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# Does Telstra's TEA Model Provide a Reasonable Estimate of the TSLRIC+ of Supplying ULLS?

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## Executive Summary

In this report I first describe the commonly accepted essential attributes of a TSLRIC+ model. I do so drawing on experience from around the world.

I then consider whether the TEA model possesses such attributes and find that, with one or two minor exceptions, it does. In particular the TEA model:

§ Defines the increment appropriately when calculating TSLRIC+ (Section 4.1);

§ Employs a scorched node methodology and reduces the network to minimise route length (Section 4.2);

§ Uses (i) a MEA approach, in which assets are valued using the cost of replacement with the modern equivalent asset, and (ii) competitively determined current equipment prices to calculate forward looking investment costs and thereby conforms with standard practice in TSLRIC+ models (Section 4.3);

§ In some cases, employs an equi-proportional mark up (EPMU) to allocate common fixed costs while in others it uses methods which have been specified in the context of TSLRIC+ modelling or are otherwise appropriate (Section 4.4);

§ Employs an annuity to estimate the annual capital charge. In terms of approximating economic depreciation this outperforms a tilted annuity in the case of all the main assets in the CAN. The method used in the TEA model tends to underestimate annual capital costs (Section 4.5 and Appendix A);

§ Uses WACC to estimate the cost of capital (Section 4.5);

§ Calculates operating expenses and indirect asset costs by applying appropriate ratios to the modelled asset base, which is standard practice in TSLRIC+ models (Section 4.6);

I have also reviewed the way in which the model's methodology has been implemented and find that, assuming that the inputs are appropriate, it should produce a reasonable estimate of the TSLRIC+ of ULLS (Section 5).

The TEA model deviates from standard TSLRIC+ methodology in that it does not separate out fixed costs that are common to ULLS and other access network services (i.e. fibre exchange lines and leased lines) and allocate them across the user services via an EPMU. However, the basis on which it allocates these common costs (i.e. in proportion to the total number of voice equivalent lines) is a reasonable one.

For network support assets such as shared exchange building facilities, the TEA model uses inputs which are derived from the Regulatory Accounting Framework (RAF). I have not seen the process for identifying and allocating network support assets within the RAF and cannot, therefore, comment on its appropriateness within the framework of a TSLRIC+ model.

I have not been asked to review the appropriateness of the inputs used in the model and have not done so.

# 1. Introduction

I have been instructed by Mallesons Stephen Jaques, on behalf of Telstra, to undertake a study whose purpose is to:

- Set out what are commonly accepted as the essential attributes of a TSLRIC+ model;
- Identify the extent to which Telstra's TEA model embodies these attributes; and
- Assess whether, assuming that appropriate inputs are used in the TEA model, a reasonable estimate of the TSLRIC+ of supplying the ULLS is provided by the model.

I have not been asked for, and do not provide, an assessment of whether appropriate inputs have been used in the TEA model. The focus of my report is on the methodology employed.

In writing this report I have drawn on the expertise of Soren Sorensen, also of NERA Economic Consulting, who has previous experience of using network optimisation approaches to model local loop costs. The opinions expressed in this report are my own opinions.

This report sets out my findings. It is structured as follows:

- The Executive Summary presents a high level summary of my conclusions;
- Section 2 defines TSLRIC+;
- Section 3 sets out the commonly accepted essential attributes of a TSLRIC+ model drawing on examples taken from the telecommunications industry;
- Section 4 takes the output of Section 3 and considers the extent to which Telstra's TEA model possesses the attributes of a TSLRIC+ model;
- Section 5 examines in some detail the way that the TEA model is constructed and assesses whether, assuming that the inputs are appropriate, it produces a reasonable estimate of the TSLRIC+ of ULLS;
- Appendix A contains a comparison of the performance of different depreciation methods;
- Appendix B identifies the documents that I have relied upon when preparing this report;
- Appendix C contains letters of instruction from Mallesons Stephen Jaques;
- Appendix D contains CVs for Nigel Attenborough and Soren Sorensen.

## 2. Definition of TSLRIC+

Before considering the essential attributes of a TSLRIC+ model, it is necessary to define TSLRIC+.

TSLRIC is an acronym for total service long run incremental cost, where:

- Incremental cost is the additional cost incurred by a firm as a result of expanding the output of a service by a given increment.[1] It is measured assuming that the volumes of all other services remain unchanged;
- Long run means that the time period under consideration is long enough for all costs to be variable or avoidable.[2] This means that all types of input costs are taken into account and that there are no sunk costs. In the absence of sunk costs, incremental cost is equal to avoidable cost, which is the cost that would be saved if the increment of output were no longer provided but all other services continued to be supplied at existing volumes;
- Total service means that the increment of output, whose cost is being measured, is the total volume of the service concerned.

Depending on which service is being considered, TSLRIC could be measured for a single service or for a group of similar services.[3] It is normally expressed on a per unit basis (i.e. the incremental cost is divided by the volume of the service(s) concerned).

As recognised by the ACCC, TSLRIC is based on forward-looking economic costs.[4] These are the costs of providing the service using the best available and commercially proven technology and efficient production practices. Such costs are derived using current asset prices.[5]

It is also necessary to take account of shared and common fixed costs. These are costs that are common to two or more services. They do not therefore form part of the incremental costs of any of the individual services to which they are common. Such costs exist, albeit to a lesser extent, even if consideration is given to sub groups of services. For example, the customer access network (CAN) and the inter-exchange network (IEN) typically share some trenches. Consequently, the incremental cost of all services using the IEN does not include the cost of these trenches as they are already required by services using the CAN and vice versa. The more narrowly one defines each service for which TSLRIC is measured, the

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1 See Kahn, A.E., ***The Economics of Regulation***, MIT Press, 1988, Volume 1, page 66 and Baumol, W.J. and Sidak, J.G., *Toward Competition in Local Telephony*, MIT Press and American Enterprise Institute for Public Policy Research, 1994, page 57.

2 This is sometimes referred to as the very long run., which, to quote Baumol, is "a period so long that all of the firm's present contracts will have run out, its present plant and equipment will have been worn out or rendered obsolete and will therefore need replacement, etc." see Baumol, W.J., Economic Theory and operations Analysis, 1977, page 290.

3 Federal Communications Commission, FCC 96-325, paragraph 677

4 ACCC, *Access Pricing Principles – Telecommunications*, 1997, page 29.

5 The reason for using current asset prices is that this is what a buyer would be prepared to pay for these assets in a competitive market and hence this is the value of the assets going forward – see Baumol, W.J. and Sidak, J.G., op. cit, page 60.

greater is the relative size of the common fixed costs. For example, the trench in the CAN that is shared between exchange lines and unbundled local loops is a common fixed cost if one is considering TSLRIC for ULLS in isolation. If, on the other hand, the increment is all copper line services in the CAN, the shared trench would become part of TSLRIC.

The existence of common fixed costs means that, if all services were priced on the basis of TSLRIC, total revenues would fall short of total costs. In order to prevent such a shortfall, common fixed costs have to be allocated and recovered via some form of mark up on TSLRIC. The ACCC refers to TSLRIC plus such an allocation of common fixed costs as TSLRIC+.[6]

[6] See, for example, ACCC, *Pricing of Unconditioned Local Loop Services (ULLS)*, Final Report, March 2002, pages 15 and 16; and ACCC, *Submission to the Productivity Commission Telecommunications Competition Regulation Inquiry*, 2000, Attachment 3, page 2.

# 3. Essential Attributes of a TSLRIC+ Model

Discussions of the essential attributes of TSLRIC models normally focus on the following areas:

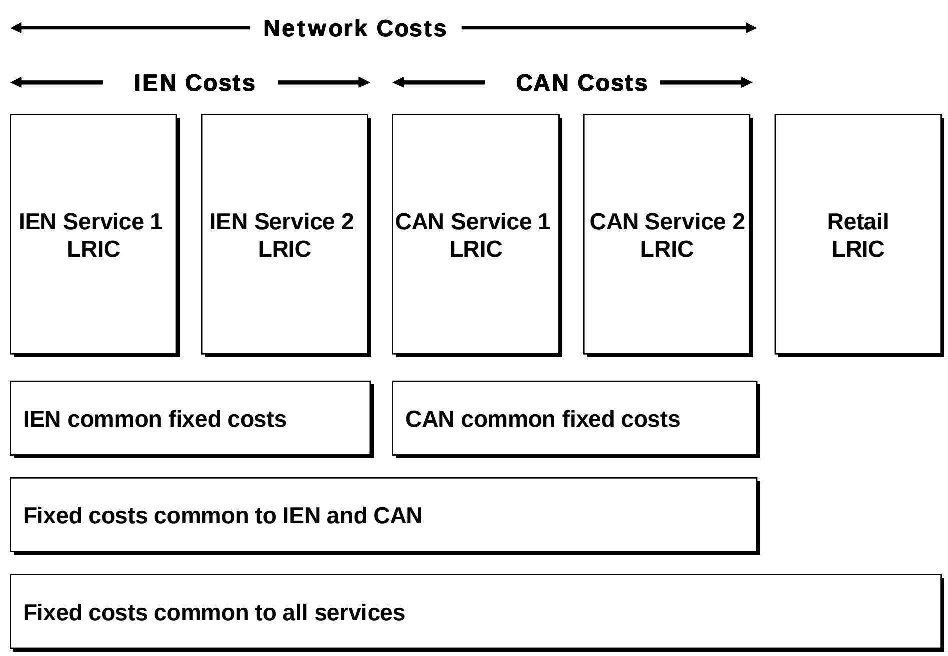
- The definition of the increment whose costs are being measured;
- Assumptions made about efficient network design;
- Forward-looking costs;
- Identification and allocation of common fixed costs;
- The method used for calculating the depreciation of assets;
- Appropriate allowance for the cost of capital;
- Methodology for estimating operating expenses.

I address each of these individually below.

## 3.1. Definition of Increment

When modelling TSLRIC+ it is necessary to define the service(s) whose incremental cost is being measured. As mentioned in Section 2, the choice of increment affects the relative size of common fixed costs and TSLRIC. This is illustrated in Figure 1 below which portrays an imaginary world where there are two IEN services and two CAN services.

**Figure 3.1**
**LRIC and Common Fixed Costs**



It can be seen that, if each service is considered as a separate increment, there are three categories of common fixed cost (as shown in rows 2, 3 and 4 of Figure 3.1).[7] However, if, for example, the two CAN services were to be defined as one increment, CAN common fixed costs would become part of the LRIC of CAN services. This is because the fixed costs that are common to the two CAN services would not be incurred if these two services were not supplied and hence are part of the combined incremental cost of the two services.[8] Consequently defining the two CAN services as one increment reduces the amount of common fixed costs both in absolute terms and relative to LRIC.

The approach taken by regulatory authorities has been to take a broad definition of service (i.e. to group individual services together). This reduces the complexity of the TSLRIC modelling process as it avoids having to identify in detail how the costs of different network components vary with traffic volumes.[9] It also reduces the extent of common fixed costs and hence lessens the importance of the often contentious issue of how to allocate common fixed costs between different services when setting prices (see Section 3.4). However, it may come at the price of reduced economic efficiency, depending on the method used for allocating common fixed costs.[10] Examples of the approaches adopted by regulators are given below.

### 3.1.1. Oftel approach

Oftel (now Ofcom) was involved in one of the earliest attempts to estimate TSLRIC+ for fixed network services. Its approach was to define just two services: call conveyance and customer access. More specifically:

*"Incremental costs include only the costs that are caused by the provision of a defined increment of output. In the methodology to calculate incremental costs, the increment in question is the whole of the output of a service – two services are considered: conveyance and access. The long run incremental cost of conveyance is the cost that would be saved in*

7 The different elements of Figure 3.1 are not drawn to scale. Row 1 shows LRIC for each service when it is treated as a separate increment. Row 2 illustrates fixed costs that are either common to the two IEN services (e.g. trench and duct between exchanges) or to the two CAN services (e.g. trench and duct in the CAN). Row 3 shows fixed costs that are common to both IEN and CAN services (e.g. trenches shared by the IEN and CAN). Row 4 shows costs that are common to all services including retail activities (e.g. corporate overheads).

8 LRIC for a service is equal to the cost avoided if the service concerned is no longer provided but all other services continue to be supplied. It is equivalent to the incremental cost of providing the service when all other services are already supplied.

9 For example, if IEN Service 1 and IEN Service 2 both make use of local switches, if one were seeking to estimate TSLRIC for IEN Service 1 in isolation it would be necessary to understand how the cost of local switches would change if IEN Service 1 were no longer provided but IEN Service 2 continued to be supplied. This requires defining a detailed cost-volume relationship for local switches. In contrast, if TSLRIC is being measured for all IEN services together, it is not necessary to define a detailed cost-volume relationship. Rather, attention can be confined to the separate identification of TSLRIC and common costs.

