[170] The TSO and CostProNZ models produce results which are expressed in nominal terms.

583. The Commission has adjusted the tilts using the inflation rate of 2.6% originally used by Telecom by adding inflation to the tilts supplied by Telecom in the first TSO determination. The tilts were adjusted using the following formula:

Nominal Tilt% = (1+ real tilt %) (1 + inflation %)-1.

The tilts once adjusted do not have to be adjusted for subsequent determinations.

Net Cost Calculation Tool

584. The 'Net Cost Calculation' tool has undergone a few minor changes. The control panel has charged from the layout shown in 'Figure 7: TSO Main Control Screen v6.' to 'Figure 8: TSO Main Control Screen 7.01.04'. The binaries are internally identified by version numbers 4.0.0.2 and 7.01.04 respectively.

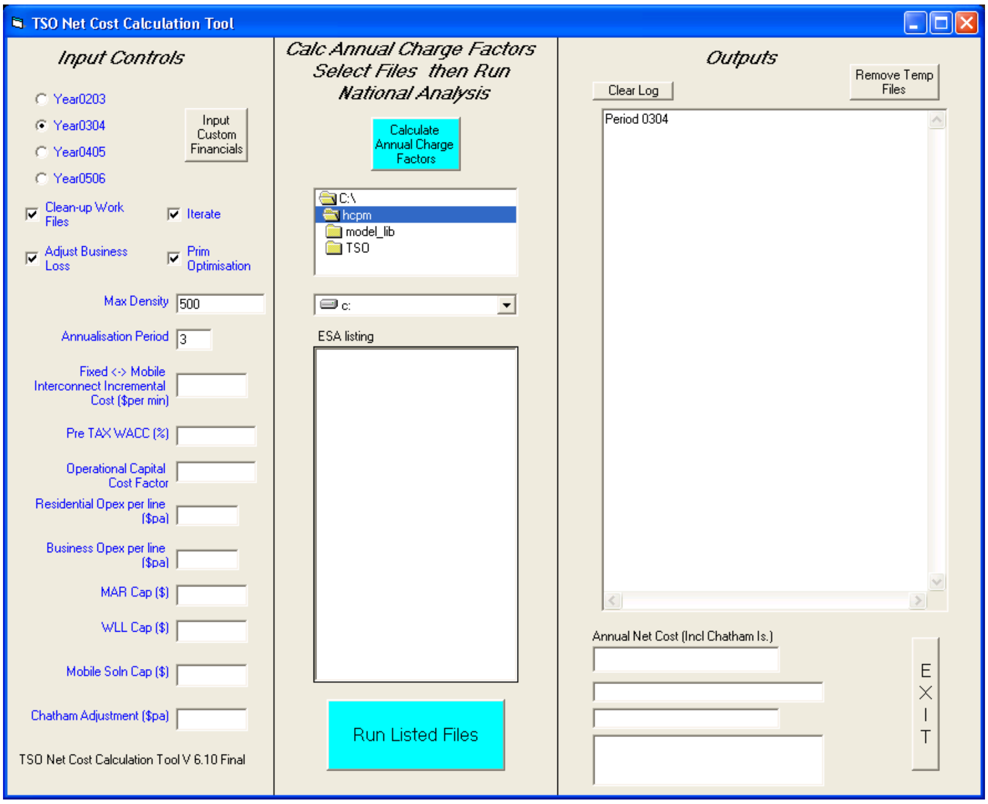

Figure 7: TSO Main Control Screen v6.10 Final

[170] Cf. Commerce Commission, *Determination for TSO Instrument for Local Residential Service for Period between 20 December 2001 and 30 June 2002*, 17 December 2003, para 125-6.

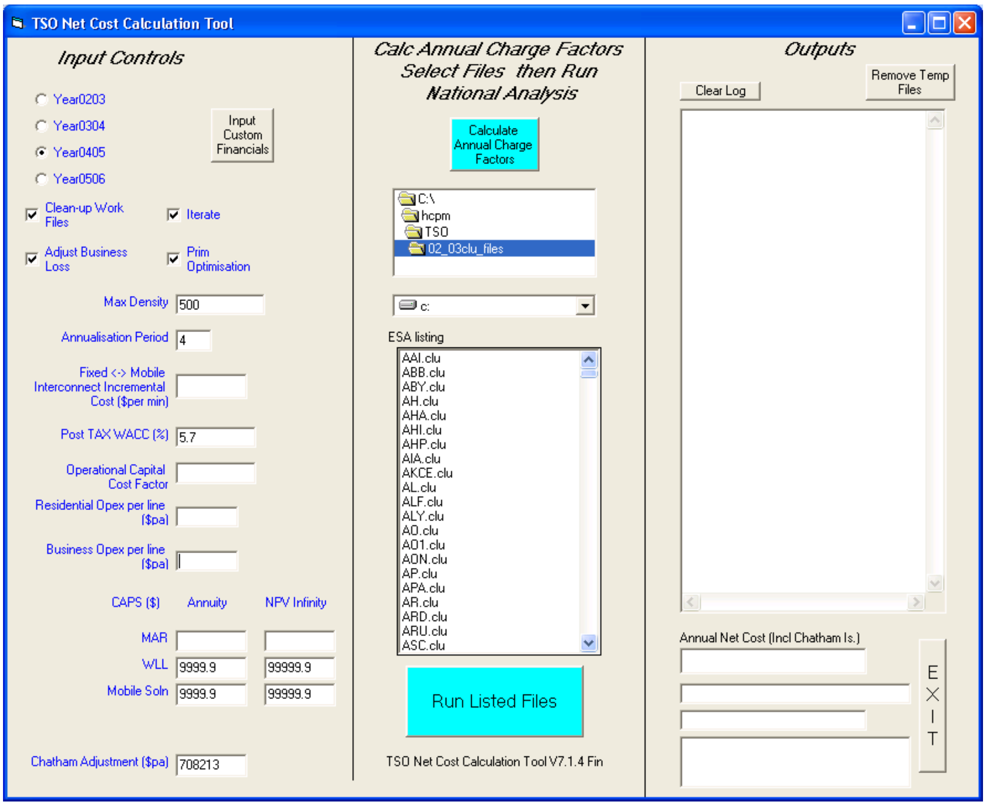

Figure 8: TSO Main Control Screen 7.01.04

585. The only substantive change from the 2003/2004 final determination is that the model now optimises to reduce the network NPV (previously it minimised the annualised cost of this capital).

586. Recent changes to the control panel:

- The NPV associated with an ongoing investment in radio caps[171] is entered on the front panel along with the equivalent annuity.

587. Changes to the underlying data structures and associated programs:

- The contents of 'annchg.txt' have changed as has been described in para 428.
- An additional set of coefficients has been provided n 'convert_to_ann.txt' for the conversion of NPV quantities reported in 'expense.csv' to annuity this is described in para 447.

<u>Installer Instructions</u>

588. The Commission has updated the TSO and the CostProNZ models. The install procedure has changed; the calculation tool has been restyled; the revenue data and traffic data have been updated.

589. The install procedure has changed – the instructions are located on the install disk in the file 'READ_ME_install_instructions.doc'. It is advisable to read these instructions before installing the applications and data.

590. The program suite comprising the TSO programme and the FCC HCPM program has been extensively operationally tested in Microsoft Windows XP and Office 2003. It has not been tested for Windows Vista. It is known that the CostProNZ program does <u>not</u> work with Excel 2007.

[171] For the purposes of this Determination these changes only effect the MAR cap.

Multiple CostProNZ Tables and Associated Scenario Information

591. There are 3 sets of active scenario information that can be directly accessed via the CostProNZ application or they can be physically accessed under the directories HCPM, HCPM0304v22, HCPM0405v22 and HCPM0506v22 located in 'c:\program files\CostProNZ\Scenarios'.

592. The multiple scenarios relating to different years files need support from multiple '.ini' files. These files have moved from ' c:\program files\CostProNZ' and are currently located in 'c:\program files\CostProNZ\ini_lib'.

Multiple HCPM Directories

593. Each year being modelled needs information related to the per customer revenue for that year. This information is held in 'c:\hcpm\TSO\wk_lib'. It is held in the four subdirectories HCPM, HCPM0304, HCPM0405 and HCPM0506. The files were originally held in 'c:\hcpm\TSO\work'. These files are important because not only do they provide the inputs to the TSO program but they also record averaged traffic costs from the CostProNZ program they record the 'decision log' (national.csv) for the TSO program and as part of that log they record the TSO loss. This loss is recorded at a cluster level. This functionality is no different from the previous version's functionality.

Updated data

Tilted data

594. Telecom has provided real tilts, the process to change them to nominal tilts is discussed on paragraph 582. Nominal tilts have been used.

TSO Model Inputs

595. The TSO application has hard coded presets set in module 'form_load()' in the TSO applications VB source code but they can be temporally overwritten via the front panel controls. The current settings are:

Table 37: TSO Model Preset Inputs

Field	Static	Set yearly	2004/2005
Annualisation period		X	4
Fixed to mobile incremental cost ($permin)		X	[ ] TCNZRI
Operational Capital cost factor	X	X	1.12
Post Tax WACC		X	5.7
Residential opex per line	X		$[ ] TCNZRI
Business opex per line	X		$[ ] TCNZRI
MARCap (opex.npv)		X	$[ ], $[ ]
WLLCap (opex.npv)		X	$9,999, $99,999
Mobile Solution Cap (opex.npv)			$9,999, $99,999
Chatham Island Correction		X	$696,451

HCPM Model Inputs

596. The directory 'C:\hcpm\TSO\wk_lib' has four directories HCPM, HCPM0304, HCPM0405, HCPM0506 corresponding 2002/2003 through 2005/2006 respectively. The files in these directories are:

Table 38: HCPM Yearly Input Files

	Static	Set yearly	created in first 1/2 of TSO	created in 2nd 1/2 of TSO	notes
defecondef. csv	X				this is the default economic constants. Tilt etc
econdef.csv					this is the economic constant, possibly after they have been modified by the pgms operator
esacost.csv			X		ESA cost information calculated by stage 1 of the modelling.
esamapping.csv	X				remap some of the names
esanames. csv	X				the link between the abbreviations and the actual names.
grossrev.csv		X			ESA revenues - this information is calculated at the beginning of the period and then left. It is calculated from information provided by Telecom. The field is made up. of the average revenue by customer type for each ESA.
incomingvols.csv		X			all the traffic volumes.
mobilevols.csv		X			mobile traffic volumes
national.csv				X	this is a log file on the TSO programs execution.
newterrain.csv	X				this is a new density scheme.
outtmpcnv.csv					
outtmpprofit.csv					
revbyline.csv			X		ESA information calculated at stage 1 -it includes revenue plus traffic costs.
wcap.csv	X	X			radio cap information
wll.csv	X	X			ESA when wireless local Loop will work.

597. The 'C:\hcpm directory' has 'V6_5 hcpm_current_inputs.xls' this is a series of excel tables that can be exported via a macro, this macro auto runs but can be manually triggered, its tables include those listed in below on Table 39. Some of the tables are overwritten by the TSO model when it runs.

Table 39: HCPM Default Inputs

Table	Static	Set yearly	Set by TSO program	notes
24gdist.txt	X			24 gauge dist unit costs – aerial, buried, ducted
24gfdr.txt	X			24 gauge feeder costs– aerial, buried, ducted
26gdist.txt	X			26 gauge dist unit costs– aerial, buried, ducted
26gfdr.txt	X			26 gauge feeder unit costs– aerial, buried, ducted
ANNCHG.txt			X TSO pgm tilts this info	Annual charge factors Capex-> Opex by technology class
CLUSTER.txt	X			Cluster info – set up
CuFDRMIX.txt	X			Copper feeder Mix of aerial, buried & ducted by density
DISTRMIX.txt	X			Distribution Mix of aerial, buried & ducted by density
DROP.txt	X			Drop Terminal costs – by size and deployment location
FDCOST.txt	X			Assorted feeder cost info
FDI.txt	X			Feeder distribution interface costs
FEEDDIST.prm	X			Feeddist info
FIBRCABL.txt	X			Fibre cable unit costs– aerial, buried, ducted
FiFDRMIX.txt	X			
FILLFACT.txt	X			Plant fill factors
HARDROCK.txt	X			Hard rock terrain costs by technology
INTRFACE.txt	X			Interface with cluster & interface software
MHCOST.txt	X			Manhole costs by duct sizes
MHSPACE.txt	X			Manhole spacing
NORMAL.txt	X			Normal terrain costs by technology
SHARING.txt	X			Plant sharing assumptions
SOFTROCK.txt	X			Soft rock terrain costs by technology
SOILTX.txt				Soil texture – NOT USED
T1fdr.txt	X			T1 Feeder costs – aerial, buried, ducted

Program Maintenance

598. The TSO program has been maintained so that common tasks, performed in different parts of the program suite, are performed by one piece of code. This has allowed improved focus on the functioning of the code and facilitates better documentation of the code but more importantly at a time when the code is being updated it results in easier maintenance by providing greater certainty that each instance of that code will also be updated.

599. The program has been updated by creating a 'type' definition. Any variable dealing with monetary quantities has been given the type NPV_1yr. This has included variables dealing with concepts such as "Profit", "Cost", and "Revenue".

600. Competing technologies (MAR) providing the same service with the lowest NPV are selected.

601. Any fiscal amount that was input as a yearly total e.g. the CostProNZ call costs or the fixed revenue was loaded both as a yearly amount and as the NPV of that amount.

<u>Elimination of 'exptot.csv'</u>

602. The TSO program has previously made extensive use of 'exptot.csv' this is an output from the HCPM program suite. It is a summation of the total expenditure for an ESA. The expenditure reported prior to the code changes was in terms of an annuity. This annuity was used by the TSO program suite which operated to minimise the value of this annuity. The program updates required that both an annualised value and a NPV value could be read by the TSO program as the costs for a particular network configuration.

603. 'Exptot.csv' was unable to provide the required information. This information was available in 'expense.csv'. The TSO program substituted use of 'exptot.csv' in favour of using 'expense.csv'. The NPV is thus directly available and the annuity is able to be derived.

<u>Regression Testing</u>

604. Regression testing is that process whereby after a program has been updated that its functioning is tested against a previously known "good" standard.

605. Regression has been achieved from within the TSO program by the following process:

- The inputs used in 'annchg.txt' are set to the annuity weightings (the required changes are identified with 'regression_testing' in the comments field of the appropriate lines).
- The 'NPV' inputs for the various technology caps are set to their annualised values; and the NPV2Infinity function in the TSO program suite has to be modified as per the comments in the code. The effect of these modifications is to restore the ORC to its previous value, i.e. it has regressed the parameters.

606. The program suite is run for TSO 2003/2004 and the system output, the 'national.csv' file, is compared with the 'national.csv' file as was used in the TSO Final Determination for 2003/2004.

Regression Testing Results

607. Regression testing was setup by overriding the inputs into the TSO model and by changing the code. The changes are identified in the TSO code by the comments "regression_testing". These changes involved changing the function that calculates

the NPV2infinity so that it returns the ORC value. This function is used in numerous places to calculate the NPV of an amount. The HCPM annual charge factor is set to the annuity factor. The radio cap NPV factor presets are set to their equivalent annualised cost.

608. As part of the maintenance, many program variables that had taken on default types were defined. In one area it was realised that there was potential for numerical rounding errors so a preferred solutions was to use 'double' length variables. It is expected that this would result in minor changes to individual answers but no net change in the total TSO loss.

Results analysis

609. The analysis spreadsheet is included on the TSO distribution disk as 'National_test_regression.xls'

610. The following changes were observed (ideally no changes should have been observed):

- 'incremental cost' has decreased by $68,900 from a base of $[ ]M CCRI;
- 'income' no change;
- 'bus lines' no change;
- 'res lines' no change;
- 'Profit' increased by $68,900 from a base of $[ ]B CCRI;
- 'Clust Cost' decreased by $349 from a base of $[ ]M CCRI;
- 'Clust TSO Cost' reduced by $630 from a base of $[ ]M CCRI;
- 'Full ESA TSO Cost' reduced by $220 from a base of $[ ]M CCRI;
- 'CostProNZ Direct Cost' reduced by $17,000 from a base of $[ ]M CCRI; and
- 'Hanging Costs' reduced by $228 from a base of $[ ]M CCRI.

611. In total, the TSO loss has increased by $16,000 from a base of $64M.

612. The two results are substantially the same. There were some instances where individual clusters had larger changes but these did not substantially affect the overall calculation. The Commission has taken the view that to this point the code changes had been correctly implemented.

Commission View Regression Testing

613. The Commission has successfully regression tested the TSO software modifications against a known good solution[172]. The error was 0.07%. The Commission has also provided improved diagnostics in the 'national.csv' file showing the NPV∞ quantities. The Commission's view is that no errors or unexplainable phenomena have been demonstrated during the submissions.

Errors

614. Network Strategies have submitted to the effect that there are serious errors in the revision of the VB program.

[172] National.xls used in the final determination for 2003/2004.

615. Network Strategies has submitted that:[173]

> The errors are simply illustrated by examining the TSO net cost output (national.csv) file for a small subset of ESAs. Exhibit 4.1 below shows an excerpt from national.csv created using 2004/2005 Commission values for all inputs, but limited to analysing three small rural ESAs:
>
> - ALF-Alfredton;
> - ARU – Auroa; and
> - DMD – Drummond.
>
> The TSO net cost generated by these ESAs in the summation of columns J to M in the national.csv file and, in this base case is around [ ]CCRI.
>
> [ ]CCRI
>
> Exhibit 4.1: Example ESAs – commission inputs [ ]
>
> One error immediately apparent from Exhibit 4.1 is that Drummond cluster #5 has a profit of [ ] CCRI, but has been marked as profitable by the TSO net cost calculation tool. This may be a reporting problem, or cluster labelling error in the rearranged iterative cost calculation code. If this is a wrongly labelled cluster, the overall impact on the 2004/2005 TSO net cost (at the Commission's Draft input values) is an underestimation of TSO cost by around $1.4 million.
>
> Network Strategies notes that there are some occasions where the negative profit of an individual wired cluster may not contribute directly to the TSO net cost, but this only occurs when the tool has determined that all remaining cluster in an ESA re both wired and unprofitable, at which point the tool uses that full ESA cost (of remaining wired clusters). This exceptions does not explain [ ] CCRI above.

616. The Drummond profit is negative [ ] CCRI. NSL has submitted that a negative profit, should be looked on as a loss and that a loss making cluster should be classified as non profitable. As outlined in "Update of the TSO 2003/2004 program Optimisation Algorithm" on page 92.

617. The Commission has modified the TSO program's reporting to log the NPV∞ variable that was previously only available internally to the TSO model. This variable is used internally by the program to decide on the profitability of a cluster. A similar example provided by Network Strategies has been reproduced below. At this point it is apparent that the profitability indicator has been correctly set by a consideration of the NPV∞ sign (a negative NPV∞ is loss-making and a positive NPV∞ is profit making). The program has then summed the related annuity.

618. In the case that NPV∞ is negative (i.e. loss making over an indefinite horizon), but is positive for the year in the study, then the annuity acts to reduce the loss. The converse (i.e. a positive NPV∞ with a negative annuity) will not be credited as a loss as the NPV∞ is positive indicating a net positive value.

[ ] CCRI

Figure 9: Demonstration of Profit making ESA Positive NPV but Negative Annualised Profit

619. The Commission is of the view that the behaviour identified by NSL is a direct consequence of optimising on one quantity, NPV∞, and summing another one, the annuity and that this is the logical outcome from the decision to optimise based on NPV.

[173] Network Strategies Limited, *Report on TSO Draft Determinations for the 2004/2005 and 2005/2006 periods*, 6 August 2007, p28,9.

APPENDIX 2: MAR RADIO CAP

620. Multi Access Radio (MAR) also known as Customer Multi Access Radio (CMAR) is a point-to-multipoint communications technology. From one central point it is able to service multiple locations. A communications channel is extended from a central location to a remote radio terminal. Service is then provided by cable from the remote radio terminal to remote customers.

621. Telecom has updated the cost used in the 2002/2003 Determination for rural MAR systems used to access customers in remote and rugged rural areas[174]. These costs are based on replacement of systems to service [ ] TCNZRI high cost customers in the Marlborough Sounds area using modern MAR systems.

622. TelstraClear argued that these MAR radio costs should apply only to extreme locations in New Zealand and that more cost effective radio solutions are available for general rural terrain. TelstraClear provided details of modelling which created a 4 step radio cost cap, utilising a mix of technologies for easy conditions through to extreme.

MAR Radio Cap Parameters

623. In the 2003/2004 TSO the Commission in response to submissions has revised the MAR cap design parameter related to the 'd-side' cabling.

624. The Commission has adopted the HCPM model as the basis for calculation, but has chosen to use the Prim algorithm for calculating the average structural distance per access lines. This distance is used to assess the average cabling distance per customer for MAR distribution cabling and the cost of this cabling. The training sample was those clusters that were MAR capped in the 2002/2003 TSO final determination.

625. The c++ code plus the output reports that the Commission used are held in the program suite under 'C:\hcpm\model_lib\prim'.

Application of MAR Cap

626. Network Strategies have submitted that the MAR cap is applied as a national average which does not provide the exact MAR costs of any real clusters or ESAs.[175]

627. The Commission considers that although the MAR cap is a national cap, when applied it will have instances where costs are less than the average and instances where the cost is greater than average and, as such, will not introduce a consistent bias into the model. Consequently, the Commission's view is that the MAR cap does not require maintenance.

Commission Calculation of Prim Capital Costs

628. The Commission has modified the Prim code used in the TSO Revised Draft for 2003/2004. Two modifications described below have been made.

