Telecommunications Act 2001

Implementation of TSLRIC
Pricing Methodology for Access
Determinations under the
Telecommunications Act 2001

PRINCIPLES PAPER

20 February 2004

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Glossary and List of Abbreviations

ACCC	Australian Competition and Consumer Commission
CAPM	Capital asset pricing model
CNVC	Commercially non-viable customer
CRA	Charles River Associates
EU	European Union
Fixed PSTN	A PSTN, or that part of a PSTN, that connects an end-user's building to the local switches or equivalent facilities; and includes those local switches or equivalent facilities
FL-LRIC	Forward-looking long-run incremental cost
Interconnection Determination	The determination of 5 November 2002 made by the Commission in respect of an application by TelstraClear (Decision 477) for the designated access services 'Interconnection with Telecom's fixed PSTN' and 'Interconnection with TelstraClear's fixed PSTN'. The determination is available at **http://www.comcom.govt.nz/telecommunications/Decisions_TelstraClearID.cfm**
ISDN	Integrated services digital network
LICA	Local interconnect calling area. A geographical area listed in Schedule 5 of the Interconnection Terms (see Appendix 2 of Interconnection Determination), as adjusted or changed from time to time.
LICA Group	Local Interconnect Calling Area Group. A LICA Group consists of a primary or secondary Major LICA and its associated Minor LICAs (see Schedule 5 of the Interconnection Terms at Appendix 2 of the Interconnection Determination).
LLN	Local loop network
LLU	Local loop unbundling
LRIC	Long-run incremental cost
MEA	Modern equivalent asset
MDF	Main distribution frame
NECG	Network Economics Consulting Group
ODTR	Office of the Director of Telecommunications Regulation (Ireland)
ODRC	Optimised depreciated replacement cost
ORC	Optimised replacement cost
ODV	Optimal deprival value
OFCOM	Office of Comunications (UK). At the end of 2003 Ofcom assumed the regulatory role previously performed by Oftel. In this paper, documents originally released under the name of Oftel are credited to Ofcom.

OFTEL	Office of Telecommunications (UK). Oftel's role was been assumed by Ofcom at the end of 2003.
ORC	Optimised replacement cost
POI	Point of interconnection
PSTN	A 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 purposes of providing telecommunication between telephone devices.
PWC	PricewaterhouseCoopers
RBOC	Regional Bell Operating Company (US)
RCU	Remote concentrator unit
RegTP	Regulierungsbehörde für Telekommunikation und Post (Germany)
RLU	Remote line unit
SLC	Subscriber line card
SS7	Signal Standard 7
TAMRP	Tax-adjusted market-risk premium
Telestyrelsen	The Danish national telecommunications regulator
TELRIC	Total-element long-run incremental cost
Tilt	The rate of change in the price of the assets
TSLRIC	Total-service long-run incremental cost, in relation to a telecommunications service: a) means the forward-looking costs over the long run (see paragraph 263 for a definition of '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	Telecommunications service obligations. Obligations in relation to a TSO instrument.
TSP	Telecommunications service provider
ULL	Unbundled local loop
VPN	Virtual private network
WACC	Weighted average cost of capital
WIK	Wissenschaftliches Institut für Kommunikationsdienste

1. Introduction

1. Under the Telecommunications Act 2001 (the Act), the Commerce Commission (the 'Commission) may apply a total-service long-run incremental cost (TSLRIC) pricing methodology when making a determination of the price of certain designated services. Schedule 1 of the Act includes two designated access services for which the Commission may apply TSLRIC pricing methodology: interconnection with Telecom's fixed PSTN and interconnection with fixed PSTN other than Telecom's.

2. This paper is intended as a guide to the principles the Commission would expect to apply when making a determination on interconnection services in respect of an application for a pricing review determination under section 42 of the Act. While the paper provides general guidance for current and future determinations, the Commission's views may evolve over time, particularly as the Commission applies the TSLRIC pricing methodology to access disputes.

3. The Commission has prepared this principles paper to:

   - promote consistency and transparency concerning the application of the TSLRIC pricing methodology in current and future access determinations;
   - provide guidance to access providers who are required to calculate the price payable for a designated 'interconnection' access service under section 45 of the Act.

4. The paper is the result of the Commission's consultation on the applicable TSLRIC pricing methodology for making determinations in respect of the price for designated 'interconnection' access services. The consultation process has involved the Commission releasing discussion papers, inviting interested parties to make submissions, reviewing the submissions received and holding a conference. The Commission has also considered related issues in other Commission work under the Act, including the TSO.

5. The Commission has previously released four other papers relating to the access determination process. These papers are relevant to an understanding of the Commission's responsibilities under the Act and the underlying concepts. They are:
   - *Interconnection Pricing Methodology,* prepared for the Commerce Commission (New Zealand) by Frontier Economics, 5 April 2002;
   - *A Guide to the role of the Commerce Commission in making Access Determinations under the Telecommunications Act 2001, a discussion paper,* May 2002;
   - *Application of a TSLRIC Pricing Methodology – Discussion Paper,* (the 'TSLRIC Paper) 2 July 2002;
   - *International Benchmarking Study: A Comparative Review of Interconnection Pricing,* 2 September 2002.[1]

[1] This paper replaced the earlier *International Benchmarks: Review of Interconnection and Retail-Minus Wholesale Discounts,* prepared for the Commerce Commission (New Zealand) by CostQuest Associates, 5 April 2002.

6. These papers and related submissions, including submissions made during a Commission conference on TSLRIC, are available on the Commission's website at **http://www.comcom.govt.nz/telecommunications/index.cfm**.

7. In completing this paper, the Commission has considered all information, including information gathered through the preparation of papers on access determinations, international experience with TSLRIC, submissions received from interested parties and other Commission decisions on related issues.

Structure of this paper

8. This paper is divided into 11 chapters. The first chapter provides an overview of the Commission's work to date on TSLRIC and the structure of this paper.

9. Chapter 2 provides a background to TSLRIC modelling and the legal framework within which TSLRIC pricing is utilised under the Act.

10. Chapter 3 discusses the merits and appropriateness of consistency between the TSO and TSLRIC in respect of the economic framework and the modelling.

11. Chapter 4 reviews several TSLRIC building blocks, including the use of a scorched node methodology and MEAs. This chapter also discusses the Commission's decision to use bottom-up modelling rather than a top-down approach, and examines the merits of using a top-down model for reconciliation purposes.

12. Chapter 5 examines the definitions of the core network applied in other jurisdictions and proposed in submissions, as well as considering the guidance offered by the Act. In this chapter, the Commission proposes a definition of the core network's boundary with the access network that could be implemented in any future modelling work.

13. Chapter 6 addresses issues concerning asset valuation and depreciation. The Commission's view is that it should, in calculating TSLRIC interconnection prices, adopt the approach used for the TSO. That approach includes:

    - undertaking asset valuation using optimised replacement cost (ORC);
    - applying depreciation with the use of tilted annuities; and
    - considering the use of the same asset lives for overlapping asset classes.

14. Chapter 7 reviews the factors that influence the appropriate WACC for interconnection services. The Commission's view is that this rate is likely to differ from the appropriate rate for the provision of TSO services.

15. Chapter 8 discusses the definition of the TSLRIC. The Commission's view is that any TSLRIC of interconnection services should define the increment as the total or whole volume of interconnection service that the access provider produces or is likely to produce.

16. Chapter 9 examines the appropriate approaches for allocating the cost of shared and common assets.

17. Chapter 10 discusses operational costs. The Commission's view is that these costs should be determined using mark-ups.

18. Chapter 11 discusses the appropriate treatment of costs that are common to both the designated interconnection services and the TSO. The Commission's view is that there should be no double recovery of costs, and that the cost for such shared infrastructure and operational expenditure should be apportioned between all the services that give rise to the cost.

2. Background

2.1 Legal framework

19. In making a determination under the Act, the Commission is required:
    - under section 19(a) to consider the purpose set out in section 18;
    - under section 19(b), to consider, if applicable, the additional matters set out in Schedule 1 regarding the application of section 18; and
    - under section 19(c), to make the determination that best gives effect, or is likely to best give effect, to the purpose set out in section 18.

20. Section 18 of the Act, which describes the statutory purpose of Part 2 and Schedule 1 to 3 of the Act, states:

> (1) The purpose of this Part and Schedules 1 to 3 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.
>
> (2) 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.
>
> (3) Except as otherwise expressly provided, nothing in this Act limits the application of this section.
>
> (4) Subsection (3) is for the avoidance of doubt.

21. Subpart 1 of Part 2 of Schedule 1 of the Act describes two designated access services for which the Commission may determine prices on the basis of a TSLRIC pricing methodology. These are:

> **Interconnection with Telecom's fixed PSTN –**
>
> Origination and termination (and their associated functions) of voice and data calls (including dial-up internet calls) on Telecom's fixed PSTN.
>
> **Interconnection with fixed PSTN other than Telecom's –**
>
> Origination and termination (and their associated functions) of voice and data calls (including dial-up internet calls) on a fixed PSTN other than Telecom's.

22. If the Commission is required to determine prices for interconnection services, the Act specifies that the determination must be made in accordance with any applicable pricing principles. Initial pricing principles apply to any initial determination made by the Commission for a designated access service. The applicable final pricing principle applies if a party to the determination makes an application under section 42 for the Commission to review the initial price set for the service. Under the final pricing principles for the designated 'interconnection' access services, the Commission is required to determine a price in accordance with one of the methods prescribed in the Act.

23. For the designated access service of interconnection with Telecom's fixed PSTN, Subpart 1 of Part 2 of Schedule 1 states that the final pricing principle will be:

> Either-
>
> (a) TSLRIC; or
>
> (b) if the Commission considers that TSLRIC does not best give effect to the purpose set out in section 18, whichever of the following methods that the Commission considers best gives effect to that purpose:
>
> (i) a pure bill and keep method; or
>
> (ii) a pure bill and keep method applied to two-way traffic in balance (or to a specified margin of out-of-balance traffic) and TSLRIC applied to out-of-balance traffic (or traffic beyond a specified out-of-balance margin).

24. For the designated access service, 'interconnection with fixed PSTN other than Telecom's', the Commission may instead apply 'the price determined by the Commission (if any) for interconnection with a network of Telecom's that corresponds most closely in nature to the access provider's network".

25. The interconnection methodology paper examined the relative merits of the two applicable pricing principles for the major types of interconnection services. That paper presented the Commission's preliminary view that the TSLRIC pricing methodology should be used to determine prices for toll-bypass, toll-free and mobile-to-fixed interconnection services.

26. The TSLRIC discussion paper examined the relative merits of bottom-up and top-down modelling approaches to the calculation of TSLRIC. In that paper, the Commission expressed a preference for a bottom-up approach to TSLRIC.

27. The TSLRIC paper also examined a range of key issues that should be considered when implementing TSLRIC, including network design issues, asset valuation, depreciation, cost of capital and the structure of interconnection prices. This principles paper provides the Commission's position on these issues.

2.2 Common issues between TSLRIC and the TSO

28. Common issues exist between the Commission's TSO modelling work and TSLRIC. These include the economic approach to asset valuation, treatment of depreciation, and the cost of capital of telecommunications assets.

29. The Commission has developed a model to calculate the TSO cost arising from commercially non-viable customers (CNVCs). This model includes parts of the PSTN network that are also used for interconnection services. While some areas of commonality exist between the approaches to the TSO and TSLRIC, it is important to acknowledge that there are several key differences arising from the method for calculating TSO costs and the method that would be developed for calculating the costs for TSLRIC. This is discussed further in Chapter 3.

2.3 Price path and duration of determination

30. The TSLRIC discussion paper included a section on the duration of the Commission's decisions and the possible use of price paths for decisions with duration greater than one year. The duration for any specific determination utilising TSLRIC is not addressed in this principles paper. The Commission will consider the appropriate duration for any determination on a case-by-case basis.

2.4 Structure of prices

31. Chapter 11 of the TSLRIC paper examined possible structuring of interconnection prices. The pricing structure could be differentiated by time of day, day of week, geographical region and volume purchased. The paper noted that there is a trade-off between the advantages of flat per-minute or per-call charges, which are easier to model, and the advantages of differentiated pricing structures, which may more accurately reflect – and more efficiently recover – the costs of providing interconnection services.

32. In particular, the TSLRIC paper discussed average-per-minute pricing, and possible departures from it (de-averaged prices) including: prices that vary by time of day and day of week, geographical region and distance; multi-part pricing; and volume discounts.

33. De-averaged prices may be efficient where the de-averaging reflects key cost-drivers. For example, it may be appropriate to adopt geographically de-averaged pricing where costs are found to differ according to geographic region. Such pricing would better reflect underlying costs, and is more likely to discourage inefficient arbitrage.

34. The identification of key cost drivers, which may in turn determine the structure of prices, is likely to become more apparent as the TSLRIC modelling is progressed.

35. In applying the final pricing principles for the designated 'interconnection' access services, the Commission may apply either TSLRIC or, if the Commission considers that TSLRIC does not give best effect to the purpose set out in section 18, one of the forms of bill-and-keep methodology described in the legislation. The Commission would need to consider pricing structures only in circumstances where it determined that TSLRIC rather than bill-and-keep gave best effect to the purpose set out in section 18.

36. In determining the appropriate pricing structure, the Commission will consider both the benefits of efficient recovery of costs that might be offered by differentiated structures, and also the additional complexity associated with creating such structures. The robustness and efficacy of the data set available to the Commission would affect the degree of benefit offered by a more complicated and differentiated pricing structure. The Commission would also take into consideration any billing and pricing constructs agreed by the parties to a determination and would, as a rule, avoid disturbing such agreements.

Conclusion: appropriate pricing structures to be determined at modeling stage

37. The Commission considers that the appropriate pricing structure for interconnection services will depend on evidence of key cost-drivers, and that this is likely to become clearer as the cost modeling is undertaken. The Commission will therefore consider the structure of interconnection prices in more detail at the modeling stage. The Commission will weigh the greater efficiency of differentiated structures with the benefits of modelling simplicity and the robustness of the data set.

3. Consistency with the TSO

38. Section 92(a)(i) requires that the Commission provide a final determination under section 90, including the net cost to the TSP of complying with the TSO instrument. The Commission's calculation of the cost Telecom has incurred to comply with its obligation under the TSO Deed has addressed issues that are common to TSO, TSLRIC and interconnection.

39. The first common issue between the TSO and TSLRIC is the construction of a core network model. The core network is that part of a network operator's infrastructure that conveys calls and other network traffic between nodes (often referred to as exchanges). Core network infrastructure is typically used to carry a wide variety of call types. In the TSO model developed by the Commission, a switching and transmission model was used in order to calculate the incremental cost of local calls provided by Telecom to commercially non-viable customers. It was also used to calculate the incremental profit margin on those customers' other calls, such as national tolls and calls involving interconnection. In building this model, the Commission has been required to consider and make decisions on a range of issues relating to the design of the core network that also need to be addressed when building a TSLRIC model.

40. The other common area between the TSO and TSLRIC is the economic approach to asset valuation, treatment of depreciation, and the cost of capital of telecommunications assets.

41. Network Economics Consulting Group (NECG) submitted, on behalf of TelstraClear, that in Australia problems arose from the use of inconsistent methodologies. NECG recommended that the approaches to the TSO and to PSTN interconnection services/TSLRIC be 'as consistent as possible'. NECG submitted that:[2]

- There is no reason why the approach used for estimating the TSO should not be consistent with the approach used for estimating PSTN access prices, with the exception of input values, methodologies that are TSO specific
- For capital values, asset lives, tilt factors for the annuity, spare capacity factors etc a consistent approach should be adopted
- This was not the case in Australia with the ACCC estimating the TSLRIC of PSTN access completely independently of the ACA estimating the net cost of the USO

42. The Commission considers that a consistent approach between the TSO and TSLRIC is required to avoid costs being either double counted or omitted from both calculations. A consistent approach will also be more efficient and reduce the overall modelling workload. Nevertheless, the TSLRIC modelling will differ from the TSO because TSLRIC includes an allocation of fixed common costs such as corporate overheads, whereas the TSO focuses on incremental costs.

[2] TSLRIC Conference, NECG Presentation, *NZCC TSLRIC Conference 15 July 2003*, Dr T Kuypers, 15 July 2003, page 24.

4. Basis of TSLRIC Modelling

43. The Commission presented its preliminary views in the earlier papers issued, which discussed several aspects of applying a TSLRIC methodology, including the use of a forward-looking cost and bottom-up modelling approach. The Commission sought submission on these preliminary views from interested parties.

4.1 Forward-looking costs

44. The Commission provided its preliminary views on implementing a forward-looking cost-based approach in Chapter 3 of the TSLRIC discussion paper. The Commission considered that forward-looking costs should:

    (i) be based on the use of a scorched node assumption of network design rather than scorched earth;
    (ii) reflect use of MEAs as the network technology modelled; and
    (iii) avoid double counting of any costs relating to the TSO and/or access network.

4.2 Scorched Node/Scorched Earth

45. The terms ‘scorched node’ and ‘scorched earth’ refer to contrasting treatments of network design issues for the purpose of implementing a forward-looking cost-based approach.

46. There are two aspects of network design which are relevant. One is the question of the location of the core network nodes. An issue commonly faced by regulators when determining the costs of an efficient network operator is whether the network model should be based on the location of the nodes in the existing network.

47. The other is the question of network efficiency, which is a matter of considering the degree of network optimisation in terms of the sizing and functionality of the core network nodes.

48. The degree of efficiency and optimisation in the network’s topology or layout can significantly affect the cost of the network being modelled, and hence the price of interconnection (or other designated services). If implementing a scorched node MEA approach, it is necessary to decide whether the model reflects the existing network architecture at each node or whether the architecture is modified to eliminate inefficiencies.

49. If the existing network topology is maintained, the assets used at existing nodes would be costed at their MEA. The choice of MEA is constrained by a need to approximate or duplicate the functionality and output of the existing assets. Such an approach is likely to lead to inefficiencies in the network design (for example costing for full switching functionality when a concentrator would be more optimal, or retaining nodes which result from mis-planning). Since these inefficiencies will be reflected in higher interconnection fees, there will be reduced incentives for the access provider to improve efficiency.

50. The alternative approach is to optimise the network topology to eliminate one or more inefficiencies. The Austrian regulator, Telekom-Control, notes that this can involve optimising one or more of the hierarchical levels, the number and location of the switches and the transmission technologies.[3] Such approaches are referred to as 'modified scorched earth'.

51. One material effect of network optimisation is that at some date it may result in a transfer of costs between the core and access networks. As noted in Telecom's submission, current trends in network design move the traffic-sensitive part of the network closer to the customer. While this change is expected to reduce overall costs, it could see some increase in core network costs and a greater reduction in access costs**.**

Submissions received

52. Telecom's submission noted that an optimal network structure would differ from the 'traditional' network topology.[4] This 'future architecture' is similar to that considered optimal by several regulators (for example ACCC in Australia, Telestyesen in Denmark and Telekom-Control in Austria) with an increased use of small remote concentrators.