10 Economic efficiency requires that prices be set equal to marginal cost. However, given the presence of service-specific and common fixed costs, such a pricing policy would lead to the firm concerned failing to recover all of its costs. In order to minimise the loss of economic efficiency, it is necessary to price above marginal cost in a way that minimises distortions from the optimal consumption pattern (e.g. via Ramsey pricing where prices are marked up in inverse proportion to price elasticity of demand). With narrowly defined service increments this is potentially possible, although in practice the information requirements are such that it is difficult to achieve. The broader the service increment the greater the amount of common costs included in TSLRIC and hence the greater the extent to which price (based on TSLRIC per unit) exceeds the marginal cost of providing the more narrowly defined service. The pattern by which price is marked up relative to marginal cost is unlikely to follow that required to minimise economic inefficiency.

*the long run if no traffic were provided over the network, but access were to continue to be provided. It is assumed that all assets are replaced in the long run and so it is assumed that there are no sunk costs in the long run. The incremental cost of access is the cost that would be saved in the long run if no final links to customers were provided (but, hypothetically, conveyance continued to be provided)."* [11]

Oftel's focus at that time was the cost of conveyance rather than the cost of access. In order to derive the incremental cost of conveyance, Oftel proceeded to calculate the forward-looking costs of the network components that are used to provide conveyance (i.e. concentrators, switches and transmission links etc). These costs were then attributed to individual conveyance services according to the amount that each service used each network component. [12]

### 3.1.2. FCC approach

In 1996, the FCC adopted a version of the TSLRIC methodology which it referred to as total element long run incremental cost (TELRIC).[13] The main reason for doing so was to reduce the extent of "joint and common costs" that must be allocated amongst separate service offerings and thereby avoid the difficulty associated with determining an "economically-optimal" allocation of such costs.

*"The incumbent LEC offerings to be priced using this methodology generally will be "network elements," rather than "telecommunications services," as defined by the 1996 Act. More fundamentally, we believe that TELRIC-based pricing of discrete network elements or facilities, such as local loops and switching, is likely to be much more economically rational than TSLRIC-based pricing of conventional services, such as interstate access service and local residential or business exchange service. As discussed in greater detail below, separate telecommunications services are typically provided over shared network facilities, the costs of which may be joint or common with respect to some services. The costs of local loops and their associated line cards in local switches, for example, are common with respect to interstate access service and local exchange service, because once these facilities are installed to provide one service they are able to provide the other at no additional cost. By contrast, the network elements, as we have defined them, largely correspond to distinct network facilities. Therefore, the amount of joint and common costs that must be allocated among separate offerings is likely to be much smaller using a TELRIC methodology rather than a TSLRIC approach that measures the costs of conventional services. Because it is difficult for regulators to determine an economically-optimal allocation of any such joint and common costs, we believe that pricing elements, defined as facilities with associated features and functions, is more reliable from the standpoint of economic efficiency than pricing services that use shared network facilities."*

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[11] Oftel, *Pricing of Telecommunications Services from 1997: Consultative Document on BT Price Controls and Interconnection Charging,* December 1995, Annex D, paragraph D.7.

[12] Oftel included leased lines in conveyance thereby ensuring that all the main services using transmission links in the IEN were taken into account when allocating the costs of different transmission links to different services.

[13] Federal Communications Commission, FCC 96-325, August 1996, paragraph 678.

The FCC's TELRIC approach is very similar to TSLRIC using a broad definition of the relevant increment. Indeed, if the service increment includes all services that use the network elements, they are effectively the same thing. The close similarity of broad increment TSLRIC and TELRIC has been recognized by the ACCC.[14]

### 3.1.3. Other regulatory authorities

The IRG, which is the group of regulatory authorities from EU countries, takes the view that the choice of increment depends on the purpose for which TSLRIC is being calculated. It also recognises that modelling complexity increases with the use of smaller increments.[15] In practice, in Europe TSLRIC+ models have used a broad service increment definition. Such an approach has also been implemented in models built in Australia (for the ACCC) and in Malaysia, Singapore and New Zealand.

### 3.1.4. Conclusion

Standard practice in TSLRIC+ modelling for interconnection services is to take a broad increment approach to service definition. Such a definition of the increment normally includes all services that make use of the assets which are required by the interconnection services. The capital and operating costs of these assets are then recovered from the full range of user services based on the extent to which each service uses the assets concerned.

## 3.2. Network Design and Topology

TSLRIC is a forward looking cost concept. This raises the question as to whether cost modelling should be based on the theoretical least-cost network configuration and technology currently available, or whether costs should be computed based on existing network infrastructures. In this context, it is possible to conceive of three main possibilities:[16]

§ **Existing network design** –This approach maintains the locations of existing network nodes and uses the types and volumes of equipment currently in place at and between nodes, regardless of whether the existing design and technology is efficient.

§ **Scorched earth** – This is based on the most efficient (i.e. least cost) network architecture, sizing, technology and operating practices that are currently available.[17] Network nodes can be relocated in order to build an optimal network and minimize the costs of access lines, switching and interoffice transport.

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[14] See ACCC, *Mobile Services Review: Mobile Terminating Access Service, Final Decision*, June 2004, page 230, footnote 566: *"TSLRIC stands for total service long-run incremental cost. Where it contains a contribution to organisational-level costs the Commission calls it 'TSLRIC+'. Other jurisdictions use TELRIC ('E' for 'element'); LRIC (long-run incremental cost); LRIC + EPMU (equi-proportionate mark up) or LRAIC (long-run average incremental cost). This different terminology is the cause of some confusion, but in all cases reference is being made to essentially the same thing."*

[15] Independent Regulators Group, *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling*, 24 November 2000, pages 3-4

[16] See, for example, Section 3.3.2 of the *ICT Regulation Tool Kit*, produced by infoDev and the ITU. This can be found at http://www.ictregulationtoolkit.org/en/Section.2092.html

[17] The least cost solution is determined taking both capital costs and operating expenses into account.

- **Scorched node** – This approach maintains the network nodes in their current positions but uses efficient technology and volumes of equipment in and between the current node locations.

### 3.2.1. Oftel approach

Oftel adopted a scorched node approach when estimating TSLRIC+, stating that:

*"For modelling purposes it has been assumed that the number and location of BT's switches are given (the 'scorched node' assumption). The alternative would be to assume a pure green field approach and allow the number and location of switches to be fully optimised, but the Incremental Cost Working Group considered that this would lead to excessive complexity in the modelling"* [18]

### 3.2.2. FCC approach

The FCC also chose scorched node, seeing it as a compromise between the use of existing network facilities and new, efficient network technology:

*"Under the third approach [scorched node] prices for interconnection and access to unbundled elements would be developed from a forward-looking economic cost methodology based on the most efficient technology deployed in the incumbent LEC's current wire center locations. This approach mitigates incumbent LECs' concerns that a forward-looking pricing methodology ignores existing network design, while basing prices on efficient, new technology that is compatible with the exiting infrastructure. This benchmark of forward-looking cost and existing network design most closely represents the incremental costs that incumbents actually expect to incur in making network elements available to new entrants. Moreover, this approach encourages facilities-based competition to the extent that new entrants, by designing more efficient network configurations, are able to provide the service at a lower cost than the incumbent LEC. We, therefore, conclude that the forward-looking pricing methodology for interconnection and unbundled network elements should be based on costs that assume that wire centers will be placed at the incumbent LEC's current wire center locations, but that the reconstructed local network will employ the most efficient technology for reasonably foreseeable capacity requirements."*[19]

### 3.2.3. Other regulatory authorities

The IRG favoured what it referred to as "modified scorched node", which took the existing network topology as the starting point but optimised technology at and between existing switching nodes and eliminated inefficiencies (e.g. by simplifying the switching hierarchy).[20]

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18 Oftel, *Pricing of Telecommunications Services from 1997: Consultative Document on BT Price Controls and Interconnection Charging,* December 1995, Annex D, paragraph D.12.

19 Federal Communications Commission, FCC 96-325, August 1996, paragraph 685.

20 Independent Regulators Group, *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling,* 24 November 2000, page 3

In practice, in Europe TSLRIC+ models have used a scorched node approach. So too has the ACCC which has stated that:

*"In practice the Commission has tended to a take a 'scorched node' forward-looking approach using best-in-use technology. This amounts to a hybrid approach which combines the best technology currently available commercially with the existing network infrastructure."* [21]

Scorched node is also used in TSLRIC+ models in Malaysia, Singapore, New Zealand and other countries.

### 3.2.4. Conclusion

Standard practice is to employ a scorched node approach to modelling TSLRIC+. This involves taking the existing number and location of network nodes but assuming best in use technology and efficient volumes of equipment within and between these nodes.

## 3.3. Forward-Looking Costs

A related question concerns the valuation of assets. In Section 3.2 reference was made to the use of efficient technology. The question this raises is which vintage of technology and assets best reflects efficient technology for the purposes of valuing assets and measuring TSLRIC+.

### 3.3.1. Oftel approach

Oftel advocated that each asset be valued at the cost of replacement by the modern equivalent asset: [22]

*"In its purest form, 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 which serves the same function as the asset being valued. It will generally incorporate the latest available and proven technology and is the asset which a new entrant might be expected to employ. In a world in which technology is changing rapidly, it is quite likely that, for some assets, the MEA will differ from the asset that an incumbent currently has in place."*

In determining the MEA, the models developed under Oftel's supervision took a 3 year forward look. This identified those assets that would be in commercial use in 3 years time. Assets such as analogue switches which were still in use in some areas in 1997 (when the interconnection prices were set) but were due to be phased out were therefore replaced by their digital equivalent and valued accordingly.

The economic rationale for valuation using the cost of replacement based on the MEA is that it would secure efficient entry into the market for interconnection:

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[21] ACCC, *Pricing of Unconditioned Local Loop Services (ULLS),* Final Report, March 2002, page 16

[22] Oftel, *Network Charges from 1997: Consultative Document,* December 1996, paragraph 3.4.

*"Since replacement costs would be the costs faced by a new entrant, signals would be given to encourage efficient entry into and exit from interconnection services, if the incumbent's interconnection charges were set on the basis of forward looking costs. An entrant into provision of interconnection services that was more efficient than the incumbent could make a profit by setting a charge below the incumbent's charge, whereas an inefficient firm would be unprofitable if it were to match the incumbent's charge".* [23]

### 3.3.2. FCC approach

In keeping with the position described in Section 3.2.2 above, the FCC specified that the TELRIC models in the US should be based on the most efficient (i.e. lowest cost) technology currently deployed in the incumbent LEC's networks and the assets concerned valued at current prices.

### 3.3.3. Other regulatory authorities

The IRG's position was very similar to that of Oftel, namely:

*"In practice, 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".* [24]

Reflecting this, European TSLRIC+ models have used an MEA approach to asset valuation.

The position of the ACCC is similar :

*"There is a variety of methods of asset valuation……. Of these methods, replacement cost is the methodology most consistent with TSLRIC."* [25]

*"Replacement cost is the present-day cost of replacing the asset with another asset that provides the same service potential. This need not be the same asset, but rather the asset that hypothetically is the best (least-cost) option under current technology. This can be the best-in-use or the best commercially available technology."* [26]

### 3.3.4. Conclusion

In TSLRIC+ models the standard practice is to value assets using the cost of replacing them with the modern equivalent asset (MEA). The MEA is the lowest cost asset, providing at

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23 Oftel, op cit., paragraph 3.3

24 Independent Regulators Group, *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling*, 24 November 2000, page 6

25 ACCC, *Access Pricing Principles - Telecommunications*, July 1997, page 42

26 ACCC, op cit., page 43

least equivalent functionality and output to the asset being valued. The operating costs of assets should also be those that relate to MEA.[27]

## 3.4. Common Fixed Costs

In order to obtain TSLRIC+ it is necessary to allocate common fixed costs to services using some kind of mark up. The main possible alternatives include:

- Ramsey pricing, which involves setting mark ups for different services that are inversely proportional to price elasticities of demand. Thus if the demand for a particular service is price elastic it receives a relatively small mark up, whereas, if the price elasticity of demand is small, the mark up is relatively large. As mentioned in Section 3.1 (footnote 10) above, mark ups of this form have the potential for reducing the deviation from optimal consumption patterns that results from pricing above marginal costs;

- Dividing the common fixed costs equally between the services which share the use of the facilities that give rise to the common fixed costs. Although this may appear completely arbitrary, it may be consistent with a game theoretic approach known as Shapley allocation given certain underlying assumptions;[28]

- Recovering the common fixed costs via an equal proportionate mark up (EPMU) on TSLRIC for each service. This is standard practice for allocating unattributable costs in accounting cost models.