629. The Commission recognising that HCPM distances are rectilinear and that Prim distances are straight line as has allowed for a factor of 0.343 to be added to the Prim distance calculation. Each piece of cable sheath has its length increased by this factor.

---

[174] Commerce Commission, *Determination for TSO instrument for Local Residential Service for period between 1 July 2003 and 30 June 2003*, 24 March 2005, para 288.

[175] Network Strategies Limited, *Report on TSO Draft Determinations for the 2004/2005 and 2005/2006 periods*, 6 August 2007, p 9.

This factor has been experimentally determined so that in aggregate Prim distances are the same as HCPM distances.

630. Any individual cable sheath length over 2030m is restricted to this maximum length. The cost of this length of cable represents the incremental cost of providing a second MAR system. It is unnecessary then to model a greater single length of cable as an efficient design would simply deploy a second radio system.

631. The analysis determined that the average cable sheath distance between customers was [ ]m CCRI (this is equivalent to the [ ]m CCRI distance in the revised draft inflated by a factor or (1+0.343)m). The optimised Prim distance allowing for the splitting of the clusters is 501m. The cost is then calculated using an average cost of $[ ]/m CCRI and allowing for a drop cost of [ ]TCNZRI at being [ ] CCRI.

MAR Cost Drivers

Table 40: Updated MAR Cost Drivers

Period 2004/05	Equipment per Customer	Cabling per Customer	Site and RMA cost per Customer	Install, Power, Rigging per Customer	Operating cost penalty (radio over fixed)
real tilt	[ ]%	[ ]%	[ ]%	[ ]%	
nom tilt	[ ]%	[ ]%	[ ]%	[ ]%	
Time to Build (years)	[ ]	[ ]	[ ]	[ ]	
Asset Life (years)	[ ]	[ ]	[ ]	[ ]	
Item CAPEX	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Annualised CAPEX	$[ ]	$[ ]	$[ ]	$[ ]	
Total Annualised CAPEX	$[ ]				
Capital Charge Factor	[ ]				
Total Cost	$[ ]	(cost inclusive of operating cost penalty)			
NPV Infinity CAPEX	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Total NPV Infinity CAPEX	$[ ]				
Capital Charge Factor	[ ]				
Total Cost NPV	$[ ]	(cost inclusive of operating cost penalty)			

(All entries TCNZRI unless otherwise indicated)

APPENDIX 3: WLL & MT RADIO CAPS

Overview

632. In the interests of a minimal set of changes to the TSO program no changes to the algorithm have been undertaken. The cap has been set at 99999. This is a value that is high enough so that the cap will not be effective.

633. The capping process shown below forms part of the algorithm's documentation.

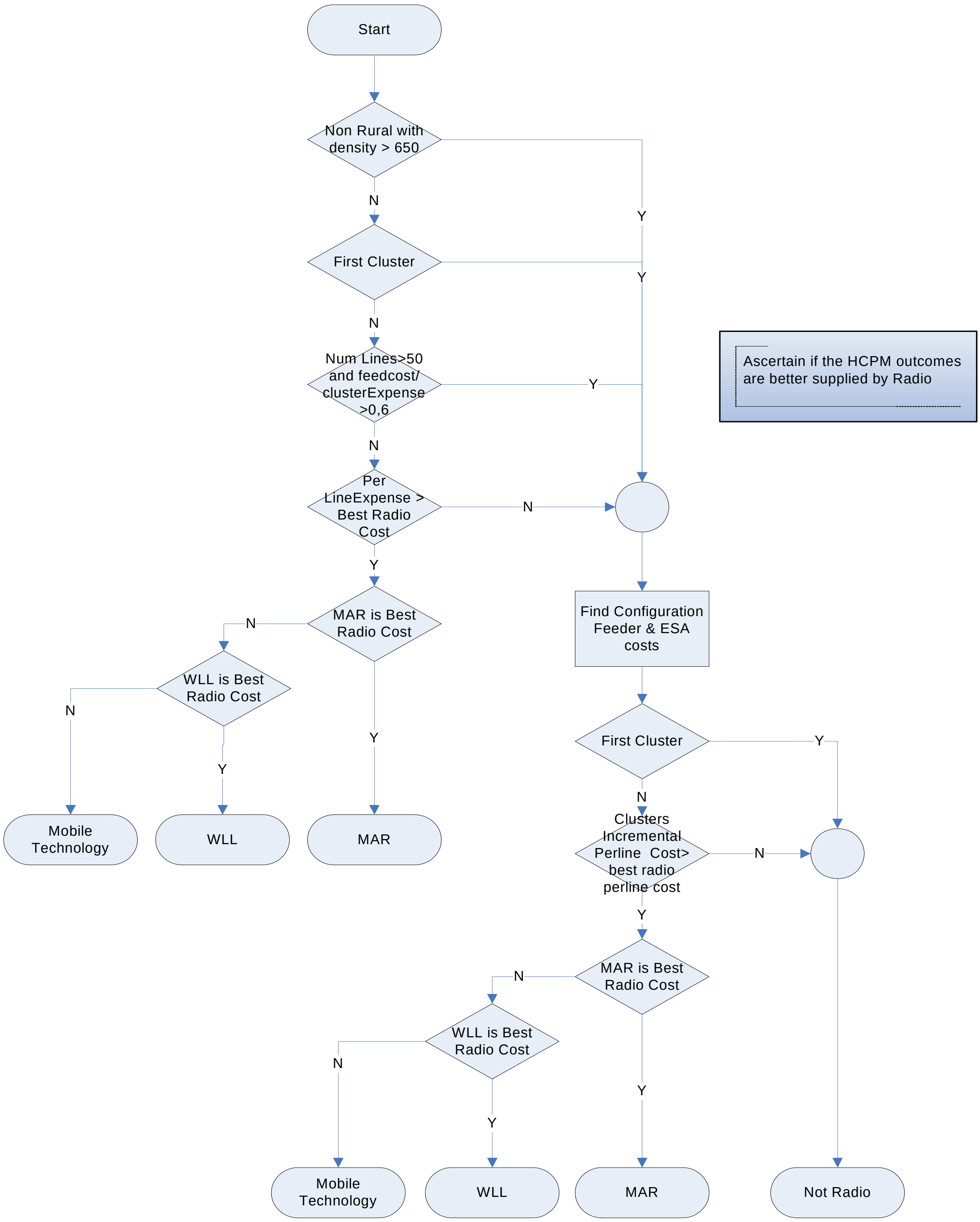

Figure 10: Capping Process

634. The Commission has not updated the WLL and MT caps despite various written and oral submissions. To do so would have effectively meant that Telecom and the Liable

Persons would still have to fund the TSP's network that was in place in 2003/2004. Telecom and the Liable Persons should be indifferent to any scenario where the NPV of this network is preserved: refer to "New access technologies, the tilt, asymmetry, and the "NPV = 0" rule" on page 37.

APPENDIX 4: COSTPRONZ CORE NETWORK/TRAFFIC MODELLING

Description of CostProNZ Model

635. The CostProNZ program calculates the LRIC cost for material and labour investments associated with the switching, signalling, and transport of landline telecommunication network functions. In conjunction with the HCPM program, the output from CostProNZ is used to calculate the TSO net cost.

636. CostProNZ was designed to use forward looking, commercially available telecommunications technologies. It also employs modelling algorithms which reflect the best practice of contemporary switch and transport engineering.

Incremental Calling Costs

637. In modelling the net cost of the TSO, the relevant increment is CNVCs and not all residential customers. The commercial viability of serving groups (or 'clusters') of customers is tested, and in doing so, both the access costs (associated with providing the customers with an access line) and the core costs (associated with the supply of call services) are considered.

638. In considering a particular cluster of customers, CostProNZ seeks to capture the incremental costs of supplying call services in respect of that cluster. Specifically, for that cluster, CostProNZ focuses on the incremental costs associated with:

- Free local calling – standard voice calls;
- Free local calling – standard facsimile calls;
- Free local calling – standard internet calls;
- Free genuine standard voice calls to emergency (111) service; and
- Supplementary services provided by the core network which offset the TSO loss, including tolls services and value-added services (such as Call Minder, etc).

639. CostProNZ complements the access model by estimating the incremental cost of calls for commercially non-viable customers. CostProNZ provides incremental cost information and cost-volume relationships, which are used in the HCPM cluster manipulation process to test areas and groups of customers for commercial viability. The output from CostProNZ feeds into the estimation of the total net incremental cost of providing service to a customer group, and allows comparison with gross revenue figures provided by Telecom.

640. As the Commission has noted previously,

> In the context of the TSO, the incremental cost of an obligation to provide services to a commercially non-viable customer is therefore equal to the difference in the firm's total costs between when it supplies that customer in conjunction with all its other customers, and when it does not.[176]

641. To the extent that costs are fixed and common across CNVCs and commercially viable customers, those costs should not be included in the incremental cost of the TSO. Such costs would continue to be incurred irrespective of whether the CNVCs are served.

[176] Commerce Commission, *TSO Cornerstone Issues Discussion Paper*, p 11.

642. However, in the modelling of the incremental calling costs associated with the TSO, the extent to which the obligation to supply service to CNVCs requires an increment to capacity within the core network needs to be identified. For example, a switch may serve both commercially viable and commercially non-viable customers. The issue is, what is the incremental cost of supplying call services to the CNVCs?

643. The Commission has used the following method to implement LRIC. The first step is to define a 'cost object'. A cost object is anything for which the measurement of cost is appropriate. Cost objects are usually thought of as products, services, network elements, or the firm as a whole. For example, in the access network, one of the cost objects is a cluster of customers. When a cluster is tested within the access network, all of the network elements attributable to that cluster are identified and costed. However, when a cluster of customers is tested within the access network for viability, the cost driver in the core network is no longer the network elements associated with that cluster, but instead is the volume of calls that were generated by that cluster.

644. These calling costs, in conjunction with the results from the access model, are then used to determine the total net incremental cost of supplying services to that cluster of customers.

<u>LRIC Approach Used in CostProNZ</u>

645. LRIC is the cost avoided through no longer providing the output of a defined increment given that costs can be varied and that some level of output is already produced.

646. An increment is the output over which the costs are being measured, and theoretically there is no restriction on what products, services or outputs could collectively or individually form an increment. In extremis, the cost of providing an extra unit of output of a service will equal the marginal cost, while the incremental cost of providing the entire output of Telecom will equal the total cost of Telecom.

647. Incremental costs are those costs that are caused by the provision of a defined increment of output. Equivalently, incremental costs can be defined as those costs that are avoided by not providing the increment of output.

648. As a case in point, the fixed Public Data Network (FPDN) and the PSTN can be said to have costs which are common between them. However, assuming that both a quantity of both FPDN and PSTN traffic is already being transmitted, TSO traffic is only incremental to the volume of traffic traversing the PSTN network.

649. Therefore, the capacity to which the transport network has been sized is based on the call volumes of free local calling (voice, facsimile and internet calls) and any other supplementary call volumes as defined by the Act. This suggests that the LRIC costs represent the avoidable costs of the provision of TSO services over the PSTN network.

650. The impact on the costs of no longer providing the defined increment is measured taking a long run view. This allows all costs to vary (even if only in the long term) to adjust to the change in output.

<u>Sharing of core costs between voice and data networks</u>

651. The Commission's models prior to CostProNZ v2.0 had not explicitly modelled the shared core costs between voice and data networks. It had instead used modified structure sharing percentages. Post CostProNZ v2.0 these costs have been explicitly

handled by the model. The percentages are presented on Table 48: CostProNZ Sharing Assumptions for Core Network.

Modelling the TSO increment

652. For the network modelling exercise, CostProNZ has used three major cost objects: cluster, exchanges (wire centre) and traffic (defined in the model as lines, minutes of usage and calls set up). The cluster has been discussed above and is typically related to the access network. The exchange cost object includes some core network assets and some access network assets. This is a key cost driver since there are some costs within the exchange that would be considered fixed with respect to individual clusters but might be considered variable within the exchange cost object. The last cost object is the volume of traffic. As clusters of customers within the access network are tested, there will be a flow-on effect into the core network, where the cost of those volumes of calls traversing the switches and transmission lines will be valued. These calls include local calls, as well as any included supplementary call services such as toll calls and fixed-to-mobile calls.

653. Figure 11: Asset Classification Decision Tree shows the typical decisions that will be made in order to classify each asset based on the change in increment of a particular cost object.

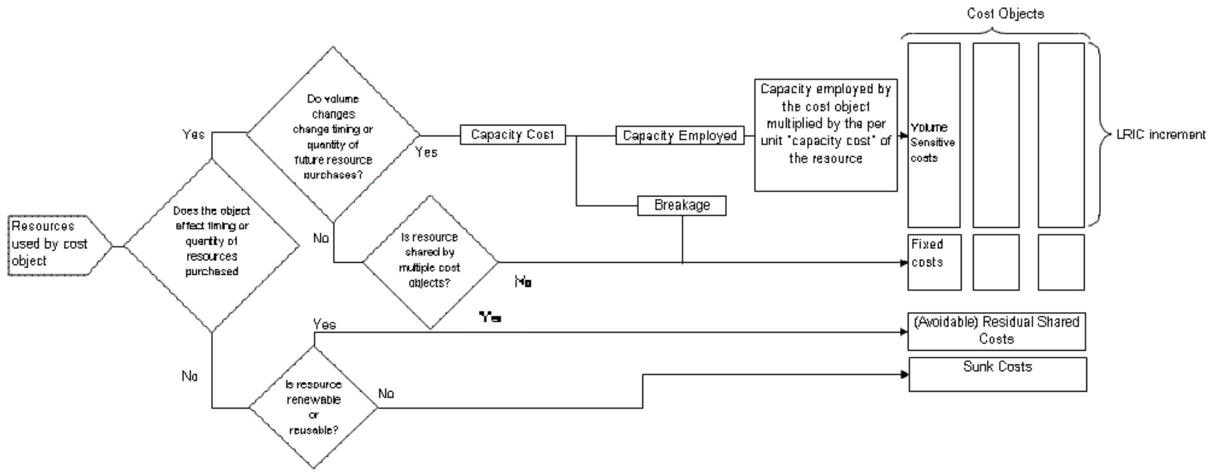

Figure 11: Asset Classification Decision Tree

654. In Figure 11: Asset Classification Decision Tree there is a split between 'Capacity Employed' and 'Breakage'. These terms are used to address the problem of costing the 'lumpy' nature of telecommunications assets. The technique to be used to address the costing of these lumps of investment is called 'Capacity Costing'. This is a way of apportioning the cost of used and unused capacity in a given asset lump. If the asset has a total cost of $x, and a total number of useable units C, then the apportioning of the costs per unit of capacity is simply $x/C. This value is the per unit capacity cost of the asset. The 'Breakage' term relates to the distinction between used and unused capacity. The used capacity ('Capacity Employed' in the diagram) is multiplied by the per unit capacity cost in order to find the total volume sensitive costs used in the increment. The capacity which is not employed is considered to be a fixed cost and is not used in the LRIC increment.

655. In other words, where the TSP has invested in incremental capacity with which to serve CNVCs, only that part of the capacity which is actually utilised is included in

CostProNZ. The unused capacity is excluded (until the point at which that capacity is actually taken up).

656. For example, consider a switch that has a capital cost of $100, a capacity of 100 units and therefore a unit capacity cost of $1. Now suppose that the used capacity amounts to 80 units, and that two equal clusters of customers are served by that switch. In testing the viability of one of those clusters, the costs of serving those 40 units are considered. CostProNZ takes the incremental capacity as being the 40 units, and determines the cost associated with those units ($40).

657. Having determined the incremental capital associated with the cost object, an annualisation factor is applied in order to generate an annual capital cost, incorporating both a return on capital and a return of capital. This is by application of a tilted annuity to the incremental capital. The annuity term includes both a return of capital (depreciation) and a return on capital.

658. The Commission's cost modelling has focussed on the capital costs of supplying TSO services to CNVCs. However, in addition to these costs, an efficient provider will incur a range of non-network operating and maintenance costs.

659. The Commission has therefore included an adjustment to reflect the level of operating expenditure (opex). The Commission believes that it is appropriate to treat opex as a function of the capital value of the network, and has therefore applied a fixed percentage to the capital base. This approach is also consistent with that followed by regulators in other jurisdictions.

660. The Commission believes that the best available indicator of the level of opex required to service and maintain a TSO services network in New Zealand is that provided by the TSP itself. Telecom has provided the Commission with a detailed analysis of the level of opex that it incurs and the Commission has developed this into a percentage value of total capital employed in CostProNZ.

CostProNZ Cost Types

661. CostProNZ employs the following definitions of costs.[177]

> ***Directly Attributable Costs*** *are those costs that are incurred as a direct result of the provision of a particular service in a particular increment. These costs fall into two types. First, the costs of some inputs vary with the level of output, so that even if the production of more than one service requires this input, the extent to which a single service causes the costs can be calculated. Second, there are assets and operating costs which are fixed with respect to the level of output but which are service specific.*
>
> ***Shared Costs*** *are the costs of those inputs necessary to produce two or more services within the same cost increment, where it is not possible to identify the extent to which a specific service causes the cost. Examples of shared costs in the core network include optical fibre, transmission equipment and related overheads, all used by PSTN, leased line and data services.*
>
> ***Common Costs*** *are the costs of those inputs necessary to produce one or more services in two or more increments, where it is not possible to identify the extent to which a specific increment causes the cost. Trenching costs provide a good example of the difference between shared and common costs. The costs of trenching specific to the access network (or the core network) will generally be shared costs since it is likely to be used by two or more services. However, some trenching will be used by both the access and the core network. In these instances, the costs will be common costs.*

[177] *version 2, CostPro*NZ Methodology Manual,* P 12.

Best Practice Engineering Design Rules for the Model

662. CostProNZ's design approach puts much of the logic and network design into user adjustable inputs so that the platform is flexible to meet changing / evolving requirements. For example, options exist for the user to place Carrier type equipment to serve smaller ESAs.

663. As a guiding set of principles (but not exhaustive):

- CostProNZ will handle switchless ESA linking costs as required by HCPM;
- the latest, currently deployed technologies are used at each point of the CostProNZ network;
- transport facilities are sized to meet demand on each route;
- transport nodes are sized to meet demand on each route;
- transport nodes are engineered to use the most economical technology (e.g., radio versus fibre);
- transport rings are determined based on new designs:
- point to point architecture is used where appropriate and is partially controlled by a user input specifying survivability requirements;
- transport modelled distance are based on road routing;
- switching components are sized to meet demand and projected growth on each route; and
- switching technology at each site is selected to recognise size of site and so that appropriate equipment (61E, RLU, etc) is placed, depending on the user input. In certain instances (as guided by user inputs) the model will deploy Carrier type systems in smaller ESAs.

Costs Captured When a Whole ESA is Unprofitable

664. CostProNZ accounts for exchange, land, and building costs for all ESAs in New Zealand. How those costs are reported is based on the user's reporting selections.

665. Land and building are based on factors of the exchange investment. Typically in examining the profitability of a group of customers, the use of ESA Capacity Costs from the CostProNZ reporting is appropriate. These capacity costs, as described above, include the long run costs incurred by those customers (whether it is line, usage, or call driven costs). However, the user has the choice to include only those costs considered Direct (CostType = 'D'), Shared (CostType = 'S'), Common (CostType = 'C'), or a combination. If the user selects a CostType of S or C, the output costs will include land building, and non-volume sensitive components of the network. While these costs are Shared or Common by nature, they are unitized in the same manner as the Direct costs they are associated with. For example, since land and building costs are developed by factors applied to investment, the capacity costs for land and building are based on the capacity costs of the exchange investment.

666. If the user wants to understand the costs incurred by the entire exchange when it is shown to be unprofitable, the user can include the Direct ESA Costs in reporting. By selecting this field, the user can now understand what costs, in addition to the capacity costs, could be avoided if the exchange was not served (alternatively, the additional costs that are incurred when the exchange is served).

<u>Incremental Cost Calculations</u>

667. Incremental costs in CostProNZ are based upon the capacity cost techniques described above. That is, what portion of the useable capacity is the cost object consuming? To develop the useable capacity and the total installed plant, each network component was reviewed to determine the major cost driver (lines, usage, or calls). With the total volumes of the cost drivers, the model then develops the quantity of components needed and the total installed amount of useable capacity.

668. For some components, the cost driver is an ESA, a route, or a ring. For these costs, the total costs were uniquely developed based on the component. For example, the amount of fibre on a ring is based on distance. For these Shared and Common portions of the network, the capacity utilisation (based on lines, usage and calls) is zero since the costs are fixed over a broader base. However, for reporting purposes, these shared and common costs are unitized based on the cost driver volumes the item supports (e.g. for fibre and structure, the capacity is based upon the number of E1s traversing the segments) or in the instance of land and buildings, it is based on the same proportion as the direct capacity costs of the switch.

669. Capacity costs do not include the unused capacity of the components. To include the unused capacity of the investments in the reporting, the user can select working cost fields. In effect, the Working cost fields represent the unitization of the network investments by the working capacity rather than the useable capacity. This Working cost is akin to the FCC's TELRIC costs.