53. PwC Consulting, on behalf of Telecom, argued that the TSLRIC modelling should be able to model this trend, but did not nominate a preferred network design for the initial modelling, noting that:[5]

> … it is important that the network topology assumptions and modelling approach adopted should be sensitive to the trends in network development. The trend for the extension of the traffic sensitive network towards the customer is perhaps the most important … a TSLRIC model should allow for the possibility of its inclusion.

54. PwC Consulting supported a scorched node approach:[6]

> agrees with the Commission's view that a scorched node assumption should be used as it would be inefficient to build a new network from scratch (scorched earth assumption), therefore the network structure (nodes) should be taken as given. Efficient use of resources requires that the legacy network structure is taken into account for purposes of network planning and operation.

55. While preferring a scorched earth approach, TelstraClear offered qualified support at a practical level for a scorched node approach:[7]

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[3] Telekom-Control, *Forward-looking Long Run Incremental Costs for the Calculation of Interconnection Fees*, 15 January 1999, paragraph 4.4.
[4] Telecom, *Submission to the Commerce Commission on Application of a TSLRIC Pricing Methodology – Discussion Paper*, 16 August 2002.
[5] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' Issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 53.
[6] PWC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' Issued by the New Zealand Commerce Commission on 2 July 2002*, 15 August 2002, paragraph 45.
[7] TelstraClear Limited, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002*', 16 August 2002, paragraph 17.

> [TelstraClear] considers that a scorched earth approach is most consistent with the costs of an efficient service provider. We have, however acknowledged that a scorched node approach may be more practical to implement.

56. TelstraClear considered that the network design should be optimised with relatively few constraints, and that such optimisation would meet the Act's requirements for efficient costs. TelstraClear cited the Australian experience where the ACCC's model did not use the 'actual location in Telstra's network but rather the planned location of nodes' and where there was some network optimisation: [8]

> That said, the rules for optimising the efficient network should remain as flexible as possible. The more constraints that are placed on the optimisation (for example claiming that certain nodes should not be scorched) the more the cost estimates move away from efficient costs required by the Act to the actual inefficient costs incurred by the access provider.
>
> The Commission should optimise the network architecture around the nodes and consider the full range of best-in-use technologies.

Overseas practice

57. Overseas experience with the optimisation of network topology is mixed particularly in the treatment of 'exchanges'. This latter point refers to the exchange equipment, which is located at sites that may or may not considered 'Nodes' by that particular regime.

58. The scorched node approach is favoured in other jurisdictions, including Australia, the U.S., the UK, Austria, Switzerland, Denmark, Netherlands and Ireland.[9] The Commission is not aware of any regulator using a scorched earth approach.

59. The ACCC, for example, proposed using a forward-looking model of the network topology, which was based on the incumbent's proposed network design. This design contains a significant use of remote concentrators:[10]

> In practice, we have essentially adopted a scorched node approach, but based on Telstra's proposed forward-looking network, which is not currently fully in place (ie the model is based on the Future Mode of Operation, or 'FMO', together with Telstra's plans for bringing 'Fibre To the Kerb', or 'FTK')[11]. We have taken as given estimates for the number of remote units, local switch and tandem switch sites in Australia on a *forward-looking* basis. With regards the numbers of transmission links, we have made estimates based on our understanding of Telstra's forward-looking network plan and planning principles.

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[8] TelstraClear Limited, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002'*, 16 August 2002, paragraphs 17 and 18.

[9] See *Determination of the Preliminary Tariffs for Interconnection and Special Access that are to be Applied to KPN Telecom B.V. from 1 July 1999 until 1 July 2000*, OPTA/99/8000, Holland, November 1999 p 32; *The Development of Long Run Incremental Costing for Interconnection Decision Notice D6/99 & Report on Consultation Paper ODTR 99/17*, Office of the Director of Telecommunications Regulation, Ireland, June 1999.

[10] NERA, *Estimating the Long Run Incremental Cost of PSTN Access: Final Report for ACCC*, January 1999, p4.

[11] The 'FMO' covers the transmission network between local and tandem switches, while it is the FTK that drives the number and location of remote units.

60. The ACCC supports its adoption of a scorched node forward-looking approach using best-in-use technology on the grounds that:[12]

- penalising bad decisions and rewarding good ones provide stronger incentives for efficient investment decisions;
- the access provider is discouraged to cost-shift from competitive areas to less competitive ones; and
- excessive access charges based on historic costs encourage access seekers to make inefficient 'build-buy' decisions.

61. The European Independent Regulators Group (IRG) also supports this approach:[13]

> IRG considers it appropriate and reasonable to adhere to a bounded rationality approach, and thus to take the existing network topology as the starting point for the cost allocation process.
>
> …
>
> IRG also considers that it is appropriate and reasonable to modify the scorched node approach in order to replicate a more efficient network topology than is currently in place.
>
> …
>
> IRG considers the implementation of a modified scorched node approach to be a principle of implementation and best practice.

62. The Danish regulator, Telestyrelsen, interpreted their legal requirement to model an 'optimally structured network', noting that:[14]

> … the optimal scenario under the scorched node assumption is constrained by the number of sites at their existing location. The exchanges for which the location should be taken as given … However, the scorched node assumption does not imply that the transport network - cables, duct/trench etc. – is fixed. Nor does the assumption imply that the same number and type of exchanges should be placed at each of these geographical locations.

63. In Denmark, a node is defined as a location where an exchange is currently placed; an exchange can be either a concentrator or a remote switch. Telestyrelsen's paper later noted that this would require determining the switching technology, switching hierarchy, and number, type, nature and size of each node. This optimisation included determining[15]:

> … whether a node would be more effectively served by a local switch or a remote subscriber-stage

64. Telekom-Control, the Austrian regulator, also adopted a modified scorched node approach that optimised the network design and was considered a practical methodology for costing an efficient network:[16]

> It is possible to arrive at costs which very closely reflect those of an efficient network operator. This hybrid approach involves taking the existing network of the firm with significant market

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[12] ACCC, *Pricing of Unconditioned Local Loop Services (ULLS) Final Report*, March 2002, p 16.
[13] IRG (EU), *Principles of Implementation and Best Practice Regarding FL-LRIC cost modelling*, IRG, 24 November 2000, p 3.
[14] Telestyrelsen, *LRAIC Model Reference Paper – Common Guidelines for the Top-Down and Bottom-Up Cost Analyses*, Denmark, 11 April 2001.
[15] Telestyrelsen, *LRAIC Model Reference Paper – Guidelines for the Bottom-Up Cost Analysis* Denmark, 6 April 2001, para 6.2.2
[16] Telekom-Control, 15 January 1999, ibid, paragraph 4.4.

> power as the starting point (scorched node approach) and attempting to eliminate inefficiencies in the network architecture (e.g. via a reduction in the number of switches and a check on the importance of existing hierarchical levels). This approach is based on the existing network and possible efficiency improvements and is therefore implementable.

65. The Irish regulator, Office of the Director of Telecommunications Regulation (ODTR), implemented a modified scorched node assumption. The ODTR took the existing node location as given, and thus recognised the historical evolution of the network, but optimised the equipment at the nodes, as well as optimising the transmission equipment connecting these nodes:[17]

> Decision 4.2.4: A modified scorched node assumption will be adopted when developing a Bottom-up model of the incumbent's network in Ireland.

66. Swisscom noted the following benefit in using the scorched node approach for its LRIC model:[18]

> This approach utilises the existing network hierarchy together with current locations and traffic management rules. Although the locations of the network elements are determined by historical development, the approach allows the size of these network elements to be optimised.

Conclusion: adopt scorched node approach

67. The Commission considers that forward-looking costs ought to be based on a network design where the location of core network nodes is taken as given. Hence the Commission considers that a scorched node assumption for network design is the most appropriate for TSLRIC modelling. This is consistent with the Commission's TSO modelling process and the widespread adoption of this approach by overseas regimes.

68. However, the application of new technology in a forward-looking network design may result in, for example, the replacement of small remote concentrators or switches with customer access transmission systems. It is possible, therefore, that the equipment at some network nodes would change in a forward-looking view, affecting whether or not that element would be included in the TSLRIC calculation.

4.3 Network Technology Modelled

69. A further network design question is which generation of technology and assets best represent the costs of an efficient forward-looking operator. In the TSLRIC paper, the Commission provided its preliminary view that forward-looking costs should reflect the costs of providing services using best-in-use technology with MEAs.[19] MEAs are defined as the best-in-use technology that is available to a network operator, not necessarily the technology used by the access provider.[20]

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[17] Office of the Director of Telecommunications Regulation, *The Development of Long Run Incremental Costing for Interconnection – Decision Notice D6/99 & Report on Consultation Paper ODTR 99/17*, June 1999, p17

[18] Swisscom, *Long-run incremental cost (LRIC) Interconnection price calculation for 2002*, Switzerland, October 2001, p 7.

[19] Commerce Commission, *Application of a TSLRIC Pricing Methodology – Discussion Paper, 2 July 2002*, paragraph 39.

[20] *ibid.*

70. The Commission has also used MEA in the calculation of the infrastructure costs of the TSO for both the core network and the local access network.

Submissions received

71. Counties Power expressed support for the use of MEA, noting that: [21]

> …in paragraph 29 of [the Commission's] paper of 2 July 2002 [the Commission] make the point that TSLRIC includes costs that once incurred are sunk. We submit that this needs to be tempered by the discussion in paragraph 39 re MEA. In our view, it would be inefficient for interconnect service users to be saddled with a share of the sunk cost of out-dated technology or of past over-design or over-building or of sundry past acquisitions.

72. Telecom's submissions provided mixed comments on the use of MEA. Submissions by PwC Consulting[22] and Charles River Associates (CRA)[23] raise concerns about MEA not fully addressing issues of dynamic efficiency. At the TSLRIC conference, PwC recommended that MEA be implemented using the 'best in use technology'.[24]

73. In response to the Commission's preliminary view on MEA, PwC Consulting:[25]

> … agrees with the broad principle that forward-looking costs are most suited to provide efficient signals to the market. PwC would emphasize, however, that great care needs to be taken in the application of this principle. The dynamic aspects of operating a network must be taken into account. It would not be efficient to replace all network assets as soon as some new technology is offered …

74. CRA argued that the Commission should adopt a meaningful and realistic efficient provider standard to address concerns about dynamic efficiency. CRA argued against the use of a static perspective on efficiency on the grounds that it is unrealistic to expect decisions about assets with long lives, which would have seemed efficient when they were made, to reflect current and future optimal network designs. CRA submitted that only allowing for the recovery of optimised costs penalises the firm for prudent but irreversible decisions and creates incentives for firms to under invest.[26]

75. At the TSLRIC Conference, PwC made the following recommendation on the use of MEA:[27]

> Modern Equivalent Assets (MEA) should form the basis of estimates of forward-looking costs.
>
> The MEA standard which should be used is that which would condition the value of investments of a national operator in a competitive market. It should reflect the investment choices and constraints faced by an efficient operator.

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[21] Counties Power, *Submission on Telecommunications TSLRIC Pricing Methodology*, 27 March 2003.
[22] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002.
[23] Charles River Associates, *TSLRIC Pricing – A Response to the Commission's Discussion Paper*, 16 August 2002.
[24] PwC, *TSLRIC Conference, July 2003*, 16 July, p15.
[25] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 56.
[26] Charles River Associates, *TSLRIC Pricing – A Response to the Commission's Discussion Paper*, 16 August 2002, chapter 3.
[27] PwC, *TSLRIC Conference Wellington 16-17 July 2003* (handout), 16 July 2003, p15.

- It is not the latest 'bleeding edge' technology
- Rather it is the 'best in use' technology
- The CCA handbook (Prof Ian Bryatt) recommends defining MEA in terms of those technologies which the operator plans to implement in the medium term

76. TelstraClear also supported the use of MEA, noting that the Commission should optimise the network architecture and consider the full range of best-in-use technologies.[28]

Overseas practice

77. Best-in-use or modern equivalent assets are widely used in other jurisdictions, including Austria, UK, Ireland, Switzerland, and Australia.

78. The Independent Regulators Group report on FL-LRIC states that:[29]

> the concept of forward-looking costs requires that assets are valued using the cost of replacement with the modern equivalent asset (MEA). The MEA is the lowest cost asset, providing at least equivalent functionality and output as the asset being valued. The MEA will generally incorporate the latest available and proven technology, and will therefore be the asset that a new entrant might be expected to employ.

79. Ofcom adopted the same rationale when it used MEA in its modelling of BT.[30]

80. In a report on interconnection charges by the incumbent, the Irish regulator ODTR states that MEA: [31]

> is a standard approach to asset valuation where technology had changed and the existing asset can or would no longer be purchased.

81. Swisscom's cost-oriented LRIC model requires the use of replacement costs or MEA:[32]

> Network costs must correspond to current replacement costs. If revaluation on the basis of replacement cost is not possible, for instance because certain network components are no longer on sale, the replacement costs of a modern equivalent asset must be taken into account.

Conclusion: adopt MEA approach

82. The Commission considers that forward-looking costs should reflect the costs of providing services using best-in-use technology with modern equivalent assets. This

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[28] TelstraClear Limited, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002*', 16 August 2002, paragraph 18.
[29] IRG (EU), *Principles of Implementation and Best Practice Regarding FL-LRIC cost modelling*, IRG, 24 November 2000, p3.
[30] Ofcom, *Network Charges from 1997 – Consultative Document*, December 1996, paragraph 3.4.
[31] Office of the Director of Telecommunications Regulation, *Report on the Comparison of Cost Models Used to Compute Interconnect Conveyance Rates Charged by Eircom*, May 2002, p14.
[32] Swisscom, *Long-run incremental cost (LRIC) Interconnection price calculation for 2002*, Switzerland, October 2001, p7.

approach is consistent with the Commission's work on the TSO, the practice of other jurisdictions, and the Act.

4.4 Bottom-up vs. top-down modelling approach

83. The TSLRIC paper examined the relative merits of the bottom-up and top-down approaches to implementing TSLRIC, and their capability to provide an estimate consistent with the Act. That paper set out the Commission's preliminary view that the flexibility provided under a bottom-up approach, and the fact that such an approach is not based on actual costs, mean that it is more suitable for estimating TSLRIC than a top-down approach.[33]

84. The TSLRIC paper noted that, conceptually, a bottom-up approach is more amenable to estimating the forward-looking costs than a top-down approach, because the latter approach captures the current costs incurred by the firm in providing the service or the costs incurred in the past. These costs may differ from forward-looking costs in a number of ways, including:[34]

- Differences in the prices of capital equipment and other inputs;
- Differences in technology;
- Differences in assets; and
- Changes in demand.

85. The paper noted that it is possible to adjust top-down costs to reflect better forward-looking costs, but that a bottom-up approach is likely to more accurately estimate forward-looking costs.[35]

86. The TSLRIC paper noted that, on the evidence available, an appropriately implemented bottom-up approach is more likely to provide an estimate consistent with the definition of TSLRIC in the Act, and provide consistency with the Commission's decision in respect of the TSO. The paper also noted that a bottom-up approach offers greater transparency and is more likely to ensure that no party has relatively greater control over the evidence forming the basis of the determination.[36]

Submissions received

87. PwC Consulting did not support the Commission's preliminary view and concluded with the following alternative recommendation: [37]

> PwC believes that interconnection costs should be either based on actual firm accounting data by using a top-down model which is adjusted in such a way that it provides forward-looking costs of an efficient operator, or based on both a top-down and a bottom-up analysis (which should be reconciled with each other as far as possible).

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[33] Commerce Commission, *Application of a TSLRIC Pricing Methodology – Discussion Paper*, 2 July 2002, pp14-15.
[34] *ibid*, p14-15.
[35] *ibid*, p15.
[36] *ibid*, pp15-17.
[37] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 66.

88. PwC Consulting stated that bottom-up models contain a number of weaknesses, including the underestimation of costs, and weaknesses in the modelling of operating costs.[38] PwC identified the following weaknesses and strengths of bottom-up and top-down models:[39]

Figure 1: PwC comparison of top-down and bottom-up models

	Top-Down	**Bottom-Up**
Positives	Based on actual (revalued) costs Reconcilable Reflects real complexity/uncertainty	Fewer confidentiality issues Perfect efficiency Transparency
Negatives	More confidentiality issues May include inefficiencies	May underestimate and/or omit costs Poor modelling of Opex Danger of over optimisation

Source: PwC *'TSLRIC Conference Wellington 16-17 July 2003'*, p21.

89. PwC further stated that both models can produce 'accurate estimates of incremental costs', but expressed a preference for reconciling the results of a bottom-up model to those from a top-down model, noting:[40]

> Either modelling approach, properly executed, is in principle capable of producing reasonable estimates of incremental costs but this requires considerable care.
>
> It is very unwise to rely on a bottom-up model in isolation. Even when there is a preference for bottom-up modelling one would be well advised to validate its results with a top-down exercise.

90. PwC noted that top-down models have a tendency to include the costs of inefficiency and overstate costs, which has led to regulators undertaking comparative efficiency studies, such as stochastic frontier analysis, to address this problem.[41]

91. PwC Consulting stated that the Commission expressed the preliminary view that:[42]

> … top-down models are unable to project forward-looking costs (as defined within the Act) accurately (as they are based on an actual network model, albeit with a modern equivalent valuation) whilst also including inefficiencies present in the operator's business.

92. The Commission did not express such a view but rather expressed a preliminary view on the relative merits of 'two common approaches to estimating the TSLRIC'.[43]

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[38] ibid, paragraph 62.
[39] PwC, *TSLRIC Conference Wellington 16-17 July 2003* (handout), 16 July 2003, p21 and TSLRIC Conference transcript p94-104.
[40] *ibid*, pp21-22.
[41] *ibid*, p26.
[42] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 61.

Further, a number of the concerns expressed by PwC about the use of a bottom-up model relate to the level of optimisation. As noted earlier, the Commission's preference is to use a scorched node approach, with which PwC has expressed general agreement.

93. TelstraClear agreed with the position in the TSLRIC paper. TelstraClear:[44]

> agree with the Commission's reasons for reaching this conclusion (in particular the transparency and control justifications). In support of this view we note:
>
> - a bottom-up model is consistent with the notion of an efficient service provider as it allows modelling of efficient technology …
> - a bottom-up approach is less vulnerable to information asymmetries … allows industry participants to be involved in the consultation process …
> - a bottom-up approach avoids cost allocation problems that are necessary for accurately measuring incremental cost …

94. At the TSLRIC conference, TelstraClear submitted that there should be only one TSLRIC model.[45] NECG, on behalf of TelstraClear, made the following comments on the merits and practicalities of using a top-down model for reconciliation purposes: [46]

> If Telecom wants the industry to rely on a TSLRIC model which utilises some of this historic cost information and it believes that a top-down reconciliation does have a role to play, then it needs to make that information available for industry scrutiny.

Overseas practice

95. The TSLRIC paper noted that the bottom-up approach is widely used by regulators in a number of jurisdictions, including the US, Australia, UK, Netherlands and Ireland.

96. When the top-down approach has been adopted, it has often been prepared by the incumbent, and used as a 'rationality' check on the results obtained from a bottom-up model. This has occurred, for example, in the UK and Australia.