### 3.4.1. Oftel approach

Oftel identified a variety of sources of common fixed costs associated with the sharing of (a) exchange facilities and (b) trench and duct between conveyance and access services.[29] Its conclusions about how to deal with these were as follows:

*"Oftel considers that mark ups over incremental cost are necessary if BT is to be able to recover the common costs that it necessarily incurs in providing its network."* [30]

*"Oftel favours the use of equal proportionate mark-ups to apportion the common costs of BT's network between conveyance and access respectively."* [31]

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[27] A point noted by the ACCC (see ACCC, op cit., page 42, footnote 43)

[28] A simplified intuitive explanation is as follows. If the services which share the use of the facility that is the source of the common fixed cost were to join the coalition of user services in random order (i.e. there is an equal probability of joining first, second, third etc) then the expected value of the incremental cost of a service joining the coalition is equal to TSLRIC for that service plus the common fixed cost divided by the number of services using the common facility. In other words, the common fixed cost is split equally between the user services. This assumes TSLRIC for each service is not affected by the number of other services provided. Further discussion of this type of allocation can be found in Hamlen, S.S, Hamlen, W.A. and Tschirhart, J.T., "The Use of Core Theory in Evaluating Joint Cost Allocation Schemes", *The Accounting Review,* Vol L11, No.3, July 1977, pp 616-627

[29] Oftel, *Pricing of Telecommunications Services from 1997: Consultative Document on BT Price Controls and Interconnection Charging,* December 1995, paragraph 5.8

[30] Oftel, op cit., paragraph 5.10

[31] Oftel, op cit., paragraph 5.9

### 3.4.2. FCC approach

The FCC recognized the need to take account of those costs shared by groups of network elements and those common to all services and elements (e.g. corporate overheads). It noted that:

*"Because forward-looking common costs are consistent with our forward-looking, economic cost paradigm, a reasonable measure of such costs shall be included in the prices for interconnection and access to network elements."* [32]

It accepted EPMU as an appropriate basis for recovering common fixed costs but explicitly ruled out Ramsey pricing because of concerns that it might "unreasonably limit the extent of entry into local exchange markets by allocating more costs to, and thus raising the prices of, the most critical bottleneck inputs, the demand for which tends to be relatively inelastic". [33]

### 3.4.3. Other regulatory authorities

The IRG, while recognising that it was standard practice to mark up incremental costs so as to recover a reasonable share of common fixed costs, did not commit itself to or rule out any of the possible allocation methods. More specifically, it noted the following:

*"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 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)."* [34]

In practice TSLRIC+ models in Europe (and indeed in other parts of the world) have generally adopted an EPMU approach.

The ACCC has noted that failure to take common costs into account could reduce incentives to maintain and invest in infrastructure and distort decisions about which technology to use by encouraging methods which have low common costs.[35] Reflecting this, the ACCC concluded that, where appropriate, a portion of common costs can be included, while noting

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[32] Federal Communications Commission, FCC 96-325, August 1996, paragraph 694

[33] Federal Communications Commission, op cit., paragraph 696

[34] Independent Regulators Group, *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling*, 24 November 2000, page 5

[35] ACCC, *Access Pricing Principles - Telecommunications*, July 1997, page 39

that allocation of common costs across services is necessarily arbitrary.[36] It did not specify a methodology but did refer to EPMU as being a commonly used approach.[37]

### 3.4.4. Conclusion

Most TSLRIC+ models use EPMU as the method to allocate common fixed costs to different services.

## 3.5. Depreciation

Once the values of the assets associated with TSLRIC and common fixed costs have been established, it is necessary to choose a method to measure the annual consumption of those assets (i.e. depreciation). Here the choice lies between:

**Economic Depreciation:** which is the change in the value of an asset from one period to the next measured by the change in the NPV of future cash flows. Changes in value are brought about by:

- changes in new equipment prices;[38]
- changes in the output from the asset reflecting factors such as:
  - substitution by other technologies, for example fixed wireless access and mobile phones;
  - declining productivity as the asset gets older. For example, the speed at which broadband services can be provided over copper lines diminishes with the number of joints and repairs;
  - loss of market share, which results in particular lines in the network becoming stranded; and
  - changes in customer locations, which result in particular lines in the network becoming stranded and unusable;
- and changes in the cost of operating the asset over time.

**Accounting Depreciation:** various methods exist including straight line depreciation (i.e. asset value divided by asset life), annuity, declining balance depreciation and sum of the years' digits.[39] They are inherently mechanistic and arbitrary and, depending on the

[36] ACCC, op cit., pages 41 and 39

[37] ACCC, op cit., page 39

[38] The reasoning behind this is as follows. In a competitive market a new operator setting up business will purchase new equipment and set its final output prices taking the cost of the new equipment into account. In order to avoid losing business, existing operators will be forced to set their own output prices as if they too had purchased new equipment. Thus, falling new equipment prices induce falling output prices and so on. The situation is the same if the new entrant purchases second hand equipment since the price of second hand equipment will be determined by the price of new equipment.

[39] Sum of the years digits can be illustrated by taking the example of an asset with a life of 10 years. In this case, the sum of the years' digits is equal to 1 + 2 + 3+ … …+ 10 = 55. In the first year, depreciation is 10/55 of the original asset purchase price, in the second year 9/55, in the third year 8/55 and so on.

circumstances, the depreciation profiles that they produce may not bear much relationship to actual changes in asset values. While, in principle, an annuity can be explicitly adjusted to take account of output changes, this rarely, if ever, happens in practice.[40]

### 3.5.1. Oftel approach

Oftel developed a bottom-up economic engineering TSLRIC model and supervised BT's development of a top-down equivalent starting with data from BT's accounting system and network records. The depreciation methods used in the two models differed. In particular:

*"The bottom up model calculates the recovery of capital costs on the basis of principles of economic depreciation. This is a methodology by which an asset is depreciated according to its earning power over its life, with the end of the asset's life coming when the earning power falls to zero. While this is conceptually the correct way to value assets and recover capital costs, the methodology requires a number of assumptions (e.g. about the future movements in asset prices and maintenance costs) in order to be implemented. These assumptions are difficult to forecast with confidence."* [41]

*"The top down incremental cost model uses straight line depreciation, with some allowance for holding gains and losses as assets change in price over time. This might approximate to the profile of capital charge recovery implied by economic depreciation and is rather simpler to implement. Whilst this type of accounting depreciation differs from the estimated economic depreciation for the bottom up model, the analysis conducted in the reconciliation exercise found no evidence of systematic bias."* [42]

### 3.5.2. FCC approach

FCC concluded that "an appropriate calculation will include a depreciation rate that reflects the true changes in economic value of an asset".[43] This is consistent with either the use of economic depreciation or something that approximates to it.

### 3.5.3. Other regulatory authorities

IRG, like Oftel, acknowledged that, in principle, economic depreciation was the appropriate method. However, it recognized that because of the implementation difficulties involved, use was often made of surrogate accounting depreciation methods.

*"It is widely accepted that annualised costs should be calculated on the basis of economic depreciation which would include an appropriate allowance for the cost of capital. While conceptually not difficult, economic depreciation is in practice very difficult to calculate. The main problem is that estimating economic depreciation is very information intensive.*

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40 While it is commonly the case that, in TSLRIC+ models, straight line and annuity depreciation are adjusted to allow for changes in asset (equipment) prices (see below), similar adjustments to take account of output and operating cost changes are not normally attempted and, in the latter case at least, would be difficult to implement.

41 Oftel, *Network Charges from 1997: Consultative Document,* December 1996, paragraph 5.23

42 Oftel, op cit., paragraph 5.24

43 Federal Communications Commission, FCC 96-325, August 1996, paragraph 703

*Because of the practical difficulties with calculating economic depreciation more simple approaches are often preferred. However, the yardstick by which these simpler approaches should be judged is how close they are likely to come, given the nature of the asset concerned, to the theoretically correct measure of depreciation.*

*The following are a number of commonly used surrogates for economic depreciation which can be appropriate and may be preferred: (tilted) annuity, (tilted) straight line, and 'sum of the years digits' depreciation."* [44]

TSLRIC+ models of fixed networks in Europe and elsewhere have generally either used tilted annuity or tilted straight line depreciation. The term 'tilted' means that the impact of changes in asset prices over time is taken into account. The impact of changes in asset utilisation (output) or running costs during the life of the asset are not, however, normally included in the tilt. In the case of mobile networks there has been a greater tendency to try to estimate economic depreciation.

In its 1997 Access Price Principles, the ACCC argued that depreciation schedules should reflect the expected decline in the economic value of assets:

*"Consistent with the TSLRIC methodology, depreciation schedules should be constructed and based on the expected decline in the economic value of assets using a forward looking replacement cost methodology. ……The decline in economic value of an asset is determined by a range of factors including its expected operational life and expectations concerning technological obsolescence."* [45]

While the reference to changes in the economic value of assets sounds like support for economic depreciation, in practice ACCC has advocated a tilted annuity approach to depreciation. The reasons it gives for this are that such an approach smoothes out depreciation over the life of an asset and "avoids the 'year 1' problem that arises when using a forward looking TSLRIC model, which assumes the network is brand new in each year which would result in higher asset values (and capital costs)." [46]

### 3.5.4. Conclusion

Most TSLRIC+ models of the fixed network use accounting methods of depreciation. However, such methods have generally been chosen on the basis of their proximity to economic depreciation. There is a greater frequency of use of economic depreciation in mobile TSLRIC+ models.

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[44] Independent Regulators Group, *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling*, 24 November 2000, pages 7-8

[45] ACCC, *Access Pricing Principles - Telecommunications*, July 1997, page 45

[46] ACCC, *Pricing of Unconditioned Local Loop Services (ULLS),* Final Report, March 2002, page 37

## 3.6. Cost of Capital

In addition to taking account of the consumption of capital, it is also necessary to include a reasonable rate of return on capital employed when calculating TSLRIC+. This is accepted by all regulatory authorities.

It is also common ground to estimate the cost of equity and the cost of debt and combine them together using suitable weights to derive the weighted average cost of capital (WACC).[47] Consequently TSLRIC+ models in all parts of the world use estimates of WACC as the reasonable rate of return to be included in TSLRIC+

As acknowledged by Oftel and IRG, there are different possible methods for calculating the cost of equity,[48] although the standard practice is to use the capital asset pricing model (CAPM).

## 3.7. Operating Expenses

It is very difficult to build up estimates of operating expenses via bottom up modelling of processes and their associated labour and non-labour costs. Attempts to do so that I have seen have not been successful.

The alternative is to use direct operating expense to investment cost ratios, indirect expense to direct expense ratios and so on. It is also often necessary to use indirect to direct asset ratios to capture the capital cost of types of equipment that have not been directly modelled such as network buildings, vehicles, computing and office equipment and so on.

This is a standard procedure in TSLRIC+ models, including the fixed network model built by NERA for the ACCC in 1999, which the latter subsequently updated.[49] [50] In some cases attempts are made to identify best practice ratios by using data from companies that are known (or found by other studies) to be efficient. However, the ratios for efficient companies may not necessarily have a large impact as these companies may, for example, be more efficient in terms of both network investment and direct expenses and hence their ratios may not necessarily differ from those of the target company.[51]

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[47] See, for example, Oftel, *Pricing of Telecommunications Services from 1997: Consultative Document on BT Price Controls and Interconnection Charging,* December 1995, Annex E, paragraphs E.7–E.18; Federal Communications Commission, FCC 96-325, August 1996, paragraph 700, which states that the cost of obtaining debt and equity financing is one of the forward looking costs of providing network elements; Independent Regulators Group, *Principles of Implementation and Best Practice Regarding FL-LRIC Cost Modelling,* 24 November 2000, page 7, which refers to the use of WACC being widely accepted; ACCC, *Pricing of Unconditioned Local Loop Services (ULLS),* Final Report, March 2002, page 37; and ACCC, *Access Pricing Principles - Telecommunications*, July 1997, page 44.

[48] See Oftel, op cit. and IRG, op cit.

[49] NERA, *Estimating the Long-run Incremental Cost of PSTN Access,* Final Report for ACCC, January 1999.

[50] Support for such an approach is contained in various FCC documents including *FCC Tenth Report and Order in the Matter of Federal-State Joint Board on Universal Service, CC Docket No. 96-45.* It is also the approach used in TSLRIC+ models throughout Europe and elsewhere.

[51] An alternative is to use the ratios of competing operators, if there are any. However, if they are efficient, their ratios may not be very different to those of the target company for the reasons just given. Alternatively these operators may not necessarily be efficient.

# 4. Is Telstra's TEA Model a TSLRIC+ Model?

Having identified the essential attributes of a TSLRIC+ model, the next task is to review Telstra's TEA model to ascertain whether it possesses these attributes. I do this in turn for each of the attributes discussed in Section 3. The purpose of this review is to consider in broad terms the methodology used in the TEA model. Further examination of how this methodology has been implemented is provided in Section 5.

## 4.1. Definition of Increment

### 4.1.1. Standard practice in TSLRIC+ modelling

As concluded in Section 3.1.4, the normal practice in TSLRIC+ modelling is to take a broad increment approach to service definition. This means taking into account all network elements used by the interconnection service under consideration, which in this case is ULLS, and all services that use those elements. [52] The costs of the elements are then apportioned between the user services on the basis of the extent to which the different services use the network elements.

### 4.1.2. Approach taken in TEA model

The purpose of the TEA model is to provide a "reasonable estimate" of TSLRIC+ for ULLS in metropolitan (Band 2) exchange areas in Australia. Given that ULLS is defined as an unconditioned service provided over a communications wire (i.e. copper pair), the TEA model estimates the cost of a copper based access network. To do so, all the elements in such a network are identified and then costed.

The network elements in a copper CAN, which are taken into account in the TEA model, include:

- Cable vaults and racks, MDF ironwork and blocks in exchanges;
- Pillars;
- Trench and duct;
- Pits and manholes;
- Copper cable and cable joints; and
- Cable lead-ins.