670. As a broad guide, the following provides the increments and drivers of the basic assets in the core network:

- Transport Electronics: The basic driver of transport electronics (SDHSystem, SDHPlugins, SDHRegenerator, DCSSystem, DCSPlugins, RadioSystem, RadioTowers, RadioPlugins) is the minutes of use touching the system. While some of the costs are fixed for the ESA (Radio Tower), all costs are unitized over the installed capacity of usage at the system or in the plug-in cards. Usage is derived from the installed E1s at the site. The E1s are derived based upon the user input for Erlangs Per Trunk and the actual traffic touching the node.
- DLC: DLC is used as an alternative to switching at very low volume ESAs. The Digital Loop Carrier (DLC) system, aggregates and concentrates traffic for transport over fibre back to a host exchange. DLC systems are sized based upon the channels and lines terminating at the system. As such, the system and plug-in cards installed investment is unitized over the lines the system and plug-in cards will support.
- Fibre and Structure: The fibre and structure investments are heavily dependent upon the road distances between transport segments. Most of the transport segments are within a ring that connects numerous ESAs along a shared, redundant, connecting path. However, a few ESAs are isolated and more cost effectively served by running spur (i.e. point to point) segments out to the ESA. In either case, CostProNZ captures the total designed traffic over each segment to determine the segment's capacity. For example, a transport segment from ESA A to B may have a remote to host ring's traffic, a host to tandem ring's traffic, and the tandem to gateway ring's traffic. Using the sum of the traffic, the segment's investment is unitized to the designed traffic over the segment. This designed traffic is derived from the E1s on the transmission

plug-in connected to the system and the Erlangs per Trunk the E1s are assumed to support. While the spur calculation is similar, the amount of traffic over the spur may be much less since it is less likely to be the route for higher level transport rings.

- Switching: Switching investment is made up of multiple components, many of which are driven by differing cost drivers. For example, the line cards of the switch are driven by the number of lines terminating at the switch. The ringer component is driven by the number of calls, while the trunk cards of the switch are, in effect, driven by the usage emanating from the lines connected to the switch. Using the capacity of each component (or the best approximation), the component's investment is unitized based on the installed capacity.
- Land and Building: Land and building are loaded via a factor in CostProNZ. As such, they are assumed to follow the same characteristics as the investment they are loaded against.

DLC modelled costs

671. DLC are a switching concentration style that is not present in the Telecom switching platform. This use is described in paragraph 670.

672. Telecom has submitted that:[178]

> …the Commission has continued to dimension carrier node transmission link requirements based on traffic rather than on the number of lines to be served, assuming (as stated in para 509) that DLCs concentrate traffic. Telecom has previously pointed out the mis-match that this causes, in that the prices for the DLC equipment used in the model are based on equipment used by Telecom, which do not incorporate this concentration functionality, and would therefore be relatively cheaper than alternative equipment that has this functionality. Telecom therefore submits that the Fixed System prices used for DLC equipment in the CostPro model should be raised by 40% to account for this functionality that the Commission is basing their modelling on.

673. In response, Network Strategies submitted that:[179]

> …the concentration functionality described by Telecom is now very standard in this type of transmission device and is surprised that a price premium of 40% could be charged for it. It may be that the 40% is calculated using the price of additional equipment required to interface Telecom's older systems to a modern concentrating interface.

674. The Commission's view is that Telecom, if acquiring a state of the art PSTN switching network, would have included this functionality. Much of the cost development would have been in the switches operating system. This cost, as well as the hardware costs, would have been used by business customers. The cost would not then be incremental to residential customer usage. The Commission has not allowed for extra costs as suggested by Telecom.

CostProNZ Modelling Inputs

675. The inputs required for CostProNZ can be broken down into three major categories: engineering design rules, asset price information and financial parameters.

Engineering Design Rules

676. The engineering design rules are used to lay out the appropriate network assets and dimension the capacity of the network according to demand. For example: what

[178] Telecom, *Submission on the TSO 04-05 and 05-06 Draft Determinations*, 6 August 2007, p 22, para 69.
[179] Network Strategies Limited, *Review of submissions to the 2004/2005 and 2005/2006 TSO Draft Determinations*, 20 August 2007, p 6.

maximum number of lines should an RLU host before being resized as a local switch, or what different types of assets should be used in particular scenarios, such as at what distances DMR is substituted for submarine fibre?

Asset Price Data

677. The asset prices are used to develop a total capital cost of the modelled network. These costs can be divided into two categories; assets required for the switching of calls and assets required for transporting calls between switches (transmission). Of principal concern to the Commission is that in gathering information on appropriate asset prices, all care is taken in collecting data which is applicable to the New Zealand commercial environment and that consistency is maintained across the network.

678. With regard to the asset prices, the Commission is cognisant of the fact that Telecom may receive discounts which are specific to the New Zealand commercial environment. These discounts may be based on Telecom's purchasing power, the strategic advantage a vendor may see in having its products placed in New Zealand or the population distribution in New Zealand and its specific geographic characteristics. With these issues in mind the Commission does not believe it is appropriate to take the list prices of overseas vendors and make the necessary adjustments to these prices in order to obtain a New Zealand specific pricing structure. To this end the Commission has looked to source asset prices that would actually be applicable to the roll out of a TSO services network in New Zealand.

679. In the case of the consistency of the information the Commission gathers, there are two issues: that the assets for which information is collected represent all of the assets required for the provision of TSO services without omission or replication, and that the assets used in the network are compatible with respect to the design of the whole network. With this in mind, the Commission asked all liable persons and Telecom to provide asset price information.

Financial Inputs

680. The financial parameters are used to turn the total capital cost of the network into an annualised capital cost. This process uses the tilted annuity formula as discussed in the Commission's 'TSO Implementation Issues'[180] paper which takes as its inputs the categories of:

Tilt	The rate of change in the price of the assets,
Asset Life	The economic life of the asset,
WACC	Weighted Average Cost of Capital,
Opex	Operational Expenditure.

The values of these parameters that have been adopted by the Commission are detailed in the following tables.

[180] Commerce Commission, *TSO Discussion Paper and Practice Note – Implementation Issues Paper*, 19 April 2002.

CostProNZ Model Parameters

Financial Parameters

681. CostProNZ financial parameters are shown below.

Table 41: CostProNZ Financial Parameters

Asset Category	Real Tilt (%)	Nominal Tilt ((%)	Asset Life (yr)	Opex Rate (%)	Time To Build (yr)
Aerial Fibre	[ ]	[ ]	14	4.3	0.5
Building	[ ]	[ ]	50	2.8	0.5
Buried Fibre	[ ]	[ ]	20	4.3	0.5
Circuit	[ ]	[ ]	8	4.3	0.5
Conduit	[ ]	[ ]	50	4.3	0.5
Land	[ ]	[ ]	1000	2.8	0
Pole	[ ]	[ ]	14	4.3	0.5
Radio	[ ]	[ ]	10	4.3	0.5
Submarine Fibre	[ ]	[ ]	20	4.3	0.5
Switch	[ ]	[ ]	10	2.8	0.25
Underground Fibre	[ ]	[ ]	20	4.3	0.5

All real and nominal price tilt information in the above table is TCNZRI

Trenching Costs

682. Trenching costs and activity percentages in CostProNZ have been updated to better match those developed for HCPM.

Table 42: CostProNZ Trenching and Activity Costs

Density Area	Activity	Base Cost	Pct Activity	Pct Assign Phone	Normal	Soft Rock	Hard Rock
Metro	Plow	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Metro	Trench & Backfill	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Metro	Asphalt Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Metro	Concrete Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Urban	Plow	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Urban	Trench & Backfill	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Urban	Asphalt Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Urban	Concrete Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Suburban	Plow	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Suburban	Trench & Backfill	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Suburban	Asphalt Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Suburban	Concrete Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Rural	Plow	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Rural	Trench & Backfill	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Rural	Asphalt Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%
Rural	Concrete Trench	$[ ]	[ ]%	[ ]%	[ ]%	[ ]%	[ ]%

683. These values are applied in conjunction with 'structure sharing' and 'structure density factors' to calculate the actual cost per metre for each structure type. For the purposes of this determination, structure sharing factors are unchanged and structure density factors are set to 100% for all terrain types.

Engineering Design Rules

684. Other CostProNZ engineering design rules are unchanged from the 2001/2002 TSO Determination.

Asset Prices

685. For each asset listed in the inputs for the CostProNZ model, there is a brief description of the input and what the source of the data is.

CostProNZ Model Inputs

686. The 'C:\Program Files\CostProNZ\Scenarios' directory four directories supplied by the Commission they are HCPM, HCPM0304v22, HCPM0405v22, HCPM0506v22 corresponding 2002/2003 through 2005/2006 respectively. Each subdirectory has its own access database being the complete set of CostProNZ scenario files for that year. Within each CostProNZ database there are the following tables

Table 43: CostProNZ tables

Table	Static	Update for each determination	Feed from hcpm->costpro	update for tslric	Description
tblAbout	X				Version info
tblCallTrafficSensitivity	X				Call Traffic Scale Factor
tblCNVC		set to 0	X	populate with cnvc	Cnvc by ESA
tblCOMAnnCapCostFactors	X				Annualisation Capital Cost Factors
tblCOMAssetClassification	X				Asset Classification against asset portfolios
tblCOMTouchCostElements	X				Switch Traffic vs. plant the traffic touches
tblCSVHcpm	X				Bus res and copper line counts by ESA
tblCSVRingPaths	X				Logical SDH ring paths
tblCSVRingPathsAirline	X				Airline distance length of ring segments
tblCSVTerrainDensity	X		X		Density & terrain % by ESA
tblDataTraffic		Refresh		= <-	Data E1 counts in SDH rings
tblINVRingElec					work space
tblINVRingFacility					work space
tblINVSwitching					work space
tblLICA	X				List of LICA
tblRoadDistances	X				From-To ESA Lat/Lon & road dist
tblRPTReport					work space
tblRPTTSLRICDensityCallType					work space
tblRPTTSLRICLICACallType					work space
tblRPTTSLRICLICAGroupCallType					work space
tblRPTTSLRICSimpleCallType					work space
tblSimpleCallType	X				
tblStats	X				CostPro Internal
tblSUMCapToWorkFactors					work space
tblSUMESATransportCosts					work space
tblSUMRingCosts					work space
tblSUMRingCostsSummary					work space
tblSUMRingParentNode					work space
tblSUMRingPathCost					work space
tblSUMRingRemoteNodes					work space
tblSUMTransportInstalledCost					work space
tblSUMTransportUtilizedCost					work space
tblSWAddlPSTNCosts	X				Costs not otherwise caught in the model
tblSWCallTypeUsage		refresh			call type usage by ESA
tblSWDiscount	X				Vendor discounts
tblSWEngineeringRules	X				Distances technologies work over
tblSWFeatureCounts		X		X	Feature penetration
tblSWFeaturesLinePenetration	X				Lines type average penetration
tblSWFillFactors	X				Max user capacity before expansion needed
tblSWGrowthRate	X				forecast growth
tblSWITU7Invest	X				switch & related costs
tblSWITU7SCP	X				SCP Costs
tblSWITU7STP	X				STP Dimensioning
tblSWLaborRates	X				Engineering labour rates
tblSWMiscFactors	X				Aircond, power plants etc
tblSWNetworkTraffic	X				Design info - busy hours erlangs, call completion ratios
tblSWSwitchDimension	X				switch dimensioning ringers, pra, bra etc
tblSWSwitchSub61E	X				61 e switch dimensioning
tblSWSwitchSubRemotes	X				RLU dimensioning
tblSWTouch	X				Call type touch table
tblSWType	X				Type of switch at each ESA
tblSYSCallTypeTraffic					work space
tblSYSDensityTypes					work space
tblSYSESASWMaster					work space
tblSYSHcpmIN					work space
tblSYSNodeMaster					work space
tblSYSRingPathMaster					work space
tblSYSRings					work space
tblSYSRingTraffic					work space
tblSYSRingTypes					work space
tblSYSTempRings					work space
tblTMPAnnCapCostPct					work space
tblTMPCallTypeQtyByTouch					work space
tblTMPCallTypeUsage					work space

Table	Static	Update for each determination	Feed from hcpm->costpro	update for tslric	Description
tblTMPCostUOMForCallTypeReports					work space
tblTMPDataE1					work space
tblTMPDataE1Prelim					work space
tblTMPESADataPaths					work space
tblTMPInstalledE1sBySwType					work space
tblTMPNonCNVCPct					work space
tblTMPRingTraffic					work space
tblTMPSumNodes					work space
tblTRAerialStruct	X				Aerial structure costs
tblTRCOFiberTerm	X				fiber termination
tblTRDensity	X				Teledensity relation to area type
tblTRDensityFactors	X				Density metro/ urban/suburban/rural
tblTRDigitalMWRadio	X				DMR Costs
tblTREngineeringRules	X				fiber engineering rules
tblTRFiber	X				unit cost of fiber
tblTRFiberPlantMix	X				Underground/ overhead … mix fr fiber
tblTRFillFactors	X				Trans trigger invest fill factors
tblTRInstallationFactors	X				engineering design factors
tblTRManhole	X				manhole unit costs
tblTRMHPoleSpacing	X				distance between poles
tblTRMiscInvestFactors	X				engineering design factors
tblTROptDistFrameBlk	X				unit costs of optical distribution blocks
tblTRRadioTower	X				unit cost radio towers
tblTRRmtFiberTerm	X				fiber termination costs
tblTRRptrEquipTower	X				tower associated costs
tblTRStructureSharing	X	X diff assump		X diff assump	structure sharing costs (there are different sharing assumptions between the TSO and TSLRIC models.
tblTRTransEquip	X				transmission equip costs
tblTRTrench	X				trenching unit costs
tblUAIStudyType		"TSO"		"TSLRIC"	Mode switch

<u>Remote Fibre Terminal, 1440 size</u>

687. Telecom submits that the 'Remote Fibre Terminal', 1440 size (see tblTRRmtFiberTerm) should be set back to 4 times that of a 360 system, which is the largest size used in practice by Telecom.

688. The Commission has decided to retain the larger size fiber terminal as it considers that an efficient provider would use the larger terminal.

<u>Remote Fibre Terminal, 120 size</u>

689. Telecom submits that the price for the 60-line system is relatively low compared to the Remote Fibre Terminal, 120 size (tblTRRmtFiberTerm) due to the 60-line system being designed especially for low density rural areas, whereas the 120-line system is a completely different system.

690. The Commission considers that a 120 line system is a reasonable technology to deploy.

<u>Update Switch/RLU UPS prices</u>

691. Telecom submits that the labour installation component within the switch unit prices should be based on actual contract prices rather than on BOP estimated man-hours per frame.

Table 44: Switching Subsystems 61E LX/RX/NX/IX

Item	2Mb DDF	MDF Term	2Mb LTE	NEAX Equip	Labour	Power/AirCond	Sub Total
Traffic-Driven Investment Items							
61E Ringer Module	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Primary Multiplexer (excl NW and CP)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
ISDN LCPM (for BRA/HDTM, excl NW and CP)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
ISDN LCPM (for PRA, excl NW and CP)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
2Mb Digital Trunk Interface (excl NW and CP)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
2Mb Host Digital Trunk Interface (excl NW and CP)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
101 N/W (including TSCPF and CP)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
101E N/W (including TSCPF and CP)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
General 101E Set Up (Excluding SS7)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
General 101 Set Up (Excluding SS7)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
101E CCSPF Set Up (Excluding SS7 links)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
101 CCSPF Set Up (Excluding SS7 Links)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
SS7 Link (Excluding CCSPF)	[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
2Mb RDLU Digital Trunk Interface (on RDLU or Host HDTM)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Line-Driven Investment Items							
A-8LC Line	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
A-4LC Line	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
A-4LT Line	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
DTLM 2Mb Termination (30 lines)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per BRA Line (excluding LCPM)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per PRA Line (excluding LCPM)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per HDTM (for RDLU) (excluding DTI's)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Fixed ISDN Investment	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]

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Table 45: Switching Subsystems RLU

Item	2Mb DDF	MDF Term	2Mb LTE	NEAX Equip	Labour	Power/AirCond	Sub Total
Traffic-Driven Investment Items							
RLU Ringer Module	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Remote Local Controller (RLOC) (including DTI's)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
General RLU Set-Up Investment per RLU.	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
General RLU Set-Up Investment per RLU Site.	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
2Mb RDLU Digital Trunk Interface (on RDLU or Host HDTM)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Line-Driven Investment Items							
RLU A-8LC Line	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
RLU A-4LC Line	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
RLU A-4LT Line	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
RLU DTLM 2Mb Termination (30 lines)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per BRA Line (excluding RDTF)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per RDLU RDTF	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per RDLU Test Module (including test lines)	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]

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Table 46: ITU No. 7 Signalling Investment Inputs

Item Description	2Mb DDF	MDF Term	2Mb LTE	NEAX Equip	Labour	Power/AirCond	Sub Total
Gen Setup Investment per STP.	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per SS7 Link on STP.	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]
Investment per STP CPM	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]	$[ ]

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Table 47: SS7 Link

# of SS7 Links				
STP	**# of CPM's**	Working	Installed	**Total Invest.**
STP1 (POP5)	[ ]	[ ]	[ ]	$[ ]
STP2 (HN6)	[ ]	[ ]	[ ]	$[ ]
STP3 (PRO4)	[ ]	[ ]	[ ]	$[ ]
STP4 (CH8)	[ ]	[ ]	[ ]	$[ ]
Totals	[ ]	[ ]	[ ]	$[ ]

TCNZRI

692. The Commission has recognised that this rate will represent a New Zealand labour rate for NEAX technologies. The CostProNZ software has been updated.

Touch tables specific to each ESA

693. Telecom submits that traffic routing is ESA specific. Each ESA should have its own specific touch table.

694. The Commission has accepted Telecom's submission. The CostProNZ software has been updated.

Traffic Sharing

695. Telecom submits that hard coded 0.2 factor used in the model as an assumed traffic sharing ratio for traffic that goes to the Host to Host ring from remote should be replaced by additional ESA and call type specific parameters in the touch table, given that describing how traffic is meant to be routed is this table's function, and that this factor is, in reality, very ESA and call type specific.

696. The coding of the 0.2 factor has been changed from being hard coded into a table lookup. The Commission instructed CostQuest to make the 0.2 factor a variable in CostProNZ. The variable input resides in tblTREngineeringRules. The variable name for the input is RemoteToHostTrafficPctAssumption. To navigate to the input from the User interface, the user should enter the "Inputs" area and go to "Transport / Telco Miscellaneous / Engineering Inputs".

Mapping of NetBits traffic categories to CostProNZ Call Types, and input Traffic rates:

697. Telecom submits that it understands that NetBits call categories ic06, ic07, ic08, and ic09 (which are all internet calls incoming from alternative networks) have been mapped to the CostProNZ call type "Dial-up Internet", as though this traffic originates from Telecom Fixed line customers. Telecom has concerns as to what effect mapping this traffic this way will have on the accuracy of the results.

698. The Commission provided traffic data to CostQuest already allocated into CostProNZ call types. The Commission reviewed the allocation of these call types and considers "Dial-up Internet" as the most appropriate CostProNZ call type to allocate them into.

It does not consider this allocation to significantly impact on the accuracy of the model.

Line Count Denominator for tblSWCallTypeUsage

699. Telecom submits that is it is unclear how the input traffic data in the tblSWCallTypeUsage input table has been derived, i.e. what denominators were used to derive the per customer rates (annual calls and annual MOU) by call type for each ESA. If the denominators were not the same as the total customer count for each ESA as per the tblCSVHcpm input table, then CostProNZ will not re-constitute the correct total traffic levels for each ESA, leading to incorrect dimensioning of the network and subsequent incorrect cost calculations.

700. The Commission provided CostQuest with traffic levels for CostProNZ model (tblSWCallTypUsage) – the same as those used for the HCPM model. These traffic levels have been normalised by matching them to the quarterly average line counts for the 2003/2004 period. The Commission is modelling the costs associated with serving the needs of the customers at the time that the TSO deed was signed. It has applied the updated customer traffic information. It is not dimensioning the network to replicate Telecom's network as it was in this year.

Dimensioning of E1 carrier node transmission link

701. Telecom submits that the number of E1's required on Transmission links between carrier nodes and their host are incorrectly dimensioned, as it has been assumed that these links carry concentrated traffic. This is not the case with Telecom's NEAX based PSTN.

702. The Commission considers that in a forward looking network (as modelled) it can be assumed that traffic from carrier nodes back to the switch would be concentrated. This concentration and the conversion from electrical to optic are the primary reasons to adopt the carrier technology.

Submissions

703. Telecom has submitted that:[181]

> In para 537, the Commission states that it considers "that in a forward looking network (as modelled) it can be assumed that traffic from carrier nodes back to the switch would be concentrated". On this basis, the Commission has continued to dimension carrier node transmission link requirements based on traffic rather than on the number of lines to be served, assuming (as stated in para 509) that DLCs concentrate traffic. Telecom has previously pointed out the mis-match that this causes, in that the prices for the DLC equipment used in the model are based on equipment used by Telecom, which do not incorporate this concentration functionality, and would therefore be relatively cheaper than alternative equipment that has this functionality. Telecom therefore submits that the Fixed System prices used for DLC equipment in the CostPro model should be raised by 40% to account for this functionality that the Commission is basing their modelling on. Telecom believes that the TSO number would increase by a little under $1m if this were to be implemented.

704. NSL has submitted that:[182]

> …the concentration functionality described by Telecom is now very standard in this type of transmission device and is surprised that a price premium of 40% could be charged for it. It may be that the 40% is calculated using the price of additional equipment required to interface Telecom's older systems to a modern concentrating interface.

[181] Telecom, *Telecom New Zealand Submission On The TSO 04-05 And 05-06 Draft Determinations*, 6 August 2007, para 69.

[182] Network Strategies Limited, *Review of Submission to the 2004/2005 and 2005/2006 TSO Draft Determinations*, 20 August 2007, p 6.

705. The Commission's view is that in a modern implementation of a PSTN platform this functionality would be a standard feature.

NEAX Software File Costs

706. Telecom submits that the CostProNZ model still does not use the NEAX Software costs that appear in the model inputs and that get past over to the SwitchLogic workbook. Although Telecom accepts that the NEAX Software file costs are not incremental and therefore should not enter into the TSO calculation, it feels for completeness of the model and its general use for other regulatory issues that the model should be modified appropriately to use and allocate these costs.