97. In 1999, the Dutch regulator concluded that an existing top-down model was 'insufficient' for the market's requirements and that a change should be made to a bottom-up long-term incremental cost model.[47] The Dutch regulator also stated:

> It is the Commission's opinion that this 'bottom-up' (BU) systematic will lead to the most legitimate determination of the interconnection costs, as they would exist in a market subject to competition.

98. The regulator developed a bottom-up model with the primary intention of obtaining more detailed information and knowledge on the specific aspects of the cost allocation method.

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[43] Commerce Commission, *Application of a TSLRIC Pricing Methodology – Discussion Paper, 2 July 2002*, paragraph 47,63 & 71.
[44] TelstraClear Limited, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002*', 16 August 2002, paragraph 28.
[45] TSLRIC Conference transcript p163.
[46] TSLRIC Conference transcript p162.
[47] OPTA, *Decisions on Tariffs for Interconnection and Special Access Services Applied by KPN Telecom BV in the period 1 July 1998 – I July 1999*, 16 December 1999 p5.

99. The ODTR consulted on issues related to the development of long-run incremental costing for interconnection. The ODTR proposed that a bottom-up model should be developed, and most respondents agreed. The ODTR noted the:[48]

> … initial view that bottom-up models are more likely to reveal the scope for efficiency improvements.
>
> The incumbent is required to provide LRIC estimates using its top-down model, the results from which are then compared with the regulator's bottom-up model before setting the appropriate LRIC rates.
>
> [The regulator] is still minded to give greater weight to the results of a realistic bottom-up approach, as this would probably be more likely to reveal the full scope for efficiency improvements.

Conclusion: adopt bottom-up modelling approach

100. The Commission considers that a bottom-up approach is likely to result in more accurate estimates of the TSLRIC than a top-down approach. The Commission also notes that:

- a bottom-up approach is consistent with the Act;
- a bottom-up approach has generally been preferred by overseas regulators;
- a bottom-up approach is more amenable to estimating forward-looking costs than a top-down approach;
- there is a considerable and growing body of overseas experience with the use of bottom-up TSLRIC models, which was unavailable when some regimes adopted an approach involving reconciliation between top-down and bottom-up models;
- bottom-up modelling has been adopted by the Commission for the TSO; and
- a bottom-up approach is likely to provide greater transparency, minimise control of the inputs by Telecom, and avoids the possible need for an accounting separation framework to capture costs in a top-down model.

4.6 Element-based approach to estimating TSLRIC

101. It is common practice among regulators to use an element-based approach to estimate TSLRIC when using a bottom-up approach. An element based approach involves developing a network model that determines the quantity and dimensions of the network elements necessary to provide the services. Examples include the number of switches by type required, the kilometres of optical fibre by type, and the kilometres of trenches. The costs of such network elements are then determined including the operating and maintenance costs, non-network costs, usage costs per network element

[48] Office of the Director of Telecommunications Regulation, *Report on the Comparison of Cost Models Used to Compute Interconnect Conveyance Rates Charged by Eircom*, May 2002, p14.

and the per-minute usage costs of the network elements used to provide interconnection services.

102. An issue that arises with the element-based approach is whether it will produce interconnection charges that are consistent with the definition of TSLRIC under the Act. Under the element-based approach, costs are allocated to particular services via a two-step method in order to calculate the cost of providing those services. First, network and non-network costs are allocated to individual network elements. Second, the costs allocated to each network element are allocated to services on the basis of the usage of the network element.

103. TelstraClear supports the use of an element-based approach but notes that 'some elements will not be completely incremental to the relevant service… Hence it will be important to share common network element costs across all services that use that network element.'[49]

Conclusion: use an elements-based approach

104. The Commission considers that an elements-based approach is the most appropriate for TSLRIC modelling, and is the approach most likely to produce interconnection charges that are consistent with the definition of TSLRIC in Schedule 1 of the Act.

4.7 Geographical aggregation

105. TSLRIC can determine the cost of origination and termination of calls for each point of interconnect. The amount of information required and the complexity of the modelling would be significant, and even if it were possible to undertake such a modelling exercise, it is likely that there would be significant errors in the estimates of the interconnect costs from each point of interconnect. An alternative approach is to model cost differences by geographic regions, which would require the Commission to begin by classifying points of interconnection into groups in accordance with their locations.

Submissions

106. Telecom submits that:[50]

> … the level of geographical disaggregation in the model will influence the price structure the Commission might propose. Therefore the correct approach is to start with a very disaggregated model so that the Commission is in a position to understand what drives costs and therefore optimal ways in which prices might be structured. The approach of the Commission in paras 139-144 suggests deciding on an appropriate level of disaggregation prior to commencing the modelling. Not only is this in the wrong order, but also possible pricing structures will be limited to these initial aggregations and may well not be optimal.

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[49] TelstraClear, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology'*, 16 August, 2002, p11.
[50] Telecom, *Submission to the Commerce Commission on Application of a TSLRIC Pricing Methodology – Discussion Paper*, 16 August 2002, p8.

> Telecom would be particularly concerned if the model structure is driven by preconceptions about key cost drivers (such as the single: double tandem model) which may not be appropriate in New Zealand circumstances.

107. PwC, on behalf of Telecom, notes that:[51]

> In order to achieve full allocative efficiency and to avoid cross subsidisation, interconnection tariffs need to reflect, as closely as possible, the actual costs of providing these services. Therefore, any bottom-up model built by the Commission with the intention of estimating interconnection costs should take into account the cost differences between different geographic regions. Based on the same rationale, TCNZ should be free to structure interconnection prices in such a way that the costs variances by time of day as well as set-up costs are reflected.

108. While supporting the use of geographic disaggregation for costs, TelstraClear suggests that the Commission should average interconnection prices:[52]

> …it is likely to be important to deaverage interconnection costs by geographic area, insofar as switching and transmission costs vary significantly across geographies. To the extent that these costs do differ, deaveraged prices will improve economic efficiency, by providing appropriate build/buy signals to access seekers. However, deaveraging interconnection prices is also likely to add significantly to the complexity of the modelling.
>
> Experience in Australia has demonstrated that core network costs (referred to as IEN or call conveyance costs in Australia) vary considerably by geographic area ... However it is TelstraClear's view that due to the vast difference between Australia and New Zealand's geographic characteristics, these cost variances will not reflect those in New Zealand. Therefore, given the practical difficulties associated with deaveraging and the expectation that geographic cost differences in New Zealand are likely to be small, TelstraClear suggests the Commission should average interconnection prices.

Conclusion: consider geographical averaging at the modelling stage

109. Decisions as to the appropriate structure of interconnection prices, including any geographic de-averaging, will be made as part of the modelling process.

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[51] PwC Response to *Application of a TSLRIC Pricing Methodology issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 Aug 2002.

[52] TelstraClear, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology*, 16 August 2002, p12-13.

5. Definition of the Core Network

110. The definition of the core network is important in any TSLRIC modelling process, as it drives the scope of costs included in the TSLRIC model for the designated interconnection access services. The core network is that part of the PSTN which conveys interconnection calls to and from the point of interconnection (POI) to the point of demarcation with the access network. The core network also conveys calls between the network operator's own customers. This chapter examines the point of demarcation between the core and access networks.

5.1 Demarcation between core and access networks

111. The TSLRIC paper provided the Commission's preliminary view that the main distribution frame (MDF) is the point of demarcation between the access network and the core network and that the costs of line cards and associated items should be considered as part of the access network.

112. The MDF is the physical point of termination of cables in the access network. One issue typically debated in the development of TSLRIC models is whether line cards should be included as part of the access network or core network. From an economic perspective, the primary difference between the access network and the core network is the driver of costs. Many of the costs in the access network are non-traffic sensitive, while many in the core network are traffic-sensitive. Arguably, most non-traffic sensitive costs should be recovered from 'up-front' fees, such as line rental and connection charges, and traffic-sensitive costs should be signalled to users through call charges.[53] The number of line cards is a non-traffic sensitive cost.

113. OFCOM notes that :[54]

> Line-driven costs are related to the number of exchanges lines serviced from the concentrator and include, for example the line card.

Submissions received

Telecom

114. PwC Consulting, on behalf of Telecom, applied the test of whether costs are traffic sensitive (core) or line sensitive (access) to determine if infrastructure is part of the core or access network:[55]

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[53] This presumes, among other things, that the decisions of individuals to connect to the network are insensitive to line rental and connection charges.
[54] OFCOM, *Long Run Incremental Costs: The Bottom-Up Network Model, Version 2.2*, March 1997, p7.
[55] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' Issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 74.

> PwC believes that the best definition of the difference between access and conveyance is at the end of the subscriber loop cable. The costs of the access network are driven by the number of customers (lines) and do not vary with the amount of traffic generated by a particular customer. The costs of the core network are traffic sensitive. Therefore, the border-line between access and core is the point where concentration occurs. Therefore, PwC believes that access transmission and traffic concentration systems should be treated as part of the core network if and when this equipment becomes the MEA (modern equivalent asset) and, hence, be included in the TSLRIC model in this case.

115. At the TSLRIC Conference, PwC submitted that some of the costs of the line card should be allocated to the core network:[56]

> The line interface card is the point where the copper pair is joined to the Core Network. The number of line cards is a direct function of the number of connected subscriber lines, which has led some regulators to treat line cards as incremental to the access network … Oftel recognised that the number of line cards was correlated with the number of subscribers but that much of the function of a line card was engineered to meet call demand … Oftel concluded if the access and core networks were truly separable the calls and lines functions would be provided separately. Oftel therefore split the calling functions of the line card to allocate costs to the Core network.

116. PwC further described a future 'optimal network structure' that uses small cabinets with concentration functionality remote of the local switch. These result in a changed cost structure. PwC noted that new technologies:[57]

> are driving a trend for extending the traffic sensitive portion of the network closer and closer to the end customer. This has the effect of increasing the traffic sensitive network costs … but reducing the costs of the line sensitive local loop to yield overall cost savings and provide for enhanced local access services.

TelstraClear

117. TelstraClear agreed with the Commission's preliminary definition of the core network. TelstraClear:[58]

> …supports the Commission's proposed demarcation point between the access network and core network. The inclusion of line cards in the access network is consistent with international practice, including Oftel and ACCC.

118. At the TSLRIC conference, Network Strategies on behalf of TelstraClear submitted that the following distinction exists between the core and access networks:[59]

- Interconnection service prices are almost always based on the long-run incremental cost (LRIC) of *traffic driven costs* (core network)
- Interconnection service prices almost always exclude all *customer line driven costs* (access network)
- Interconnection costs exclude all network components up to and including the SLC[60]

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[56] PwC Consulting, *TSLRIC Conference Wellington 16-17 July 2003* (handout), 16 July 2003, p10.
[57] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' Issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 50.
[58] TelstraClear Limited, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002'*, 16 August 2002, paragraph 33.

[59] Dr Suella Hansen (Network Strategies), *TSLRIC Modelling Issues* (Conference Handout), July 2003, p4.
[60] SLC subscriber line card, also known as the line card or line interface card.

119. Network Strategies also identified the use of a cost driver test to distinguish between the two networks, and the choice of the line card as the point of demarcation.

Overseas practice

120. The Commission has examined the approaches followed in other jurisdictions, including Australia, Denmark, Switzerland and Germany, to determine the boundary between the core and access networks.

121. The ACCC uses the distinction between traffic and line-related costs to define, respectively, the core and access networks, noting that:[61]

> all traffic-related costs (such as switch processors, multiplexing equipment, cable and trench in the core network) are attributed to the cost of call conveyance;
>
> all line-related costs (such as the cost of the copper local loop and line cards) are attributed to the cost of providing customer access.

122. Telestyrelsen has provided the following description of the distinction between the access and core networks, and the functionality of the line card:[62]

> Costs in the core network are driven by the volume of traffic and the number of call attempts, whereas costs in the access network are driven by the number of subscribers.
>
> Assets within the core network include concentrators, excepting line cards; exchanges; transmission links between the exchanges; leased-line specific cross-connect equipment; radio equipment in the core network; optical fibre and trenching between all levels of exchanges; and signalling equipment.
>
> The access network depends on the number of customers, but not the number of calls. Consistent with this, an alternative definition of access is that it is the service that allows the customer to make and receive calls.
>
> Both definitions suggest that the access network includes all cable and trenching costs associated with customer lines between the customer's premises and the concentrator. Furthermore, the definitions suggest that the access network includes the line card within the concentrator. … line card requirements are driven by the number of subscribers or, more accurately, by the subscriber requirements for lines. The line card is essential to making and receiving calls.
>
> Since each line must terminate on a line card, irrespective of its use, all line-card costs must be allocated to the access and there should be no allocation to the core.

123. Swisscom includes the line card in the access network on the boundary with the core network.[63]

124. In a paper prepared for the German national regulator RegTP, WIK also applied the cost driver test and allocated the cost of the line card to the access network, noting that: [64]

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[61] NERA, *Estimating the Long Run Incremental Cost of PSTN Access – Final Report for ACCC*, January 1999, section 1.1, p2.
[62] Telestyrelsen, *LRAIC Model Reference Paper – Common Guidelines for the Top-Down and Bottom-Up Cost Analyses*, Denmark, 11 April 2001, section 3.2, pp10-13.
[63] Swisscom, *Long-run incremental cost (LRIC) Interconnection price calculation for 2002*, Switzerland, October 2001, p7.
[64] WiK, *Analytical Cost Model National Core Network*, 30 June 2000, p42.

> From a subscriber's viewpoint, the line card precedes the concentrator, and hence expected subscriber traffic demand is of no importance. The investment in line cards must therefore be fully allocated to the subscriber line network costs and need not be taken into account in calculating the cost of interconnection.

Conclusion: line card is part of the access network

125. Traffic-sensitive costs should be apportioned to the core network and customer-sensitive costs should be apportioned to the access network.

126. For current MEA technology in New Zealand, that point of demarcation between the access network and the core network is at the main distribution frame, meaning that the line card is on the access network side of the boundary between the core and access networks.

127. The costs of line cards and associated items (such as the line card shelf and frame) are part of the access network.

128. Changes in network technology over time might alter efficient network design, and hence the location of the future demarcation between the two networks.

5.2 Use of LICA Groups in the TelstraClear Interconnection Determination

129. In the TelstraClear Interconnection Determination[65], the parties to the determination agreed to apply the Commission's determined interconnection rate to the LICA Group construct.

Conclusion: For the pricing review apply LICA Groups

130. For the pricing review of the TelstraClear Interconnection Determination, the LICA Group construct used by the parties in the Determination will be applied to the TSLRIC modelling work.

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[65] Commerce Commission, Decision 477, *Determination on the TelstraClear Application for Determination for Designated Access Services*, Determination under section 27 of the Telecommunications Act 2001 (the Act) in the matter of an application for determination for designated access services under section 20 of the Act, 5 Nov 2002.

6. Asset Valuation and Depreciation

131. There is a significant overlap between the net costs of the TSO and any TSLRIC modelling the Commission might undertake. This section considers the similarities and differences between TSLRIC and TSO, submissions made during the TSLRIC consultation process, issues addressed previously in the TSLRIC paper and overseas practice.

6.1 Asset valuation

132. The Commission considered a number of possible approaches to the valuation of assets used in the provision of interconnection services. These approaches included opportunity cost, historic cost, optimised replacement cost (ORC), and optimal deprival value (ODV).[66]

133. The Commission noted that, in the presence of sunk costs, the use of opportunity cost, which values an asset according to its next best use, is inappropriate. In terms of the alternatives, the use of ORC was proposed because it was considered to provide an estimate of forward-looking costs. A number of reasons were given.[67]

134. First, the assets currently used to provide the services may not be MEAs that will be used to provide the services in the future. The ACCC notes:[68]

> …in telecommunications where technology advances rapidly, historically incurred expenditures often have little relationship with (and generally overstate) the true economic costs of replicating an asset's service potential.

135. A fixed PSTN will generally be a hybrid made up of assets of differing generations of technology. As network elements of the PSTN, such as switches, near obsolescence or otherwise require replacement, they could be replaced with more recent models or different equipment.

136. Second, even if the assets were to be replaced by the same asset, historical costs will not capture the current and future cost of purchasing and installing that equipment. Technological improvements have resulted in substantial decreases in the real cost of network equipment. For example, advances in computing technology have substantially reduced the real cost of switching equipment. Further, the cost of installing the equipment has changed over time. Changes in labour costs and the technology used to install equipment (such as trenching equipment) have altered installation costs over time.

137. Third, changes in technology and the relative costs of equipment have affected the mix of equipment used in telecommunications networks. An example of this might be the

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[66] Commerce Commission, *Application of a TSLRIC Pricing Methodology – Discussion Paper*, 2 July 2002, pp38-40.
[67] *ibid*, pp39-40.
[68] ACCC, *Access Pricing Principles – Telecommunications: A Guide*, 1997, p43.

increase in the use of fibre over copper cables in transporting calls. The mix of current network assets may not reflect such efficiencies.

138. Typically in bottom-up TSLRIC models, network and non-network assets are valued according to their optimised replacement cost. According to the ACCC:[69]

> Estimating TSLRIC requires assets to be valued at their economic costs. There is a variety of methods of asset valuation … Of these methods, replacement cost is the methodology most consistent with TSLRIC.

139. Valuing assets on the basis of ODV could create circularity because, in the event an asset will not be replaced, its value would depend on the interconnection price.

Submissions received

140. PwC, on behalf of Telecom, agrees that the use of ORC is appropriate for formulating forward-looking TSLRIC costs.[70] However, PwC emphasise that care must be taken in applying an ORC methodology to ensure that realistic results are obtained. For example, PwC submit that unproven technology should not be considered.

141. TelstraClear submits that the asset valuation approach should be an optimised, forward-looking approach, consistent with TSLRIC principles.[71] The appropriate variation of optimised replacement cost (ORC or ODRC) will depend on which annualisation approach is used. TelstraClear notes that, if a tilted annuity approach is going to be used by the Commission, then an ORC approach is required to allow the access provider to recover fully the cost of its investment.

Conclusion: use ORC as asset valuation methodology

142. ORC is the appropriate asset valuation methodology for the purposes of any determination that applies TSLRIC as the final pricing principle.

6.2 Depreciation

143. The TSLRIC paper outlined a number of alternative methodologies by which assets could be depreciated. Common depreciation methods include straight-line depreciation, declining balance depreciation, sum-of-digits depreciation, and annuity-based depreciation.

144. In considering the appropriate depreciation profile, the Commission noted that:[72]

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[69] *ibid*, p41.
[70] PWC, *Response to Application of a TSLRIC Pricing Methodology*, 15 August 2002, p 23.
[71] TelstraClear, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002'*, 16 August 2002, p 16.
[72] Commerce Commission, *Application of a TSLRIC Pricing Methodology: Discussion Paper*, 2 July 2002, p44.