[52] The ACCC has specified that ULLS is a "declared service" for the purposes of Part XIC of the Trade Practices Act 1974. In its declaration, dated 28 July 2006, the ACCC defined ULLS as follows: "The unconditioned local loop service is the use of unconditioned communications wire between the boundary of a telecommunications network at an end-user's premises and a point on a telecommunications network that is a potential point of interconnection located at or associated with a customer access module and located on the end user side of the customer access module."

In keeping with other TSLRIC+ models an allowance is also made (via a mark up on direct investment costs) for indirect and support assets such as network buildings, vehicles, computing and IT equipment etc.[53]

The CAN has two constituent parts: the distribution network and the feeder network. The model makes a distinction between those parts of the distribution network that are fed by copper lines and those that are fed by fibre. The latter are ignored because ULLS is a service provided over copper. For those parts of the distribution network fed by copper, the total cost of each of the network elements is divided by the number of copper pairs (exchange lines and ULLS) in order to obtain a cost per element per line.[54]

I am instructed that in Telstra's feeder network there is fibre as well as copper, the former being required to supply service to those parts of the distribution network that are fed by fibre. The TEA model takes account of the cost of fibre and related multiplexing equipment as well as the cost of network elements required to provide copper lines in the feeder network. The total cost of each of the network elements (copper and fibre) is divided by the total number of copper pairs and fibre lines (expressed as voice equivalents) sharing the feeder network. The resulting average cost per line is taken to apply to copper lines and hence ULLS.[55]

This treatment of costs in the feeder network allows the sharing of trench and duct costs by fibre and copper lines to be taken into account, which is appropriate. It also means that the cost of a ULLS line includes some fibre and related costs. On the other hand copper and related costs are spread over more than just copper lines. The overall impact of these two offsetting effects will depend on whether the average feeder network cost of a fibre line is less than or greater than the average feeder network cost of a copper line. If the cost of a fibre line is lower, which is likely to be the case, the estimated total cost per line in the feeder network will be lower than the cost per copper line and hence the true ULLS cost per line will be understated.[56]

I am also instructed that the TEA model accounts for fibre leased lines as well as fibre exchange lines in the feeder network when the cost per line is calculated. As regards fibre leased lines in the distribution network, I am further instructed that there are no fibre leased lines in the distribution areas that are relevant to Band 2 ULLS.

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[53] See, for example, NERA, *Estimating the Long-run Incremental Cost of PSTN Access*, Final Report for ACCC, January 1999.

[54] I am instructed that instances of fibre to the home installations in Telstra's distribution network are rare and generally occur in those parts of the distribution network that are exclusively fed by fibre. In those cases where the distribution network is fed by both copper and fibre the TEA model estimates the costs of the distribution network as if it were exclusively fed by copper.

[55] See also Telstra Corporation Limited, *Telstra's Efficient Access Model: Model Documentation*, 1 March 2008, paragraph 144.

[56] The total cost of the feeder network can be expressed as $L_FC_F + L_MC_M$ where L is the number of lines, C is unit cost and the subscripts F and M refer to fibre and metal (copper) respectively. The total cost per line is therefore $(L_FC_F + L_MC_M) \div (L_F + L_M)$. If $C_F = C_M$ the expression for total cost per line simplifies to $C_M$ which is the unit cost of a copper line in the feeder network. If $C_F = C_M - \delta$ (i.e. the unit cost of a fibre line is lower than the unit cost of a copper line by an amount $\delta$) the expression for total cost per line becomes $(L_FC_M - L_F\delta + L_MC_M) \div (L_F + L_M)$ which simplifies to $C_M - (L_F\delta \div (L_F + L_M))$ which is clearly less than $C_M$

### 4.1.3. Conclusion on TEA model approach

In defining the relevant increment, the TEA model is consistent with standard TSLRIC+ methodology with one exception, namely that it does not separate out fixed costs that are common to ULLS and other access network services (i.e. fibre exchange lines and leased lines) and allocate them across the user services via an EPMU. However, the basis on which it allocates the common costs (i.e. in proportion to the total number of lines) is a reasonable one.[57]

For the reasons given above, the impact of this deviation from standard practice is likely to be small and may in fact lead to a lower cost for ULLS. Consequently, this does not prevent the TEA model from producing a reasonable estimate of TSLRIC+ for ULLS.

## 4.2. Network Design and Topology

### 4.2.1. Standard practice in TSLRIC+ modelling

As discussed in Section 3.2, the standard practice in TSLRIC+ models is to employ a scorched node approach. This involves taking the existing number and location of network nodes but assuming best in use technology and efficient volumes of equipment within and between these nodes. The question therefore is whether the TEA model follows such an approach.

### 4.2.2. Approach taken in TEA model

The aim of the TEA model is to estimate the cost a new entrant would incur if it were to provide a copper based ULLS in Band 2 exchange areas.[58] [59] It is assumed that the new entrant would operate at the same scale and with the same scope as Telstra. This involves estimating the cost of a replacement CAN based on best-in-use equipment and efficient engineering practices and provisioning rules, assuming that the network could be built instantaneously.[60] To do this, the model starts with the:

- actual geographical customer locations in each Band 2 exchange area fed by copper; and
- existing structure points.

It then identifies the efficient set of cable routes in the feeder and distribution networks that is required to connect the structure points and customer locations while minimising distance. To do so it starts with existing routes, which necessarily take account of rights of way and topographical features such as hills, rivers, roads, railway tracks etc, and identifies only those

[57] I am instructed that in order to make such an allocation the number of leased lines is expressed in terms of voice line equivalents. In my view this is appropriate.

[58] As mentioned in Section 4.1.2, the economies of scope derived from the sharing of parts of the feeder network by fibre and copper is taken into account (although fibre is not itself used to provided ULLS service).

[59] A useful overview of the TEA modelling process is provided in *Telstra Efficient Access (TEA) Model Overview,* Telstra Corporation Limited, 21 December 2007.

[60] In other words, there are no costs associated with the fact that in reality a new network would be rolled out over time and there would be a cost of having capital being tied up before being used.

that are necessary to link existing structure points and customer locations. Where there are multiple possible routes, only the route which minimises distance is taken into account. Legacy routes in the CAN which are not required to link existing structure points and locations are excluded. So too are unnecessary duplicate duct and cable sets on the same route. The detailed information necessary to do this is contained in Telstra's Cable Plant Records database and its Network Plant Assignment and Management system.[61].

Having identified the required set of minimum distance routes, the model identifies equipment capacity requirements at and between structure points and customer locations, taking account of route distances and the number of customers (and hence copper lines) served by each point in the network.

According to the ACCC, Telstra has indicated (via a paper prepared for it by Professor Harris[62]) that the TEA model does not apply a scorched node approach because it assumes the existing locations of pillars in the CAN.[63] However, the question here is what is meant by scorched node. Pure scorched node only involves "scorching" equipment at and between nodes. It does not involve changing the location of nodes. Thus, when Professor Harris states that "the scorched node approach ignores the locations of nodes in the "outside plant" portion of the network" [64], he is implicitly referring to some form of modification to the scorched node approach. Moreover, as noted in Section 3.2.3 above, the ACCC itself states that it "has tended to take a 'scorched node' forward-looking approach" combining best available technology with the ***existing*** network infrastructure. If pillar locations are changed and the network restructured accordingly, it would be difficult to argue that this represents the existing infrastructure.

Similarly, Optus refers to scorched node network design in its public submission on Telstra's ULLS undertaking and cites the approach taken in the US, Germany and Austria.[65] However, in this approach, while the MDF locations reflect the existing situation, the rest of the access network is totally redesigned, which is effectively a scorched earth approach for that part of the network.[66]

### 4.2.3. Conclusion on TEA model approach

Reflecting these various points and the review in Section 3.2 above, my conclusion is that the TEA model's methodology in respect of network design is consistent with a scorched node approach. Existing exchange, pillar and customer locations are taken as given but the network linking them is optimised taking actual topographical and physical circumstances

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61 See *Telstra Efficient Access (TEA) Model Overview*, paragraph 24.

62 Professor Robert G. Harris, *Use of TEA Cost Model in ULLS Costing and Pricing,* 21 December 2007.

63 ACCC, *Telstra's Access Undertaking for the Unconditioned Local Loop Service: Discussion Paper*, June 2008, page 27

64 ACCC, op. cit.

65 *Optus Public Submission to Australian Competition and Consumer Commission on Telstra's Access Undertaking for the Unconditioned Local Loop Service: Response to Discussion Paper, August 2008, paragraphs 4.81 to 4.92*

66 For example, the Austrian regulator states that "In this approach an efficiently structured, abstract state-of-the-art access network is set up which aims at efficiently satisfying the existing number of subscribers." The key word here is "abstract". See *Local Loop Unbundling in Austria: Summary of the Decisions Z 12/00, Z 14/00, Z 15/00 of the Telekom-Control Commission (TKK) of March 12,2001*, page 2.

and property rights into account. Indeed by choosing the shortest routes between nodes and removing unnecessary links the TEA model has taken a step in the direction of modified scorched node. A more detailed review of how the method has been implemented is provided in Section 5.1.

## 4.3. Forward-Looking Costs

### 4.3.1. Standard practice in TSLRIC+ modelling

Standard practice in TSLRIC+ models is to value assets using the cost of replacing them with the modern equivalent asset (MEA).[67]

### 4.3.2. Approach taken in TEA model

The TEA model estimates the cost of building an efficiently designed network today. As already noted, it does not include the costs of any legacy network that exists now but is not necessary for the efficient provision of ULLS.

The types of network components required to provide ULLS are summarised in Section 4.1.2 above. The TEA model is forward-looking since the types of equipment that it assumes are those that will be used in the medium term future to provide ULLS. The latter is a service based on a copper network and I am not aware of any expected medium term fundamental changes in the technology used to provide such a copper network. In other words existing types of asset are the MEA.

In order to derive the investment cost for different types of network component the TEA model calculates the quantity of equipment required and then estimates what it would cost to purchase that equipment at current prices. The model's source of prices in this context is what Telstra has agreed to pay for different types of work and equipment under the terms of the [redacted] contracts that it signed with [redacted] contractors in [redacted]. The process by which these prices were derived is explained in some detail in the statements provided by [redacted] and [redacted].[68]

[redacted][70] The prices paid can therefore reasonably be regarded as efficient since they result from a competitive bidding process.[71]

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[67] See Section 3.3

[68] Statement of [redacted], August 2008, and Statement of [redacted], August 2008.

[69] [redacted]

[70] The tendering process is described in [redacted] op.cit., paragraphs 22 -31.

[71] See Telstra Corporation Limited, *Telstra's ULLS Undertaking is Reasonable*, 4 April 2008, paragraph 14c. See also [redacted] op. cit., paragraph 35, which notes that, [redacted]

[redacted]

### 4.3.3. Conclusion on TEA model approach

The Telstra model uses an MEA approach when determining costs. In the case of the CAN, MEA assets are those types of asset that are currently used in the network, there being no prospective technological developments in the near future. The prices for the different types MEA equipment that are used in the TEA model were obtained from the current [redacted] supply contracts that resulted from a competitive tendering process.

Given that that the TEA model uses MEA and competitively determined current equipment prices to calculate investment costs, it conforms with standard practice is TSLRIC+ models.[73]

## 4.4. Common Fixed Costs

### 4.4.1. Standard practice in TSLRIC+ modelling

As explained in Section 3.4, the standard approach is TSLRIC+ models is to identify common fixed costs and allocate then in proportion to TSLRIC.

### 4.4.2. Approach taken in TEA model

The TEA model deals with a variety of common fixed costs including:

- Duct and trench shared by the CAN and the IEN;
- Exchange building facilities shared by the CAN and the IEN;
- Duct shared with third parties;
- Duct and trench in the feeder network that is shared by fibre that links to non-Band 2 exchange distribution areas and copper that links to Band 2 exchange areas; and
- General overhead and administration costs (referred to in the TEA model as indirect expenses).

The sharing of duct and trench between the CAN and the IEN involves the main (feeder) network.[74] In the TEA model the relevant costs are shared equally between the CAN and the IEN. This is one of the possible approaches to sharing common fixed costs that was proposed by the IRG in its TSLRIC+ modelling guidelines (see Section 3.4.3). Thus, while it is used less frequently than EPMU, it is still regarded as an approach that is consistent with TSLRIC+ methodology.

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72 See [redacted], op. cit., paragraphs 5-9.

73 [redacted]

74 I am instructed that there is no sharing of duct and trench between the CAN distribution network and the IEN.

For network support assets such as shared exchange building facilities, the TEA model uses inputs which are derived from the Regulatory Accounting Framework (RAF).[75] I am instructed that network support assets allocated to CAN assets can be identified from the RAF and that these are used to calculate the network support asset factors employed in the TEA model.[76] I have not seen the process for identifying and allocating network support assets within the RAF and cannot, therefore, comment on its appropriateness.

I am instructed that Telstra also receives revenues from leasing the use of some of its duct to third parties. This is dealt with in the TEA model by taking the leasing revenue, estimating the share that is attributable to the CAN and then calculating the revenue per CAN line.[77] The estimated leasing revenue per CAN line is then subtracted from the annual cost per Band 2 exchange area line.[78] In my opinion, this is a reasonable way of dealing with network sharing with third parties.