707. TelstraClear state[183] that the Commission should continue to model an efficient network and not be limited by technical constraints which are a direct result of Telecom's historical investment decisions.

708. In the TSLRIC determination this cost was not captured in the detailed switching logic. However, it can be assumed to be covered in the common factor. In addition, this change is not vital to the TSO determination since the costs are not incremental to the CNVCs. Accordingly no changes have been made to the model.

Land and buildings

709. TelstraClear submits that land and buildings costs:

b. do not implement transmission related building and land mark-ups as these mark-ups are not necessary or appropriate when calculating TSO incremental costs of CNVC traffic, as the TSO should not include fixed and common costs of equipment carrying commercially viable traffic; and

c. the Commission should carefully review the overall allocation of fixed and common costs to TSO traffic in the 03/04 TSO implementation of CostProNZ;

d. the Commission should ensure that changes made to CostProNZ to accommodate a TSLRIC calculation have not been inadvertently carried over to the TSO implementation; and

e. the Commission should ensure that the TSO cost excludes common fixed costs as it is the result of a purely incremental calculation;

710. The Commission considers that the latest version of CostProNZ captures a modelled forward looking network that provides service to the Telecom customer, irrespective of whether TSO or TSLRIC is being discussed.

Network Capital Results sheet of the TransLogic workbook cells C21 and G21

711. Telecom submits[184] that these formulas in the Network Capital Results sheet of the TransLogic workbook cells C21 and G21 should be picking up the Suburban trenching rates in the Calculations sheet but are currently picking up the Urban rates instead.

712. The Commission has accepted Telecom's submission and made the appropriate changes to the model.

Double allocation of structure costs to the Data Network

713. Telecom submits[185] that in the 2002/2003 TSO determination, sharing of the structure costs with the data network was simulated by halving the sharing rates in the tblTRStructureSharing table (see 2002/2003 TSO Determination para A6.17 – A6.20).

[183] Network Strategies Limited, *Response to Telecom's submission on the 03-04 TSO Draft Determination*, Section 2.1 – 3 and TelstraClear, *Cross Submission on the 03 – 04 TSO Draft Determination*, para 22 – 26.
[184] Telecom, *Submission on the TSO 03-04 Draft Determination*, Annex 2, para a2.13, pp 23-4.
[185] Ibid, para b2.13, pp 24.

In the current version of CostProNZ, data traffic has been added so as to model the requirements of the data network and therefore better apportion core costs, including fibre and transmission equipment costs, between the PSTN and FPDN. Given that an appropriate allocation for the data network has now been made, there is no requirement to keep the structure sharing rates in the tblTRStructureSharing table at their reduced values, and the halving should be eliminated.

714. In the current version of CostProNZ, the data network is modelled and costs are appropriately assigned. The updated TSO inputs do not have any assumed data sharing, and are as per the following table:

Table 48: CostProNZ Sharing Assumptions for Core Network

Forward Looking Sharing Assumption for Core Network

Buried and Underground

sharing component	Dedicated Core Structure	Assumed Average Cables per Access/Core shared structure	Core's portion of Shared Access/Core Structure	Other utility Sharing	Telecom's Portion	Portion of Structure Attributed to Core	CostPro Input to avoid double counting in HCPM and TSO runs
column	*a*	*b*	*c = (1 - a) / b*	*d*	*e = 1 - d*	*f = (e * a) + (e * c)*	*g = e * a*
Metro	[ ]%	[ ]	[ ]%	[ ]%	[ ]%	**[ ]%**	[ ]%
Suburban	[ ]%	[ ]	[ ]%	[ ]%	[ ]%	**[ ]%**	[ ]%
Rural	[ ]%	[ ]	[ ]%	[ ]%	[ ]%	**[ ]%**	[ ]%

Aerial

sharing component	Dedicated Core Structure	Assumed Average Cables per Access/Core shared structure	Core's portion of Shared Access/Core Structure	Other utility Sharing	Telecom's Portion	Portion of Structure Attributed to Core	CostPro Input to avoid double counting in HCPM and TSO runs
column	*A*	*b*	*c = (1 - a) / b*	*D*	*e = 1 - d*	*f = (e * a) + (e * c)*	*g = e * a*
Metro	[ ]%	[ ]	[ ]%	[ ]%	[ ]%	**[ ]%**	[ ]%
Suburban	[ ]%	[ ]	[ ]%	[ ]%	[ ]%	**[ ]%**	[ ]%
Rural	[ ]%	[ ]	[ ]%	[ ]%	[ ]%	**[ ]%**	[ ]%

CCRI and TCNZRI

<u>Submission Sharing Assumptions</u>

715. Telecom has submitted that in relation to Table 48: CostProNZ Sharing Assumptions for Core Network above:

> Telecom also note that the percentage of Dedicated Core Structure in column ‘a’ for Rural in the structure sharing tables shown in par 701 should be 50%, not 40%, meaning that the CostProNZ input for Telecom’s share of Rural Buried and Underground structure should be 42.5%, not 34%, and for Aerial structure should be 30%, not 24%

716. Buried and underground core sharing costs have been set at 40% in response to a Telecom submission[186] which stated that 60% of the core network trenches are shared with the access network. Thus the remainder i.e. 40% of trenches are dedicated.

[186] Telecom, *Report to the Commission on Modelling of the TSLRIC Toll-Bypass Interconnect Cost*, 31 August 2004, para 33.

SDH Regenerator Cost Type Allocation:

717. Telecom submits[187] that in the tblAssetClassification table, SDH Regenerators have been assigned Cost Type "S" (Shared) instead of "D" (Direct). Regenerators are associated with individual transmission rings, not whole fibre paths, i.e., regenerators on a leg of a transmission ring are associated with the SDH systems either side of that leg of that transmission ring. Hence they should be assigned the same Cost Type as SDH systems and SDH Plug In equipment.

718. The Commission considers that if the model is creating a ring, and a regenerator is required, it is not possible to infer whether this is the direct investment of any node on the ring. If however, the regenerator is part of a dedicated spur, even though the regenerator is labelled as "S" (Shared), the model captures it as a Direct ESA investment, so Telecom's suggested change should not be made.

[187] Telecom, *Submission on the TSO 03-04 Draft Determination*, Annex 2, para c2.13, pp 24.

APPENDIX 5: CHATHAM ISLAND ADJUSTMENT

Background

719. Telecom's geo-coded line information did not include customer locations for lines on the Chatham Islands. To estimate the TSO net costs associated with the Chatham Island in a manner consistent with the Commission's overall modelling approach, the Commission has geocoded customer locations on the island over an area approximating the coverage of Telecom's existing cabled network. The resulting files <wtg.in> and <wtg.clu> are included with this release of the HCPM model.

720. The cabled network area includes Waitangi Village, which is the principal centre of population of the island. The total number of lines covered is [ ], split as [ ] first residential (Res1) and [ ] business.

721. Telecom weighted line data reports [ ] Res1 customers served from the Waitangi switch, which leaves a total of [ ] Res1 customers to be served by radio systems. (Note that the HCPM radio cost cap is likely to identify additional radio clusters currently contained in <wtg.clu>.) The lines which fall outside <wtg.clu> are likely to be centred around the smaller remote centres at Owenga, Kaingaroa, Pitt Island etc.

Modelling of Additional Costs

722. In addition to the costs now identified by HCPM, the Chatham Islands has specific TSO related costs associated with:

- [ ] residential customers served by MAR radio systems;
- Satellite Earth Station equipment required for the spur link to mainland New Zealand; and
- Satellite transponder (capacity) costs

723. Using the HCPM MAR radio cost cap costing (WACC = 5.7%, *t* = 4), each additional Res1 radio line on the island contributes a TSO net cost equal to the sum of the radio price, the standard operating costs and rural local calling costs minus the Res1 revenue. This equates to a total cost of:

Additional Radio Residential Lines	*$[ ] per annum*

724. Telecom have provided earth station investment and space segment annual costs for the Chatham Islands as follows:

Table 49: Chatham Island Cost not Modelled by HCPM

Item	Investment	Residential component	Annualisation based on CostProNZ Radio	Annualised Cost
Equip @ WTG	$[ ]		[ ]	$[ ]
Equip @ WW	$[ ]		[ ]	$[ ]
Annual Space Segment Fee	$[ ]	[ ]		$[ ]
Total				$[ ]

725. Annual costs are calculated using the annualisation factor for radio equipment from the CostProNZ model. Capacity costs associated with the 30 channel space segment are split based on the proportion of residential traffic to business traffic on the link

726. The additional (i.e. not calculated using HCPM) annual TSO net cost associated with serving the Chatham Island is therefore calculated as:

Table 50: Total Chatham Islands Adjustment

Factor	*Per Annum Cost*
Radio Lines	*$[ ]CCRI*
Earth Station and Space Segment	*$[ ]CCRI*
Total Adjustment	*$696,451*

APPENDIX 6: COMMISSION NET COST CALCULATION METHODOLOGY

727. The purpose of this appendix is to outline the approach to modelling the TSO net cost. This section discusses submissions mainly received in the TSO's for years 2001/2002 and 2002/2003.

728. HCPM is a computer based, cost model which is used by regulatory authorities to estimate the forward-looking economics costs of network facilities and services. The model, as used in the United States, and associated documentation is publicly available for download from the FCC's web site:

    http://www.fcc.gov/wcb/tapd/hcpm/welcome.html

729. The model was introduced to industry by Commission and FCC staff during the Commission's TSO Modelling Workshop, November 12, 2002. This model takes an approach which:

    - is consistent with the Commission's bottom-up, scorched-node modelling position;
    - can be adapted to calculate TSO net cost as required by the Act;
    - is transparent;
    - can be supported and validated by international experts in a cost effective manner; and
    - is well known to the industry both in New Zealand and overseas.

730. The model was originally developed by the FCC as an alternative to models being promoted by USA industry players for various regulatory purposes, including the calculation of Universal Service Obligation (USO) levies. In its standard form, the model performs engineering design and costing for both the local loop and switching/transport networks, using economic cost minimisation principles.

731. The switching/transport module supplied with the standard HCPM package is an older version of the Hatfield (HAI) model configured for USA network conditions. The Commission determined that adaptation and verification of this switching model for Commission purposes was likely to be less cost effective than development of the CostProNZ model. For the Commission's purposes, only the access components of HCPM are utilised.

732. The HCPM access model consists of two independent modules – a customer location module and a loop design module.

    - The Customer Location Module (cluster.exe) uses geo-coded customer location and demand information for an ESA (exchange) in the form of an <ESAname.in> file and groups customer locations into clusters, using engineering design rules, to form distribution cabinet areas. The output is a cluster file <ESAname.clu>.
    - Loop Design Algorithms (clusintf.exe and feeddist.exe). Clusintf computes cluster customer density information to be used in the network design and converts <ESAname.clu> files into binary files for feeddist. Feeddist designs and costs distribution network and feeder network plant for the ESA.

733. The loop design module determines the total investment required for an optimal distribution and feeder network by building access network plant to the designated customer locations. Details of the design process are contained in the HCPM documentation on the Commission website 'Computer Modelling of the Local Telephone Network October 1999', http://www.comcom.govt.nz/IndustryRegulation/Telecommunications/TelecommunicationsServiceObligations/ContentFiles/Documents/Commerce%20Commission%20TSO%20Model%20Documentation%20-%20Appendix,%2023%20April%2020030.pdf

734. For use in some USA regulatory applications, HCPM has the facility to use a proxy for real customer location and demand information, based on Census Block customer densities and demand forecasts. This feature is not used in New Zealand.

735. The HCPM modules are written in high level programming languages, and compiled versions can be supported on a number of computing environments, including standard desktop PCs.

Adaptation of HCPM to New Zealand Regulatory Requirements

736. Adaptation of HCPM for the purposes of determining TSO net cost comprises:

- processing of geo-coded customer location and terrain information into clusters based on pre-determined engineering rules;
- determination of the status of clusters as viable or non-viable based on their incremental costs and revenues (with the exception of areas for which the Wireless Technology Cost Cap has been exceeded); and
- calculation of the overall net cost of the TSO arising from commercially non-viable wire-line and wireless areas.

737. The first step in the process is the creation of clusters and their storage as a set of <ESAname.clu> files which represent the whole network.

738. Service demand and customer location information, geographically separated into ESAs, has been supplied to the Commission by Telecom.

739. The model operates with 783 ESAs, which mostly correspond to historical nodes in Telecom's network. Of these, [ ] TCNZRI currently house 'nodes' which may be NEAX 61E switch/RLU or older type NEC technology. Without rationalisation of some very small switching nodes, this identifies [ ] TCNZRI 'switchless' ESAs which require to be connected via feeder technology to the nearest appropriate host node site.

740. The rationalisation of small nodes, assignment of host nodes for switchless ESAs and the design of the (sometimes lengthy) switchless ESA feeder links is performed by the CostProNZ switching and transport model.

741. The Cluster processing phase is illustrated in Figure 12: Cluster Processing below:

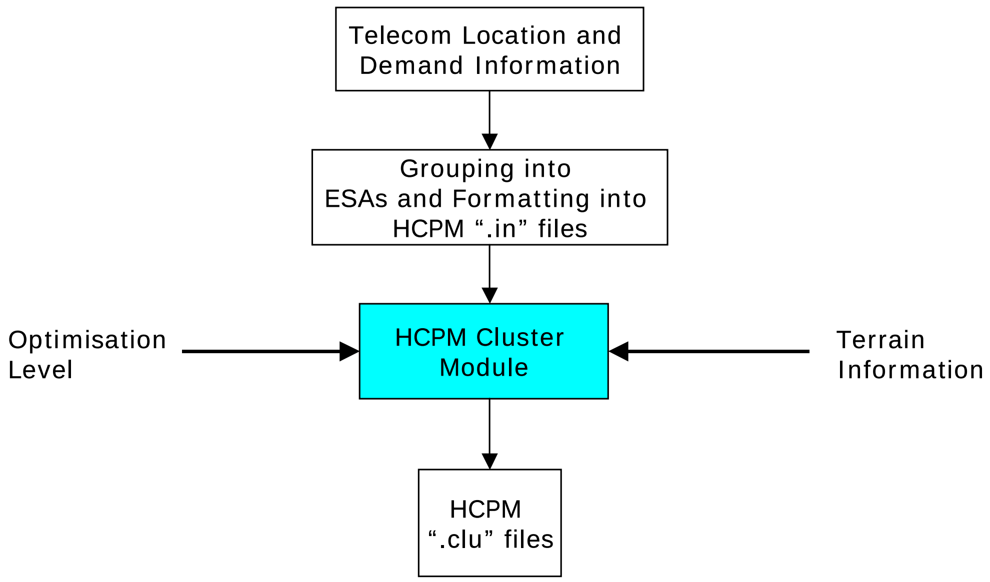

Figure 12: Cluster Processing

742. In addition to the set of <ESAname.in> customer location and demand information files, the HCPM clustering process requires the operator to set the level and type of cluster optimisation and to determine a range of geographical terrain settings for each cluster.

743. HCPM network design optimisation utilises a Minimum Spanning Tree algorithm (Prim Algorithm) developed for the purposes of finding the shortest connection network for linking a number of known points.

744. HCPM always applies the Prim Algorithm for feeder network design and may optionally apply it in the design of distribution networks within each cluster. The optimisation has the greatest impact for clusters which have low customer densities, where the distribution network most resembles a feeder network layout.

745. HCPM Terrain Information for each cluster has been derived from ESA cable laying difficulty analyses supplied by Telecom.

746. The set of <ESAname.clu> files, produced by clustering, can be used directly to generate capital and expensed costs for each ESA as illustrated in Figure 13: HCPM Costing Process below.

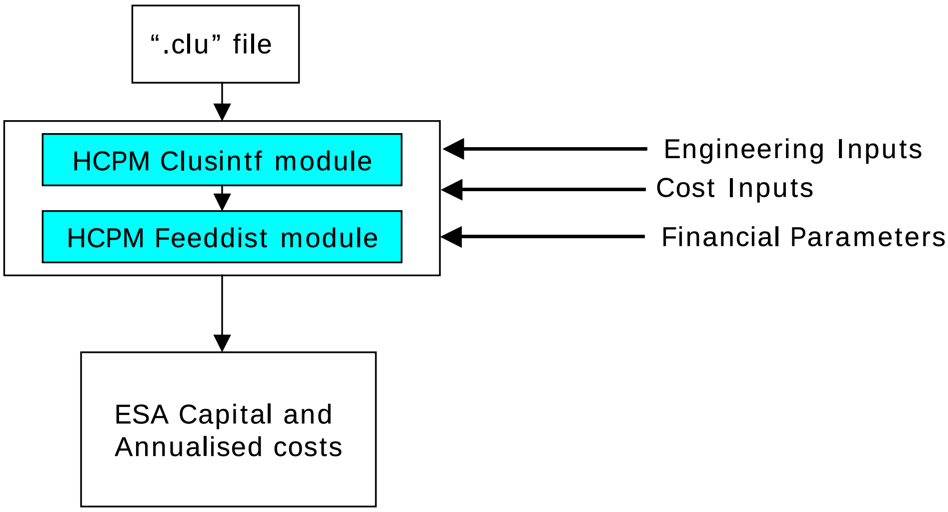

Figure 13: HCPM Costing Process

747. The basic costing process requires a range of engineering, cost and financial inputs. The inputs used by the Commission have been developed following industry consultation and are included in 'Appendix 1: TSO Model Inputs, Updates and Changes' on page 91 and 'Appendix 4: CostProNZ Core Network/Traffic Modelling on page 142.

748. HCPM creates a number of reports on the optimised network design. These are in the form of '*.csv' files in the 'c:\hcpm' directory. The reports include annualised costs of clusters and their component parts in 'EXPENSE.CSV'.

749. Although individual cluster expenses are available directly from this file, HCPM performs an allocation of feeder costs to each cluster which, in some cases, may over or understate the incremental cost of that cluster.

750. The Commission's methodology for implementing the first stage of TSO radio cap is to examine the cluster expenses recorded in EXPENSE.CSV and apply the cap if cost per line exceeds the cap. The radio cap covers both the cost of feeder and distribution for the cluster. The radio cap is not applied at this stage for high cost clusters which have more than 50 lines and feeder costs which exceed 60% of the total cluster cost. This avoids using expensive radio systems for clusters which have been allocated feeder costs that are more properly incremental on remote clusters which share feeder infrastructure with the cluster being examined.

751. Consequently, remote clusters may report low costs in EXPENSE.CSV and not be identified by the radio cap process. For this reason, a second radio cap test is applied during the initial costing of wired clusters.

752. Radio clusters are removed from the '*.clu' files before wired costing begins.

753. The process for calculating the incremental costs of wired clusters, checking for viability and collecting the net cost associated with non-viable clusters is illustrated in Figure 14: Cost Calculation Process below.

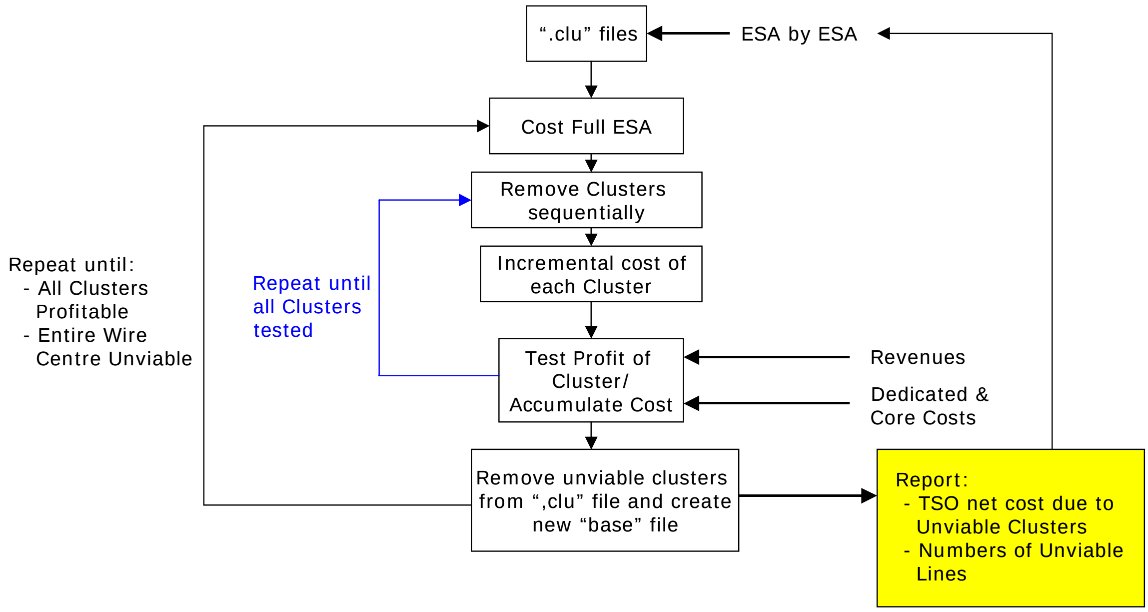

Figure 14: Cost Calculation Process

754. The incremental cost of an individual wired cluster is calculated by comparing the costs calculated for the full ESA with the costs calculated for the ESA with that cluster removed.

755. The clusters are removed by automatically identifying the clusters within an ESA and editing the <ESAname.clu> file to remove each one in turn. The incremental cost identified is the difference between the full cost of the ESA and the cost determined by passing the edited '.clu' file through the HCPM design and costing modules. It should be noted that HCPM designs a new ESA network based on the modified '.clu' file. The costs being compared are, therefore, those of the full ESA and those of the ESA re-designed to remove the costs associated with the cluster being tested.