> In order for the access provider to have the expectation of recovering the costs of prudent investment, without 'over-recovering' those costs, the Commission must ensure 'consistency' in its pricing determinations over time. In each pricing determination the Commission proposes to value the assets on the basis of optimised replacement cost. Given the rapid rate of technological change in telecommunications networks it is likely that ORC will decrease in real terms over time. In order for access providers to be able to recover the costs of prudent investment in such circumstances, the depreciation of the asset must be 'front-loaded'. That is access providers must recover a high proportion of the cost of the asset early in its life before its value declines with improvements in technology. Specifically, the 'front-loading' of the depreciation rates must be consistent with the rate of decline of the replacement cost of the asset. The more rapid the rate of decline of ORC, the more the depreciation must be 'front-loaded'.
>
> If access providers are required at any point in time to provide access to their networks at prices that reflect the network costs valued on an ORC basis, then the only way to ensure that the costs of investments can be recovered (but not over-recovered) is to base depreciation on a tilted annuity, where the 'tilt' is based on the rate of change of the ORC. …
>
> The tilted annuity 'bundles' depreciation and the return on funds into a single amount. It adjusts the capital costs over time in line with the rate of increase or decrease of the replacement cost of the capital equipment.

145. The Commission also discussed the parameters used in the tilted annuity formula; namely, the life of the assets and the rate of change of the replacement cost of capital equipment (the 'tilt').

Submissions received

146. PwC, on behalf of Telecom, acknowledges that the tilted annuity approach:[73]

> … provides a practical method for approximating economic depreciation (plus cost of capital) if appropriately parameterised.

147. PwC argues that an asset's economic life must be used to develop a forward-looking cost estimate, and that this should be based on an adjustment to the technical life that reflects the pace with which replacement technologies have been introduced in recent years. This should also reflect any supplier plans to develop new technologies.

148. PwC also submits that the use of recent pricing data may not result in forward-looking estimates of the tilt. Wherever possible, expectations should be preferred to historical estimates.

149. TelstraClear agrees with the use of a tilted annuity approach to depreciation.[74] TelstraClear note that the advantages of this approach are that it provides a close approximation to economic depreciation, it smoothes prices when assets are replaced, and it avoids the need to assess the risk of technological redundancy through the WACC.

150. TelstraClear recommends that the economic lives of assets be based on the expected physical life, adjusted only in cases where there is a high risk of the asset becoming

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[73] PWC, *Response to Application of a TSLRIC Pricing Methodology*, 15 August 2002, p25.
[74] TelstraClear *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology' – 2 July 2002*, 16 August 2002, p17.

technologically obsolete. This measurement should be based on a process of industry consultation and international benchmarking.[75]

151. On the estimation of the tilt, TelstraClear refers to the approach taken by the ACCC, which adopted price trends used by NERA based on international experience. TelstraClear also notes that indices could be constructed to model the main cost drivers in different asset classes, and that historical asset prices could be used to extrapolate pricing trends into the future.[76]

Conclusion: use tilted annuity

152. The tilted annuity approach, which combines both a return on capital and a return of capital (depreciation), is the most appropriate approach for TSLRIC modelling. This approach is consistent with the Commission's approach to TSO and the approach of the ACCC in Australia.[77]

153. The Commission will examine the key parameters of the tilted annuity in the context of any specific application, but considers that it will be appropriate to use the estimated economic life of assets in the tilted annuity, while acknowledging a degree of subjectivity in deriving such estimates. The physical life of the asset is likely to be an appropriate starting point, although this may need to be adjusted, for example, in light of evidence of new technology challenging the existing asset and reducing its expected economic life.

154. For the purposes of consistency, the Commission will also consider the tilt factors and asset lives used in the context of its TSO determinations, where there are similar or common assets used in both contexts.

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[75] *ibid*, p*18.*
[76] *ibid*, p19.
[77] See for example ACCC, *A Report on the assessment of Telstra's undertaking for the Domestic PSTN Originating and Terminating Access Services*, July 2000, Appendix 5.

7. Cost of Capital

Introduction

155. The appropriate return of funds, or the cost of capital employed, is an important component in estimating the TSLRIC of providing interconnection services. The cost of capital is the cost of the funds invested in network and non-network assets.

156. The appropriate cost of capital is the opportunity cost of the funds in the market. This is the rate of return an investor would expect to achieve in the market from investing in assets with a similar risk profile. If the Commission were to set a cost of capital below this return, investors would prefer to invest in other assets. As the access provider would not achieve the return it could achieve in the market, its incentives to invest in assets to provide interconnection services would be undermined.

157. The Commission has previously considered the cost of capital in TSLRIC and TSO discussion documents, most extensively in the TSLRIC pricing methodology document[78] and in the TSO determination. The Commission has also examined the cost of capital in a number of other areas including airfield services, electricity lines companies and Fonterra. As many of the issues pertinent to the determination of the appropriate cost of capital are relevant to all regulated industries, the Commission does not start with a blank slate. Further, although the Commission is willing to reconsider its position on common issues, it sees considerable merit in maintaining a consistent approach.

158. The purpose of this section is to set out the Commission's current position on the approach to the cost of capital, without specifying actual estimates of parameter values. Such estimates will be considered in the context of specific determinations.

7.1 Weighted average cost of capital

The choice of model

159. In the Airfields Report[79] and the TSO determination[80], the Commission estimated the cost of capital as the weighted average of the costs of debt and equity; that is:

$$WACC = k_e(1-L) + k_d(1-.33)L \qquad (1)$$

where k_e is the cost of equity capital, k_d the current interest rate on debt capital, 0.33 is the corporate tax rate, and L the leverage ratio. It was also generally agreed that k_d should be estimated as the sum of the current risk free rate (R_f) and a premium (p) to reflect marketability and exposure to the possibility of default; that is:

[78] Commerce Commission, *Application of a TSLRIC Pricing Methodology: Discussion Paper*, 2 July 2002.
[79] Commerce Commission, *Final Report Part IV Inquiry into Airfield Activities at Auckland, Wellington, and Christchurch International Airports*, 1 August 2002.
[80] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001and 30 June 2002*, 17 December 2003.

$$k_d = R_f + p \qquad (2)$$

160. In respect of the cost of equity, the Commission used a simplified version of the Brennan-Lally version of the Capital Asset Pricing Model (CAPM),

$$k_e = R_f(1 - T_I) + \phi\beta_e \qquad (3)$$

where T_I is the average tax rate on interest income, ϕ the market-risk premium, and β_e the beta of equity capital. This model is a simplified version of that in Lally[81] and Cliffe and Marsden[82], in which it is assumed that capital gains taxes are zero, that firms attached maximum imputation credits to their dividends, and that shareholders are able to utilise fully the imputation credits.

161. In respect of the equity beta, this is sensitive to the leverage ratio L, and it was generally agreed that the relationship is

$$\beta_e = \beta_a\left[1 + \frac{L}{1-L}\right] \qquad (4)$$

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

162. Equations (1) and (2) are uncontroversial, and accord with generally accepted practice. In respect of equation (3), there are alternative specifications of the cost of equity capital. These include the standard version of the CAPM,[83] the Officer model,[84] and models that recognise international investment opportunities.[85]

Submissions received

163. PwC, on behalf of Telecom, have used a variant of the simplified version of the Brennan-Lally model that allows for capital gains taxes payable by investors, but assumes that dividends give rise to no further taxes at the investor level.[86]

164. In terms of the appropriate form of WACC and CAPM, CRA consider that a standard WACC calculation and the Brennan-Lally form of the CAPM represent an appropriate starting point to the estimation of a reasonable rate of return.[87]

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[81] Lally, M, *The CAPM Under Dividend Imputation*, 1992.
[82] Cliffe, C & Marsden, A, *The Effect of Dividend Imputation on Company Financing Decisions and the Cost of Capital in New Zealand*, 1992.
[83] Sharpe, W, 'Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk', *Journal of Finance*, 1964, vol. 19, pp425-42; Linter, J, 'The Valuation of Risky Assets and the Selection of Investments in Stock Portfolios and Capital Budgets', *Review of Economics and Statistics*, 1965, vol. 47, pp13-37; and Mossin, S, *Commentary on the WACC Assumptions Adopted by CIAL*, 2000
[84] Officer, R, 'The Cost of Capital of a Company Under an Imputation Tax System', *Accounting and Finance*, 1994, vol.34, pp1-17.
[85] For example, Solnik, B, 'An Equilibrium Model of the International Capital Market', *Journal of Economic Theory*, vol. 8, 1974, pp500-24.
[86] PWC, *Telecom New Zealand Limited: The Cost of Capital to be Applied in Calculating the Total Service Long Run Incremental Cost of Interconnect Services*, 11 April 2003.
[87] CRA, *TSLRIC Pricing: Financial Issues*, 16 August 2002.

165. TelstraClear have submitted that the Commission should use the Officer model on the basis that it is comparable with regulatory actions in Australia, consistent with the recent trend towards the Officer approach, and benefits from the availability of public and objective data.[88]

Conclusion: use simplified Brennan-Lally version of CAPM

166. The simplified Brennan-Lally model as set out in Equation (3) is commonly used in New Zealand. It has been used in the Airfields' inquiry by the Commission and all parties to the Airfields' inquiry and by the Commission in the estimate of cost of capital for electricity line companies and in the estimate of the cost of equity for Fonterra. The model was also used in the Commission's TSO determination[89]. Equation (3) better reflects the personal tax regime operating in New Zealand than the standard or Officer versions of the CAPM, since the former assumes that all forms of personal income are equally taxed and the latter assumes that interest and capital gains are equally taxed.[90] The Officer model may therefore be appropriate in Australia due to the differences in tax regimes between Australia and New Zealand. However, it would be inappropriate to adopt the Officer model on the basis of use in Australia, without taking into account the impact of the differences in tax regimes between the two countries. Second, as the Brennan-Lally model has been used for regulatory decisions in New Zealand, the use of the Officer model would reduce comparability with Commission decisions in other sectors.

167. In comparing equation (3) with international versions of the CAPM, the former assumes that national equity markets are completely closed, whilst the latter assumes that they are completely integrated. The truth is clearly between these two extremes. However, in using an international version of the CAPM, estimates of the parameters needed are much less reliable than their domestic counterparts and there is no consensus on them or even on the particular model that should be used.

168. The Commission therefore considers that the simplified Brennan-Lally version of CAPM is appropriate for estimating the cost of capital for TSLRIC purposes.

7.2 Risk-free rate

169. The risk-free rate is the rate of return required by investors in order for them to willingly invest in a riskless asset. The risk-free rate is measured by the return on government bonds (as government bonds are considered to be almost free of risk). The major issue in determining the risk-free rate is the maturity of government bonds that ought to be used.

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[88] TelstraClear, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology'*, 16 August 2002, p19.
[89] Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001and 30 June 2002*, 17 December 2003.
[90] Lally M., *The Weighted Average Cost of Capital for Electricity Lines Companies* (Report for the Commerce Commission), 2003.

Appropriate maturity

170. The CAPM is a single-period model of fixed duration. Hence it provides little or no guidance as to the appropriate maturity of government bonds that ought to be used for the risk-free rate. Typically regulators have adopted one of three alternatives in determining the appropriate maturity of government bonds:

1. base the maturity on the lifetime of the assets used to provide the regulated service; this reflects the planning horizon of investors in those assets;
2. base the maturity on the duration of the Commission's determination; this is based on the recognition that the risk-free rate will be adjusted in any subsequent determination; or
3. use the bond term used to measure the market-risk premium; this ensures consistency within the CAPM.

Lifetime of the assets used to provide the regulated service

171. Investors in long-lived assets consider returns over the economic life of those assets. In determining whether to invest, investors will compare these expected returns to the opportunity cost of making the investment. The opportunity cost is the return investors could achieve in the market with a similar commitment of funds in terms of risk and duration. An example of this is a government bond of similar duration. The optimal financing strategy for long-life assets is to finance the assets with long-life debt. This implies that the appropriate maturity of government bonds should be similar to the economic life of the assets.

Duration of the Commission's determination

172. Basing the maturity of government bonds on the duration of the Commission's determination ensures that the present value of future cash flows derived from making an investment matches the cost of the investment. Lally[91] notes that the use of interest rates of a longer term than the regulatory period leads to two issues in the presence of non-flat-term structure. If the non-flat-term structure is due to a liquidity premium, the use of long-term spot rates for setting prices will lead to revenues being too large ex-ante; that is, their present value will exceed the initial investment. In addition, if the non-flat-term's structure is due to predictable change over time in the short-term spot rate, then the use of the longer-term interest rates for setting prices will lead to revenues that are sometimes too large and sometimes too small, ex-ante.

173. The duration of individual TSLRIC determinations may differ, and in any case agreement between the parties to the determination may apply the TSLRIC price upon the expiry of the TSLRIC determination. For example, where the Commission makes a determination for a specific period, the parties may, towards the end of that period, commercially negotiate an extension to the agreement. The expiry date of each TSLRIC determination will be fixed in the final determination.

[91] Lally, M. *Determining the Risk-free Rate for Regulated Companies*, Report for the ACCC, 2002.

7.3 Bond rate used to estimate the market-risk premium

174. The market-risk premium measures a margin over the risk-free rate necessary in order to encourage investors to hold the market portfolio. This margin is typically estimated relative to a risk-free rate based on the yield of long-term government bonds. It could be argued that the risk-free rate should be based on the government bonds with the same maturity as that used to estimate the market-risk premium.

175. However, as Lally[92] points out, using the risk-free rate consistent with the market-risk premium for discounting cash flows from investment may result in under or over-recovery of the investment. He also notes that the choice of risk-free rate in determining the market premium is unlikely to change the estimate of the market-risk premium due to the broad range of plausible values for the market-risk premium and the relatively modest impact of changing the term of the risk-free rate.

Submissions received

176. PwC, on behalf of Telecom, submitted that the Commission should use the longest possible term government bond (maturity date of 2013) on the grounds that the life of the assets used to provide interconnection services is in excess of this period. PwC estimated the risk-free rate to be 6.2%, based on the six month average of 2013 bonds for the six months prior to 31 March 2003.[93]

177. PwC submitted that, due to the long-run nature of the investment in providing interconnection services and the uncertainty of the future cost base, the Commission should be consistent with the approach it took in the Fonterra determination, and use a risk-free rate with a long-term maturity. [94]

178. TelstraClear argued for the use of long-dated government bonds of 10 years on the basis that this period is the closest bond to the actual life of assets used to provide telecommunication services.[95] However, in their submission on the Commission's TSO WACC paper, Marsden Jacob Associates (MJA), on behalf of TelstraClear, submitted that the maturity of the risk-free rate should be consistent with the regulatory period. In that case, where the TSO is recalculated on an annual basis, MJA supported the use of a 12 month risk-free interest rate.[96]

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[92] *ibid.*
[93] Commerce Commission TSLRIC Conference, PwC, *TSLRIC of Interconnect Services – Cost of Capital*, July 2003
[94] *ibid.*
[95] TelstraClear, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology'*, 16 August 2002, p22.
[96] Marsden Jacob Associates, *Commentary on the Commerce Commission's TSO Weighted Cost of Capital Paper*, 13 June 2003, p1

Other Commission decisions

179. In previous decisions, the Commission has based the maturity of the government bond rate on the duration of the regulatory period. The Commission, in the airfield activities report to the Minister of Commerce under section 54(1) of the Commerce Act 1986, determined the risk-free rate using a government bond rate with a maturity aligned with the regulatory period; that is, the price-setting period. Similarly in estimating the WACC of the electricity lines businesses, the Commission used a government bond rate based on the period over which prices were set.

180. In the determination of the Fonterra cost of equity, the Commission used a 10-year bond rate, on the basis that the valuation of shares it was appropriate to use the risk-free rate for every period for which a dividend is received. Finally, in its TSO determination, the Commission aligned the term of the bond rate with the term of the TSO determination. [97]

181. Following its consideration of this issue in previous determinations, in particular in relation to the TSO, the Commission intends to use a risk-free maturity that reflects the term of each TSLRIC determination. The term of the pricing review determination will reflect the term of the initial determination.

Average rates

182. The next question is whether to use the interest rate on the day just prior to the next regulatory period or to take an average over a number of days prior to the start of the regulatory cycle to dampen any impact of spikes in the interest rate and/or abnormally low observations. In considering the WACC for the TSO, the Commission proposed averaging the appropriate bond rates over a period of one month. In the airfields decision, the Commission used a six-month average, on the basis that this reflected the period of consultation between the airports and their major customers.

183. In setting TSLRIC-based prices for interconnection services, the Commission considers that an averaging period of six months is appropriate, to balance the trade-off of timeliness of the data with a sufficient time to smooth out abnormal effects. The relevant time period will depend on the start date of the TSLRIC determination period.

184. Three alternative averaging techniques may be employed: median, arithmetic, and geometric averaging. Since arithmetic averaging is most suited for matching the firm's allowed revenues to its borrowing costs, this approach will be employed by the Commission.[98]

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

[98] See Lally, M, *Determining the Risk-free Rate for Regulated Companies,* ACCC, 2002, pp. 17-19 for a more detailed discussion.

7.4 Beta

185. Risk relates to the possibility that expected returns may not actually materialise. The total risk of an asset or business is made up of both diversifiable risk and undiversifiable risk:

- Diversifiable (or unsystematic) risk is unique to the asset or firm and can be eliminated by diversification. The risk of obsolescence of its technology, the risk of reduced revenues caused by increasing competition, and the risks associated with patent approval, legislation and regulation, labour contracts, management styles, and geographic location are all examples of unique risks.

- Undiversifiable (or systematic) risk is market risk, which is 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 more systematic risk that is inherent in the operations of a company, the higher will be the cost of any debt and equity used to fund its operations.

186. Under the framework of the CAPM, only the undiversifiable risk is relevant in determining the cost of equity. Investors are not compensated through CAPM for diversifiable risk. The CAPM implies that investors hold a diversified portfolio and diversify away this risk.

187. Beta measures the systematic risk of a security i.e. the expected sensitivity or volatility of an asset's return to the market as a whole.[99] It is probably the most contentious of the WACC components. It also significantly affects the resulting WACC.

188. The asset beta (β_a) measures the sensitivity of a company's return to market returns when the company has no debt.

189. Equity betas take into account the entity's leverage[100]. Financial risk is the incremental risk (difference between the equity and asset betas) that arises when a firm takes on debt. Leveraged firms are more risky than firms without debt, as interest is a fixed cost that must be paid before shareholders receive anything—making the equity of such a firm more risky.

190. The equity beta is determined by the following formula:

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

191. If a company has no debt (L=0 that is, is entirely financed by equity), then its asset and equity beta are identical. By adding debt to a company's capital structure (L>0), the shareholding becomes more risky, such that its equity beta is greater than its asset beta. The level of systematic risk associated with equity (the equity beta) is magnified

[99] Non-systematic risks necessarily have no effect on beta. However, they may affect the expected cashflows and should, therefore, be dealt with there.
[100] Crighton Seed and Associates, *Weighted Average Cost of Capital for Christchurch International Airport*, June 1999, p8.

according to the proportion of debt in the funding mix. The greater the proportion of debt, the greater the systematic risk associated with the residual cash flows available for distribution to shareholders, and the greater the difference between its asset and equity beta. 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.

192. The Commission considers that information from a range of sources may assist in determining the appropriate beta for investments in the provision of interconnection services. They are:

- direct estimation of betas from market data; and
- betas of comparable companies in New Zealand or other countries.

193. As noted below, each of these approaches has advantages and disadvantages. As a result, they can best be thought of as determining a range within which the beta lies.