Turning to the distribution network, in the case of new housing estates trench is provided at no cost to Telstra. This is taken into account in the TEA model, where the relevant percentage of distribution trench costs is subtracted from the total amount required.[79] In my view, this is an appropriate procedure.

The sharing of the main (feeder) network between copper and fibre has been addressed in Section 4.1.2, as has the sharing of the CAN with leased lines. The approach used in the TEA model departs from the standard approach in TSLRIC+ models in that the costs of the shared assets are not allocated in proportion to TSLRIC (see Section 3.4) but this is unlikely to have a large impact on costs and may (at least as far as the sharing of copper and fibre is concerned) lead to a reduction in costs.

General overhead and administration costs (i.e. indirect expenses) are allocated as an equi-proportional mark up on direct expenses.[80] This is consistent with the approach taken in many TSLRIC+ models. Indeed it is the approach used by NERA in its TSLRIC+ models, including the fixed network model built for the ACCC in 1999, and subsequently updated by the latter.[81]

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75 Reports from the RAF are filed by Telstra with the ACCC. Network support assets include network land and buildings, network power systems and network management systems.

76 See also Telstra Corporation Limited, ULLS Undertaking, *Operations and Maintenance and Indirect Cost Factor Study*, Public Version, 7 April 2008, paragraphs 21 and 41-48

77 The model assumes that all the revenue is associated with sharing of the main network. This is not necessarily the case but the assumption does not affect the estimated cost per line.

78 This can be seen in the 'Annual Cost Summary' sheet in Telstra Output.xls.

79 The model assumes that 1% of distribution trench is provided by new housing estates.

80 For each type of indirect expense Telstra has calculated the ratio of that expense to total direct expenses. The indirect expenses are then allocated to different network elements in proportion to the direct expenses associated with each network element.

81 NERA, *Estimating the Long-run Incremental Cost of PSTN Access,* Final Report for ACCC, January 1999.

### 4.4.3. Conclusion on TEA model approach

The TEA model uses an EPMU approach to allocate general overheads but does not use it to allocate other types of common fixed costs. It therefore departs from the standard approach in TSLRIC+ models which involves allocating common fixed costs using EPMU. In the case of sharing between the CAN and the IEN the relevant costs are shared equally between the two networks. This is one of the possible approaches to sharing common fixed costs that was proposed by the IRG in its TSLRIC+ modelling guidelines and in these circumstances it is not obviously inferior to EPMU. At the same time, as mentioned in Section 4.4.2, the treatment of the sharing of the main (feeder) network between copper and fibre may also have reduced costs (see Section 4.1.2). For the other types of common fixed costs (e.g. those shared between the CAN and leased lines) it is not possible to reach a conclusion about whether the costs attributed to the CAN are higher or lower than if EPMU had been used.

## 4.5. Depreciation and Cost of Capital

### 4.5.1. Standard practice in TSLRIC+ modelling

In TSLRIC+ models an attempt is normally made to choose a depreciation method that is a reasonable approximation of economic depreciation (Section 3.5). Possible methods indicated by national regulatory authorities include straight line, tilted straight line, annuity and tilted annuity (see Section 3.5.3) .

### 4.5.2. Approach taken in TEA model

The TEA model uses an approach that is akin to an annuity. It is derived by "levelising" the capital charge profile that would be obtained using straight line depreciation in conjunction with the cost of capital applied to the net book value of the asset. The process is described in more detail in Section 5. The resulting constant annual capital charge is very slightly lower than that obtained by an annuity.

The question then is how good an approximation does an annuity provide to economic depreciation? To answer this, NERA has carried out a detailed analysis for the four main asset types in the CAN network: main duct, main copper cable, distribution duct and distribution copper cable. This involved constructing an economic depreciation model and comparing the resulting annual capital charge profile for each asset with the profiles produced by the main accounting depreciation methods (see Appendix A.4).

The conclusion from this analysis is that in the early years of the asset's life (which is what is relevant here because it is assumed that the network is brand new and at the same time ULLS prices are regulated and will be reset at intervals of 3 years or less) an annuity of the kind adopted in the TEA model provides:

- For main duct, a very good approximation to the annual capital charge given economic depreciation;
- For distribution duct and distribution copper cable, a good approximation to the annual capital charge given economic depreciation but with some tendency to understate economic depreciation;

- For main copper cable, a poor approximation to the annual capital charge given economic depreciation with a pronounced tendency to understate economic depreciation.

Generally speaking the annuity method will tend to understate substantially the level of economic depreciation for assets with lives of 10 years or less, which includes main copper cable. The reason for this is that when an asset has a relatively short life this is either because new equipment prices are falling, output is falling due to technological obsolescence, loss of market share or relocation of customers, or operating costs are increasing (or some combination of the three). This means that the earning power of the asset declines over time and hence so too does the capital charge. This contrasts with the constant annual capital charge given an annuity.

For the cost of capital, the TEA uses an estimate of WACC derived using the capital asset pricing model. This is standard practice in TSLRIC+ models.

### 4.5.3. Conclusion on TEA model approach

The TEA model's use of an annuity produces annual capital charges that, during the early years of an asset's life, either approximate to or understate the annual capital charge given economic depreciation. It is these early years on which attention needs to be focused firstly because TSLRIC+ models assume that the relevant assets are new and secondly because, in Australia, ULLS prices have historically been reset by the ACCC at intervals of 3 years or less.

The use of an annuity, when estimating forward looking annual capital charges for the CAN in Australia, provides, in most circumstances, a good approximation to economic depreciation for duct but performs less well in the case of copper cable, for which it understates economic depreciation. For all the main CAN assets, an annuity more closely approximates depreciation than a tilted annuity.[82] In my view, the use of an annuity for the CAN is appropriate and consistent with TSLRIC+ methodology.

The reason for the inferior performance of a tilted annuity is that, while it takes account of changing asset prices, it fails to take account of declining output over an asset's life due to factors such as technological obsolescence, declining productivity and asset stranding due to loss of market share or changing customer locations. It also makes no allowance for changes in operating costs during an asset's life. As a result, when asset prices are forecast to increase, which is typically the case for CAN assets, the use of a tilted annuity either implies an infinite asset life (see Section A.5) or a cataclysmic decline in output and/or increase in operating costs in the final minutes of an asset's life. Neither of these scenarios is realistic.

The model also uses an estimate of WACC derived using CAPM, which conforms to standard practice in TSLRIC+ models in the calculation of annual capital charges.

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[82] Two other methods of accounting depreciation, straight line and tilted straight line (which are explained in Section A.3 ), outperform an annuity in the case of copper cable. However, their use would have the effect of increasing ULLS costs.

## 4.6. Operating Expenses

### 4.6.1. Standard practice in TSLRIC+ modelling

In TSLRIC+ models it is standard practice to model operating expenses using ratios for direct operating expenses to investment costs and ratios for indirect expenses to direct expenses.

### 4.6.2. Approach taken in TEA model

The TEA model uses what are referred to in the model documentation as operations and maintenance (O&M) factors. These were calculated in a separate study using a top-down approach.[83] This involved calculating the required ratios using data from Telstra's accounts prepared under the Regulatory Accounting Framework (RAF). However, recognising that in the case of duct and copper cable there may be a large gap between historic purchase costs of equipment and current replacement costs, the direct expense to investment cost ratios for these assets were derived using modelled investment costs as the denominator (i.e. replacement costs). The same forward-looking adjustment was not made for other types of asset. However, because the vast majority of O&M expenses are accounted for by duct and copper cable[84] and the other assets are unlikely to have such a large gap between historic and current prices (not least because they have shorter asset lives and hence have been in existence for a shorter period of time), this is unlikely to affect materially the estimates of direct expenses associated with ULLS.

Telstra also derive indirect expense and indirect asset ratios using the RAF data. This is explained further in Section 5.

### 4.6.3. Conclusion on TEA model approach

The approach adopted in the TEA model to measure operating expenses and indirect assets is consistent with the standard approach in TSLRIC+ models. Moreover, the TEA model avoids a potential problem by using current investment costs when deriving the O&M factors for duct and copper cable.

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83 A description is provided in Telstra Corporation Limited, ULLS Undertaking, *Operations and Maintenance and Indirect Cost Factor Study*, Public Version, 7 April 2008

84 According to Telstra, O&M expenses associated with assets apart from duct and copper cable account for only 4% of total O&M expenses in the CAN (see Telstra, op. cit., paragraph 20).

# 5. TEA Model Implementation

In this section I address the following question: assuming appropriate variable inputs are used in the TEA Model, will the TEA Model produce a reasonable estimate of the TSLRIC+ of supplying the ULLS?

The TEA Model is structured around the following three main modules:

§ Engineering Distribution Module. This module uses engineering design rules together with base data extracted from Telstra's Cable Plant Records to design an optimised copper distribution network.

§ Engineering Main Module. This module uses engineering design rules together with base data extracted from Telstra's Cable Plant Records to design an optimised copper main network.

§ Cost Calculation Module. This module brings together all of the elements required to calculate the total costs. It does so via the following steps:

  – First, the Cost Calculation Module takes the summary output of the two engineering modules, which is the volume of labour, plant and equipment required to deploy the efficient access network, and applies the input costs to these volumes to calculate the total direct investment cost of the efficient access network.

  – Secondly, the Cost Calculation Module converts the total direct investment cost into an annual capital cost.

  – Thirdly, the Cost Calculation Module calculates O&M expenses and indirect capital costs.

In my review of the TEA Model I have gone through the calculations in detail and generally find that, assuming that the inputs are appropriate, the TEA Model will produce a reasonable estimate of the TSLRIC+ of supplying the ULLS.

In this section I focus on areas where a different methodology could have been used, or where there is some uncertainty over how calculations have been made (e.g. because calculations have been done outside the TEA Model).

The areas I focus on are:

§ Network Design and Topology. This relates to both the Engineering Distribution Module and the Engineering Main Module.

§ Forward-Looking Costs. This relates to the Cost Calculation Module.

§ Common Fixed Costs. This relates to the Cost Calculation Module.

§ Depreciation. This relates to the Cost Calculation Module.

§ Operating Expenses. This relates to the Cost Calculation Module and the separate Operations and Maintenance and Indirect Cost Factor Study.

## 5.1. Network Design and Topology

### 5.1.1. Review of implementation

The issue of network optimization in the TEA Model is important because the network design assumptions and engineering rules provide the underlying basis for determining ULLS network costs. Furthermore, network optimisation methodologies have been a distinguishing feature of earlier cost models used to estimate Telstra's network costs.[85]

It can be argued that the earlier cost models were more assumption driven reflecting the fact that detailed data on the topography of Australia were not available. In contrast, the TEA Model attempts to represent Telstra's rights of way and topographical circumstances by starting with information about the actual existing network, which is based upon Telstra's records of the locations of its equipment and customers, rather than a hypothetical lay-out of its network.

The TEA model reflects a substantial reduction in trench and cable sheath length and in the number of pits and manholes compared to what actually exists in Telstra's network.[86]

The TEA Model uses two databases:

- the Cable Plant Records database which records Telstra's records of physical cables; and
- the Network Plant Assignment and Management System which stores information about customer services and network plant interconnectivity.[87]

The TEA Model takes a scorched node approach under which it is assumed that the following components of the existing network are retained:

- the exchange locations;
- distribution area boundaries;
- pillar locations;
- customer locations; and
- distribution and main cable routes.

However, while the distribution and main cable routes are retained, the model uses only an 'optimised' subset of the existing main cables and conduit routes from the exchange to the pillars using the existing right of ways, and the existing cables and conduit (duct) routes from the pillar to the customer premises using the existing right of ways. The cable routes used in the model do not include any duplicative cable (i.e. legacy effects, such as duplicate cable runs, which exist in Telstra's current network as a result of the construction and

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85 *Telstra's ULLS Undertaking is Reasonable,* Telstra Corporation Limited, 4 April 2008, paragraph 1 and Attachment 1.

86 See *Measure of TEA Model Efficiency, ULLS Band 2, Procedure Document No TAF0001-366515,* 8 September 2008, op. cit.

87 See *Telstra Efficient Access (TEA) Model Overview*, paragraph 24.

reinforcement of the network over the course of a number of years, are removed). This is a critical point which I will turn to in the next subsection.

In short, the TEA model employs the following two-step methodology:

- Step 1: Delete duplicate cable routes, so that each customer node is connected to the exchange in a unique way. While some routes share distribution and main trenching, the network of cable routes is made to look like a tree with the root at the exchange and branches which reach every customer node. This step is not an integral part of the TEA Model, rather it has been applied to the datasets that are used as inputs in the TEA Model.[88]
- Step 2: This step is carried out within the model and is also described in various places in the model documentation.[89] Network components are dimensioned based on best practice engineering rules.[90] The network components that are 'optimised' include: feeder cables from the exchange to the pillar; the conduits (ducts and associated trenching) to accommodate the feeder cables; the distribution cables from the pillar to the customer premises; the conduits to accommodate the distribution cables; the number and size of pits and manholes; sizing of pillars; and sizing of cable joints.