756. The viability of a cluster is tested by comparing its access network costs (determined by HCPM, or by the second application of the radio cap process if HCPM costs now exceed the radio threshold) with its allowable direct and indirect revenues. Revenues for Residential and Business customers in each ESA are determined from information provided by Telecom. The process for calculating the average revenue per line is described in Appendices 1 and 4 and the Model Input section of the 2002/2003 TSO Determination.

757. A single pass through all of the clusters in an ESA could identify a number of viable and non-viable serving areas. The single pass, however, is not sufficient to identify if some apparently viable areas are dependent on economies of scale provided by surrounding non-viable clusters. For example, Figure 15 below is the scenario of a viable cluster (number 3) which shares a feeder route with 2 non-viable clusters (numbers 2 and 4).

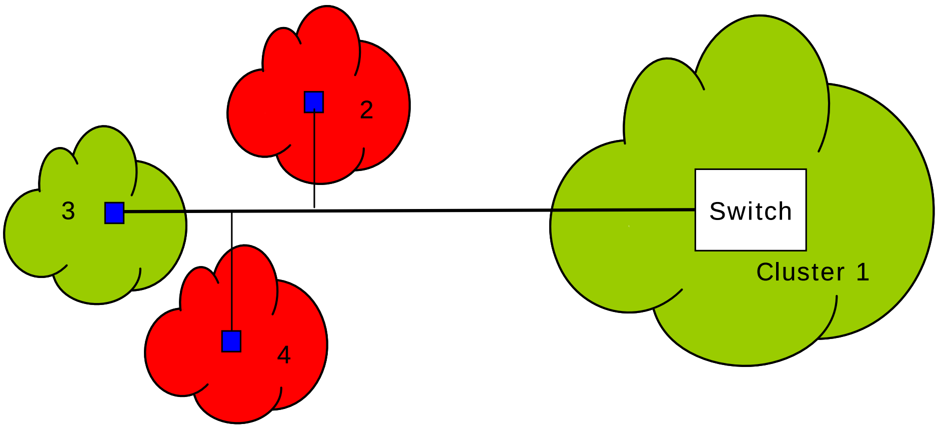

Figure 15: Cluster Scenario

Cluster Scenario

758. In this case, the first pass through the clusters has identified two viable and two non-viable areas. It is clear however, that the incremental cost tested for cluster 3 may include only its dedicated distribution infrastructure, a small amount of dedicated feeder infrastructure and a share of feeder cabling with clusters 2 and 4. Cluster 3 must be re-tested to determine its viability in the case that clusters 2 and 4 were not served.

759. The model performs this test by iterating the incremental cost analysis. The steps are:

- create a new 'base' ESA cluster file including only the clusters identified as viable on the first pass;
- re-test the incremental costs of all clusters; and
- repeat iteration process if further clusters have proven non-viable.

760. Iteration finishes when all remaining clusters remain viable on iteration, or when all clusters have proven non-viable, in which case the entire ESA is non-viable. When a result is achieved for an ESA, the process moves on to the next ESA, accumulating a net cost for the entire network.

761. For the scenario illustrated above Figure 15: Cluster Scenario, cluster 3 may be able to cover the full costs of the re-designed feeder network (without clusters 2 and 4) or may become non-viable when loaded with the additional costs. If cluster 3 proves non viable, then its net cost is added to that accumulated for clusters 2 and 4.

762. In cases where all of the clusters in an ESA have proven incrementally non-viable, the model re-tests cluster 1 as a stand-alone network, which may prove viable after having removed all costs associated with feeder networks serving other clusters.

763. In some instances, the incremental cost process developed around HCPM may treat some costs as fixed, which should be incremental to a group of clusters. For example, the figure below Figure 16: Incremental Cost Scenario shows a modification of the above scenario Figure 15: Cluster Scenario, where two incrementally viable clusters share a significant fixed feeder investment.

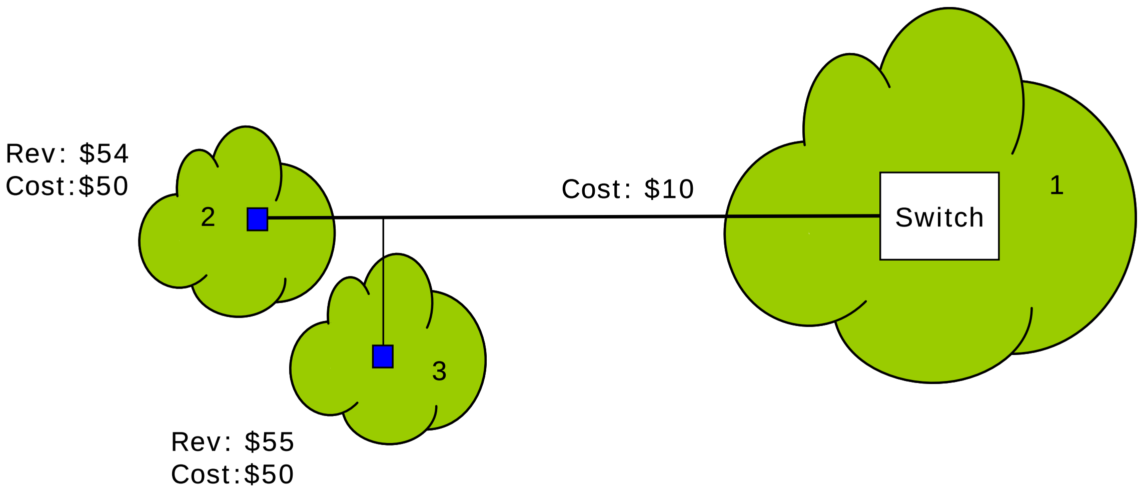

Figure 16: Incremental Cost Scenario

Incremental Cost Scenario

764. Individually removing clusters 2 and 3 above and testing for viability, shows each to be profitable with cluster 2 revenues exceeding cost by $4 and cluster 3 by $5. However, looking at the entire feeder segment with two clusters shows a total cost of $110, which exceeds the combined revenues of $109. This scenario could occur within an ESA, but is not normally observed as remote/low density rural clusters seldom cover the economic costs of their distribution networks. The radio cap process correctly identifies feeder costs associated with such clusters.

765. A similar situation may occur when clusters 2 and 3 in Figure 16: Incremental Cost Scenario are independently non-viable. (e.g. when both sets of revenue are reduced to less than $50). These clusters would both be removed on the first iteration, leaving a hanging network cost of $10, which would not be identified as variable unless the entire ESA became non-viable. For this reason, the model identifies 'hanging' costs associated with the removal of non-viable clusters by testing the costs of removed clusters against the original ESA cost and the viable network costs remaining after iteration. Any identified hanging network costs are added to the TSO cost accumulation.

766. To prevent the inclusion of costs associated with non-viable business customers, the model is set to test the viability of business lines within a non-viable cluster to determine whether their average income exceeds the average cost per line within the cluster. If average business costs exceed revenues, both the revenues and costs attributable to business lines are removed from the calculation of net cost.

Accumulation of CostProNZ Direct ESA costs

767. When the TSO cost calculation methodology identifies that the entire wired portion of an ESA has become non-viable, the full HCPM wired ESA annual cost plus the CostProNZ Direct cost for that ESA is accumulated into the TSO net cost (assuming there are no profitable radio clusters).

768. Different basis for optimisation could have been selected. These could have included how a efficient service provider in the position of the TSP might have:

- contracted out the TSO; and
- planned the deployment of technology to meet its TSO obligations.

769. The Commission has chosen to model the latter and thus the modelling has been based on cluster viability.

770. The Commission notes that Telecom increasingly provides service across ESA boundaries, combines radio infrastructure for rural ESAs and intends to break the ESA structure completely with migration to NGN.

771. The modelling considers the extent that the current core network is optimised in serving the needs of the current cluster base. There is a requirement to model existing behaviour (e.g. calling patterns) and it was decided to largely accept the reality of the TSP's transport network. It was realised that the design could have been manipulated to either increase or decrease the cost. e.g. a feeder to CNV exchange could carry viable traffic, this might have happened if the ESA's boundaries had changed.

772. Cluster 'number 1' is the base cluster of each ESA – it is generally an 'in-town' cluster and will probably have at least one business customer. Given that it has one business customer sharing the common line it is not a TSO cost.

HCPM Model Inputs

The HCPM Model Inputs and discussions of their derivation are contained in 'Appendix 1: TSO Model Inputs, Updates and Changes'.

APPENDIX 7: TSO MODEL REVENUE INPUTS

Background

773. HCPM and CostProNZ cost modelling determines the viability of clusters of lines through comparison of efficient costs with average revenues derived from Telecom's revenue information for the relevant TSO period.

774. The base revenue information is provided on a quarterly basis and is categorised as follows:

- Line and supplementary service revenue for residential first line customers (Res1);
- Line and supplementary service revenue for residential second and subsequent line customers (Res2);
- Line and supplementary service revenue for residential lines on per call payment plans (ResPay); and
- Business Customers (Bus).

Revenue Analysis

775. For the purposes of determining the TSO net cost, only residential first line (Res1) costs may contribute. For this reason, all other residential lines are treated as business lines in the modelling. This ensures that loss making residential second or special plan lines do not contribute to the TSO net cost.

776. Practically, HCPM input files <***.clu> have been adjusted to ensure that the geocoded residential locations report only one residential line. Second and subsequent lines are converted to business lines at the same location. Note that multi tenanted locations have multiple location entries (at the same geo-located point) in the input files.

777. Res1 revenues are calculated as the standard line rental for the period plus the applicable supplementary revenues:

- National and international toll calling, smart-phone services;
- Calling to and from mobile networks; and
- Incoming revenues due to business local calling and residential/business national calling into the ESA.

778. Some relevant costs associated with this revenue are not calculated directly by the HCPM or CostProNZ models. Specifically these are:

- Interconnect charges, including fixed to mobile (Vodafone);
- Fixed to mobile termination costs (Telecom Mobile); and
- Incoming call costs.

779. Interconnect charges are sourced directly from Telecom's reported revenue and call volume data.[188] Incoming call costs are calculated using reported call volumes, and per minute call charges calculated using the CostProNZ model:

[188] Fixed to mobile termination costs have been modelled by Telecom and supplied to the Commission. The Telecom figure of [ ] TCNZRI cents per minute is an estimate of the incremental cost of terminating a call on

780. Business revenues are calculated as a summation of Bus, Res2 and ResPay, using the additional cost modelling described for Res1.

Telecom's Reporting of Their Revenue Information

781. Telecom, as part of the preparation for the TSO supplies annual data including traffic and revenue information. This information has been supplied in advance of the relevant draft determination to the Liable Persons who have identified a number of improvement opportunities for Telecom's documentation. Telecom has had an opportunity to respond to these improvement opportunities. Parties' positions are discussed under "Modelling" on page 101.

782. The raw revenue information is now provided by Telecom as part of the TSO information under section 83 of the Act. In addition, liable persons comment and Telecom's response to these comments are attached as part of the model's documentation.

the Telecom mobile network. According to Telecom, this is not a TSLRIC estimate but one made in the context of the TSO net cost calculation.

APPENDIX 8: CORRECTION TO THE TILTED ANNUITY FORMULA

Overview

783. In response to parties submissions noted under "Correction to the tilted annuity formula caused by a 6 month offset in the TSO commencement date" on page 97 the Commission has examined a correction to the tilted annuity equation.

784. Under Part 3 of the Act, the Commission is required to determine the net cost incurred for the supply of the services required by the TSO instrument, the allocation payable by all liable persons and the measurement of compliance to the specified standard.

785. The Commission has used a tilted annuity formula initially discussed in Equation 14 on page 128 as depicted in Equation 15:

Equation 15: Standard Tilted Annuity with a Time to Build Adjustment

$$V_{Jul01}\left(\frac{1+r}{1+\alpha}\right)^{u}\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^{N}}$$

Where:
α = nominal tilt
r = post-tax WACC
u = time to build
t = time parameter
V_{Jul01} = capital cost at July 2001
N = asset life (the annuity has a corresponding number of periods).

786. The tilted annuity can be pictured as a number of cash flows as shown on Figure 17. This takes the form of an initial investment, where funds are committed at period *u,* the time to build, before the project is commissioned and $t = 0$ when its revenue flows start after the investment is operational. At periodic intervals $t = 1$, $t = 2$ etc the revenue is realised to the service provider. The following figures show the phasing of the revenue flows. The magnitude of these flows would normally be expected to be decreasing over time. V_{Jul01} in Equation 15 is the value at $t = 0$ i.e. in the standard formulation the opening value of the asset is taken at the time that the project is commissioned.

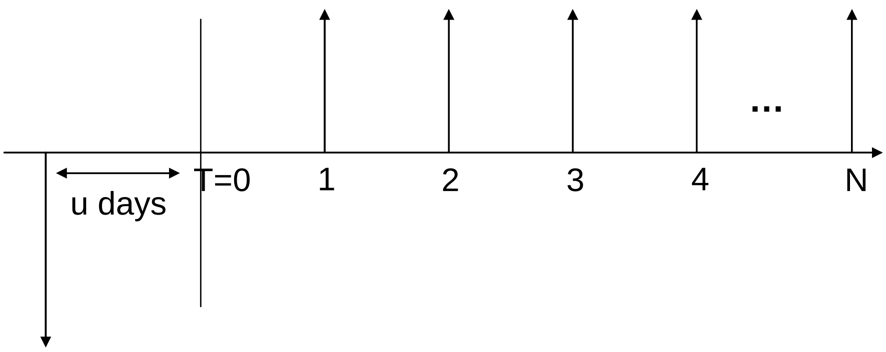

Figure 17: Phasing of Tilted Annuity Cashflows

Discussion on Tilted Annuity

787. The tilted annuity shown in Equation 15 can be rearranged as Equation 16.

Equation 16: Components of Tilted Annuity– showing the different factors

$$V_{Jul01}\frac{1}{(1+\alpha)^u}(1+r)^u\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^N}$$

788. The terms in Equation 16 can be identified from right to left as follows:

- $\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^N}$ are the annuity weightings;
- $(1+r)^u$ is compensation for return on investment of an asset committed at a time u days before the plant is operational at $t = 0$;
- $\frac{1}{(1+\alpha)^u}$ which is a correction for the cost of an asset known at $t = 0$ but corrected for its cost at an earlier period at a time u days earlier when the investment decision was made and the funds invested; and
- V_{Jul01} a cost known at one point in time (1 July 2001).

As Built vs. As Designed

789. The design criteria for the correct implementation of the TSO's tilted annuity included two factors in addition to those identified in Equation 15. The modelled investment date was 6 months too early and each annuity realisation occurred six months too early and should be delayed. (The Commission in TSO 2001/2002 realised that the full annuity was an inappropriate payment for this first period and determined that a prorate payment based on the number of days from when the TSO deed was signed until the end of the TSP's financial year). This correction applied in year 1 is not relevant to the ongoing operation of the annuity and has not been further discussed.

790. The TSO deed came into effect when the deed was signed on the 20 December 2001. The Commission has approximated this date as being a point half way through the TSP's 2001/2002 financial year (1 Jan 2002). For computational ease 1 Jan 2002 will be used as ($t = 0$) the start of the annuity. Annuity payments are scheduled for June/July which is the end/start of the TSP's financial year.

791. A complication has occurred due to the scheduling of payments, whereby the yearly annuity is started at a point half way through the TSP's financial year. This is captured in Figure 18(a) by the initial downward bolded arrow.

792. It is however, expected that the annuity's yearly realisations shall happen at the end of the TSP's financial year and before the start of the next year. This is shown on the upwards pointing bolded arrows Figure 18(b).

793. In the following discussion, the term "as built" refers to the yearly annuity that was set up by the Commission, whilst "theory" refers to the yearly annuity starting at the correct point though offering realisations at 1 Jan each year.

794. The yearly tilted annuity, as designed, started on 1 January 2002 and should have been set up for a realisation of cash flows as per Figure 18(a) aligning with a 1 Jan - 1 Jan year. It was not however modelled this way. The tilted annuity as built was set up for the realisation of cash flows as per Figure 18 (b) on a 1Jul-1Jul year. Since it is a yearly annuity the initial period must have started on 1 July 01, twelve months before the first annuity was realised.

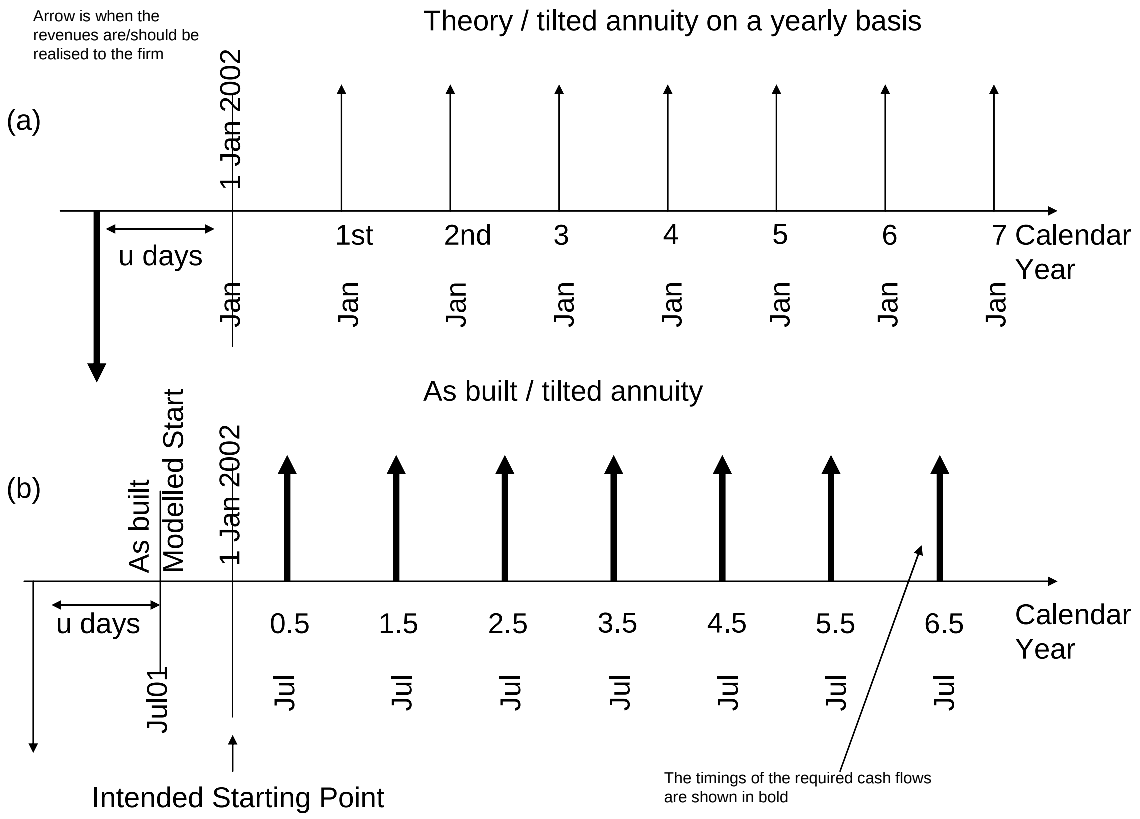

Figure 18: Phasing as built vs. design

795. The modelling approach implemented by the Commission did not meet the structure of the problem, specifically the requirement was that the first yearly annuity realisation was to have occurred 6 months or half a year after the start of the TSO. The correct initial capital investment is shown in bold on Figure 18(a) while the correct realisations of the annuities are shown in bold on Figure 18(b). There were two major improvement opportunities:

- phasing was incorrect, resulting in the TSP receiving compensation at an incorrect time e.g. at period 1.5 (seen on Figure 18(b)) the Commission was attempting to allow a realisation of a cash flow that based on the yearly annuity's starting time was due at period 2 (seen on Figure 18(a)); and
- the build event was modelled as taking place ½ a period or 6 months too early at a time *u* days before July 2001 when it should have occurred at a time *u* days before Jan 2002.

796. These issues gave rise to two apparent complications: the NPV of the modelling has not been preserved whereby the TSP has not effectively enjoyed the modelled WACC and; the initial value of the modelled asset was calculated incorrectly.

Redesign of the Tilted Annuity

797. The design of the tilted annuity has a structural feature that does not align with the Commission's use of the Tilted Annuity this is demonstrated on Figure 18.

798. The annuity must start at a time midway through a financial year and then continue on integer boundaries corresponding to the start of financial years. If the Tilted Annuity were set up so that it was a semi-annual event then it could have started at 1 Jan 2002, had have its realisations at 1 Jul 2002, 1 Jan 2003, 1 Jul 2003 etc. At this time the structure of the problem would have matched the structure of the modelled solution.

799. Semi-annual payments occurring in January happen at a time for which the Commission cannot provide a determination under s92(a) of the Act. The Commission can only determine the net costs as at the end of the TSP's financial year.

800. In concept the Commission could have performed this semi-annual modelling and on each January "banked" the annuity at the WACC rate. Then six months later released the WACC adjusted amount of the previous annuity plus the annuity for the 1 July ending periods. This approach was not possible under the act which requires the TSO calculation to occur annually as the TSP's end of financial year.