Estimation of Betas

194. Differences in betas across companies arise from differences in the sensitivity of returns to unexpected changes in the economy. The sensitivity of equity returns to such changes is potentially dependent on a number of factors.[101]

- Industry; that is, the nature of the product or service. Firms producing products with low income elasticity of demand (necessities) should have lower sensitivity to unexpected changes in the economy than firms producing products with high income elasticity of demand (luxuries), because demand for their product is less sensitive. The Commission considers that the income elasticity of basic telecommunication services is low.

- Nature of the customer. There are a number of aspects to this.

  – The split between private and public sector demand. Firms producing a product whose demand arises exclusively from the public sector will typically have lower sensitivity to unexpected changes in the economy than firms producing a similar product demanded exclusively by the private sector.

  – The residency mix. It would be expected that a firm with a high concentration of its activity in New Zealand would, when compared to a firm with a higher concentration of its activity offshore, be more exposed to New Zealand-specific systematic risk and its returns would be more closely correlated to the returns of the New Zealand market portfolio.

[101] This list of factors is based on Lally, M. *The Weighted Average Cost of Capital for Electricity Lines Businesses* (Report for the Commerce Commission), 2003.

- Pricing structure. Firms with revenues comprising both fixed and variable elements should have lower sensitivity to unexpected changes in the economy than firms whose revenues are entirely variable. Interconnection services are variable and are derived from demand for calls.

- Duration of contract prices with suppliers and customers. The effect of this on beta will depend upon the type of shock and the firm's reaction to it in the absence of a temporarily fixed price. For example, in the absence of restrictions on prices, and in the face of a positive economy-wide demand shock, a profit-maximising monopolist will increase its output price. An output price that is contractually fixed for some period prevents the firm from immediately acting in that way, and thereby reduces the firm's beta. By contrast, in the presence of an adverse cost shock (which induces an adverse economy-wide reduction in output), the same restriction on output price also prevents a firm from immediately raising its output price to mitigate the adverse cost shock, and this magnifies its beta.

- Presence of price or rate-of-return regulation. Firms subject to rate-of-return regulation should have lower sensitivity to unexpected changes in the economy, because the regulatory process is geared towards achieving a 'fair' rate of return. Price regulation will have a similar effect, providing prices are frequently reset. However, as the reset interval increases, such a firm tends to resemble one with an output price contractually fixed for a long period. The TSLRIC determination sets a price for interconnection services. However, it differs from standard price cap regulation in that the period of the determination may be as short as a year. The length of the determination period will determine to what extent TSLRIC resembles price or rate-of-return regulation.

- Degree of monopoly. So long as firms act to maximise their profits, theory offers ambiguous results with the impact depending on firm-specific characteristics. If, on the other hand, monopolists do not maximise their profits (perhaps because of the threat of regulation), they can use the cushion provided by suboptimal pricing and control to respond to unexpected changes in demand. As a result, their returns should exhibit less sensitivity to demand, and hence to unexpected changes in the economy. Interconnection services are not effectively competitive, therefore to the extent, if any, that market power reduces beta, Telecom's beta will be reduced by this effect.

- Nature of the firm's real options. The existence of options permitting expansions of the firm (adopting a new product, expanding existing operations etc) should increase the firm's sensitivity to unexpected changes in the economy, as the values of these growth options should be more sensitive to such changes than equity value exclusive of them, and these two value components should be positively correlated. By contrast, the existence of options permitting contractions of the firm should reduce the firm's sensitivity to unexpected changes in the economy, because the option value should be negatively correlated with equity value exclusive of it.

- Operating leverage. If firms have linear production functions and demand for their output is the only random variable, then firms with greater operating leverage (higher fixed to total operating costs) should have greater sensitivity to unexpected changes in the economy, because their cash flows will be more sensitive to their own demand. Telecom will have a significant degree of fixed costs; these will have the effect of increasing its beta.

- Market weight. Increasing a firm's weight in the market proxy against which its beta is defined will draw its beta towards 1 (although not necessarily in a monotonic fashion). Even for a market weight as low as 5%, the effect can be substantial. Telecom's market weight is substantial at 21% of the NZSE 40 in March 2003 [102].

- Capital structure. Firms with greater financial leverage will have greater sensitivity of equity returns to unexpected changes in the economy because cash flows to shareholders will be more sensitive to own demand. In addition, firm leverage matters only in relation to market leverage. Thus, for a given level of firm leverage, firms in different markets that have different market leverages will have different betas.

195. Comparative firms used to estimate an entity's beta should ideally be similar in the above respects. However, so long as differences can be corrected for, this will expand the set of comparators, with resulting improvement in the reliability of the beta estimate. TelstraClear submitted that the Commission should estimate the beta from first principles by the consideration of such factors as operating leverage, income elasticity, terms of the contractual arrangement and the nature of the regulatory regime.[103] The Commission considers that it is important to take account of these factors, but that the use of appropriate comparators also provides guidance as to the impact of these factors.

Direct Estimate of Beta from Market Data

196. For a publicly-listed company, it is possible to estimate the expected company beta based on historical data (assuming sufficient historical data exists); that is, comparing the past share price to past market movements. Data exists to estimate the equity beta for Telecom.[104]

197. Care must be taken in adopting this approach. Three issues are likely to be particularly relevant. These can best be demonstrated by reference to Telecom as the access provider.

198. First, the equity beta for Telecom reflects the systematic risk of investments in Telecom as a whole, rather than investments in the assets used to provide interconnection services. An investor in Telecom invests in a business providing a

[102] NZX, *NZSE Indices*, February 2003, p.10
[103] TelstraClear Limited, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002*', 16 August 2002, paragraphs 85-91 .
[104] Estimates of the equity beta on the basis of historical data are likely to reflect forward-looking systematic risk as long as there have been no major changes in either the structure of Telecom or its gearing over this time.

broad range of communications and telephony services, including mobile telephony services, data and internet services, as well as investments in other countries (such as AAPT in Australia). The required expected return on that investment is an average of the required rates of return across all these investments. This is likely to differ from the required return on assets to provide interconnection services. The access provider business is primarily concerned with providing call origination and termination on Telecom's fixed PSTN.

199. Whether or not the equity beta for Telecom as a whole is larger or smaller than the equity beta for investments in Telecom's provision of interconnection services will depend on a range of factors, including the demand and costs characteristics of the other services provided by Telecom compared to fixed PSTN services.[105] The provision of interconnection services may have higher variability than access due to the fixed revenue component of access; on the other hand, it is likely to be lower than other parts of Telecom's business such as broadband internet access and mobile services. If market power reduces the beta, then provision of interconnection services is likely to have a lower beta than competitive PSTN services in New Zealand or Telecom's AAPT operation.

200. Second, it is possible that Telecom's equity beta may differ from that of an efficient access provider as a result of the manner in which it structures its finances.

201. Third, there is likely to be a degree of error in an estimate of the equity beta for a single firm. Use of appropriate comparator firms may therefore provide a useful cross-check on any single-firm estimate.

202. As noted above, a further problem is that because Telecom is a significant portion of the NZSE 40 (estimated to be around 20%), direct estimates of Telecom's beta will tend to be biased upwards.

Comparable companies in New Zealand

203. The Commission has previously identified utilities, such as electricity and gas companies, as possible benchmarks for fixed PSTNs. These utilities have a number of similar characteristics to a fixed PSTN (particularly Telecom's fixed PSTN). First the demands for electricity, gas and telephony services are similar insofar as their use is ubiquitous and their income elasticities of demand are small. Second, the characteristics of the costs of providing these services are similar, involving a high proportion of relatively fixed costs. The Commission therefore considers that utilities are likely to provide an indication of the appropriate beta on the basis of their cost and demand characteristics. As noted below, it would be necessary to adjust the betas for differences in the gearing of the utilities and Telecom's fixed PSTN business.

204. The equity betas of utilities in New Zealand are measured relative to the market risk in New Zealand; in this respect they may provide more useful benchmarks for Telecom's fixed PSTN than telecommunications companies in other countries.

[105] For instance, the variability of demand over the business cycle, the extent to which costs are fixed, etc.

205. Telecom[106] submitted that utilities in New Zealand should only have minor applicability in the estimation of the WACC for interconnection services on the basis that:

- interconnection services will have greater exposure to the New Zealand economy as use of telephony services is more discretionary than electricity;
- telecommunications are more susceptible to competition than electricity utilities. There has been no growth of parallel electricity networks as there has been for telecommunications;
- there are greater growth prospects for telecommunications services compared to electricity; and
- telecommunications is subject to a faster pace of technological change than electricity.

206. In regard to the level of exposure an access provider has to the New Zealand economy, this is likely to vary between telecommunication services. While some services, such as residential broadband internet access and mobile services, may have high income elasticities, interconnection services or call origination and termination are likely to have lower income elasticities.

207. In terms of the impact of competition, the relevant question is not whether telecommunications services are more competitive than electricity, but whether interconnection services are more competitive. As noted by the ACCC[107] and the OECD[108] access providers have market power over access to those end-users connected to their network and therefore have weakened incentives to engage in price competition to provide access rights. In any case, the impact of competition on risk is unclear. Lally noted that the impact of market power on beta is unclear, depending on whether or not a monopolist optimises cash flows.[109]

208. The Commission accepts that technological change in some telecommunications markets is likely to be faster than in electricity distribution. However call origination and termination on the fixed PSTN is reliant on mature technologies and is unlikely to experience significant change under current conditions.

209. The Commission, therefore remains of the view that the use of electricity companies betas are relevant to the estimate of Telecom's beta in the context of interconnection services.

Comparable companies in other countries

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[106] PWC, 11 April 2003. Also CRA, 16 April 2002.
[107] ACCC, *Revised Pricing Guidelines for Access Prices of PSTN Terminating and Origination Access Services provided by Non-dominant or Smaller Fixed Networks*, January 2002, p12
[108] OECD *The Regulation of Access Services (with a focus on telecommunications)*, JT00153240, 7 November 2003, p7.
[109] Lally, M, *The Weighted Average Cost of Capital for Electricity Lines*, Commerce Commission, 2003.

210. In the TSLRIC paper, the Commission discussed the use of international benchmarks to estimate a beta for Telecom's fixed PSTN. The Commission noted that one source of international benchmarks for Telecom's fixed PSTN would be the Regional Bell Operating Companies (RBOCs) and major interstate telecommunications network operators (such as AT&T) in the United States. There are a number of reasons for this. First, the primary activity of the RBOCs is to provide fixed PSTN services similar to those provided by Telecom. Second, they face somewhat similar regulatory environments with respect to interconnection services.

211. The Commission noted that it maybe necessary to adjust estimates of the equity betas for these firms to ensure that 'like-for-like' comparisons are made with Telecom's fixed PSTN.

212. Two adjustments may be made, which relate to differences in market risk faced by the comparator firms and the financial leverage of the comparator firms, relative to Telecom's fixed PSTN services.

213. The equity betas of firms relate to the market in which they operate. For instance, the 'market' against which the volatility of the stock is measured is the market in that country; for example, equity betas for US stocks can be measured relative to the S&P 500 Index, New Zealand stocks can be measured relative to the NZSE 40 index. The relative risks of the market portfolios that these indices reflect could be different. The difference in the relative market risk faced by firms in different countries may be a source of difference between equity beta estimates across countries.

214. The systematic risk of a security as measured by the equity beta will reflect a firm's financial leverage. Therefore, when making comparisons across firms, the effect of leverage is typically removed (that is, an estimate of the beta is produced assuming the firm has no debt) by converting an equity beta to an asset beta. This is referred to as de-levering. The asset beta is then estimated for the regulated firm and the asset beta is re-levered based on the access provider's financial structure to obtain an estimate of its equity beta.

215. There are a number of methodologies that can be used for de-levering and re-levering. In principle, the de-levering and re-levering approach used must be consistent with:

(a) *the approach that is used to estimate the cost of capital and cost of equity:* for example, if a simplified Brennan-Lally CAPM is used, then the re-levering approach used must be consistent with the tax environment and with this form of CAPM; and

(b) *the assumptions concerning the cost of debt faced by the firm:* if it is assumed that the beta of debt is zero, then a relatively simple re-levering formula can be used.

Conclusion

216. The Commission considers that information from all of the above sources will be useful in estimating a beta for the purposes of a TSLRIC determination on

interconnection. However, in using such information, the Commission is mindful of the need to ensure that the information is appropriate to the specific issue, namely the pricing of PSTN originating and terminating services.

217. The Commission will also be mindful of its recent consideration of a beta estimate in the TSO determination. While there are likely to be some similarities with the TSLRIC interconnection exercise, there are also some important differences. In particular, in determining a beta appropriate for the TSO, the Commission gave some weight to an insurance effect operating under the TSO funding regime. Furthermore, the annual review of TSO costs was considered to be an important influence on beta.

7.5 Market-risk premium

218. The post-tax market-risk premium represents the additional premium that investors require to hold the market portfolio—a diversified basket of 'risky' assets – over and above the return that can be obtained from investing in risk-free assets. It is not affected by firm-specific factors. Continuing debate exists about the appropriate size of the market-risk premium.

219. A number of approaches can be used to estimate the market-risk premium. The common approach is to observe ex-post risk-free rates and market returns and calculate an arithmetic average over a number of years. Other methods involve estimating the relationship between the market-risk premium and market volatility changes over time; estimating the market-risk premium in line with the current value of shares and expected growth in market dividends; and considering estimates of the market-risk premium for foreign markets. Whatever approach is used, it is important to ensure that current estimates of investors' expectations are incorporated.

220. In estimating the market-risk premium from averaging of historical returns, a time period for the analysis has to be chosen. The choice involves a trade-off between using more data (which potentially improves the statistical precision of the estimate), and using potentially less relevant data (by using data that is too historic). Whatever period is used, there will always be some statistical uncertainty surrounding the market-risk premium estimate.

221. There are a number of available estimates of the post-tax market-risk premium in New Zealand. Some of these estimates were set out in the Commission's TSLRIC paper.[110]

222. Furthermore, it is important to note that the market-risk premium changes over time. Therefore, the appropriate estimate will depend on the period under consideration, which in turn is determined by the period of the initial determination. The Commission will therefore consider estimates of the post-tax market-risk premium in the context of a particular pricing review application.

7.6 Leverage

223. Leverage represents the degree of gearing or the ratio of debt to equity for a firm. Leverage is be measured by the ratio of debt to the sum of debt & equity. Under the

[110] Commerce Commission, *Application of a TSLRIC Pricing Methodology: Discussion Paper*, 2 July 2002, p57.

simple Brennan-Lally model, the WACC is not materially changed by small changes to gearing.

224. PwC submitted on behalf of Telecom for the TSLRIC cost of capital (11 April 2003), that a reasonable leverage for the access provider is 30%. PwC noted that Telecom's current leverage is 37% and the average gearing over the last 5 years was 28%. The current average leverage of their survey of other telecommunication companies is 35%, while the five-year average is 26%.[111]

225. In his report to the Commerce Commission on the cost of capital for electricity companies,[112] Lally states that it would be consistent to use optimal rather than actual levels of leverage in conjunction with the use of efficient costs and actual levels of gearing with actual costs. Lally suggests that the optimal level of leverage may be determined by considering similar unregulated firms, and on this basis suggests a gearing of 30% leverage.

226. There is evidence that gearing of telecommunications companies significantly increased in the 1990s and that regulators have responded to these trends by using higher levels of gearing in regulatory determinations. There is also some evidence of telecommunications companies seeking to reduce their debt levels more recently in response to concerns about excess debt.

227. The Commission is of the view that an optimal leverage ratio is likely to be appropriate. The Commission will take into account evidence of Telecom's current and past gearing, gearing of other telecommunication companies and the gearing for regulated telecommunication companies.

7.7 Debt premium

228. The cost of corporate debt is made up of a risk-free component and a company specific risk premium. The size of the debt premium is linked to the amount of risk borne by bondholders. This means that if Telecom's debt level and leverage increase, then the debt premium might also be expected to increase.

229. The Commission considers that Telecom's debt premium is likely to provide some indication of the debt premium for Telecom's interconnection services. However, the debt premium may differ to the extent that Telecom encompasses a broader range of services and accordingly the actual gearing of Telecom may differ from the optimal gearing adopted for the determination.

230. In estimating the debt premium for the purposes of a TSLRIC determination, the Commission will have regard to Telecom's debt premium and leverage ratio, as well as the debt premiums used in other jurisdictions by the Commission and other regulators.

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[111] PricewaterhouseCoopers, *Telecom New Zealand Limited - The Cost of Capital to be Applied in Calculating the Total Service Long Run Incremental Cost of Interconnection Services*, 11 April 2003, Appendix A

[112] Lally, M, *The Weighted Average Cost of Capital for Electricity Lines Companies*, Commerce Commission, 2003.

7.8 Tax rates

231. There are two tax rates used in the simplified version of the Brennan-Lally model; the investor tax rate and the corporate tax rate.

232. The investor tax rate is the marginal tax rate of the 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 dividends.

233. In its final report on the Airfields inquiry, the Commission concluded that:[113]

> Assuming fully imputed dividends (and that investors have the ability to fully utilise them), the average investor faces a 33% marginal tax rate on interest, and capital gains are not taxed. It follows that t_{div} and t_{divm} are zero and t_{int} is 33%. … While there has recently been a change in the top marginal personal tax rate, the assumption that the average investor faces a 33% marginal tax rate is still valid.

234. In the TSO determination the Commission adopted an investor tax rate of 33%.

235. The corporate tax rate is the tax rate of the access provider. This is generally accepted to be the statutory rate of 33%. The TSO determination used a corporate tax rate of 33%.

Conclusion: Use the same rates as the TSO determination

236. For the designated interconnection services, the current investor tax rate is 33% and the corporate tax rate is 33%. These rates are consistent with the TSO determination, but may change over time.

7.9 Conclusion on WACC

237. This chapter provides some guidance on the approach the Commission intends to take in determining the cost of capital for the purposes of a TSLRIC determination. The discussion is necessarily qualitative, with specific parameters to be considered in the context of a particular application. This is because the parameter values themselves will often depend on the period and service under consideration.

Increment to WACC

238. In the TSLRIC paper, the Commission raised the issue of asymmetric risks. In particular, two potential sources of such risks under regulation were discussed; truncated returns, and removal of options to delay investment. Both of these are

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[113] Commerce Commission, *Final Report Part IV Inquiry into Airfield Activities at Auckland, Wellington and Christchurch International Airports*, 6 August 2002, para 6.15-6.16.

particularly relevant in the presence of uncertainties associated with technological change and fluctuations in demand.

239. CRA characterise the value attributable to the option to delay investment as additional capital on which a return should be earned.[114] In other words, the option should be valued and added to the capital base. CRA also submit that:

> The value of timing options derives from the fact that the economic life of an asset is uncertain in the presence of technical change and changes in patterns of demand. The provision of interconnection services requires the use of the fixed PSTN, and a share of the common cost of the fixed PSTN is a cost of interconnection. Since the fixed PSTN is subject to the threat of technical change and demand uncertainty, the value of timing options must be reflected in any calculations of the cost of the common, shared and service-specific costs of the network that are attributed to interconnection.