The way engineering rules are employed under step 2 is relatively straight forward. For example, to determine the length of distribution cables, the engineering rule used by the TEA Model is to deploy 100 pair copper cables throughout the entire distribution network. This engineering practice is referred to as a "non-tapered" distribution network design. Under this design rule, 100 pair cables are used for every distribution route from the customer premises to the pillar. If a copper cable on a particular route reaches its maximum capacity and an additional cable is required to serve the residual demand then an additional 100 pair cable will be installed. A similar methodology applies to the dimensioning of other network components, namely: follow the unique route from each customer back to the exchange and calculate required capacity along the way, using the engineering rules. This methodology is feasible since the network has been reduced to a unique tree structure in step 1. As I will demonstrate below, separation of steps 1 and 2 may introduce an inefficiency to the network optimisation process.

Telstra writes in the TEA Model Overview: "*A crucial feature of the modeling process is the ability to identify and select efficient distribution and main cable routes that minimize distance, from all existing CAN routes. In the distribution network, only routes necessary to connect network serving structure points to pillars are identified and selected. Further, when multiple routes are identified, only the route that minimizes distance is selected. Likewise, in the main network, only routes necessary to connect pillars and main-fed building terminals to the exchange building are identified and selected; and, when multiple routes are identified, only the route which minimizes distance is selected. Consequently, the routes that would not*

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88 See Telstra Corporation Limited, *Telstra Efficient Access (TEA) Model Overview*, 21 December 2007, paragraphs 22-25

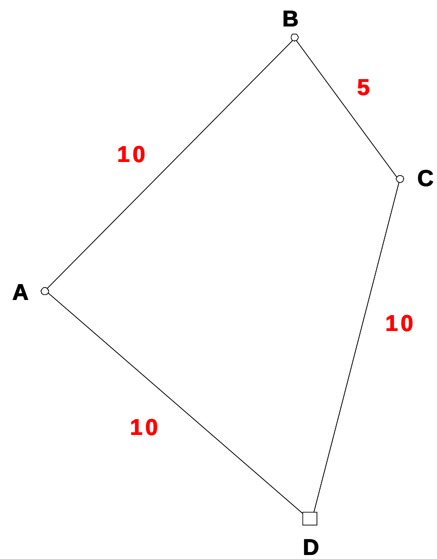
89 Telstra Corporation Limited, *Telstra's Efficient Access Model: Model Documentation*, 1 March 2008.

90 Best practice in this context means rules that achieve a given objective at the lowest cost.

*be deployed today, given the opportunity to replace the network from scratch, have not been included in the TEA model".*[91]

I interpret the procedure described by Telstra as follows. Suppose part of the actual network can be represented by Figure 5.1 below. There are four nodes in the hypothetical distribution network, three cable joints (A, B and C), and one pillar node (D). All lines from cable joints must be routed to the pillar node, D. The red numbers indicate the length of each segment between the nodes. The hypothetical network has redundant cable routing because one of the segments (A-B), (B-C), (C-D) or (A-D) can be deleted.

**Figure 5.1 Actual Network Topology**




Telstra has deleted the segment (A-B) in order to produce the shortest distance network where all customer nodes are connected to the exchange. In other words, the TEA Model is running on a subset of cable routes similar to Subset A in Figure 5.2 below.

[91] Telstra Corporation Limited, *Telstra Efficient Access (TEA) Model Overview*, 21 December 2007, paragraph 23.

**Figure 5.2 Subset A**

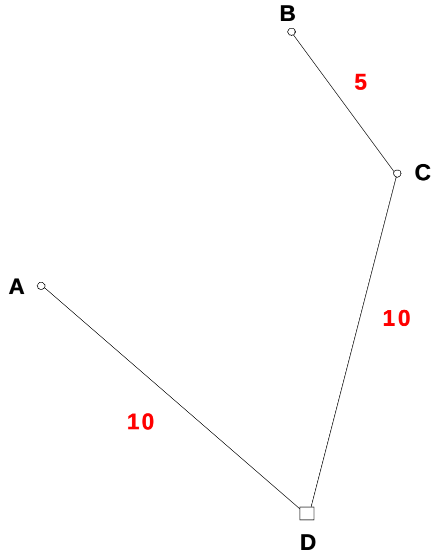
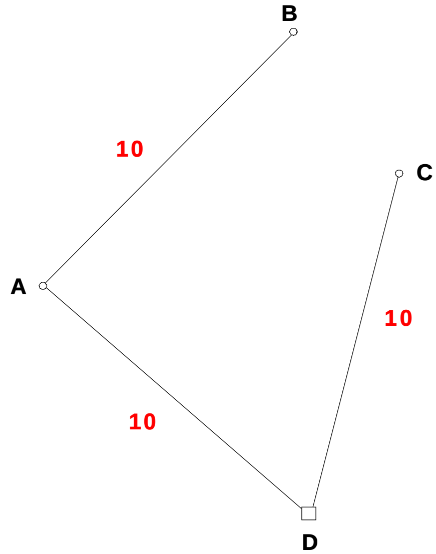



**Figure 5.3 Subset B**




An alternative feasible subset would be Subset B as depicted in Figure 5.3. The length of the Subset A network is 25 whereas the length of the Subset B network is 30. However, the Subset B network might in certain circumstances be more economically efficient (have a lower total cost) if network components are better utilized in this network. For example, since the TEA Model employs 100 pair cables, suppose the capacity requirement along segment C-D is 90 whereas it is only 50 along segment A-D. If node B adds an additional capacity requirement of say 30, it can be accommodated along segment A-D without adding another 100 pair cable. On the other hand, it cannot be accommodated along segment C-D without adding another 100 pair cable. The point of this example is to illustrate the trade-off between shortest length and best utilisation of discrete size network components.

This simplified example illustrates that one cannot in general separate steps 1 and 2 as described in the previous subsection. Optimisation over network components and cable routing must be done simultaneously in order to produce an efficient network design that maximises cable utilisation.

The size of any potential inefficiency due to separating out cable routing and dimensioning of discrete size network components, such as conduit and cables, depends on:

- The number of network links deleted. If deletion of duplicate cable routes is a minor issue, the potential inefficiency is correspondingly limited.
- Utilisation of equipment. The source of the potential inefficiency is the trade off between network length and equipment utilisation, as illustrated by the example above. If the optimised network components have a high degree of utilisation, there is less potential for savings and the trade off is likely to favour the shortest route criterion.
- Tapered vs. non-tapered design. By selecting non-tapered network design in the TEA Model, the issue of discrete equipment size is less of an issue.

According to a recent Telstra study, the TEA Model has reduced trench length by 34.5%, the number of manholes by 83.2%, the number of pits by 20.8% and cable sheath length by 56.8%, relative to Telstra's inventory records.[92] These measures indicate that the TEA model is being applied to a network of cable routes that has been pruned substantially compared to what actually exists in Telstra's network. Such measures do not in themselves indicate how close the TEA Model is to a fully optimised network topology (i.e. one that minimises costs). However, this can be inferred indirectly from other information in the TEA model.

First, in the TEA Model, trench and duct (conduit) accounts for 58% of the total direct cost per line (main and distribution network), copper cables account for 33% and the remaining 9% is related to other cost categories. Since trench and duct (conduit) account for the majority of costs, Telstra's approach of minimizing the length of cable routes (by deleting duplicate cable routes), followed by the re-dimensioning of cables and other network components, is a reasonable one in that the costs are minimized with respect to the main cost driver (trench length).

Secondly, since installed conduit (duct and associated trenching) is the largest component of network cost, any re-dimensioning of the network that results from eliminating cable routes is likely to have its largest impact on costs in cases where a second conduit is triggered.[93] However, the default results from version 1.2 of the TEA model show that 99% of the total distribution conduit length and 97% of total distribution conduit investment are for routes with a single conduit. Since two conduits are used in the modelled distribution network only 1% of the time, and in some fraction of these cases the use of a second conduit on a distribution route would not be avoided by choosing a longer distance routing option, rather than the least distance option currently used, the extent of any inefficiency from focusing solely on minimising the length of cable routes is likely to be negligible.

### 5.1.2. Conclusion

The TEA model incorporates a substantial reduction in trench and cable sheath length and in the number of pits and manholes compared to what actually exists in Telstra's network.[94] Any inefficiency as a result of focusing solely on minimising the length of cable routes appears, for the reasons given above, to be negligible.

Moreover, to attempt to apply simultaneous optimisation over cable routing and network component loadings would be extremely complex given that removing cable links in one part of the network will affect cable loadings (utilisation levels) in other parts of the network and hence affect the conclusions regarding the most cost effective cable routings in those parts of the network. The whole system needs to be solved simultaneously. Reflecting this, where such optimisation has been attempted, it is typically carried out on a subset/sample of the actual network, and a very simplified representation of the network is used. Hence the ability

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92 *Measure of TEA Model Efficiency, ULLS Band 2, Procedure Document No TAF0001-366515*, 8 September 2008, page 5.

93 The engineering rules in the TEA model dictate that 100mm conduits are deployed as standard distribution conduit, and the maximum number of 100 pair distribution cables that will fit in a 100mm conduit is 4. If more than four 100 pair cables are required additional conduits will be required. See *Access Network Dimensioning Rules*, page 8.

94 See *Measure of TEA Model Efficiency, ULLS Band 2, Procedure Document No TAF0001-366515*, 8 September 2008, op. cit.

to apply a fully efficient network algorithm for optimising the network generally comes at the cost of an unrealistic representation of the network, which may fail to take into account properly the full complexities that exist because of the interactions between different parts of the network.

Given all these complexities and associated issues, in my view the approach used in the TEA model is a reasonable one.

## 5.2. Forward-Looking Costs

The TEA-Model relies on replacement costs derived from bids furnished by contractors in Telstra's competitive bidding process. The process of converting multiple bids into a single price for each asset category is not an integral part of the TEA Model, hence evaluation of the methodology is outside the scope of my instruction.

[redacted]

[redacted]

A second point is that using identical equipment unit costs for all ESAs should make no difference if the model is run on all ESAs. However, if the model is run on selected ESAs, it would make more sense to use equipment prices for the [redacted] that corresponds to the particular ESA. I do not know what, if any, the overall impact of such a change would be since the cost of some [redacted] would increase and others would decrease.

## 5.3. Common Fixed Costs

As explained and discussed in Section 4.4.2 the TEA model deals with a variety of common fixed costs:

- Duct and trench shared by the CAN and the IEN. In Version 1.2 of the TEA model 50% of the costs of the shared part of the trench and duct is allocated to CAN. In earlier versions of the TEA model none was assigned to CAN, which meant that CAN costs were understated;
- To derive an allocation of network support assets, the TEA model multiplies network support asset factors (derived within the RAF) by the investment per line. The resulting

95 Statement of [redacted] op.cit..

costs are correctly added to the annual cost, in the Annual Cost Summary sheet. This is consistent with the approach that is used in some TSLRIC+ models with which I am familiar;

- Duct shared with third parties. Conduit leasing revenues have been subtracted from annual costs in the Annual Cost Summary sheet, ensuring that ULLS costs are correspondingly reduced;
- To the extent that duct and trench in the feeder network is shared by fibre that links to distribution areas (and/or fibre leased lines) where ULLS is not available and copper that links to distribution areas where ULLS is available, this has been dealt with by dividing the costs by the total number of lines (copper and fibre);
- General overhead and administration costs (referred to in the TEA model as indirect expenses). Indirect expense cost factors are multiplied by O&M expenses and correctly added to total costs in the Annual Cost Summary sheet.

## 5.4. Depreciation

### 5.4.1. Review of implementation

Annual capital costs in the TEA Model consist of depreciation and the opportunity cost of capital. Depreciation is calculated using the straight-line method, where the level of depreciation is equal in every year of the asset's life, and the opportunity cost of capital is calculated by applying the pre-tax WACC to the written down value of the asset for each year. A process of "levelisation" is then introduced so as to produce the same annual capital charge in each year. This is implemented in the TEA Model using the following three steps:

- Step 1: Calculation of annual capital cost factors
- Step 2: Calculation of levelised annual capital cost factors
- Step 3: Calculation of annual capital costs

I consider each of these steps below.

**Step 1: Calculation of annual capital cost factors**

The calculation of annual capital costs in the TEA Model is implemented through the use of capital cost factors for each asset category. The capital cost factor for each year is equal to depreciation plus pre-tax WACC times the write-down-value of the asset.

Table 5.1 contains an example of an asset with a life of 10 years (e.g. copper cable in the main network).

**Table 5.1**
**Capital Cost Factors**

| Year | Depreciation | Write Down Value | Write Down Value * WACC | Capital Cost Factor |
|---|---|---|---|---|
| 1 | 0.1 | 1.0 | 0.15894 | 0.25894 |
| 2 | 0.1 | 0.9 | 0.143046 | 0.243046 |
| 3 | 0.1 | 0.8 | 0.127152 | 0.227152 |
| 4 | 0.1 | 0.7 | 0.111258 | 0.211258 |
| 5 | 0.1 | 0.6 | 0.095364 | 0.195364 |
| 6 | 0.1 | 0.5 | 0.07947 | 0.17947 |
| 7 | 0.1 | 0.4 | 0.063576 | 0.163576 |
| 8 | 0.1 | 0.3 | 0.047682 | 0.147682 |
| 9 | 0.1 | 0.2 | 0.031788 | 0.131788 |
| 10 | 0.1 | 0.1 | 0.015894 | 0.115894 |

The first column shows the year, and the second column shows the annual depreciation using the straight-line depreciation method. The third column shows the written down value of the asset, i.e. the investment value minus accumulated depreciation. The fourth column contains the written down value times the relevant WACC, in this case WACC is the post-tax vanilla WACC adjusted for tax, (i.e. post-tax WACC times (1+tax gross-up)). Column five contains the annual capital cost factor, which is the sum of depreciation (column two) and the written down value times WACC (column four).