801. The same effect has been achieved by the adjustments which are described in the remainder of this section.

802. This approach is shown on Figure 19 where: (a) shows a semi annual tilted annuity; (b) shows a delayed realisation; and (c) shows realisation on 1 July boundaries. The remainder of this section discusses the correction between the Commission's as built annuity and the corrected annuity shown on Figure 19(c). The correction takes the nature of a factor in the form of $\frac{CorrectedAnnuity}{OriginalAnnuity}$ The correction is also identified by the arrows on Figure 20(b) and Figure 20(c)

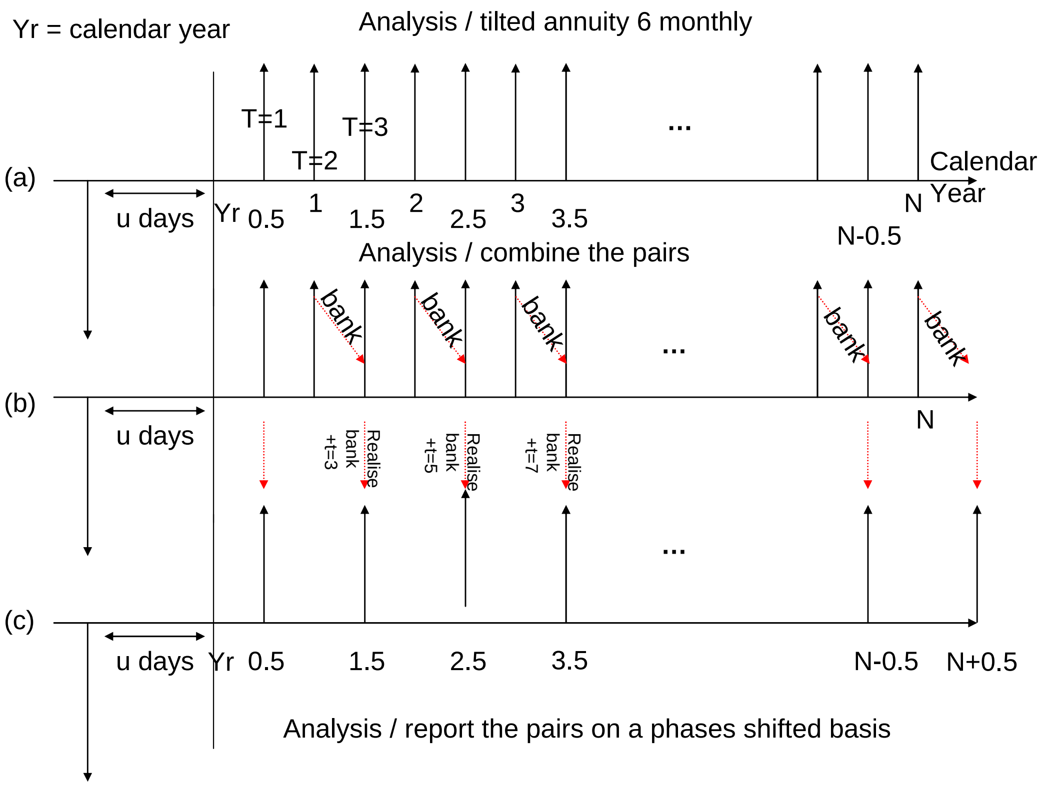

Figure 19: Semi Annual mapping to an Annual Annuity

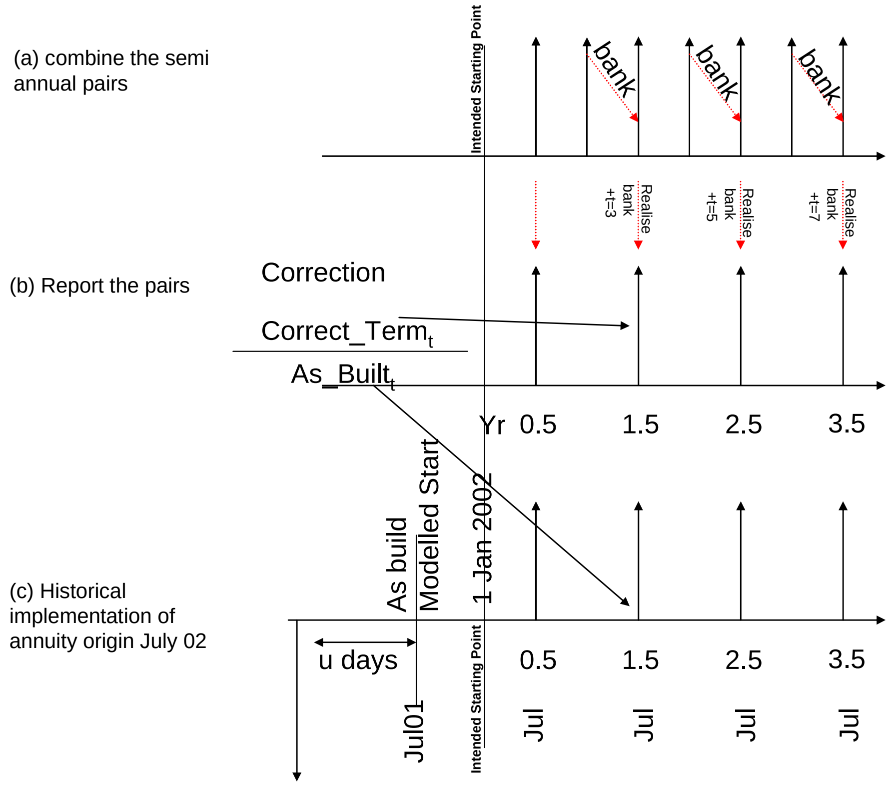

Figure 20: Correction Term Identified

Mathematics Correction

803. To give greater visibility to the nature of the correction the Commission has taken an approach drawing on the fundamental maths behind the problem. The annuity will last for *N* periods. It has first, last and middle years. Three sets of corrections are recognised as they correspond to the following terms:

(i) **First Term**: the initial 6 month annuity 'due' at the beginning of July would be 'paid' directly at mid year aligning with the end/start of the TSP's financial year;

(ii) **Last Term**: the final 6 month annuity would be 'due' in January it would have been 'banked' for 6 months and realised to the TSP at the start of the TSP's financial year; and

(iii) **Middle Term**: the middle term has two 6 month periods: one from January which has been 'banked' at the WACC rate, the second produced in July is 'paid' directly along with the "banked" amount.

<u>Geometric Series:</u>

804. However the problem is approached, the derivation of the formulae involved depends on the formula for the sum of *N* terms of a geometric series which is

Equation 17: Geometric Series

$$\sum_{i=1}^{N} AR^{i-1} = A + AR + AR^2 + \cdots + AR^{N-1} = A\frac{R^N - 1}{R - 1} = A\frac{1 - R^N}{1 - R}$$

805. Upper case symbols are used to avoid confusion with the lower case *r* traditionally used for WACC (the cost of capital).

Outline of the problem:

806. The TSP has invested V_0 dollars in a technology class (a piece of equipment) and is to recover their investment over the lifetime N of the equipment in such a way that the company will receive a nominal rate of return of r% per annum on the investment.

807. The repayments are to be made to conform with a *tilted annuity* formula.

808. An allowance is to be made for the time to build u which is taken to be the time after the initial investment is made before the investment begins to generate returns. In what follows the value of t time measured in years when it begins to generate returns is taken to be $t = 0$.

809. The calculation which follows allows for any starting time for repayments.

Repayment of V_0 with a rate of return of r%.

810. If an amount V_0 is to be repaid by nominal payments A_1, A_2……A_n at times t_1, t_2…….t_n then

Equation 18: NPV of Annuity A_i

$$V_0 = \frac{A_1}{(1+r)^{t_1}} + \frac{A_2}{(1+r)^{t_2}} + \cdots$$

811. In particular, if the repayments are to be made in N instalments at times t_1, $t_2 = t_1 + 1$, $t_3=t_1+2$, $t_4=t_1+3$…….$t_N = t_1+N-1$, then the equation which must be satisfied by the repayments is

Equation 19: Alternate form - NPV of annuity A_i

$$V_0 = \sum_{i=1}^{N} \frac{A_i}{(1+r)^{t_i}} = \sum_{i=1}^{N} \frac{A_i}{(1+r)^{t_i+i-1}}$$

812. Any values of the A terms which satisfy this formula are fair, in the sense that the NPV for the whole repayment scheme is zero, as this is the nature of an annuity. There is an infinite collection of such values but there are only a few which are amenable to a simple pattern. One simple solution is to make all the A terms equal (a uniform annuity such as might be entered into for a house purchase); another simple solution, one leading to a tilted annuity, is to assume that:

Equation 20: Effect of tilt

$$A_i = A_1(1+\alpha)^{i-1} \quad i = 1 \ldots N$$

813. This leads to:

Equation 21: NPV of annuity including tilt

$$V_0 = \sum_{i=1}^{N} \frac{A_i}{(1+r)^{t_i}} = \sum_{i=1}^{N} \frac{A_1(1+\alpha)^{i-1}}{(1+r)^{t_1+i-1}} = A_1 \frac{1}{(1+r)^{t_1}} \sum_{i=1}^{N} \frac{(1+\alpha)^{i-1}}{(1+r)^{i-1}}$$

The last expression is a geometric series with first term equal to $\frac{A_1}{(1+r)^{t_1}}$ and referring to the notation of Equation 17 $\quad R = \frac{1+\alpha}{1+r}$

Hence A_1 the initial annuity realisation can be determined.

Equation 22: NPV of annuity recognising the 'R' structure

$$V_0 = A_1 \frac{1}{(1+r)^{t_1}} \frac{\left(\frac{1+\alpha}{1+r}\right)^N - 1}{\left(\frac{1+\alpha}{1+r}\right) - 1} = \frac{A_1(1+r)[(1+r)^N - (1+\alpha)^N]}{(1+r)^{t_1}(r-\alpha)(1+r)^N}$$

and

Equation 23: First annuity payment

$$A_1 = V_0 \frac{(1+r)^{t_1 - 1}(r-\alpha)(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

Time to Build

814. If, in fact the initial investment is not V_0 at $t = 0$ but is V_I (I for initial) at $t = -u$, then the only change that needs to be made to the above calculation is to replace V_0 by $V_1\ (1+r)^u$ which allows for the fact that the initial investment should be capitalised at r% per annum in the u years before the investment begins to generate returns. This assumes that the whole amount V_I is outlaid at the beginning of the build period.

815. The initial cost, V_I, was derived by valuing the equipment at time $t = 0$, to be $\hat{V}_0$ and assuming that therefore the initial investment was

$$\hat{V}_0 \frac{1}{(1+\alpha)^u}$$

816. It would then be the case that the value of the investment at $t = 0$ was

$$\hat{V}_0 \frac{(1+r)^u}{(1+\alpha)^u}$$

and in all the above calculations we would then need to take the value of V_0 to be adjusted in this way.

Repayments made Mid-Year

817. If repayments are to be made in the mid-year then this is easily taken into account by giving t_1 an appropriate value in Equation 23, the equation which determines the values of the repayments. For example t_1 may be taken to be 0, ½ or 1.

818. Repayments are to be made at mid-year but that, instead of using Equation 20 and Equation 23 directly for each of N yearly payments, there are to be, effectively, $2N$ payments, one every half year, with the proviso that all but the first and last are to be amalgamated in pairs. Hence there are $N + 1$ payments in all, each payment being made mid calendar year to align with the TSPs financial year.

819. Since the repayments are to (notionally) be made each half year r must be replaced by

Equation 24: Semi annual WACC

$$\hat{r} = \sqrt{1+r} - 1$$

and α must be replaced by

Equation 25: Semi annual α

$$\hat{\alpha} = \sqrt{1+\alpha} - 1$$

and N must be replaced by *2N* in Equation 20 and Equation 23 and since the first repayment is made one half year after the start of the annuity, t_1 must be replaced by 1 (one half year). Thus there are (notionally) *2N* repayments where

Equation 26: Semi annual first payment

$$A_1 = V_0 \frac{(\hat{r} - \hat{\alpha})(1+\hat{r})^{2N}}{(1+\hat{r})^{2N} - (1+\hat{\alpha})^{2N}}$$

and

Equation 27: Semi annual effect of tilt

$$A_i = A_i(1+\hat{\alpha})^{i-1}, \qquad i = 1 \ldots 2N$$

820. A_1 is to be made in the middle of the first year and can be made directly. A_{2N} is due to be made at the end of the *N*th year so must, in fact, be made in the middle of year *N*+1. For the remainder, year *2j* and *2j*+1 are amalgamated into one payment which is made in the middle of calendar year *j*+1 *j*=1,2,3,….*N*-1, at the end of each of the TSPs financial years.

821. Thus the actual payments are:

$\hat{A}_1 = A_1$
$\hat{A}_2$ which is an amalgam of A_2 adjusted for late payment and A_3
$\hat{A}_3$ which is an amalgam of A_4 adjusted for late payment and A_5
...
$\hat{A}_{j+1}$ which is an amalgam of A_{2j} adjusted for late payment and A_{2j+1}
...
$\hat{A}_N$ which is an amalgam of A_{2N-2} adjusted for late payment and A_{2N-1}
$\hat{A}_{N+1}$ which is A_{2N} adjusted for late payment.

822. In each case, the adjustment for late payment is made by multiplying by $(1+\hat{r})$).

823. Using Equation 23, substituting with the semi-annual quantities and setting $t_1 = 1$

Equation 28: Semi annual annuities, paired into years, offset by 6 months

$$\hat{A}_1 = V_0 \frac{(\hat{r} - \hat{\alpha})(1+\hat{r})^{2N}}{(1+\hat{r})^{2N} - (1+\hat{\alpha})^{2N}}$$

$$\ldots$$

$$\begin{aligned}
\hat{A}_{j+1} &= A_{2j}(1+\hat{r}) + A_{2j+1} \\
&= \hat{A}_1(1+\hat{r})(1+\hat{\alpha})^{2j-1} + \hat{A}_1(1+\hat{\alpha})^{2j} \\
&= \hat{A}_1(1+\hat{\alpha})^{2j-1} + [(1+\hat{r}) + (1+\hat{\alpha})] \\
&= \hat{A}_1(1+\hat{\alpha})^{2j-1} + (2+\hat{r}+\hat{\alpha})
\end{aligned}$$

$$\ldots$$

$$\hat{A}_{N+1} = \hat{A}_1(1+\hat{\alpha})^{2N-1} + (1+\hat{r})$$

824. In terms of *r* and *α*, that is

Equation 29: Semi annual annuities, paired into years, offset by 6 months using *r* and *α*

$$\hat{A}_1 = V_0\left[(1+r)^{\frac{1}{2}} - (1+\alpha)^{\frac{1}{2}}\right]\frac{(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

...

$$\hat{A}_{j+1} = V_0\left[(1+r)^{\frac{1}{2}} - (1+\alpha)^{\frac{1}{2}}\right]\left[(1+r)^{\frac{1}{2}} + (1+\alpha)^{\frac{1}{2}}\right]\frac{(1+\alpha)^j}{(1+\alpha)^{\frac{1}{2}}}\frac{(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

$$= V_0(r-\alpha)\frac{(1+\alpha)^j}{(1+\alpha)^{\frac{1}{2}}}\frac{(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

...

$$\hat{A}_{N+1} = V_0\left[(1+r)^{\frac{1}{2}} - (1+\alpha)^{\frac{1}{2}}\right](1+r)^{\frac{1}{2}}\frac{(1+\alpha)^N}{(1+\alpha)^{\frac{1}{2}}}\frac{(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

825. Under the as built scheme that the Commission is currently operating :

Equation 30: 'as built' First, Middle and Last annuities

$$A_1 = V_0(r-\alpha)\frac{(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

...

$$A_j = V_0(r-\alpha)(1+\alpha)^{j-1}\frac{(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

...

$$A_N = V_0(r-\alpha)(1+\alpha)^{N-1}\frac{(1+r)^N}{(1+r)^N - (1+\alpha)^N}$$

826. Note A_n not A_{N+1} for the final term. The annuity expressed in Equation 29 extends to period N+1 this is one year beyond the Commission's as built annuity. This has been caused the annuity lasting N periods starting half way through a financial year having to extend 6 months beyond the end of the Nth financial year. These formulae are directly derived from Equation 23 using t_1 =1.

827. Hence the ratios of the $\hat{A}$s to the related As the corrections are as follows:

<u>First Term's Correction</u>

Equation 31: Tilted Annuity Correction First Term (*t* = 1)

$$\frac{\hat{A}_1}{A_1} = \frac{(1+r)^{\frac{1}{2}} - (1+\alpha)^{\frac{1}{2}}}{r-\alpha}$$

$$= \frac{(1+r)^{\frac{1}{2}} - (1+\alpha)^{\frac{1}{2}}}{(1+r) - (1+\alpha)}$$

$$= \frac{1}{(1+r)^{\frac{1}{2}} + (1+\alpha)^{\frac{1}{2}}}$$

$$= \frac{1}{\sqrt{1+r} + \sqrt{1+\alpha}}$$

Mid Terms Correction

Equation 32: Tilted Annuity Correction Middle Terms ($t \geq 1$ and $t < N$)

$$\frac{\hat{A}_j}{A_j} = \frac{(1+\alpha)^{j-1}}{(1+\alpha)^{\frac{1}{2}}} \frac{1}{(1+\alpha)^{j-1}}$$

$$= \frac{1}{\sqrt{1+\alpha}}$$

Last Term's Correction

Equation 33: Tilted Annuity Correction Last Term ($t = N$)

$$\frac{\hat{A}_{N+1}}{A_N} = \frac{(1+r)^{\frac{1}{2}} - (1+\alpha)^{\frac{1}{2}}}{r-\alpha} (1+r)^{\frac{1}{2}} \frac{(1+\alpha)^N}{(1+\alpha)^{\frac{1}{2}}} \frac{1}{(1+\alpha)^{N-1}}$$

$$= \frac{(1+r)^{\frac{1}{2}} - (1+\alpha)^{\frac{1}{2}}}{(1-r) - (1+\alpha)} (1+r)^{\frac{1}{2}} \frac{(1+\alpha)^N}{(1+\alpha)^{\frac{1}{2}}} \frac{1}{(1+\alpha)^{N-1}}$$

$$= \frac{(1+r)^{\frac{1}{2}} (1+\alpha)^{\frac{1}{2}}}{(1+r)^{\frac{1}{2}} + (1+\alpha)^{\frac{1}{2}}}$$

$$= \frac{\sqrt{1+r}\sqrt{1+\alpha}}{\sqrt{1+r} + \sqrt{1+\alpha}}$$

Initial Price V_0 correction

828. A correction has been established for the middle terms in the annuity (Equation 32). It is now important to establish the correct initial cost V_0. The Commission has an established position where there are *u* days time to build and a correction has been applied as discussed in paragraph 788.

829. The tilted annuity implemented by the Commission required both a correction to determine the nominal value of a unit cost that was known at July 2001 (refer Figure 20(c)) but that had to be invested at time *u* days earlier. Once an investment was made then an allowance has to be made for the cost of this capital investment up until the time when cash flows started. Given that the cash flows have started on 1 January 2002 and not 1 July 2001 then the commissioning date can be brought forward in an absolute sense from that initially modelled by the Commission by the six months between 1 July 2001 and 1 January 2002. This absolute movement in time will affect the exponent in the factor relating to the cost at the time that the initial investment was

made, it will reduce it by 6 months or 0.5 of a year. The commissioning date is now recognised as 1 January 2002. This will mean that the any capital value that was previously calculated as

$$V_{Jul01}\,\frac{1}{(1+\alpha)^{u}}$$

830. will now be calculated as

$$V_{Jul01}\,\frac{1}{(1+\alpha)^{u-0.5}}$$

831. The factor to calculate cost of holding this capital during the construction phase will remain $(1+r)^{u}$ as there remains u days time-to-build.

832. The value of the initial investment adjusted for the cost of holding that capital during the build phase is:

Equation 34: V_0 the capitalised cost of the asset when commissioned

$$V_{Jul01}\,\frac{1}{(1+\alpha)^{u-0.5}}\,(1+r)^{u}$$

Modified Tilted Annuity as Implemented by the Commission

833. The Commission has recognised that there are three sets of corrections that apply to the Initial, Middle and Final terms of the tilted annuity. Only the middle term in this correction has been considered for correction in the Commission's modelling as the other terms are not relevant to the modelling periods currently being considered.

834. The following specific correction are provided:

- Equation 35- this is the full tilted annuity for the first period drawing on the correction in Equation 31;
- Equation 36: Corrected Tilted Annuity Last Term (t = N) - this is the full tilted annuity for the last period drawing on the correction in Equation 33; and
- Equation 37: Corrected Tilted Annuity Middle Terms (t ≥ 1 and t < N) drawing on the correction in Equation 32 this has been simplified as Equation 38.

Equation 35: Corrected Tilted Annuity First Term (*t* = 1)

$$V_{Jul01}\frac{1}{(1+\alpha)^{u-0.5}}(1+r)^{u}\frac{1}{\sqrt{1+r}+\sqrt{1+\alpha}}.\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^{N}}$$

Equation 36: Corrected Tilted Annuity Last Term (*t* = *N*)

$$V_{Jul01}\frac{1}{(1+\alpha)^{u-0.5}}(1+r)^{u}\frac{\sqrt{1+r}\,\sqrt{1+\alpha}}{\sqrt{1+r}+\sqrt{1+\alpha}}.\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^{N}}$$

Equation 37: Corrected Tilted Annuity Middle Terms (*t* ≥ 1 and *t* < *N*)

$$V_{Jul01}\frac{1}{(1+\alpha)^{u-0.5}}(1+r)^{u}\frac{1}{\sqrt{1+\alpha}}.\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^{N}}$$

835. The annuity term in Equation 37 simplifies to:

Equation 38: Simplified Corrected Tilted Annuity Middle Terms ($t \geq 1$ and $t < N$)

$$V_{Jul01} \frac{1}{(1+\alpha)^u} . (1+r)^u . \frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^N}$$

836. This is recognised as being the tilted annuity that the Commission has used for the TSO as is shown in Equation 16.

Commission View

837. The Commission's view is that the tilted annuity does not need an adjustment for other than the starting and ending terms of the annuity, accordingly as these adjustments do not affect this TSO period, no adjustment need to be applied .

APPENDIX 9: QUALITY MEASURES SQM 11.1 A & B

838. The Telecommunications Service Obligations (TSO) Deed for Local Residential Telephone Service was agreed on December 2001. A key part of the deed is the Specific Quality Measures (SQM) they are an agreed minimum performance metric.