240. In the TSO determination, the Commission stated that risks associated with changes in technology and/or demand can be taken into account in the cash-flow expectations under the tilted annuity.[115] For example, adjustments to the estimate of the tilt can be made to reflect the rate of technical progress. Under the TSO, such adjustments can be made on an annual basis, and so any error in estimating the tilt is likely to be relatively minor. However, to the extent that the period over which TSLRIC prices are set exceeds that for which the TSO is calculated, the risks associated with any errors may be larger. Any adjustment to parameters such as the tilt in a TSLRIC exercise is likely to be a matter of some judgment, which the Commission intends to consider within the context of a specific application.

241. In summary, the Commission considers that the approach taken in its TSO determination in respect of any proposed 'increment' to WACC will also be appropriate in principle in the context of TSLRIC determinations. Specifically, rather than adding a margin to WACC, the Commission considers it is appropriate to take account of these risks in the cash flows.[116] There are likely to be some important differences between the TSO and TSLRIC frameworks; for example, in relation to the frequency with which parameters are reset. The Commission considers it is appropriate to take such differences into account when considering the cash flow parameters.

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[114] Charles River Associates, *TSLRIC Pricing – Financial Issues*, 16 August 2002, page 7

[115] The Commission also notes that the value of timing options is likely to be quickly eroded where the threat of competition and new technology is present. For example, see Grenadier, S.R. 'Option Exercise Games: An Application to the Equilibrium Investment Strategies of Firms', *Review of Financial Studies*, 2002, 15, 3, pp691-721.

[116] For the reasons set out in the Commerce Commission, *Determination for TSO Instrument for Local Residential Service for period between 20 December 2001and 30 June 2002*, 17 December 2003, the Commission considers that this is consistent with the position it has taken in respect of electricity lines businesses.

8. Defining TSLRIC

242. Schedule 1 of the Act defines TSLRIC as:

> TSLRIC, in relation to a telecommunication service, -
>
> (a) means 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.

243. The definition of the increment and the associated incremental costs are influenced by the scope of the services provided and the time frame adopted. The treatment of forward-looking costs is discussed earlier in the paper. The treatment of common costs, and the implications of assets that are shared with other telecommunications services, are addressed later in this paper.

8.1 The increment

244. At the TSLRIC Conference, PwC, on behalf of Telecom, supported the use of a broad definition of the increment, and noted that narrow definitions may be inconsistent with the regulatory purpose of equity and non-discrimination.

245. A narrow increment may approach marginal cost where the increment is defined as an additional unit of volume (such as one additional call minute). Such a narrow increment would be inappropriate in the presence of high fixed and common costs. It would also be likely to result in a relatively large proportion of common costs, which would then have to be allocated according to some reasonable mechanism. As the increment expands, more fixed and common costs, previously not assigned to the increment, are encapsulated within the increment.

246. An increment that corresponds to the total volume of interconnection services is consistent with that used by overseas regulators, including the ACCC, one of whose papers referred to TSLRIC as applying to the full volume of likely demand.[117] Similarly, Telekom-Control in Austria adopted a 'whole of additional service' definition and noted that Telekom-Control had: [118]

> …chosen this definition of an increment because using smaller increments would lead to an unfair distribution of cost between network operators.

[117] NERA, *Estimating the Long Run Incremental Cost of PSTN Access – Final Report for ACCC*, January 1999, Section 1.1, pp1-2.
[118] Telekom-Control, *Forward-looking Long Run Incremental Costs for the Calculation of Interconnection Fees*, 15 January 1999, paragraph 4.3.

Conclusion: increment is total volume of interconnection services

247. The TSLRIC for interconnection services should define the increment as the total or whole volume of interconnection service that the access provider produces or is likely to produce.

8.2 Total service

248. Typically, in TSLRIC models, total service is defined to include all or most services that are provided using the same network elements as interconnection services. Such an approach is consistent with the definition of TSLRIC in Schedule 1 of the Act, which, as noted above, includes a requirement to take into account the service provider's provision of other telecommunications services.

249. The definition of total service typically includes a range of call services, such as local calls, national toll calls, fixed to cellular calls, etc.

250. In constructing a TSLRIC model of Telstra's fixed-line network for the ACCC, NERA defined the total service as follows:[119]

> We have taken the service as being the whole of Telstra's inland PSTN and ISDN service together with its leased line (or 'private circuit) service. Both Telstra's own customer services as well as traffic for interconnection operators are taken into account. … Our definition is also consistent with the definition used in the US, UK and other parts of the world.

251. PwC also noted that:[120]

> Demand for all services (Total Service) using access and core networks is usually included (Oftel, ComReg, ACCC, NTA, OPTA).

252. Therefore, the total service refers to the services supplied by the access provider, in particular those whose supply shares network elements with interconnection services. This definition also includes the volumes supplied by the access provider to its own customers.

253. The TSLRIC paper listed a number of fixed PSTN services pertaining to the definition of total service. A number of other potentially relevant services were also discussed, such as ISDN and leased lines. Both PwC and TelstraClear noted that these services are often included in definitions of total service in other jurisdictions.[121]

254. The TSLRIC paper noted that these services would include calls provided to both business and residential users, including those services provided by the access provider to its own customers.

255. In discussing the treatment of other services, the TSLRIC paper provided three options:

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[119] NERA, *Estimating the Long Run Incremental Cost of PSTN Access: Final Report for ACCC*, January 1999, p1.
[120] PWC, *TSLRIC Conference Wellington 16-17 July 2003*, handout distributed, p9.
[121] For example, PwC, *Response to 'Application of a TSLRIC Pricing Methodology' issued by the New Zealand Commerce Commission*, 15 August 2002, paragraph 69.

1. exclude other services from the methodology to estimate TSLRIC of providing interconnection services;
2. include other services as part of the network model; or
3. determine the contribution of other services to common costs 'outside the model'.

256. The purpose of the second and third approach is the same – to determine a reasonable contribution from other services to the common costs of providing interconnection services. Under the first approach, all the common costs are effectively loaded onto the interconnection services, resulting in a stand-alone cost of interconnection. As discussed in chapter 9, this will overstate the costs of interconnection.

Submissions

257. Telecom submits that limiting the services modelled to fixed PSTN services is a valid modelling approach to provide a ceiling for the appropriate interconnection price. In terms of including other services, Telecom cautioned that this:[122]

> … needs to be done with great care, particularly because of the common cost allocation procedures which then come into play. This model (the full services model) provides a floor for the appropriate interconnect price.
>
> Telecom considers the most appropriate course of action would be for the Commission to carry out both exercises. Such an approach is a reasonable recognition of the approximations and uncertainties inherent in the TSLRIC modelling exercise. The final interconnect price should then be set somewhere between these two modelling outcomes so as to best meet the purposes of the Act.

258. TelstraClear submits that the exclusion of other services from the TSLRIC methodology would be inconsistent with the 'incremental cost' provision in TSLRIC, and would result in inclusion of all common costs, rather than a 'reasonable allocation' as required by the Act.[123]

259. TelstraClear submits that the second approach results in an average cost approach. Only if all common costs were allocated to non-PSTN services would the interconnection prices based on this approach be consistent with an incremental cost approach. TelstraClear submits that the third approach is an alternative method of allocating common costs and would result in more of an average cost approach than an incremental cost approach.[124]

> In practice, the approach taken is usually a combination of option (ii) and (iii) for exactly the reasons identified by the Commission. For example, in its modelling for the ACCC, NERA included all PSTN services, ISDN services and leased line services and then separately allocated common costs to pay TV services, other utilities and other parts of the network. The Commission adopted this approach, as it could allocate costs to network elements for some services on a straight-forward basis but not for other services. For ISDN services the ACCC simply allocated the

[122] Telecom, *Submission to the Commerce Commission on 'Application of a TSLRIC Pricing Methodology – discussion paper'*, 16 August 2002, p3
[123] TelstraClear, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology'*, 16 August 2002, p11.
[124] *ibid*, p12.

> costs associated with a given network element, say a local to tandem transmission link, to all minutes of traffic that passed over that link, including ISDN minutes. For pay TV services, the allocation was more problematic, as there is no common unit of analysis which can be used to allocate costs. Hence, the ACCC used leasing revenue to allocate costs away from the PSTN for pay TV in one of its decisions and the number of parties sharing a trench to allocate costs away from the PSTN in another decision.[125]

260. At the TSLRIC Conference, Network Strategies, on behalf of TelstraClear, submitted the model should include all "relevant services" and that the inclusion of more relevant services would increase "the accuracy of the model". The inclusion of non-PSTN services was considered important because most of the growth in network demand is from data services[126].

Conclusion

261. The total service should in principle include all services that use the assets used by the designated interconnection services. This definition of the total service takes into account the access provider's provision of other telecommunications services, in the sense that these services share costs with interconnection services. This should lead to an appropriate range of services over which to allocate the assets' costs.[127]

262. In applying this principle, there may be circumstances where the inclusion of a specific service can not be justified due to its being too problematic or immaterial. Such situations will be assessed on a case by case basis.

8.3 Long Run

263. The TSLRIC paper noted that the long run is the time horizon where all facilities used in providing the services are variable and included in the cost calculations:[128]

> **Long run** refers to a period over time in which all resources are variable. That is a period of time sufficient for the firm to be able to alter all the inputs it uses to provide the service. In this way, long-run costs include the costs of all the inputs used to provide the service. Importantly, TSLRIC includes costs that, once incurred, are sunk. For instance, the costs of assets that have no alternative use once deployed.

264. Omission of these costs, which are significant in telecommunications, would be likely to have an adverse impact on the access provider's ability and incentives to invest in the provision of interconnection services.

265. This definition is consistent with that used by overseas regulators, including Ofcom, ACCC and Telekom-Control. The inclusion of fixed or sunk costs in this definition helps ensure that all network operators contribute towards this element of the costs.

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[125] *ibid*, p12.
[126] TSLRIC Conference transcript p207.
[127] As discussed in the following chapter.
[128] Commerce Commission, *Application of a TSLRIC Pricing Methodology: Discussion Paper*, 2 July 2002, paragraph 29.

266. The IRG noted that a long-run view of costs should 'take all costs as variable' and, in elaborating on this point:[129]

> … the 'long run' is defined as the time horizon within which the operator can undertake capital investment or divestment to increase or decrease the capacity of its existing productive assets. Thus a very long time horizon is observed in which all costs, including investment capital and all costs related to network capacity, are potentially variable with no fixed element.

Conclusion: long run is the period over which all resources are variable

267. The long-run is the period of time over which all resources, including fixed or sunk, costs are variable.

[129] Independent Regulators Group, *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling*, 24 November 2000, p6.

9. Shared and Common Assets

268. The preceding chapter discusses the services to which the Commission intends to have regard in determining interconnection costs. This raises the issue of the treatment of shared and common costs. This chapter considers the question of the treatment of shared and common network assets.

9.1 Common network costs

269. Assets that provide interconnection services are also used to provide other services. For example, a trench may be shared between interconnection services, other PSTN services and leased lines. This raises two main cost allocation questions from a TSLRIC modelling perspective:

- To which service or services should these costs be allocated?
- What basis should be used for any allocation of these costs?

270. The more additional services that are included (explicitly or implicitly) in the TSLRIC model, the lower the level of costs that are allocated to those services already in the model. For example, if a model that splits $100 of fixed costs evenly between services had two services, the addition of a third service would see the amount allocated to each of the original two services fall from $50 to $33.33.

271. Shared infrastructure can also be referred to as 'joint' infrastructure or 'shared and common' infrastructure. In some material, a distinction is made between those assets that are shared or joint to two or more identifiable services, and those assets that are common to all services produced by a firm. For example, a trench which accommodates PSTN infrastructure as well as leased lines is shared across those two services; while head-office costs are common across all services.

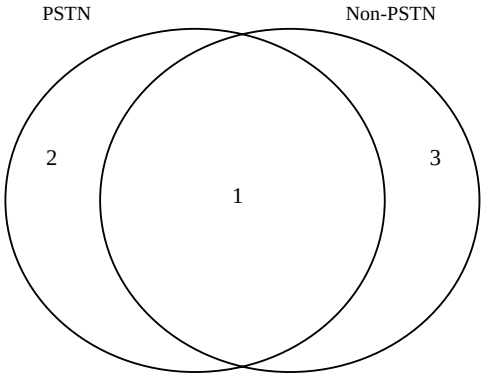
272. As noted earlier, the statutory definition of TSLRIC in Schedule 1 requires the Commission, in determining the costs, to take into account the service provider's provision of other telecommunications services.

273. The Schedule 1 definition of TSLRIC refers to both incremental costs and common costs. This definition can be illustrated using the following diagram, which depicts the provision of PSTN and non-PSTN services using some common network elements. For example, PSTN services and data services often share transmission capacity and trenching. These common network assets are represented by area 1 in the diagram. The associated common costs give rise to 'economies of scope', which are discussed below.

274. For example, in assessing the costs of providing PSTN services, one possibility would be to exclude all common costs, and to focus on those costs that are purely incremental. In Figure 2, these incremental costs are represented by the area 2, and these costs appear to be those referred to in part (a) of the Schedule 1 definition of TSLRIC. However, this would in effect allocate the entire common cost to the non-

PSTN service (that is, the cost of the non-PSTN service would be a stand-alone cost). Alternatively, all the common costs could have been allocated to the PSTN, resulting in an estimate of the stand-alone cost of the PSTN (area 1+2).

Figure 2: Incremental and Common Costs



275. The difficulty with these extreme positions is that they ignore any economies of scope that are available when both PSTN and non-PSTN services are supplied. Economies of scope arise when the unit cost of production falls as a result of providing multiple services across the same asset. In modelling each of the PSTN and non-PSTN services on a standalone basis (for example, PSTN as 1+2), such economies will tend to be overlooked. The resulting costs will be overestimated, as the common costs would, in effect, be recovered more than once. However, modelling the services in incremental terms (PSTN as 2) may lead to under-recovery of common costs.[130]

276. The Act's definition of TSLRIC falls between these two extremes, in the sense that it refers to the incremental costs (area 2) and an allocation of common costs (that is, an allocation of area 1). As noted in the preceding section, this approach has often been applied in other jurisdictions.

Submissions Received

277. At the TSLRIC Conference, PwC submitted that a TSLRIC model should include joint costs and fixed common costs. PWC noted that international best practice for TSLRIC modelling includes all service demands that use the shared network elements.

278. PwC notes that in the presence of fixed common and joint costs, setting prices at incremental costs will not allow a firm to cover its total costs. Therefore, a mark-up would be required to cover those costs. PwC considers that the Act's use of the phrase 'a reasonable allocation of forward-looking common costs'[131] provides for the recovery of these costs, but notes that all mark-up methods are arbitrary.[132]

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[130] 'Combinatorial tests' are sometimes used in modelling incremental costs, to ensure that common costs are accounted for. These tests involve modelling different increments and combinations of increments.
[131] Paragraph (b) of the definition of TSLRIC at Part 1 of Schedule 1 of the Act.
[132] PwC, TSLRIC Conference handout, 16-17 July 2003, p30.

279. PwC discusses the appropriate interpretation of the phrase 'reasonable allocation' and possible methods of recovering common costs. Of those methods, PwC notes that only Ramsey pricing and ECPR seek to satisfy any economic efficiency goals, that ECPR is specifically disallowed by the Act, and that Ramsey pricing is difficult to apply in practice.[133] PwC submit that Equi-Proportional Mark-up (EPMU) and metric-based allocations are the only methodologies with the advantage of simplicity. PwC notes that the equal shares method seeks to replicate the negotiations on sharing costs by two rational parties who would each bear the full cost of the input in the absence of an agreement.[134]

280. PwC recommends the use of Ramsey pricing as a first, and the equal shares method as second, best option.

281. At the TSLRIC Conference, Network Strategies submitted that to 'achieve correct cost allocation', the TSLRIC modelling should include 'all services that use the resources that the interconnection services use'.[135] They argued that the inclusion of non-PSTN services such as the use of leased lines by mobile networks can have a 'major impact' and that 'most of the growth in network demand is from data services as opposed to PSTN services'.[136]

282. Network Strategies also submitted that 'in other jurisdictions the number of services sharing costs is expanding' as presented below.[137]

Figure 3: Network Strategies: Comparison of overseas practice

	PSTN	*ISDN*	*Leased lines*	*xDSL*	*Raw copper*	*Fibre*	*Cost sharing in the future*
Australia	●	●	●				more data services
Denmark	●	●		●	●	●	Cable TV, VPN, frame relay
Sweden	●	●		●	●	●	
United Kingdom	●		●				
United States	●						HAI 5.3 considers sharing with ISDN, ADSL, DS1 and DS3

283. Network Strategies submitted that trench sharing could occur both between the access and the core network, and also with other utilities. Denmark and Sweden were offered as examples of countries where the core network shares trench with both the access network and other utilities, such as cable TV operators.

[133] *ibid*, p33.
[134] *ibid*, pp31-33.
[135] Network Strategies, *TSLRIC modelling issues*, 15 July 2003, p13.
[136] *ibid*, p14.
[137] *ibid*, p16.

284. NECG submitted that shared and common costs should be allocated across all services that use the PSTN network elements and that the basis of allocation should be the per-minute cost for each element:[138]

> PSTN costs should be defrayed across all services that use PSTN infrastructure. Minutes of use is an appropriate way to allocate common costs.

Overseas Experience

285. In the U.S., the FCC notes that setting the price for each discrete network element solely on the forward-looking incremental costs will not recover the total forward-looking costs of operating the wholesale network. Joint and common costs are referred to simply as common costs, and no distinction is necessarily made between them. The FCC states that a reasonable measure of such costs will be included in the prices for interconnection and access to network elements. The FCC cautions, however, that prices should never exceed the stand-alone cost for a specific element, and should, in most cases, be below stand-alone costs.[139]

286. In Australia, the ACCC distinguishes between shared and common fixed costs. Both types of fixed costs, where they relate to the service being considered, are included in the definition of costs for the purposes of determining interconnection charges. Consequently, some kind of mark-up over the costs estimated using TSLRIC is needed to ensure adequate cost recovery. The advantages of this approach are that all costs are accounted for within the model, costs are allocated on some reasoned basis, and pure TSLRIC costs can still be estimated by simply subtracting the shared and fixed costs.[140]

287. The IRG notes that it is fairly standard practice to mark-up LRIC by an amount estimated to cover a reasonable proportion of common costs. Three suggested methods of recovering common costs are Ramsey pricing, accounting rules that split the common cost equally between two products, and equal proportionate mark-up (EPMU) that recovers common costs in proportion to the incremental costs of the products.[141]

288. In Denmark, Telestyrelsen defines common costs as 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. The National Telecom Agency distinguishes between shared and common costs.[142]

289. WIK, in a report for the RegTP, notes that common costs appear as mark-ups on the incremental costs to cover the total costs of the service portfolio. International

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[138] NECG, *TSLRIC Conference Handout* 15 July 2003, p 23.
[139] FCC, 96-325: *First Order and Report in the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act*, 8 August 1996.
[140] See the NERA paper commissioned by the ACCC: NERA, *Estimating the Long Run Incremental cost of PSTN Access – Final Report for ACCC*, January 1999, pp6-8.
[141] IRG, *Principles of implementation and best practice regarding FL-LRIC cost modelling*, 24 November 2000.
[142] Telestrelsen, *LRAIC Model Reference Paper – Common Guidelines for Top-down and Bottom-up Cost Analyses*, 11 April 201.

benchmarks, Deutsche Telekom cost-accounting data, and data supplied by other network operators are used to calculate the mark-ups. Mark-ups using a common percentage will be applied if the capital and operating costs arising from investments cannot be generally attributed, or the cost-accounting method used does not coincide with the defined network elements.[143]

290. In the U.K., Ofcom uses EPMU to determine the allocation of common costs between the conveyance and access networks. If only a subset of the network components gives rise to the common costs between conveyance and access, only these components will bear a mark-up. After initial consideration, Ofcom found that there were no common costs (and therefore no mark-up) associated with the tandem switch, the junction transmission link and the trunk transmission link. However, after a more detailed review of the source, nature and relevance of common costs, Ofcom determined that some of the common costs that arise from indirect costs are associated with all the components. The costs of interconnection services, including mark-ups, are derived by applying routing factors to the component costs.[144]

Conclusion: shared and common costs to be allocated across all services using the assets

291. The cost of shared and common network assets should be allocated across the services that use the assets. This approach will ensure that all services receive an equitable allocation of the costs and that the risk of under or over recovery is minimised.