**Step 2: Calculation of levelised of annual capital cost factors**

The annual capital cost factors in Table 5.1 above vary over the asset's lives as the opportunity cost of capital, which is based on the written-down value of the asset, declines over time. The annual capital cost factors are therefore 'levelised'. Table 5.2 shows two alternative methods of performing the levelisation: the approach taken in the TEA Model, and the annuity approach.

**Table 5.2**
**Levelisation of Capital Cost Factors**

| | TEA Model | Annuity |
|---|---|---|
| Asset Life | 10 | 10 |
| WACC | 0.11862 | 0.15894 |
| NPV | 1.14676 | 1 |
| Levelised Capital Cost Factor | 0.20181 | 0.20609 |

Levelisation in the TEA Model is achieved by first calculating the net present value of the capital cost factors across all years of the asset's life, using the post-tax WACC as the discount rate. The Excel function 'PMT' is then used to calculate the capital cost factor that is equal in each period of the asset life and yields the same NPV as the non-levelised capital cost factors, again using the post tax WACC.

An alternative method of levelising capital cost factors is to calculate an annuity[96], using the pre-tax WACC. This method yields a slightly higher levelised capital cost factor than the TEA Model, 0.20609 compared to 0.20181.

The approach taken in the TEA Model would yield the same result as the annuity approach, if the pre tax WACC was used instead of the post tax WACC in the levelisation process. In that case, both approaches would yield a levelised capital cost factor of 0.20609. The difference is therefore caused by the choice of WACC in the levelisation calculation. Since the post-tax WACC used in the TEA Model is lower than the pre-tax WACC assumed in the annuity approach, more weight is given to later capital cost factors in the TEA Model, hence the slightly lower levelised capital cost factor.

**Step 3: Calculation of annual capital costs**

The final step in the calculation of annual capital costs is to apply the capital cost factors to derived investment levels in the TEA Model. For each asset type, this involves simple multiplication of that asset's capital cost factor by the level of investment.

### 5.4.2. Conclusion

The depreciation methodology used in the TEA Model closely resembles an annuity, which would produce a slightly higher "levelised" capital cost factor. The difference is due to the choice of discount rate in the levelisation of the annual capital cost factors. The TEA Model can therefore be seen as conservative in this sense. In my view, the depreciation methodology used in the TEA Model is a reasonable one, a conclusion which is supported by the analysis in Appendix A, which considers how well different depreciation methodologies, including an annuity, approximate to economic depreciation for the main types of asset used in the CAN.

## 5.5. Operating Expenses

In the TEA Model operating expenses comprise operating and maintenance (O&M) costs and indirect costs. Both types of costs are calculated using a top down approach, by directly or indirectly applying cost factors to the level of investment for each category of plant and equipment.

The cost factors are applied to the level of investment in the 'Annual Cost Summary' sheet of the TEA model.

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96 For an annuity the total annual capital charge (depreciation plus cost of capital) as a percentage of the asset purchase price is equal to $r \div [1-1/(1+r)a]$ where r is the required return on capital (WACC) and a is the total life of the asset.

The calculation of these cost factors is carried out by Telstra in a separate model and is documented in the “Operations and Maintenance and Indirect Cost Factor Study”.[97] Review of this study is outside the scope of my instruction. I do, however, provide some comments on the methodology, as described in the model documentation, in the following sub-sections.

### 5.5.1. Operating and Maintenance Costs

O&M factors are derived using data from Telstra’s accounts prepared under the Regulatory Accounting Framework (RAF). However, as explained in Section 4.6.2, a forward-looking adjustment is made in the case of duct and copper cable. For these assets the replacement costs (modelled investment costs) are used instead of historic investment costs.

The O&M Factors are calculated as operating expenses divided by investment costs.

Two adjustments are made to operating expenses:

§ reclassification of cable costs; and

§ elimination of installation costs.

In the first of these two adjustments, Other Cables-CAN is reclassified as Inter-Exchange cables. This reclassification is necessary because the RAF does not contain a separate investment account for Other Cables-CAN. As regards the elimination of installation costs, this has been carried out because these costs are not part of the ongoing O&M expenses associated with the access network. Both types of adjustments are, in my opinion, sound and reasonable.

Two adjustments have also been made to investment costs:

§ a forward-looking adjustment; and

§ an asset reclassification.

As explained in Section 4.6.2, the forward-looking adjustment applies to duct and copper cable, where the replacement costs (modelled investment costs) are used instead of historic investment costs. Meanwhile, the asset reclassification was necessary in order to realign the output from the RAF accounts with the asset categories of the TEA Model.

### 5.5.2. Indirect Costs

There are three sets of indirect factors used in the TEA Model:

§ Indirect expense factors: calculated as indirect expenses divided by total direct expenses. Four adjustments have been made: elimination of depreciation to avoid double counting, elimination of ULLS specific costs, elimination of installation costs and elimination of operator service costs.

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97 Telstra Corporation Limited, Operations and Maintenance and Indirect Cost Factor Study, Public Version. 7 April 2008.

- Network support asset factors: calculated as CAN network support assets divided by CAN direct assets.
- Indirect asset factors: calculated as indirect assets divided by total direct assets. Six adjustments have been made: incorporation of accumulated depreciation, removal of retail depreciation, removal of non-communications assets, removal of retail investment costs, removal of ULLS specific costs and removal of other investment and receivables.

The adjustments that have been made all serve the purpose of realigning the accounting data from the RAF with the specific asset classification of the TEA Model, so that the TEA Model can be used to estimate ULLS costs.

Indirect expenses are calculated in the TEA Model by multiplying the indirect expense factors by the calculated O&M costs. As with O&M costs, the network support costs and indirect asset costs are calculated in the TEA Model by multiplying the relevant factors by the modelled investment costs in 'Annual Cost Summary' sheet.

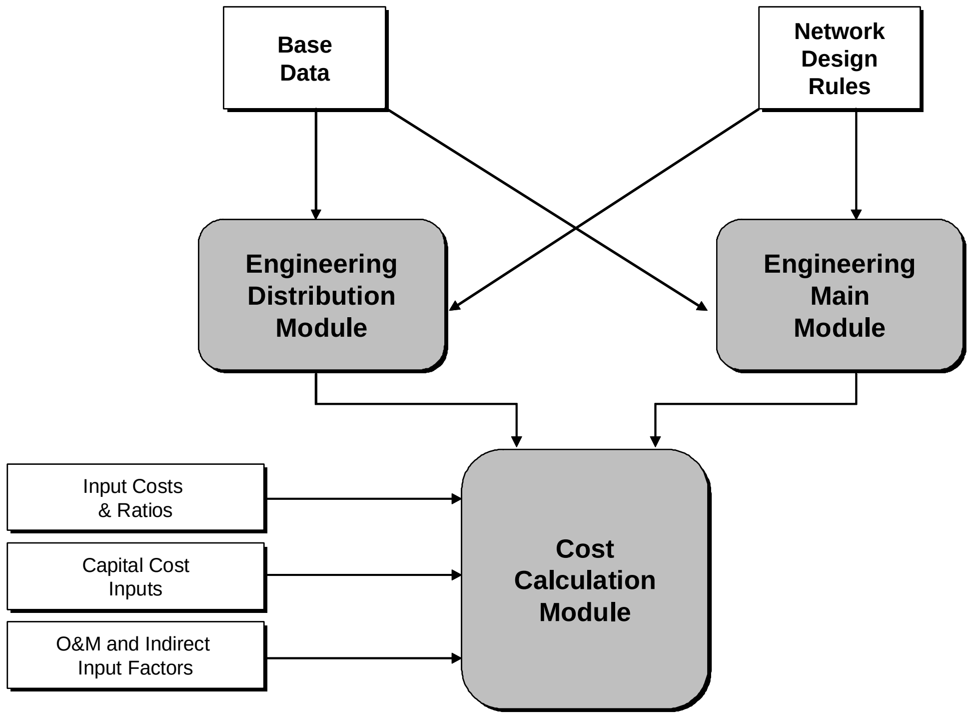
### 5.5.3. Conclusions

Review of the precise derivation of operating expense factors (O&M factors and indirect cost factors) is outside the scope of my instructions. However, I believe that in principle the adjustments Telstra has made to the relevant expense and investment levels, as described in the Operations and Maintenance and Indirect Cost Factor Study, are reasonable.

## 5.6. User Operability

The fact that the TEA Model has a modular structure makes it easier to understand and operate than would otherwise be the case. Figure 5.4 provides an overview of the model structure, as described in the Model Documentation.

**Figure 5.4**
**Modular Structure of the TEA Model**




However, the diagram does not show that outputs from the Cost Calculation Module (efficient investment) feed into the calculation of O&M and Indirect Input Factors, which again feeds into the Cost Calculation Module. This circularity makes operation of the model somewhat laborious. For example, if a user of the model changes a parameter, he or she should run the TEA model, read the investment required, feed that into the O&M calculation, recalculate O&M factors, and use the updated O&M factors to re-run the TEA Model.

# 6. Compliance with Expert Witness Guidelines and Sufficiency of Inquiries

In preparing this report I have complied with the Federal Court of Australia's *Guidelines for Expert Witnesses*. I have made all the inquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have, to my knowledge, been withheld in this report.

Nigel . G . Attenborough

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Nigel Attenborough
Date: 16 January, 2009

# Appendix A. Comparison of Depreciation Methods

## A.1. Introduction

The TEA model uses something that closely approximates to an annuity to calculate the annual capital charge for different assets. The specifics of the TEA model approach are discussed in more detail in Section 5. However, for present purposes, it is reasonable to assume that the TEA model uses an annuity.

The question this raises is whether an annuity provides a reasonable approximation to economic depreciation. To examine this further, the remainder of this Appendix provides a comparison of annual capital charges as a percentage of investment cost using (a) economic depreciation and (b) different accounting methods of depreciation which have been used in TSLRIC+ models. Annual capital charge profiles using each of the depreciation methods have been derived for each of the four most important assets in cost terms in the TEA model. These assets are:

§ Main (feeder) network duct;

§ Distribution network duct;

§ Main (feeder) network copper cable; and.

§ Distribution network copper cable.

## A.2. Economic Depreciation

Economic depreciation is defined as the change in the value of an asset during a specified period of time (typically a year).[98] The value of the asset is equal to the sum of the discounted future net cash flows arising from its use. These net cash flows are in turn determined by future output prices and volumes and by the future operating costs of the equipment concerned.

If it is assumed that the market for the product or service produced by the asset is competitive (or contestable), and hence that price is always set equal to cost (including WACC), it follows that the output price will move in line with the purchase price and operating costs of new equipment.[99] The reason for this is that a new operator contemplating entry at any given point in time will have its costs determined by the current price and operating cost of new equipment. An existing operator will therefore have to ensure that its prices do not exceed such costs because otherwise it will be uncompetitive. The future path of output prices will thus be determined by the future evolution of new equipment prices and operating costs.

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98 H. Hotteling (1925), "A General Mathematical Theory of Depreciation", *Journal of the American Statistical Association*, Vol. 20, pp 340-353.

99 For simplicity it is assumed here that there is only one product (or service) produced by one asset. However, the analysis remains fundamentally the same if there is more than one product (or service) and more than one asset.

Reflecting this I have built an economic depreciation model which forecasts future annual cash flows from an asset based on the following inputs:

- The initial purchase price of the asset;
- The initial level of operating costs as a percentage of the asset purchase price;
- Future changes in new equipment prices and operating costs (which determine future output prices);
- Future changes in the operating costs of the existing asset;
- Future changes in the volume of output from the asset. Possible reasons for such changes include technological obsolescence and declining demand due, for example, to loss of market share or relocation of customers; and
- The cost of capital (WACC), which is used as the discount rate.

Given these inputs, together with the cost of capital (WACC), it is possible to estimate the net present value (NPV) of future cash flows each year and hence economic depreciation (which is the change in NPV between one year and the next) over the life of the asset.[100] At the same time, the cost of capital associated with the asset for any given year is derived by multiplying the NPV (i.e. the asset value) by WACC.[101]

The resulting annual capital charges given economic depreciation can then be compared with those resulting from the application of different accounting methods of depreciation in order to determine which method provides the best proxy for economic depreciation.