839. The Deed has eight SQM:

- 11.1 Line connect capacity for standard Internet Calls
- 11.2 Additional connect speed measures
- 11.3 Unsuccessful standard residential call attempts that under normal conditions cannot terminate as a percent of total stand residential call attempts
- 11.4 Unsuccessful standard Internet call attempts that under normal conditions cannot terminate as a percent of total stand residential call attempts
- 11.5 Whole minutes of Telecom complete switch downtime for standard residential calls
- 11.6 111 calls that under normal conditions are answered by the 111 National Service Centre within 15 seconds
- 11.7 Whole minutes of complete 111 National Service Centre downtime that arise from reconfigurations in the Telecom's network.
- 11.8 Whole minutes of complete 111 National Service Centre downtime that do not arise from reconfiguration in Telecom's network.

840. In principle there are two ways that statistics can be compiled. They are either as a census, which has no sampling errors, or as a sample, which has defined statistical properties normally expressed as a mean plus a confidence interval for the mean.

841. Each SQM with the exception of 11.1 can be measured directly or in sufficiently large numbers so that there is an arbitrarily small sampling error with a correspondingly small confidence interval.

842. SQM 11.1 is unable to be measured directly from Telecom's billing and network management equipment.

843. SQM 11.1 states:

> 11.1 Line connect speed capacity for standard Internet calls
>
> The measures (which apply for standard Internet calls from and after the second anniversary of the commencement date) are:
>
> (a) 95% of all existing residential lines meet the 14.4pks(sic) connect speed;
>
> (b) 99% of all existing residential lines meet the 9.6kps (sic) connect speed.
>
> For the purposes of assessing Telecom's performance against these measures:
>
> (c) an inability for an existing residential line to reach the kps (sic) connect speed measure arising from an event of force majeure or a specified matter beyond Telecom's reasonable control is to be disregarded;
>
> (d) the measurement will consist of the application of a calibrated model to the installed local access plant records held by Telecom

844. SQM 11.1 is to be measured by a 'calibrated' model. The Commission used a statistically valid calibrated model based on randomly sampling those lines that were connected at the time that the TSO Deed was signed.

845. Telecom selected a stratified random sample of 1000 phone lines, allocating the sample across seven technology types. The stratified sample design was chosen since there is an expectation that the line speeds vary by technology type.

846. There are seven different technology types: 0+2; CMAR; CMAR-2M; Copper; Country Set; PCM; and Siescor.

847. The allocation of the sample is proportional to stratum size. This led to two technology types (Country Set and Siescor) having no sample allocated and hence no chance of selection. The estimates that Telecom eventually provided do not apply to lines of these two types, since they had no chance of inclusion in the sample. Other technology types 0+2; CMAR and CMAR-2M have very low sample sizes.

Sampling Methodology

848. The following sampling methodology was employed in evaluating SQM11.1:

- Allocate each of the lines that was in service in December 2001 to a unique technology class in a database;
- Allocate a random number to each record in the database;
- Sort by this random number;
- Take the first ‘n’ records from each technology class, where n is the desired sample size for that technology type.

Replacement Samples

849. Replacement samples are normally drawn so that in the eventuality that a sample cannot be obtained such as may happen if the line no longer exists or if the customer would not cooperate and allow a line measurement to be taken then a substitution is possible. No replacement samples were drawn.

Analysis

850. The Commission acceptance criterion is that the relevant tests are statistically significant using a 95% confidence interval.

APPENDIX 10: NSL RECOMMENDATIONS FROM PREVIOUS SUBMISSIONS

Introduction

851. In NSL's report for TelstraClear and Vodafone, it submitted that given that the TSO process has been delayed the Commission should take further time to improve certain aspects of the TSO model.[189] Telecom also made submissions on opportunities for improving certain aspects of the model, many of which are discussed below.

852. The Commission has examined each of the following submissions on their merits and addressed the submissions made. The Commission, when faced with two reasonable though on occasions conflicting submissions as refinements to the modelling approach, has balanced the interests of Telecom and Liable Persons and decided on the matter taking into account the requirements of Part 3 of the Act. The Commission recognises that in some case this balancing exercise may trade off the need for a speedy resolution of the issue with improved modelling.

853. TelstraClear submitted:[190]

> 21. TelstraClear and Network Strategies have raised many modelling issues in multiple submissions on the 2004/05 and 2005/06 draft decisions, which the Commission does not appear to have addressed in its revised draft determinations. In the interests of probity and transparency, TelstraClear considers that it is important that the Commission addresses the points raised by the submitting parties.

854. The Commission has addressed each of these issues in this appendix.

855. NSL for TelstraClear and Vodafone has submitted to the effect "that the Commission has introduced a number of serious errors and that these errors result in unreliable and unexpected model behaviours for the Draft". [191] NSL noted that these "potentially serious" issues have been examined and explained as the correct functioning of the model and, further the absence of submissions in the revised draft submission would seem to indicate that the parties agree to this.

856. NSL has submitted that Project PROBE revenues should be included as a factor offsetting TSO costs in ESA where this investment has occurred. The Commission has accepted this point and included the revenues in the modelling which has resulted in a decrease of TSO costs of $200,000 or 0.3% for 2004/2005.

857. The Commission has outlined below its views on a number of the points set out in NSL's submissions.

TSO Revenue Submission

858. NSL has submitted:[192]

> *Data extraction methodology*
>
> Recommendation: We recommended that the Commission reviews the data extraction methodology. This includes lines not being purged within the data extraction process, unbundled revenue and coding changes, and lines matched to ESAs based on PROBE data. Telecom: has

[189] NSL submission dated 20 June 2008, Annex B.

[190] TelstraClear, *Local Service Telecommunications Service Obligation Revised Draft Determinations for 2004/05 and 2005/06*, 24 June 2008, para 21.

[191] Network Strategies Limited, *Report on the TSO Draft Determinations for the 2004/2005 and 2005/2006 Periods*, 6 August 2007, p iii.

[192] Network Strategies Limited, Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods, 20 June 2008, section B.1.

made some changes relating to matching lines to ESAs, to improve the quality of the data. It is unclear whether these changes have been made retrospectively to the 2004/05 data.

859. Telecom has advised in response to the NSL submission that they consider:[193]

7 No issue that needs to be addressed.

Commission View

860. The modelled revenues at a cluster level are composed of the product of the number of lines in a cluster times the average revenue per line. An incorrect mapping of lines to ESAs in Probe will not affect the TSO lines count of customer within an ESA. This count is static it is based on the December 2001 line count. The proposed update would however result in an aggregation of a slightly different set of customers for which the average revenue per line is calculated it is expected that this will result in slight if any change to modelled revenues and thus the TSO cost.

861. The Commission's view is that this is a minor improvement opportunity which will not materially affect the TSO. The Commission has therefore not implemented this change.

ADSL Net Revenue Submission

862. NSL has submitted:[194]

While, in general, the Commission has not made changes to the ADSL revenue model (or required Telecom to make any changes) for 2004/05, it does make this comment:

Numerous issues have been identified by Network Strategies and responded to by Telecom.

The Commission has reviewed the detail of these questions and is comfortable that no major or systematic issues have occurred in the modelling. The net ADSL revenue at least for the CNVC customers is slight or negligible. The Commission expects Telecom's modelling accuracy to improve over time.

863. Specific recommendations from NSL on behalf of Vodafone and TelstraClear are addressed in the remainder of this appendix:

ADSL Net Revenue Submission - historical model

864. NSL has submitted:[195]

Recommendation: remove inefficiencies of the historical model and implement MEA approach.

Telecom: Telecom believes that the Commission is not required to optimise costs associated with 'indirect' revenues. However our primary concern was the mix of historical configuration with the theoretical transport network, leading to inefficiencies that no real-world operator (efficient or otherwise) would operate under.

865. Telecom has submitted:[196]

31 Telecom has already addressed the MEA issue. In essence we do not agree that MEAs should be used in a model addressing the indirect revenues. We note that elsewhere in the TSO NSL are arguing that much of the TSO can be delivered over a mobile network – in other words that this mobile network represents MEA replacing the copper loop. Following NSL's logic, this would

[193] Telecom, *Telecom New Zealand Response To The Network Strategies Report On TSO Revenue for 2004/5 and 2005/6,* 19 February 2007,para 7,

[194] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[195] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[196] Telecom, *Telecom New Zealand Response To The Network Strategies Report On Adsl Net Revenues,* 19 February 2007, para 31.

> then suggest that ADSL in these areas be costed as if delivered over a mobile network rather than the copper loop.

Commission View:

866. The Commission's view is presented at paragraph 493 of this determination.

ADSL Net Revenue Submission - Efficient backhaul solutions

867. NSL has submitted:[197]

> Telecom should verify that HCPM calculates the most efficient, forward-looking solution for cabinet backhaul because "in general, we would expect that a remote DSLAM be located on the same ring as its parent, and we would expect the parent to be located at the nearest major exchange (or for a cabinet, at the parent exchange)." Telecom believes HCPM is deemed to model the most efficient cable network[198]

868. Telecom has submitted:[199]

> 3 NSL point out that Telecom uses an historical configuration for the ADSL equipment. Further, the network modelled is Telecom's actual network rather than one based on Modern Equivalent Assets (MEAs).
>
> 4 In Telecom's view it would be inappropriate for the Commission to optimise this part of the network for the purposes of the TSO. The calculation of efficient costs is confined to those areas of the network where the TSP is deemed to be providing a service that is both essential and that no other provider can supply profitably. Because there is no competition for these services, the Commission considers Telecom is not under competitive pressure to supply these services at the most efficient cost. The Commission therefore calculates the cost based on what it would cost an efficient new entrant to supply these services.

Commission View:

869. The backhaul costs calculated in Telecom's model *ADSLaccess_Jun05_Time2withNewESAs.xls* are typically considerably less than those of the local portion of the ADSL access network. Three ESA with CNVC clusters of customer have been randomly chosen to illustrate this point.

ESA	Annualised Cost of Backhaul[200]	Total Annualised Costs ADSL plant [201]
BAL	$[ ]TNZRI	$[ ]TNZRI
OMM	$[ ]TNZRI	$[ ]TNZRI
RUT	$[ ]TNZRI	$[ ]TNZRI

870. In each case the annualised Cost of the Backhaul is a small fraction of the Total Annualised Cost of ADSL Plant. This total Annualised cost in itself is a relatively small component of the TSO cost. If this cost were to be made more efficient then it would not materially affect the TSO cost. The Commission's view is that, given the relatively minor significance of backhaul costs, and that the Commission has constructed a virtual network that was efficient in year 0, it is reasonable that this existing network's cost structure be used.

ADSL Net Revenue Submission - Review the backhaul costs calculation

871. NSL has submitted:[202]

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[197] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.
[198] Revised draft, paragraph 535.
[199] Telecom, *Telecom New Zealand Response To The Network Strategies Report On TSO Revenue for 2004/5 and 2005/6,* 19 February 2007, para 3,4.
[200] Telecom, file ADSLaccess_Jun05_Time2withNewESAs.xls, Tab, "esa summary", Column P.
[201] Telecom, file ADSLaccess_Jun05_Time2withNewESAs.xls, "esa summary", Column Y.

> Review the calculation of backhaul costs with particular emphasis on the problem of mixing a historical configuration with a theoretical transport network, and ensure the transport paths have been correctly dimensioned for the traffic they are carrying. Note that this does not require that the location of any nodes should be changed. Telecom: Telecom believes that its deployment is the most efficient given the growth of the ADSL network.

872. Telecom has submitted:[203]

> 11 NSL's key issue is that the Telecom model uses CostPro to calculate backhaul costs. They argue that the CostPro model is not optimised to deliver ADSL backhaul.
>
> 12 This raises the same issues as the previous recommendations and Telecom's response is the same. The purpose of this calculation is to ensure that where Telecom can use the TSO assets for other services, and this is efficient, then this is taken into account in the TSO calculation. Hence the issue here that the Commission is addressing is: given that the TSP is modelled with a backhaul network designed and optimised for PSTN only, what is the optimal way of using those same assets to deliver other non-TSO services. This is the reason Telecom used the CostPro model and its costs.

Commission View:

873. The Commission's view is expressed at paragraph 870.

<u>ADSL Net Revenue Submission - Working and actual lines</u>

874. NSL has submitted: [204]

> Review the installed capacities and ensure that the ESAs are accurately costed for the actual lines installed (and not just those working). Telecom disagrees.

875. Telecom has provided an extensive response to NSL's original submission selective quotes follow:[205]

> 19 Second we agree with NSL when they say on page 7 that an efficient operator would install sufficient capacity to cater for expected growth in demand. This is allowed for in the model.
>
> 20 Third we do not believe there is a place in the model where different line counts are used for different cost calculations. We note that NSL do not state that this is the case, only that there would be problems if it were the case (page 7).
>
> 21 Fourth NSL suggest that marginal costs be used for backhaul and other shared costs. Telecom considers that using working ports as the denominator is appropriate where the service is growing rapidly and the spare capacity which exists at any one point in time is geographically restricted – such as for DSLAMs and backhaul particularly in rural areas. If this is not done then Telecom would not be able to recover its costs. We demonstrate this with a stylised example in the next section.
>
> 24 We understand NSL to be arguing that the model should calculate a unit cost by dividing the equipment cost by its installed capacity. Presumably NSL are suggesting that the actual cost used in any year in the model be the working ports multiplied by this 'capacity' cost.
>
> 25 The problem with this approach is that it would not allow Telecom to recover all the costs of this equipment.
>
> 29 NSL raise concerns about apparent gross over-provisioning of lines in a number of ESAs. Closer examination shows that this is due to minimum equipment sizes, multiple DSLAM sites within the ESA, and/or provision for expected growth.

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[202] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[203] Telecom, *Telecom New Zealand Response To The Network Strategies Report On Adsl Net Revenues*, 19 February 2007, para 11,12.

[204] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[205] Telecom, *Telecom New Zealand Response To The Network Strategies Report On Adsl Net Revenues*, 19 February 2007, paras 19,20,21,24,25,29.

Commission View:

876. The Commission's view is that the approach suggested by NSL would not allow Telecom to recover the costs of this equipment. The Commission's view stated at paragraph 495 is that costs modelled for supplementary revenues should reflect the actual costs that Telecom faces.

ADSL Net Revenue Submission - Exchange rates

877. NSL has submitted:[206]

> "Use average annual exchange rates". Telecom disagrees.

878. Telecom has submitted:[207]

> Telecom does not agree that average exchange rates should be used. For the annuity formula to work correctly, all costs are those costs at the beginning of the period. Changes in those costs, and changes due to exchange rate fluctuations are one of these, are dealt with in the price change parameter. The NSL proposal would contradict this. Nevertheless we would agree that there need to be periodic reviews of the costs and tilt parameters to ensure that the original values are still broadly valid.

Commission View

879. The Commission's view is that the TSO cost is insensitive to whether average ADSL costs be taken across a period or a value be taken at one point in time. Principally, the initial value of the titled annuity should be set at the time that an investment is occurring and any changes from then be accounted for via the tilt mechanism. The Commission has determined that the costs at one point in time shall be used.

ADSL Net Revenue Submission - MEA and tilt

880. NSL has submitted:[208]

> "Update the model so that modern equivalent assets are used and the appropriate tilt for the equipment should be applied. Telecom disagrees; same reasoning as MEA recommendation above.

881. Telecom has submitted:[209]

> 31 Telecom has already addressed the MEA issue. In essence we do not agree that MEAs should be used in a model addressing the indirect revenues. We note that elsewhere in the TSO NSL are arguing that much of the TSO can be delivered over a mobile network – in other words that this mobile network represents MEA replacing the copper loop. Following NSL's logic, this would then suggest that ADSL in these areas be costed as if delivered over a mobile network rather than the copper loop.
>
> 32 NSL recommend an appropriate tilt be applied without indicating what is incorrect about the approach Telecom has adopted. In Telecom's view the decline in prices which occurs as new technologies are introduced (as occurred when Alcatel equipment was used in place of Nokia) are the appropriate prices to be included in the tilt – along with expectation of future price changes.

Commission View:

882. The Commission's view is stated at paragraph 495.

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[206] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[207] Telecom, *Telecom New Zealand Response To The Network Strategies Report OnAdsl Net Revenues*, 19 February 2007, para 30.

[208] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[209] Telecom, *Telecom New Zealand Response To The Network Strategies Report OnAdsl Net Revenues*, 19 February 2007, para 31,32.

ADSL Net Revenue Submission - Project PROBE

883. NSL has submitted: [210]

> "To avoid Telecom being reimbursed twice in areas where ADSL infrastructure has been subsidised by Project PROBE, ADSL costs should take into account the impact of the subsidy and this should flow through to higher ADSL revenues. Telecom treats PROBE as a one-off revenue, not a subsidy on costs".

884. Telecom has submitted:[211]

> 33 The issue of how to deal with Project Probe revenues has not yet been explicitly addressed. The revenues may have been included in the revenues presented here. We have yet to confirm whether that is the case or not though it is unlikely. We note that these revenues were one-off and are not ongoing. They were largely addressing customers classed in the TSO as business customers. They were delivered using equipment available at the time and the tenders were based on that equipment.
>
> 34 Telecom will identify the timing of these payments, issues around the allocation of these revenues to ESA, and issues around the residential:business split of these revenues, with a view toward ensuring that these are included as revenues in the 04/05 and possibly 05/06 modelling.

Commission View:

885. The Commission's has included an annualised correction to take account of the impact of the Project PROBE subsidy, in paragraph 487.

ADSL Net Revenue Submission - Wireless broadband revenue

886. NSL has submitted:[212]

> "For both 2004/05 and 2005/06, exclude wireless broadband revenues for technologies not using the access network common to the TSO service. Action: Telecom agrees and notes it has already been done for 05/06."

887. Telecom has submitted:[213]

> 35 Telecom agrees. This only affects 04/05 as this has already been done for 05/06.

Commission View:

888. The removal of wireless revenues would reduce the contribution that ADSL revenues make to the TSO. Only 41 of the approximately 780 ESAs had a positive net contribution and could have potentially impacted on the TSO. These ESAs tended to be associated with cities and towns that were not in themselves CNVC. The elimination of this revenue stream is not expected to materially impact on the 2004/05 TSO.

889. The Commission has decided not to require that the 2004/2005 model be made consistent with the later 2005/2006 model in relation to its modelling of wireless broadband revenues. In any event the changes are not expected to materially alter the TSO net cost.

ADSL Net Revenue Submission - Scope of retail costs

890. NSL has submitted[214]

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[210] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.
[211] Telecom,*Telecom New Zealand Response To The Network Strategies Report OnAdsl Net Revenues*, 19 February 2007, para 33,34.
[212] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.
[213] Telecom, *Telecom New Zealand Response To The Network Strategies Report OnAdsl Net Revenues*, 19 February 2007, para 35.

> "The Commission should request information on the scope of the retail costs. Telecom has confirmed that the costs are ADSL customer costs only.

891. Telecom has submitted: [215]

> Telecom can confirm that costs relate specifically to ADSL customers.

Commission View:

892. Telecom has confirmed that the ADSL Retail costs are those related to ADSL customer costs.

<u>ADSL Net Revenue Submission - Acquisition costs, churn rates and alternative methodology for retail costs</u>

893. NSL has submitted:[216]

> "Telecom clarifies the definition of the acquisition costs, provides information on relevant churn rates. Further, our alternative methodology for retail costs should be used. Telecom agrees in general, and will attempt to do what the Commission requires".

894. Telecom has submitted:[217]

> 43 In principle Telecom agrees with these recommendations. We note that there may be issues around churn data which are notoriously difficult to define and collect. However we are happy to implement these if the Commission wishes us to do so. We doubt that the impact on the TSO number for 05/06 will be significant, as the ratio of acquisitions to the customer base has probably not changed that much from 04/05. However the impact will change over time as growth profiles change.

Commission View:

895. The Commission's view is that these costs are such a minor portion of what is a minor contribution to the TSO costs and that further refinement is not required.

<u>ADSL Net Revenue Submission - Alignment of costs and revenues</u>

896. NSL has submitted:[218]

> "That the costs and revenues of the model be better aligned so that a customer that connects near the end of the year does not incur a full year's costs. Telecom states that it intended to do this for 2005/06 TSO[219]. We recommended that the costs and revenues be aligned for 2005/06 as well. Telecom has done this for 2005/06 and will do for 2004/05 if required

897. Telecom has submitted:[220]

> 47 Telecom is happy to do this for 04/05 if requested by the Commission. It has been done for 05/06.

Commission View:

898. The Commission's view is that these costs are such a minor portion of a minor contribution to the TSO costs that further refinement is not required.

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[214] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[215] Telecom, *Telecom New Zealand Response to the Network Strategies Report On Adsl Net Revenues*, 19 February 2007, para 42.

[216] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[217] Telecom, *Telecom New Zealand Response to the Network Strategies Report On Adsl Net Revenues*, 19 February 2007, para 43.

[218] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.

[219] Telecom , *Broadband Net Revenues for the TSO calculation (draft)*

[220] Telecom, *Telecom New Zealand Response to the Network Strategies Report On Adsl Net Revenues*, 19 February 2007, para 47.

ADSL Net Revenue Submission - Weighted average line count

899. NSL has submitted:[221]

> "Use a weighted average line count, similar to that for TSO, for the broadband line count. Telecom will do for 04/05 if required".

900. Telecom has submitted:[222]

> 48 As mentioned above, the 05/06 model already incorporates weighted average broadband line counts, and Telecom is happy to derive weighted average broadband line counts for 04/05 if requested by the Commission.

Commission View

901. The Commission's view is that these costs are such a minor portion of a minor contribution to the TSO costs that further refinement is not required for the immediate future.