9.2 Cost allocation methodology

292. This raises the issue of the appropriate mechanism for determining a 'reasonable allocation of forward-looking common costs.' The appropriate method for the allocation of common costs will depend on the robustness of the data set and the trade-off between efficiency in recovery of costs (in the sense of minimising the distortionary impact on economic surplus) and simplicity in modelling.

293. The TSLRIC and general economic literature identify several methods for allocating common infrastructure costs. Options include Ramsey pricing, EPMU, equal share and use of a related metric such as minutes of use or the number of cables. The IRG has noted that:[145]

> … it is fairly standard practice to mark-up LRIC by an amount considered appropriate to cover a reasonable proportion of common costs. There are various methods of recovering common costs across a range of services. From an economic point of view distortion is minimised by recovery of common costs according to Ramsey Pricing. This recovers common costs from the products based on the products' relative marginal cost of production and price elasticities. However, this method of recovering common costs requires robust and detailed information on elasticities, which is often hard to find. The alternative is to recover common costs according to an accounting rule. For example, if the common input were used to produce two separate, regulated services, one simple rule would be to split the common cost equally between the two

[143] WIK, *Analytical Cost Model Local Loop – Consultative Document 2.0*, 8 November 2000.
[144] Ofcom *An Assessment of the Interim 1996/7 Top Down Model*, July 1997, Chapter 3
[145] IRG, *Principles of implementation and best practice regarding FL-LRIC cost modelling*, 24 November 2000, p5.

services. Another example would be to recover common costs in proportion to the incremental cost of the two services. This method of allocating costs is known as equal proportionate mark-up (EPMU).

294. Ramsey pricing is a considerably more complex approach to the recovery of common costs, requiring robust and detailed information on, for example, own-price and cross-price elasticities and price-marginal cost ratios. In light of the complexities associated with the calculation of Ramsey mark-ups, and their sensitivity to the quality of the underlying data, the Commission will treat common network costs according to one of the simpler allocation methods.

295. In practice, the actual mechanism by which common costs are allocated may vary, depending on the nature of the costs to be allocated. For example, the allocation of switching and transmission costs across PSTN and non-PSTN services may take a different form from the allocation of other common costs, such as those associated with head office functions. However, the Commission believes that, where possible, common cost mark-ups should be activity-based or usage-based.

296. For example, in the case of a trench housing PSTN and non-PSTN cables, trenching costs could be allocated on the basis of the number of cables within the trench. While each individual cable does not drive the costs of the trench, such an allocation bears some reflection of use of the trench. For a transmission link that has been provisioned to serve local, long-distance, and interconnection calls, the cost could be spread across each of these services according to call minutes traversing the link.[146]

Conclusion: the basis of cost allocation will be network usage

297. Common costs will be allocated across services according to each service's network usage. However, the metric for network usage may vary, depending on the nature of the costs to be allocated.

[146] See for example ACCC, *A Report on the assessment of Telstra's undertaking for the Domestic PSTN Originating and Terminating Access Services*, July 2000, Appendix 1.

10. Operational Costs

298. In order to determine the total cost of providing a service under TSLRIC, it is necessary to determine the efficient level of operating costs. These costs are then combined with the capital costs to produce a total forward-looking cost for the service.

299. Network operation and maintenance costs in a TSLRIC model are typically expressed as a percentage of capital investment.[147] Explicit or direct modelling of the operating costs for the proposed network design is extremely complex, costly and time-consuming.

300. Operating costs include both costs that are directly attributable, and costs that are indirectly attributable, because there is an intermediate cost/volume relationship. For example, some maintenance costs may be indirectly related to the number of interconnection call minutes. The Commission considers that such indirect costs are 'reasonably identifiable' as incremental to the service.

10.1 Alternative approaches

301. The TSLRIC paper presented three alternative approaches to estimating applicable percentages for network operating and maintenance costs and sought industry feedback. The alternatives identified were:[148]

1. percentages based on the access provider's actual costs;
2. benchmarking against similar telecommunication networks in other countries; and
3. percentages used by regulators in other countries.

302. A TSLRIC model may combine elements from two or more approaches. For example, direct operational and maintenance costs may be derived from the operator's actual costs, while overheads are based on benchmarking to overseas regimes. It is also possible that a specific figure could be a hybrid of two or more approaches.

303. The TSLRIC paper, while discussing the merits of each approach, did not present a preliminary view. Rather it sought industry feedback on the issues for both direct operations and maintenance (O&M) and non-network costs.

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[147] Commerce Commission, *Application of a TSLRIC Pricing Methodology: Discussion Paper*, 2 July 2002, pp84-92.
[148] Commerce Commission, *Application of a TSLRIC Pricing Methodology: Discussion Paper*, 2 July 2002, pp86-92.

Submissions

Telecom

304. Telecom's written submission questioned the suitability of bottom-up models for calculating O&M costs and, of the options presented, preferred the one based on the access provider's actual costs. Telecom considers that this is 'the most accurate approach', while noting that it was presently unachievable. In particular, PwC Consulting:[149]

> … acknowledged that TCNZ would be unable to provide the necessary granularity of information at the present time. TCNZ are, though, able to identify O&M costs that relate to switching and transmission separately to other O&M and this information may complement the benchmarking to be undertaken.

305. The submission also noted that the use of percentage mark-ups is practical in comparison to the 'time consuming and impractical' alternative of explicitly modelling cost drivers.

306. PwC Consulting made the following comments about the TSLRIC paper's second and third approaches:[150]

> PwC does not consider the other two approaches justifiable. However, if the second approach is used, the benchmarking exercise needs to recognise the inherent inaccuracies in simple benchmarking procedures. …
>
> The third approach, consisting in using other regulators' percentages, is considered unacceptable. The reasons are those percentages would reflect different market conditions and the method is not forward-looking.

307. PwC Consulting submitted that while the use of the access provider's actual costs is the most accurate approach, the lack of sufficiently granular information necessary for that approach means that a benchmarking approach should initially be adopted:[151]

> Until access providers are able to provide such information a benchmarking approach based on similar networks is favoured. However, the estimates must be adjusted to take account of, amongst other factors:
> - Differing network sizes and structures;
> - The use of different network technologies (where one technology may for example require less maintenance);
> - Differing labour costs.
> - Such a benchmarking approach could be conducted with relative ease and within a reasonable short timescale by the CC.

308. At the TSLRIC Conference, PwC submitted that bottom-up models typically apply simple percentage multipliers to take account of operating costs and indirect investment. However, in this presentation, PwC questioned the suitability of such multipliers:[152]

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[149] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' Issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 133.
[150] *ibid*, paragraphs 131, 135.
[151] *ibid*, paragraph 134.
[152] PwC, *TSLRIC Conference Wellington 16-17 July 2003* (handout), 16 July 2003, p25.

> There is no reason to believe that such relationships hold true. At best they may yield the correct result in a specific set of circumstances but if these circumstances change it is unlikely that the same coefficients would still hold true. The coefficients are often based on simple benchmark analysis, e.g. Oftel, ACCC which may not be applicable to a particular jurisdiction for a variety of reasons …

309. When asked at the Conference which set of benchmark rates it considered to be best, PwC suggested using the ARMIS data from the USA with an adjustment for local factors: [153]

> The FCC requires that the incumbent LECs publish what they call a set of ARMIS reports; and those are very detailed accounting information, they're historic cost accounts, but they're very detailed functional information, they include a large amount of operational data as well. Actually, that is the best publicly available source of detailed information. I think the best approach to doing this is probably to take that information and to understand what adjustments you need to make to that information to account for differences between the US and the country in question.

TelstraClear

310. TelstraClear's written submission and NECG's presentation at the TSLRIC conference both saw merit in using Telecom's actual costs if certain conditions were met (for example, in relation to the forward-looking costs of an efficient service provider). NECG suggested that benchmarking could be used in instances where information from the access provider could not be validated, scrutinised and tested by interested parties,[154] while TelstraClear's written submission proposed benchmarking as a form of sanity check on any estimates based on the access provider's costs:[155]

> Telecom's actual O&M and capital expenses may not reflect the expenses of an efficient service provider and the Commission would need to identify the relevant cost items from Telecom's accounts and then determine an appropriate method of allocating network O&M cost items across the PSTN and other related services … this approach will not be transparent to competitors.
>
> … TelstraClear supports the estimation of the mix of O&M to capital costs of an efficient provider. However, such an approach is likely to impose a significant burden on the Commission. Given the arguments above, the likely best alternative for the Commission is to measure Telecom's cost mix directly and make efficiency adjustments to those measures. As a sanity check the Commission should compare its findings with those reached by regulators in other jurisdictions.

311. The presentation by Network Strategies submitted that US data from the FCC is often used for benchmarking O&M costs (as a percentage of capital investment) and can be used for determining efficient cost levels. Network Strategies also submitted that some expenses such as customer service and plant non-specific expenses can be determined on a per-line basis using multi-variable regression analysis.[156]

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[153] TSLRIC Conference Transcript, pp112-113.
[154] NECG, *NZCC TSLRIC Conference*, (handout) 15 July 2003, p3.
[155] TelstraClear, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology'*, 16 August 2002, paragraphs 108, 110.
[156] Network Strategies, *TSLRIC modelling issues*, (handout), 15 July 2003, p21.

Overseas Experience

Australia

312. In Australia, the bottom-up model developed by NERA for the ACCC used a hybrid of ratios determined after considering data from the US carriers (ARMIS database) and BT in the UK for the indirect (non-network) costs, and estimation based on a competing carrier and expert opinion for maintenance costs. Telstra recently constructed a cost model (PIE II) which used percentages based on their actual costs adjusted for price changes. The ACCC recently stated that it intends:[157]

> … to use it (the PIE II model) to inform itself in relation to determining model price terms and conditions.

313. The follow quotes describe the methodology used for operating and indirect costs in the bottom-up model developed by NERA for the ACCC. Appendix A of this report lists some of the figures determined by the above process. Operating costs as a percentage of capital largely varied from 5% to 12% depending on the asset type.[158]

> **2.4.2. Maintenance and operating costs**
>
> For each equipment type we have estimated the annual operating/maintenance cost as a percentage of the capital cost in 1998. These figures are based on estimates provided by Optus (for certain equipment in the core network) together with NERA experience elsewhere. We note that Telstra have provided data on the basis of their current operating costs by equipment category group for historic assets – this data has not been used as it does not represent the optimised operating costs for new assets.
>
> **2.4.3 Other 'indirect' costs**
>
> There are a number of other capital costs and operating costs which are relevant to call conveyance and access but which do not form part of the direct 'network' costs.
>
> To model these costs we have used data for the US LECs and AT&T reported to the FCC, as well as data for BT. The data for the LECs is a relevant comparator for costs associated with the access network and the 'local' network (in which we include the remote to LAS links, the remote units and the LASs). The data for AT&T is a relevant comparator for costs associated with the longer distance networks (the LAS-LAS, LAS-TS and TS-TS links and the TSs).

Denmark

314. According to Telestyrelsen, the Danish regulator:[159]

> **Operating costs:** should only include efficiently incurred operating costs. Operating costs arise largely from the costs of maintaining capital equipment. Only costs related to the wholesale division should be included in interconnection charges. Costs related to customer service,

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[157] ACCC, *Draft Determination for model price terms and conditions of the PSTN, ULLS, and LCS services*, June 2003, p26.

[158] NERA, *Estimating the Long Run Incremental cost of PSTN Access – Final Report for ACCC*, January 1999, p39.

[159] Telestyrelsen, *LRAIC Model Reference Paper – Common Guidelines for the Top-Down and Bottom-Up Cost Analyses*, 11 April 2001.

> marketing etc. should not be included. Most pay costs can be classified as operating costs although when labour is involved in installing capital equipment, its costs may be capitalised.

Austria

315. The Austrian regulator's approach to costs varied according to the cost type and information available on its causality. Telekom-Control's general approach to cost allocation has some relevance to the issue of operating costs:[160]

> Wherever possible, in accordance with the principle of cost causation, joint and overhead costs should be appropriately attributed to products and services. When a transparent allocation basis is lacking, remaining joint and overhead costs form the basis for the calculation of mark-ups.
>
> Specific difficulties are posed by the fact that a firm with significant market power has, in addition to products which are subject to price regulation (e.g. interconnection), other spheres of activity which are not regulated (e.g. end-user equipment rentals). When allocating joint and overhead costs, care must be taken that no unjustified transfer of cost from unregulated spheres to regulated spheres takes place.

Europe Economics/European Union

316. Europe Economics of the UK developed a TSLRIC model that the EU has made publicly available to assist member states' regulators in determining TSLRIC rates for interconnection. According to Europe Economics, the model has been used (to varying degrees) to set interconnection rates in several European countries including Austria, France, Denmark and the Czech Republic.[161]

317. The default version of the model calculated network and non-network operating costs as a percentage of capital value for each asset class. These mark-ups varied from 1% to 11.2% and are listed in Appendix 2.

318. Non-network operating costs were calculated as an additional 10% of capital value. This estimate was based on the 1999 ACCC study referred to earlier. Benchmarking ratios from the US were also used.

USA

319. The FCC publishes cost accounting information from US network operators in the Statistics of Communication Common Carriers (ARMIS). This database lists expenses by asset type for network operators and as noted earlier has been used as benchmark data both within and outside the USA.

Germany

320. In advising the German regulator, WIK noted the following:[162]

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[160] Telekom-Control, *Forward-looking Long Run Incremental Costs for the Calculation of Interconnection Fees*, 15 January 1999, Section 4.7.
[161] As noted on Europe Economics' website http://www.eer.co.uk/
[162] WIK, *Analytical Cost Model Local Loop – Consultative Document 2.0*, 8 November 2000.

> **Operating costs** – Taking asset-related operating costs into proper account in a bottom-up model is difficult. The reasons are the complex work processes that make it hard to identify the cost drivers, and the company-specific nature of the processes. … work processes must be described in terms of activity-based costing, which reproduces the relevant cost drivers appropriately and hence allows allocation to individual services or network elements.

321. A separate study by WIK on access and call costs in several German towns and cities calculated operational and maintenance costs as being between 0.0098% and 20% (the 20% was for building but was in the context of a USO service mix).[163] This report also noted that operational and maintenance costs should be lower in countries with lower labour costs.

New Zealand Telecommunications Service Obligation

322. When calculating the cost of providing the Telecommunications Service Obligation (TSO), the Commission modelled applicable operating and indirect costs related to switching and inter-nodal transmission. These costs were expressed as a percentage mark-up on capital investment costs.

Use of Operator's Actual Costs

323. The use of actual data may lead to problems with confidentiality and data transparency, and can also involve several problems with cost allocation. In a forward-looking cost regime, the use of actual data generated from existing operations may also necessitate some form of adjustment to remove inefficiencies. This adjustment could be made either by applying an efficiency co-efficient or by relying on professional estimation and/or reference to other regimes or networks.

324. An efficiency co-efficient could be determined by benchmarking (for example international best practice) or expert assessment. If actual costs are adjusted by an efficiency co-efficient, then the effect could be similar to having calculated the costs using the approach used to determine the co-efficient. Similar issues exist when adjustments are made by expert estimation or reference to other networks and regimes.

325. Another issue regarding actual costs (and in some cases benchmarked costs) is the trade-off between operational costs and capital costs, and the fact that what are efficient costs for the operator's current network may not necessarily be efficient costs in a forward-looking network design.

326. Use of actual data also involves judgment in the treatment of shared and common costs and in assessing which costs are justifiable costs of the designated service. The issue of which costs are justifiable is important, as incentives exist for an access provider to allocate as much cost as possible to regulated services.

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[163] WIK, *Costing and Financing the USO in a Competitive Telecommunications Environment in the EU*', Germany, October 1997.

Conclusion: apply percentage mark-ups

327. In modelling interconnection services, operational and maintenance costs and indirect costs should be calculated using percentage mark-ups applied to the capital asset base. This is consistent with the several bottom-up models developed overseas and the Commission's work in modelling the cost of the TSO.

328. The Commission considers that, where possible, the values used should be consistent with those used for the Commission's TSO modelling. The use of the same rates for the TSO and TSLRIC modelling should reduce the risk of over or under recovery and is likely to offer long-term modelling benefits. However the Commission notes that some adjustments may be required, due to differences in how the Act defines costs for the TSO and interconnection services.

329. Should the TSO modelling not provide an appropriate mark-up, then the mark-up rate should be developed after considering the rates used by other regimes. The Commission considers that reliance solely on an access provider's actual data, as the basis for a mark-up rate, could create problems with access to the data, cost allocation and the extent and basis for any efficiency adjustments.

11. Double Recovery and Costs Common to TSO

Introduction

330. This section discusses the relationship between the TSLRIC modelling of interconnection services and the TSO. Two specific and related issues are considered in this context: the issue of double-recovery of costs, and the treatment of costs that are common across the provision of interconnection services and the TSO.

11.1 Double recovery of costs

331. The Act requires that TSLRIC should include 'a reasonable allocation of forward-looking common costs', where forward-looking common costs:

> (a) means those costs efficiently incurred by the service provider in providing the service that are not directly attributable to providing an additional unit to that service; but
>
> (b) does not include any costs incurred by the service provider in relation to a TSO instrument.

332. The TSLRIC paper included the following comments on the implications of this part of the Act:[164]

> It is the Commission's preliminary view that the purpose of not including 'any costs incurred by the service provider in relation to a TSO instrument' is to prevent 'double recovery' of the net cost of the TSO instrument. That is to avoid (some) service providers paying Telecom for the net cost of the TSO twice, once as payments as liable persons and again through interconnection charges.

333. The Commission provided its preliminary view in the TSLRIC paper that the TSLRIC of interconnection services provided by Telecom should not include any net losses for non-viable exchange areas recovered via the TSO provisions; nor should it include any costs attributable to the access network.[165]

Submissions

334. In submitting on behalf of Telecom, PwC noted that it: [166]

> … agrees that there should be no over-recovery of costs, e.g. through TSO and interconnection charges at the same time. However, PwC would emphasise that, likewise, there should be no under-recovery of costs.

335. PWC later stated in this submission that:[167]

> the over-riding principle must be that costs are recovered: neither over-recovered nor under-recovered … Consider the example of a trench shared between TSO related and other services. All

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[164] Commerce Commission, *Application of a TSLRIC Pricing Methodology – Discussion Paper*, 2 July 2002, paragraph 41.
[165] *ibid*, paragraph 46.
[166] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' Issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraph 58.
[167] PwC Consulting, *Response to 'Application of a TSLRIC Pricing Methodology' Issued by the New Zealand Commerce Commission on 2nd July 2002*, 15 August 2002, paragraphs 92-93.

> costs of the trench should be recovered. Common costs should be split between services in such a way that is proportionate to the avoided costs of each service.

336. CRA, submitting on behalf of Telecom, contended that a TSLRIC price for interconnection services should include fixed costs specific to providing interconnection services as well as an allocation of those shared costs relating to the core network costs and an allocation of the fixed and common costs which contribute to the provision of both interconnection and local access services. CRA concluded this discussion:[168]

> In our view the price that will best approximate the TSLRIC of interconnection is the price that includes service specific fixed costs, and allocation of shared (core network) costs and an allocation of fixed and common (access network) cost.

337. TelstraClear submitted that TSLRIC should exclude:[169]

- net losses from CNVCs (if any);
- other costs of providing KSO and TSO services (whether incremental or common, and whether to CNVCs or commercially viable customers); and
- costs attributable to the access network

338. Woosh Wireless concluded their submission by stating that: [170]

> It is therefore imperative that any aspect of the interconnection regime that reflects Telecom's costs does not provide for double recovery by Telecom of TSO losses.

Overseas Practice

339. Overseas TSLRIC modelling specifications often include requirements to ensure that cost allocations are performed in a manner to minimise costs being allocated to multiple elements or services. For example, in Denmark, where a model that covered both the core and access networks was developed, the modelling criterion included the following:[171]

> The bottom-up model should identify all the cost categories that have been aggregated into single network elements and justify the basis on which costs categories have been allocated to more than one network element when this occurs.

340. A second example is from the Independent Regulators Group who, when discussing common costs, described a procedure of 'combination tests' to ensure that LRIC figures were 'cost orientated' and did not over-recover common costs.[172]

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[168] Charles River Associates, *TSLRIC Pricing – A Response to the Commission's Discussion Paper*, 16 August 2002, paragraph 40

[169] TelstraClear Limited, *Submission on the Commerce Commission's Discussion Paper 'Application of a TSLRIC Pricing Methodology – 2 July 2002*', 16 August 2002, paragraph 26.

[170] Walker Wireless, *Submission on the Commerce Commission Paper 'Application of a TSLRIC Pricing Methodology'*, paragraph 77.

[171] Telestyrelsen, *LRAIC Model Reference Paper – Guidelines for the Bottom-Up Cost Analysis*, 6 April 2001, p60.

[172] IRG (EU), *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling*, 24 November 2000, p5.

Conclusion: no double counting

341. The Commission considers that there should be no double counting, and therefore no double-recovery, of costs between interconnection services and the TSO and access network.

11.2 Costs incurred by the service provider in relation to a TSO instrument

342. In the TSLRIC paper, the Commission noted that:[173]

> Typically in TSLRIC models these common costs are allocated to the access and core networks on a 50/50 basis. However, as noted above, in determining a reasonable allocation of common costs, the Commission must 'not include any costs incurred by the service provider in relation to a TSO instrument'.
>
> The Commission's preliminary view is that costs common to both the access and core networks related to a TSO instrument should be entirely excluded from TSLRIC calculations. The Commission seeks comment on this approach.

343. At the TSLRIC conference, parties were asked to comment on how costs relating to the TSO should be treated in the TSLRIC exercise. In a subsequent submission, TelstraClear noted that Schedule 1 of the Act defines forward-looking common costs to exclude *any* costs incurred in relation to the TSO. TelstraClear argued that 'any' includes both incremental and common costs in relation to the TSO. In addition, TelstraClear submitted that:[174]

> … because the Act refers to 'any cost' rather than 'net cost' it includes cost regardless of whether they are in relation to commercially-viable customers or commercially non-viable customers (CNVCs).

344. In commenting on the Act's definition of forward-looking common costs, Telecom considers that:[175]

> … there are two plausible interpretations to be given to the relevant words '… does not include any costs incurred by the service provider in relation to a TSO instrument':
>
> (a) only the allocated net costs in relation to a TSO instrument cannot be treated as forward-looking common costs; or
> (b) only common costs reflecting assets based in entirely unprofitable ESAs are excluded.

345. Telecom supports the first interpretation, on the basis that it is consistent with the purpose and language of the legislation, and avoids the counter-intuitive outcome produced by TelstraClear's proposed approach.

346. In terms of the second interpretation, which Telecom considers to be inferior to the first, Telecom considers the example of two local switches used to supply local calls as well as interconnect calls. Switch A lies in an unprofitable ESA, while switch B

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[173] Commerce Commission, Application of a TSLRIC Pricing Methodology – Discussion Paper, 2 July 2002, p39.
[174] TelstraClear letter to Telecommunications Commissioner, *Treatment of common costs in the calculation of TSLRIC for interconnection*, 28 July 2003.
[175] Telecom letter to Telecommunications Commissioner, *TSLRIC-Interconnection-Common Costs—TSO Exclusion*, 22 August 2003, paragraph 3.

lies in a profitable ESA. Telecom submits that none of the costs of switch A would be included in the TSLRIC charge, as that switch would be recovered through the TSO cost recovery process. However, TSLRIC would include a reasonable allocation of costs associated with switch B. As a result,[176]

> … this avoids a 'double recovery', yet ensures that interconnection services contribute to the recovery of common costs in profitable areas, and leaves the second limb of the TSLRIC definition as meaningful.

Modelling Recovery of Costs Common to the TSO

347. In implementing a TSLRIC model of interconnection services, it is important that the methodology ensures that the call traffic used in the final costings corresponds to the network being modelled. Hence the modeller should ensure that not only those costs which are recovered through the TSO are excluded from the final TSLRIC calculation, but also that the network traffic volumes are adjusted for that traffic associated with the commercially non-viable exchange service areas (ESAs).

348. One approach to achieving this would be to remove all non-viable ESAs from the data set and to build the TSLRIC network model using the reduced data set. Such an approach would remove not only those costs which are reimbursed via the TSO, but also the traffic associated with those customers. The use of a data set that is derived from the TSO should offer a degree of consistency between the TSO determination and determinations where Telecom is the access provider and hence reduce the risk of over or under recovery of costs.

349. The TSLRIC model should, where possible, follow the methods and proportions adopted for the TSO modelling for those network elements and the common costs associated with these elements that are shared by the core and access networks. The use of consistent proportions should ensure that these costs are recovered, but only once. Allowance should also be made for network elements that are used in providing other services (e.g. public data networks). This approach avoids having assets that are common to both the TSO and the designated interconnection services costed at the levels of a standalone network in either model. This method is consistent with the principles of the "combination test" described by the Independent Regulators Group[177].

350. The use of mark-ups for operating costs (e.g. indirect costs, maintenance costs) in both the TSO and TSLRIC modelling should reduce the risk of double recovery. As each model only applies the mark-up to the capital investment costs identified as relevant to the service being modelled, each model will capture its own relevant costs. As noted in Chapter 10 mark-ups have been used by overseas regimes (e.g. Austria, Denmark and Germany) which sought to calculate forward looking interconnection costs which did not include those costs attributable to the local access network.

Conclusion: Common costs exclude costs allowed under the TSO regime

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[176] *ibid*, paragraph 13.
[177] IRG (EU), *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling*, 24 November 2000, p5.

351. There should be no double counting of costs under the TSO and TSLRIC regimes. This raises the issue of how to interpret what Telecom refer to as the 'TSO exclusion', namely the exclusion from 'forward-looking common costs' of any costs incurred by the service provider in relation to a TSO instrument.

352. This exclusion relates to that component of TSLRIC that includes a reasonable allocation of forward-looking common costs. The legislative aim in respect of this component of the definition is clear. It is to prevent an element of double counting that might arise if the forward-looking common costs were to include costs that have been accepted by the Commission as claimable as the costs of complying with TSO obligations, and which therefore qualify for apportioned liability between the relevant service provider and other liable persons, under the TSO regime. There is an obvious complementarity between having the forward-looking common cost component of the TSLRIC quantified to exclude such amounts, and the Commission dealing under other statutory provisions with the quantification of the cost of complying with TSO obligations, for the purpose of allocating those costs between the service provider and other liable persons.

353. The Commission considers that a purposive approach to interpretation would therefore treat the reference to '… any costs … in relation to a TSO …' as referring to those costs that are recognised as qualifying for contribution from liable persons and the service provider because they were incurred in discharging TSO obligations.

354. A further reason for adopting the purposive approach is that TSLRIC includes a 'reasonable allocation of forward-looking common costs' and, therefore, requires the exercise of judgement as to what will influence a 'reasonable' allocation. Because of this judgemental element, a purposive interpretation which accords with the statutory aim of excluding costs that have been taken in account in quantifying the cost of TSO obligations, is the dominant influence in interpreting the exclusion from 'forward-looking common costs' of any TSO costs.

355. The contrary argument raised by TelstraClear depends on attributing a literal meaning to 'any costs'. However this fails to take account of the context in which this part of the definition of forward-looking common costs appears. It is also subject to potential ambiguity when the concept of 'any costs' is assessed in its context of 'in relation to a TSO'. It is unclear how close a connection is required for 'any cost' to be 'in relation to' a TSO. Thus the scope intended by application of a literal interpretation is in any event not particularly clear.

356. The Commission considers that a TSLRIC model should not include those costs recovered through the TSO in the final calculation of the cost of interconnection services. Equally the TSLRIC modelling of interconnection service should adjust for or remove the network traffic associated with those network elements which are determined to be commercially non-viable and for which costs are recovered via the TSO. Such an approach will ensure that there is no double recovery of costs relating to the TSO and also ensure consistency between the traffic volumes and network costs used to determine the cost of interconnection services. Having modeling procedures to ensure that costs are allocated to only one service is consistent with practices used in overseas' regimes and the principles noted in several submissions.

Appendix A: Data from ACCC/NERA Modelling in Australia

Assumptions for equipment costs for transport network

	Capital investment AUS $	Asset life	Price trend	Operational costs as a % of capital cost
IRIM (per 480 line unit, excl MUX))	c-i-c	10	-4%	7%
IRIM – port	c-i-c	10	-4%	7%
IRIM – site	c-i-c	24	1%	12%
RSS/RSU (per 2048 line unit)	c-i-c	10	-4%	7%
RSS/RSU – port	c-i-c	10	-4%	7%
RSS/RSU – site	c-i-c	21	0%	11%
LAS (per 2048 line unit)	c-i-c	10	-5%	7%
LAS - port	c-i-c	10	-5%	7%
LAS - fixed (processor)	c-i-c	10	-8%	7%
LAS - per BHCA (processor)	c-i-c	10	-8%	7%
LAS - site	c-i-c	20	-1%	11%
TS - port	c-i-c	9	-6%	7%
TS - fixed (processor)	c-i-c	9	-6%	7%
TS - per BHCA (processor)	c-i-c	9	-6%	7%
TS - site	c-i-c	17	-1%	10%
Synchronisation PRC	c-i-c	4	0%	13%
Synchronisation SSU equipment per tandem switch	c-i-c	9	0%	13%
Synchronisation SSU licence per tandem switch	c-i-c	9	0%	13%
SDH MUX STM1	c-i-c	10	-10%	6%
SDH MUX STM4	c-i-c	10	-10%	6%
SDH MUX STM16	c-i-c	10	-10%	6%
Digital cross connect	c-i-c	10	-9%	7%
Line termination system	c-i-c	10	-9%	6%
STM - 1 Regenerator	c-i-c	9	-10%	5%
STM - 4 Regenerator	c-i-c	9	-10%	5%
STM - 16 Regenerator	c-i-c	9	-10%	5%
Repeater Site Cost	c-i-c	23	1%	12%
12 fibre cable / metre	c-i-c	24	-5%	10%
24 fibre cable / metre	c-i-c	24	-5%	10%
48 fibre cable / metre	c-i-c	24	-5%	10%
96 fibre cable / metre	c-i-c	24	-5%	10%
Trench / metre - CBD	c-i-c	34	0%	11%
Trench / metre - Metro	c-i-c	34	0%	11%
Trench / metre - Provincial	c-i-c	34	0%	11%
Trench / metre - Rural (ploughed)	c-i-c	34	0%	11%
Trench / metre - Rural (ploughed - no duct)	c-i-c	34	0%	11%
Signalling transfer point	c-i-c	9	-5%	8%
Core network management centre per switch node	c-i-c	9	-7%	62%

c-i-c = commercial-in-confidence information removed.

Indirect Operating Costs as a Percentage of Direct Network Operating Costs

Expense category	Benchmark (median) Local	Benchmark (median) Trunk	Environment adjustment	Relevance to Interconnection	Local	Trunk
Cost of carrier services*	6.00%	6.00%		100%	6.00%	6.00%
Executive	1.70%	3.56%		40%	0.68%	1.42%
Planning	0.28%	0.28%		60%	0.17%	0.17%
Accounting and finance	4.08%	8.90%		60%	2.45%	5.34%
External relations	3.20%	2.71%		60%	1.92%	1.63%
Human resources	3.17%	2.85%		50%	1.58%	1.43%
Information management	12.93%	17.25%		40%	5.17%	6.90%
Legal	1.06%	4.86%	50%	50%	0.26%	1.21%
Procurement	0.69%	0.16%		80%	0.55%	0.13%
Other general and administrative	11.98%	38.59%		50%	5.99%	19.30%
TOTAL	**45.09%**	**85.17%**			**24.78 %**	**43.53%**

** BT benchmark*

It is important to note that this uplift applies to the direct network operating cost only, not to the total annualised cost (which also includes depreciation and return on capital) - this appears to have been mis-understood in our draft report. On average these figures suggest just over 50% of these non-network costs are relevant to network activities. The estimation of the proportion of costs that is relevant to interconnection involves a degree of judgement. However, we note, that non-network expenses account for around 10%-20% of total interconnection charges. Misjudging the overall proportions of cost that are relevant to interconnection by say 10 percentage points (i.e. adjusting the average allocation to interconnection to around 40% rather than around 50%), would result in over estimating interconnection charges by around 2-4%. This implies that our results are relatively robust to these estimates. In presenting our results we have separated out the uplift for indirect costs. It is then straightforward to see what the impact of altering our assumptions would be.

Source for tables and explanatory text: NERA, *Estimating the Long-run Incremental Cost of PSTN Access, Final Report for the ACCC*, January 1999, pages 43 & 83

Appendix B: EER/EU Adaptable Interconnection Model

Cost Input Assumptions 2. Network costs	Operating costs as a percentage of equipment capital cost (%)
Switching	
Remote Concentrator Units	
Fixed cost of processor	11.2%
Site cost for RCU	9.8%
Processing cost per BHCA (variable costs)	11.2%
Cost per BHE for switchblock	11.2%
Digital line termination unit (2mbit/s port)	11.2%
Local Switching	
Fixed cost of processor	11.2%
Site cost for LS	9.8%
Processing cost per BHCA (variable costs)	11.2%
Cost per BHE for switchblock	11.2%
Digital line termination unit (2mbit/s port)	11.2%
Tandem Switching	
Fixed cost of processor	11.2%
Site cost for TS	9.8%
Processing cost per BHCA (variable costs)	11.2%
Cost per BHE for switchblock	11.2%
Digital line termination unit (2mbit/s port)	11.2%
Transmission	
Electronics	
STM 1	4.4%
STM 4	4.4%
STM 16	4.4%
STM 64	4.4%
Regenerators STM	4.4%
Digital cross connects	4.4%
Line termination system STM 1	4.4%
Line termination system STM 4	4.4%
Line termination system STM 16	4.4%
Line termination system STM 64	4.4%
Infrastructure	
Cable/metre	
12 fibre cable	11.2%
24 fibre cable	11.2%
48 fibre cable	11.2%
96 fibre cable	11.2%
Duct/metre	
Metropolitan	12%
Urban	12%
Rural	12%
Buried cable	12%
Other costs	
Synchronisation related cost	11.2%
Signalling Transfer Points	11.2%
Network management: switching	1%
Network management: transmission	1%
Network management: infrastructure	1%

3. Non-network costs

Non-network Capital Costs (as a percentage of network capital costs)	Local network (Average of US LECs)	Long distance network (AT&T)	Adjusted local network	Adjusted long distance network	Operating costs as a percentage of equipment capital cost (%)
Total	*8.69%*	*9.95%*	*4.87%*	*5.47%*	*10%*
Non-network Operating Costs (as a percentage of network operating costs)	**Local network (Average of US LECs)**	**Long distance network (AT&T)**	**Adjusted local network**	**Adjusted long distance network**	
Total	*45.09%*	*85.17%*	*24.80%*	*43.44%*	

Appendix C: Data from analysis of the German network

Extract from Appendix C of WIK *'Costing and Financing the USO in a Competitive Telecommunications Environment in the EU'*, Germany, October 1997.

The costs of operation and maintenance are made a function of the level of investment. For the purpose of this study, ratios between investment and expenses are based on data which have been reported by US local telephone companies in the ARMIS reports. The assumed values for economic lifetime, capital cost factors and operation and maintenance factors for various categories of investment together with the resulting annual charge factor (ACF) are depicted in Table C.3-1.

Table C.3-1: Determination of annual charge factors

Asset category	Economic lifetime	Capital recovery factor	Operation & maintenance factor	ACF
Buildings	25	0.1018	**0.2**	0.3018
Digital circuit	10	0.1558	**0.0132**	0.1690
Digital switches	10	0.1558	**0.0589**	0.2147
Underground cable	18	0.1142	**0.0356**	0.1498
Underground fibre	18	0.1142	**0.0082**	0.1224
Buried cable	18	0.1142	**0.0057**	0.1199
Buried fibre	18	0.1142	**0.0042**	0.1184
Conduit systems	55	0.0908	**0.0098**	0.1006

The factors for operation and maintenance shown in Table C.3-1 were adjusted for the medium and low cost country cases. Adjustment factors are based on a comparison of labour costs published by Eurostat. For Spain a labour cost level of 78% compared with Germany is used; for Portugal the corresponding value is 34%. These percentages are highly aggregated and not specific to the telecommunications sector. Furthermore, they do not reflect possible differences with respect to productivity. Administrative costs, including for example billing and collection costs and complaint management, are estimated on a per line basis and amount to 3 ECU per line and month. For the medium and low cost country cases the value was adjusted the way described in the preceding paragraph. Joint administrative costs which are shared by all services using the asset in question, for example expenses that are related to the administration of buildings, are not included in the calculations.

Source: http://europa.eu.int/ISPO/infosoc/telecompolicy/en/append_c.pdf