Anomalous Gross Broadband Revenues

902. NSL has submitted:[223]

> "Review ESAs with anomalous gross broadband revenues. Telecom believes it has treated these reasonably"

903. Telecom has submitted: [224]

> 49 Most of the issues raised here by NSL are probably due to small anomalies in the source data. [ ]TCNZRI, although classed as suburban, only has 43 PSTN lines and a weighted average ADSL line count for 05/06 of 0.165, so applying the average rural cost per line would not be an inappropriate assumption. In the 2004/05 model, some wireless broadband revenue was not excluded as previously noted, so it is not surprising that there was a reasonable group of ESAs that showed up as having no ADSL costs and zero working ports but positive "so-called" ADSL revenue. [ ]TCNZRI is clearly served predominately by wireless so the 2-3 lines that show up in the revenue data as "ADSL" may be due to incorrect coding.
>
> 50 Telecom feels that an appropriate way to handle these anomalies is to apply the average rural cost per line (as it has done), rather than just ignore them, and so allow the model to derive net ADSL revenue per line in the same way as for other ESAs. Telecom does not, as implied by NSL, assume zero net ADSL revenue for these ESAs, as can be seen for the [ ]TCNZRI ESA where the model derives non-zero net ADSL revenues per line.

Commission View:

904. The Commission's view concerning data qualities is expressed in paragraph 477 of this report.

Cross submission Tilted Annuity Formula

905. NSL has submitted:[225]

> "That the Commission retains the current approach to periods in the tilted annuity formula this issue is discussed …above.

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[221] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.
[222] Telecom, *Telecom New Zealand Response To The Network Strategies Report On Adsl Net Revenues,* 19 February 2007, para 48.
[223] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.2.
[224] Telecom, *Response to NSL ADSL Report,* 19 February 2007, paragraph 49,50
[225] Network Strategies Limited, *Report on TSO Revised Draft Determinations for the 2004/2005 and the 2005/2006 periods*, section B.4.

<u>Commission View:</u>

906. The Commission's view which has resulted in the revison to the modelling approach as used in the TSO Draft for 2004/2005 is discussed in "Appendix 8: Correction to the Tilted Annuity Formula".

APPENDIX 11: ESA ABBREVIATIONS

907. Exchange Service Areas (ESA) are the fundamental geographic unit that the TSO is based around. There are 786 ESAs. Each ESA is given an abbreviation. The full names of the ESA are shown in this appendix.

ESA	Esa Name	ESA	Esa Name	ESA	Esa Name	ESA	Esa Name
AAI	Awanui	CE	Clive	GDW	Glendowie	HYD	Hyde
ABB	Andersons Bay	CH	Christchurch	GG	Gore	IBY	Island Bay
ABY	Albury	CI	Carterton	GG1	Gore 1	ID	Inglewood
AH	Ashhurst	CL	Coromandel	GID	Green Island	IN	Invercargill
AHA	Ataahua	CLB	Clarence Bridge	GL	Glenavy	INE	Invercargill East
AHI	Ahitit	CLE	Claudelands	GLB	Glenbrook	INJ	Inangahua Junction
AHP	Arthurs Pass	CLV	Colville	GLE	Glen Eden	IRW	Irwell
AIA	Aria	CMW	Cromwell	GLF	Glenfield	ISL	Islington
AKCE	Auckland	CO	Clinton	GLS	Gladstone	JFK	John F Kennedy Dr.
AL	Alexandra	COL	Colyton	GLT	Gleniti	JV	Johnsonville
ALF	Alfredton	CPC	Courtenay Place	GLU	Glentunnel	KA	Karaka
ALY	Albany	CT	Cheviot	GLY	Glenroy	KAA	Kaiaua
AO	Akaroa	CTE	Corstorphine	GM	Greymouth	KAM	Kamo
AO1	Akaroa1	CTP	Canturbury Tech Park	GMY	Glen Murray	KAN	Kairanga
AON	Aongatete	CU	Cust	GN	Greytown	KAO	Kaeo
AP	Apiti	CVD	Culverden	GNH	Greenhithe	KAP	Kapuka
APA	Ahipara	CVE	Cloverlea	GNO	Glen Oroua	KAU	Kawau Island
AR	Ashburton	CW	Collingwood	GOR	Gordonton	KC	Kerikeri
ARD	Arundel	CY	Chertsey	GOV	Governors Bay	KEN	Kennington
ARU	Auroa	CYD	Clyde	GPK	Greenpark	KEU	Kawerau
ASC	Ashley Clinton	DA	Devonport	GS	Gisborne	KF	Kaipara Flats
ATM	Atiamuri	DB	Duvauchelle	GTN	Garston	KFR	Kaingaroa Forest
ATN	Alicetown	DBK	Dunback	GV	Gonville	KG	Kekerengu
AU	Ahaura	DHB	Diamond Harbour	HA	Hampden	KGR	Kelvin Grove
AVD	Avondale	DIP	Dipton	HAG	Hangaroa	KHA	Kaharoa
AVO	Avonhead	DMD	Drummond	HAL	Halcombe	KHO	Kaikohe
AW	Arrowtown	DN	Dunedin	HAS	Haast	KHO1	Kaikohe 1
AWF	Ashwick Flat	DOB	Dobson	HAW	Hawarden	KI	Kaiapoi
AWI	Atawhai	DOR	Dorie	HBC	Hibiscus Coast	KIL	Kilbirnie
AWU	Awhitu	DRF	Darfield	HBN	Hastings	KIM	Kimbolton
AY	Amberley	DRF1	Darfield 1	HBN1	Hastings 1	KIN	Kirikopuni
BAL	Balfour	DRL	Dargaville	HCK	Howick	KIO	Kiokio
BBK	Bell Block	DS	Douglas	HDS	Hinds	KIW	Kiwitahi
BD	Birkenhead	DSD	Dunsandel	HFB	Halfway Bush	KK	Kaikoura
BDE	Benneydale	DUN	Duntroon	HG	Hikurangi	KKT	Kakatahi
BEA	Beachlands	DUR	Dunrobin	HGH	Hedgehope	KLB	Kelburn
BEL	Belfast	DV	Dannevirke	HIG	Highbank	KM	Karamea
BGN	Brighton	EDD	Edendale	HIL	Hilton	KME	Kumeu
BGW	Brightwater	EDG	Edgecumbe	HIM	Himatangi	KNA	Kaitangata
BHB	Blockhouse Bay	EE	Eastbourne	HIN	Hinuera	KNG	Kensington
BHE	Bethlehem	EGV	Egmont Village	HIT	Hilderthorpe	KNH	Khandallah
BHN	Burnham	EKA	Eketahuna	HK	Hokitika	KOU	Kohukohu
BID	Bideford	ELL	Ellerslie	HKA	Hikutaia	KOW	Kurow
BKL	Birkdale	ELP	Elsthorpe	HKO	Herekino	KP	Kaka Point
BKM	Beckenham	ELS	Elstow	HL	Helensville	KPA	Kaukapakapa
BL	Balclutha	ELT	Eltham	HLY	Huntly	KPE	Kerepehi
BLF	Bluff	ENF	Enfield	HMB	Halfmoon Bay	KPO	Kaponga
BLI	Blairlogie	ETM	East Tamaki	HMN	Haumoana	KRI	Karori
BM	Blenheim	EUR	Eureka	HN	Hamilton	KT	Katikati
BM1	Blenhiem 1	FB	Foxton Beach	HNE	Hamilton East	KTA	Kaitaia
BM2	Blenhiem 2	FDL	Fordell	HO	Hororata	KTI	Kaiteriteri
BMT	Belmont	FDN	Fendalton	HOI	Hoi-O-Tainui	KUA	Kumara
BN	Browns	FG	Feilding	HOT	Horotiu	KV	Kawakawa
BOB	Bombay	FGF	Flagstaff	HP	Hanmer Springs	KW	Kai Iwi
BRW	Broadwood	FJG	Franz Josef Glacier	HR	Huia	KWA	Kawhia
BS	Bulls	FJN	Frankton	HRD	Harewood	KWI	Kirwee
BSK	Brunswick	FK	Fairlie	HRI	Harihari	KWK	Kaiwaka
BSY	Browns Bay	FLH	Frankleigh Park	HRT	Heriot	LAW	Lawrence
BTN	Barrytown	FME	Flaxmere	HSD	Horsham Downs	LBN	Loburn
BUN	Bunnythorpe	FN	Featherston	HSL	Halswell	LCN	Lincoln
BUR	Burwood	FOR	Forrest Hill	HSN	Henderson	LCR	Lake Coleridge
BV	Bay View	FP	French Pass	HTI	Hataitai	LEI	Leith Valley
BYM	Brymer	FX	Foxton	HTN	Hillmorton	LEP	Lepperton
CAM	Cheltenham	FXR	Fox Glacier	HUN	Hunua	LH	Leigh
CAV	Cave	GAL	Galatea	HV	Havelock	LHT	Lower Hutt
CB	Cambridge	GBI	Great Barrier Island	HVL	Hunterville	LIN	Linwood
CD	Clevedon	GC	Granity	HVN	Havelock North	LLD	Lichfield
CDV	Clydevale	GD	Geraldine	HW	Hawera	LMC	Linton Milatry Camp

ESA	Esa Name	ESA	Esa Name	ESA	Esa Name	ESA	Esa Name
LMO	Lower Moutere	MRE	Mangere	OKR	Oakura	POH	Pohangina
LMS	Lumsden	MRI	Makuri	OMI	Omihi	POP	Papatoetoe
LOB	Lochmara	MRN	Morven	OMK	Omakere	POW	Port Waikato
LRV	Little River	MRP	Mt Ruapehu	OMM	Omarama	POY	Ponsonby
LSN	Leeston	MRT	Mataroa	OMO	Omokoroa	PPM	Paparimu
LTK	Lake Tekapo	MS	Masterton	OMT	Otematata	PRM	Paraparaumu
LTN	Linton	MSI	Mosgiel	OMU	Omakau	PRO	Porirua
LVN	Levin	MSM	Mt Somers	ON	Onehunga	PTA	Patearoa
LYE	Lynmore	MSY	Massey	ONG	Ohingaiti	PTE	Patetonga
LYN	Lytton West	MT	Mataura	ONH	Onewhero	PTN	Petone
LYT	Lyttelton	MTA	Matata	OOK	Okawa	PTO	Patoka
MA	Manaia	MTG	Matangi	OP	Opotiki	PTS	Picton Sounds
MAB	Mt Albert	MTK	Matakana	OPA	Opito Bay	PTU	Pukeatua
MAE	Manawahae	MTL	Mt Roskill	OPK	Opiki	PUA	Puahue
MAG	Mangamahu	MTM	Motu	OPN	Opononi	PUE	Puketurua
MAK	Makikihi	MTP	Mangatangi	OR	Ohura	PUH	Puhoi
MAM	Matamata	MTW	Matiere	ORA	Outram	PUI	Papanui
MAN	Maungati	MU	Motueka	ORH	Onerahi	PUK	Pukekohe
MAO	Maraetotara	MUP	Murupara	ORM	Ormond	PUT	Putaruru
MAT	Murchison	MUS	Manutuke South	ORN	Orini	PW	Pukekawa
MAU	Maungaturoto	MV	Mauriceville	ORP	Orepuki	PWA	Parawera
MAW	Marewa	MVE	Melville	OT	Otaki	QST	Queenstown
MBA	Martinborough	MVN	Methven	OTE	Otumoetai	RAG	Raglan
MBB	Macandrew Bay	MWD	Matawai	OTN	Otane	RAI	Rai Valley
MCF	Macraes Flat	MWI	Mangawhai	OTO	Okato	RAK	Rakaia
MCK	Mt Cook	MWN	Mt Wellington	OTR	Otatara	RAM	Raumati
MDL	Middlemarch	MX	Maxwell	OTU	Otipua	RBH	Ryal Bush
MDX	Middleton	MXL	Maxwells Line	OTW	Otewa	RCK	Renwick
MFD	Mayfield	NA	Napier	OU	Oamaru	RCM	Runciman
MFL	Millers Flat	NAE	Naenae	OUN	Oamaru North	RD	Richmond
MG	Maungatautari	NAT	National Park	OV	Ormondville	RDB	Red Beach
MGA	Mangaweka	NB	Normanby	OW	Ohaeawai	REO	Reporoa
MGI	Mangonui	NBO	New Brighton	OWI	Orawia	RET	Raetihi
MGK	Maungakaramea	NE	Ngahere	OWN	Owhango	REW	Rerewhakaaitu
MGL	Mangakahia	NG	Ngunguru	OX	Oxford	RGT	Rangitaiki
MH	Mahia	NGB	Ngatapa	PA	Patea	RGW	Rangiwahia
MHG	Mahurangi	NGC	Nightcaps	PAE	Paekakariki	RHU	Rahotu
MHL	Maori Hill	NGI	Ngatimoti	PAK	Papakura	RI	Riverton
MHO	Maheno	NGT	Ngatea	PAN	Parnassus	RIC	Riccarton
MI	Milton	NGU	Ngarua	PAP	Paparoa	RKW	Ruakawakawa
MIA	Maruia	NHI	Ngahinapouri	PAR	Paroa	RL	Russell
MID	Midhurst	NK	Nuhaka	PAU	Pukerau	RN	Reefton
MIH	Maihiihi	NLN	New Lynn	PBL	Peebles	RNF	Ranfurly
MIK	Makirikiri	NN	Nelson	PBO	Portobello	RNF1	Ranfurly 1
MIR	Miramar	NOA	Ngongotaha	PC	Port Chalmers	RNU	Rangiotu
MKE	Manutuke	NOM	Ngaroma	PCV	Pacific View	RO	Rotorua
MKJ	Mkj	NR	Ngakuru	PE	Pukehina	ROG	Rotongaro
MKK	Maraekakaho	NRN	Netherton	PEG	Paengaroa	ROI	Rotoiti
MKN	Mokihinui	NT	Ngaruawahia	PER	Peria	ROL	Rolleston
MKO	Mangakino	NU	New Plymouth	PGA	Pakuranga	ROM	Rotoma
MKT	Maketu	NVY	North East Valley	PGB	Pigeon Bay	RON	Rongotea
MKW	Makarewa	NWD	Norsewood	PH	Porangahau	ROO	Rotoorangi
MKY	Manukau City	OAA	Otara	PHA	Pahiatua	ROW	Rotowaro
ML	Marton	OAG	Onga Onga	PHA1	Pahiatua 1	RPG	Raupunga
MMA	Memorial Ave	OAH	Okaihau	PHI	Patutahi	RR	Rangiora
MMK	Mamaku	OAK	Owaka	PHO	Patumahoe	RS	Ross
MMN	Mt Maunganui	OAR	Otamauri	PIA	Piha	RSB	Ravensbourne
MMR	Maramarua	OAU	Otautau	PIH	Paihia	RSN	Rissington
MN	Manutahi	OAU1	Otautau 1	PIN	Pirinoa	RTG	Ruatangata
MNA	Moana	OEA	Oturehua	PIO	Piopio	RUE	Remuera
MNG	Mornington	OF	Okere Falls	PIR	Pirongia	RUK	Ruakaka
MNK	Manakau	OGU	Ongarue	PK	Pokeno	RUN	Runanga
MNR	Manurewa	OH	Otahuhu	PKB	Pukerua Bay	RUT	Ruatoria
MNW	Manawaru	OHA	Otorohanga	PL	Palmerston	RUW	Ruawai
MOA	Mokau (Ahititi)	OHE	Ohope	PLB	Palliser Bay	RVD	Riversdale
MOB	Mossburn	OHG	Ohangai	PLM	Plimmerton	RWN	Rawene
MOD	Mt Eden	OHK	Ohoka	PLO	Pelorus	RXB	Roxburgh
MOE	Motea	OHP	Ohaupo	PLP	Pleasant Point	SA	St Arnaud
MOT	Motukarara	OIA	Okoia	PM	Palmerston North	SB	Springburn
MOV	Morrinsville	OIH	Ohai	PMA	Papamoa	SCG	Scargill
MPE	Maungatapere	OK	Opunake	PN	Picton	SCK	Spring Creek
MPK	Matatoki	OKE	Okareka	PNT	Panetapu	SD	Sheffield
MPL	Mt Pleasant	OKI	Okaiawa	PNY	Pukenui	SDL	Springdale
MPR	Manapouri	OKL	Oakleigh	POA	Paeroa	SDN	Seddon
MPU	Maungatapu	OKN	Ohakune	POB	Poolburn	SEF	Sefton
MPX	Mapua	OKO	Okoroire	POG	Pongaroa	SFD	Stratford

ESA	Esa Name	ESA	Esa Name	ESA	Esa Name	ESA	Esa Name
SHB	St Heliers	TIO	Tirohanga	UMO	Upper Moutere	WKP	Whakapara
SHN	Shannon	TIR	Tirau	UNP	Urewera National Par	WKU	Waiuku
SKH	South Kaipara Head	TIS	Three Kings	UP	Upper Hutt	WKW	Waikiwi
SN	Sanson	TK	Temuka	UPN	Upper Hutt North	WLB	Willowbank
SOD	South Dunedin	TKE	Te Kaha	URE	Urenui	WLD	Wakefield
SOU	Southbridge	TKG	Tokanui	UTI	Uriti	WLN	Walton
SPE	Spencerville	TKK	Te Karaka	WA	Wairoa	WM	Waimauku
SPF	Springfield	TKO	Tikokino	WAA	Whataroa	WMG	Waimangaroa
SPN	Springston	TKT	Te Kuiti	WAD	Wardville	WMK	Waimahaka
SR	Shirley	TKU	Tuakau	WAE	Waikanae	WMM	Whangamomona
STA	St Andrews	TKW	Te Kowhai	WAF	Waiau Pa	WMN	Waimana
STI	South Invercargill	TKY	Tokomaru Bay	WAH	Waihi	WN	Wellington
STJ	Studholme	TMK	Tamaki	WAK	Waitakere	WND	Woodend
STK	Stoke	TMN	Taumarunui	WAO	Waotu	WNK	Wanaka
STL	St Albans	TN	Tinui	WAU	Waianiwa	WNL	Waituna West
STM	Strathmore	TNA	Takapuna	WAY	Washdyke	WNU	Wakanui
SUM	Sumner	TNU	Te Anau	WB	Ward	WO	Winton
SV	Stokes Valley	TO	Toko	WBA	Waihau Bay	WOA	Wainuiomata
SWO	Spotswood	TOB	Tokoroa	WBH	Waihi Beach	WOK	Waikoikoi
TA	Te Puna	TOI	Towai	WBY	Welcome Bay	WP	Westport
TAA	Taitapu	TOK	Tokomaru	WCM	Winchmore	WPI	Waipahi
TAE	Tauhei	TP	Tapanui	WD	Waipu	WPR	Waipara
TAI	Tariki	TPE	Taihape	WDL	Woodlands	WPU	Wakatipu
TAK	Takaka	TPI	Taupiri	WDV	Woodville	WR	Whangarei
TAP	Tapu	TPO	Taupo	WE	Waimate	WR1	Whangarei 1
TAR	Tairua	TPR	Tapora	WEB	Weber	WRE	Warea
TAT	Te Atatu	TPS	Te Puia Springs	WEI	Whenuapai	WRH	Whangarei Heads
TAU	Te Pahu	TPU	Takapau	WEN	Whenuakite	WRK	Wairakei
TAW	Te Awamutu	TPV	Te Puke	WFD	Wellsford	WRM	Waimarama
TBY	Torbay	TPW	Tapawera	WG	Wanganui	WRU	Wairau Valley
TDL	Taradale	TRA	Turua	WGA	Waerenga	WRY	Woodbury
TEA	Taneatua	TRF	Turitea	WGE	Wanganui East	WS	Wanstead
TEF	Te Akau	TRG	Te Ranga	WGH	Whangara	WSF	Westerfield
TEG	Te Anga	TRL	Te Araroa	WGL	Wanganui Girls Colle	WSR	Windsor
TEK	Te Kawa	TRS	Tarras	WGM	Whangamata	WT	Waitara
TEP	Te Poi	TRV	Te Rapa	WGU	Whangaehu	WTA	Whatatutu
TEY	The Key	TSM	Tasman	WH	Waiheke	WTB	Whitby
TG	Tauranga	TTA	Tarata	WHD	Whitford	WTE	Waiterimu
TGB	Tolaga Bay	TTE	Tuatapere	WHI	Waiotahi	WTH	Wellington South
TGI	Turangi	TTI	Tutira	WHK	Whakatane	WTI	Waitati
TG1	Motiti Island	TTK	Te Teko	WHN	Whangaruru	WTN	Waitangirua
TGN	Titirangi	TTR	Tahunanui	WHR	Waiharara	WTO	Waitoa
TH	Thames	TU	Timaru	WHT	Whitianga	WU	Waiau
THE	Te Pohue	TUA	Turakina	WHV	Waihopai Valley	WUA	Waiatarua
THK	Taheke	TUB	Tuai	WHW	Whatawhata	WUK	Waimamaku
THN	Tahuna	TUK	Te Uku	WI	Waipawa	WUR	Wainuioru
THO	Te Horo	TUP	Te Puru	WI1	Waipawa 1	WV	Waverley
THP	Thorpe	TUW	Te Kauwhata	WI2	Waipawa 2	WW	Warkworth
THR	Te Aroha	TWA	Tawa	WIL	Willowby	WWS	Wairoa West
THS	Tihoi South	TWE	Tauwhare	WIR	Waiouru	WY	Waipukurau
THU	Te Hauke	TWH	Tauwhareparae	WK	Waikouaiti	WYD	Wyndham
TIB	Titahi Bay	TWL	Twizel	WKG	Waitakaruru		
TII	Tikitiki	TY	Thornbury	WKK	Waikaka		