## A.3. Accounting Depreciation

The accounting depreciation methods with which I have compared economic depreciation are those cited by the IRG as being possible surrogates for economic depreciation (see Section 3.5.3), namely:

- **Annuity**: the total annual capital charge (depreciation plus cost of capital) as a percentage of the asset purchase price is equal to $r \div [1-1/(1+r)^a]$ where "r" is the required return on capital (WACC) and "a" is the total life of the asset;
- **Tilted annuity**: the total annual capital charge as a percentage of the gross <u>replacement</u> cost of the asset is $(r- Dp) \div \{1-[(1+ Dp)/(1+r)]^a\}$ where "Dp" is the annual % asset price change and the other symbols are as before;

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[100] This is done by setting an initial output price which ensures that the present value of future net cash flows during the life of the asset is equal to the investment costs (purchase price) of the asset. In an economic depreciation model, the life of the asset is determined by the point at which revenue no longer covers operating expenses.

[101] The NPV of the asset is the value at which it could be sold. Multiplying this by WACC gives the opportunity cost of the asset.

- **Straight line**: the annual depreciation charge is equal to the original asset price divided by the total life of the asset, while the cost of capital in any particular year is equal to WACC × NBV, where NBV is the original asset purchase price minus accumulated depreciation. NBV necessarily declines over time and, given a constant WACC, so too does the annual cost of capital;

- **Tilted straight line**: the annual depreciation charge is equal to the current replacement cost of the asset divided by the total life of the asset, while the cost of capital in any particular year is equal to WACC × NRC, where NRC is the current replacement cost of the asset minus accumulated depreciation. An allowance is also made for holding gains associated with asset price changes. The holding gain is equal to Dp ×NRC and is equivalent to a reduction in depreciation. If the asset price falls, the holding gain is negative (i.e. it is a holding loss) and this is equivalent to an increase in depreciation;

- **Sum of the years' digits**: which can be illustrated by taking the example of an asset with a life of 10 years. In this case, the sum of the years' digits is equal to 1 + 2 + 3+ … …+ 10 = 55. In the first year, depreciation is 10/55 of the original asset purchase price, in the second year 9/55, in the third year 8/55 and so on. The cost of capital in any particular year is equal to WACC x NBV.

## A.4. Comparison of Different Depreciation Methods

To test the extent to which the different accounting depreciation methods approximate economic depreciation it was necessary to choose the inputs used in the economic depreciation model. Recognising the fact that the pattern of economic depreciation over time reflects temporal variations in the earning power of the asset, two alternative scenarios are considered:

- the first (referred to as "gradual") assumes a steady acceleration in the rate of decline of output and hence revenue over time and a steady acceleration in operating costs; while

- the second (referred to as "sharp") assumes that initially output and operating costs change at a modest but steady rate but that a sharp acceleration in the rate of decline of output and hence revenue and a sharp increase in operating costs occurs towards the end of the asset's life.[102]

The reason for assuming that output falls and/or operating costs increase over the life of the asset is that experience indicates that this happens. Moreover, if asset prices are either not falling or are rising, which is the assumption here for duct and cable, it is necessary to assume that output falls and/or operating costs increase over time in order for the asset to have a finite economic life under economic depreciation.[103]

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[102] Operating costs in this context exclude depreciation.

[103] If asset prices and hence output prices are rising, output does not fall and operating costs do not increase, revenue from using the asset would never fall below operating costs. In these circumstances the asset would have an infinite life. In reality this would not happen because operating costs increase as the asset gets older and/or demand for the asset's output declines over time due, for example, to technological obsolescence, loss of market share or relocation of customers.

In each case, the investment cost of the asset is assumed to be $100, so that the resulting annual capital charges can readily be interpreted as percentages of the investment cost. Other inputs, which are common to the two sets of inputs, include the ratio of operating costs to investment costs at the start of the period (for which I use the relevant O&M ratios from the TEA model), WACC (which is taken from the TEA model) and the future change in asset prices and new asset price operating costs, which are based on NERA assumptions.

The assumptions for the operating cost and output volume trends used in the gradual and sharp scenarios are not forecasts as such but have been chosen so as to produce the characteristics of the respective scenarios (i.e. a steady deceleration in the earning power of the asset in the gradual scenario and a modest decline initially followed by a sharp deceleration in earning power later on in the sharp scenario).[104]

A further point to note is that, in order to allow direct comparisons between annual capital charges using economic and accounting depreciation, the same asset life time has to be assumed. This means that the output and operating cost trend assumptions in the economic depreciation model are adjusted so as to produce the required asset life.

### A.4.1. Main Duct (Gradual)

Telstra's main duct (i.e. duct in the feeder network) is assumed in the TEA model to have a 40 year life and is depreciated accordingly.

The assumptions used in the economic depreciation model under the "gradual" scenario were explained above and are shown in Table A.1 below. The same asset life, asset price trend (where appropriate) and WACC are used for the accounting depreciation methods.

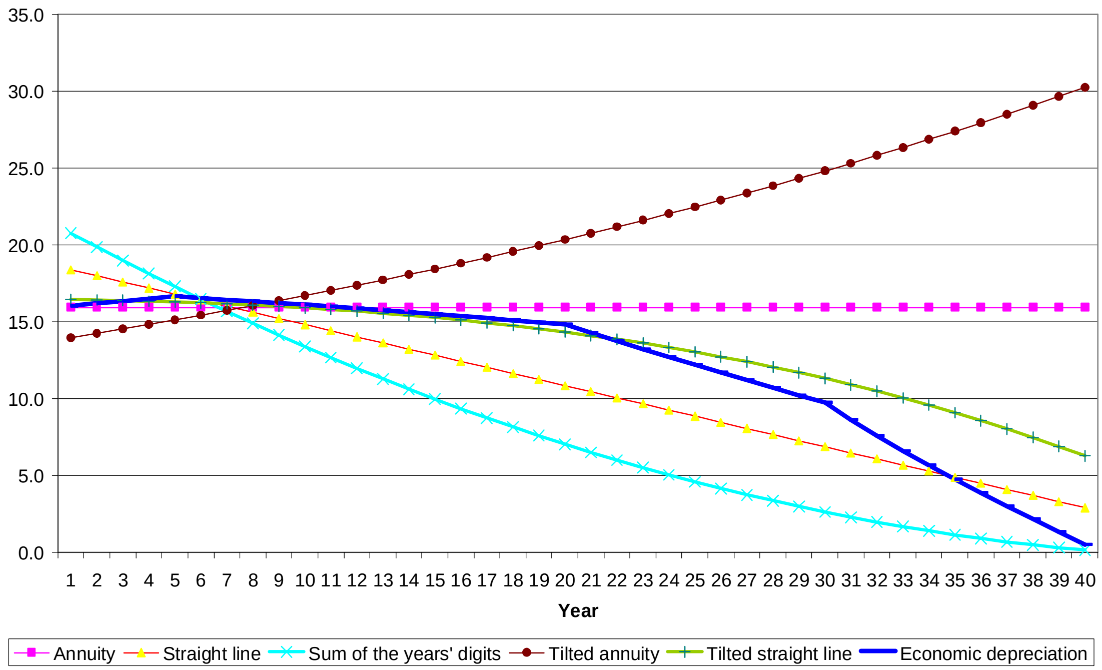
**Table A.1**
**Main Duct (Gradual): Economic Depreciation Assumptions**

| | | |
|---|---|---|
| Asset life | 40 | years |
| Investment cost | 100 | $ |
| Asset price trend | 2.0% | p.a. |
| Starting operating cost as % of investment | 0.3% | |
| Operating cost trend (first 5 years) | 2.5% | p.a. |
| Operating cost trend (years 6 to 10) | 5.0% | p.a. |
| Operating cost trend (years 11 to 20) | 6.8% | p.a. |
| Operating cost trend (years 21 to 30) | 7.5% | p.a. |
| Operating cost trend (years 31 to 40) | 10.0% | p.a. |
| New asset operating cost trend | 2.0% | p.a. |
| Output volume trend (first 5 years) | -1.0% | p.a. |
| Output volume trend (years 6 to 10) | -2.5% | p.a. |
| Output volume trend (years 11 to 20) | -2.5% | p.a. |
| Output volume trend (years 21 to 30) | -5.0% | p.a. |
| Output volume trend rest of life | -10.0% | p.a. |
| Cost of capital | 15.9% | |

104 In each scenario for each of the asset types it is assumed that there is an output volume decline of at least 1% p.a. over the first five years of the asset's life reflecting anticipated developments such as fixed to mobile substitution and the development of fixed wireless access.

A comparison of the profile of annual capital charges using economic depreciation with those generated by different accounting depreciation methods is provided in Figure A.1 below.

**Figure A.1**
**Main Duct (Gradual): Comparative Annual Capital Charge**




Given that it is the costs of a new network that are being estimated by the TEA model and that the ULLS undertaking has a maximum duration of 3 years, it is the early years of the comparison that matter because the regulated prices can be expected to change at regular intervals. In this context, it can be seen that, for main duct, in the early years of the asset's life (indeed for the first 20 years), an annuity provides a good proxy for the annual capital charge given economic depreciation.

### A.4.2. Main Duct (Sharp)

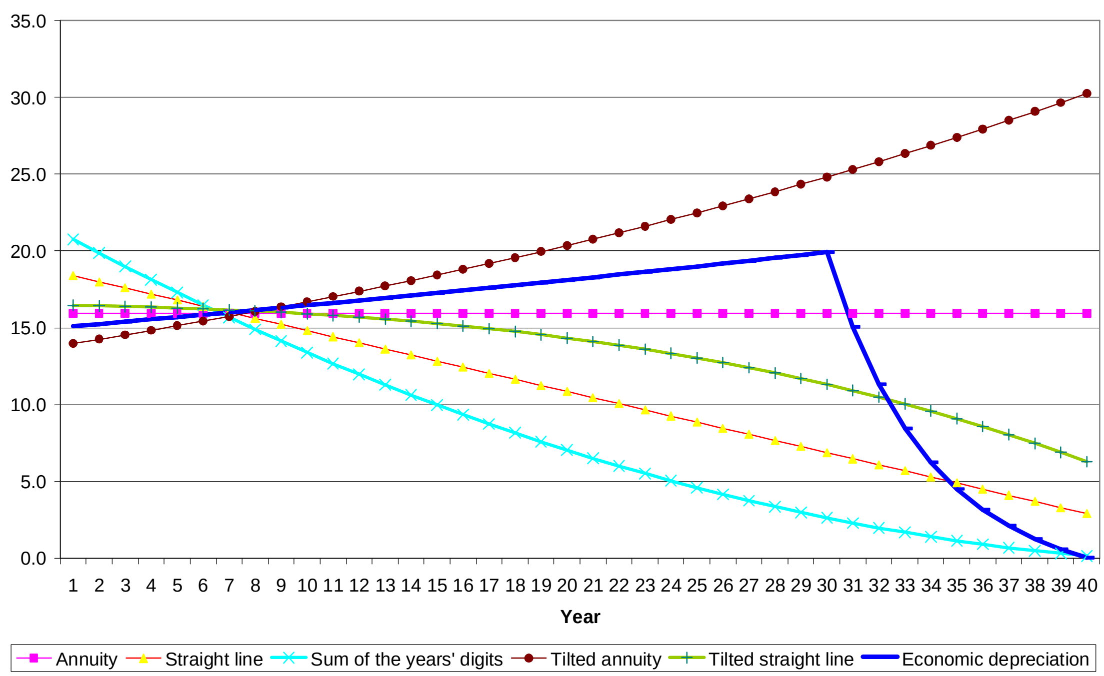
The assumptions used in the economic depreciation model given the "sharp" scenario were explained earlier and are shown in Table A.2 below.

**Table A.2**
**Main Duct (Sharp): Economic Depreciation Assumptions**

| | | |
|---|---|---|
| Asset life | 40 | years |
| Investment cost | 100 | $ |
| Asset price trend | 2.0% | p.a |
| Starting operating cost as % of investment | 0.3% | |
| Operating cost trend (first 5 years) | 2.0% | p.a |
| Operating cost trend (years 6 to 10) | 2.0% | p.a |
| Operating cost trend (years 11 to 20) | 2.0% | p.a |
| Operating cost trend (years 21 to 30) | 2.0% | p.a |
| Operating cost trend (years 31 to 40) | 10.0% | p.a |
| New asset operating cost trend | 2.0% | p.a |
| Output volume trend (first 5 years) | -1.0% | p.a |
| Output volume trend (years 6 to 10) | -1.0% | p.a |
| Output volume trend (years 11 to 20) | -1.0% | p.a |
| Output volume trend (years 21 to 30) | -1.0% | p.a |
| Output volume trend rest of life | -25.0% | p.a |
| Cost of capital | 15.9% | |

Using these assumptions, the comparison between economic depreciation and different types of accounting depreciation is provided in Figure A.2.

**Figure A.2**
**Main Duct (Sharp): Comparative Annual Capital Charge**



As with the gradual scenario, for main duct it can be seen that, in the early years of the asset's life, an annuity provides a good proxy for the annual capital charge given economic depreciation.

### A.4.3. Main Copper Cable (Gradual)

Telstra's main copper cable (i.e. copper cable in the feeder network) is assumed in the TEA model to have a 10 year life and is depreciated accordingly.

The assumptions used in the economic depreciation model under the gradual scenario are shown in Table A.3 below. As before, the same asset life, asset price trend (where appropriate) and WACC are used for the accounting depreciation methods.

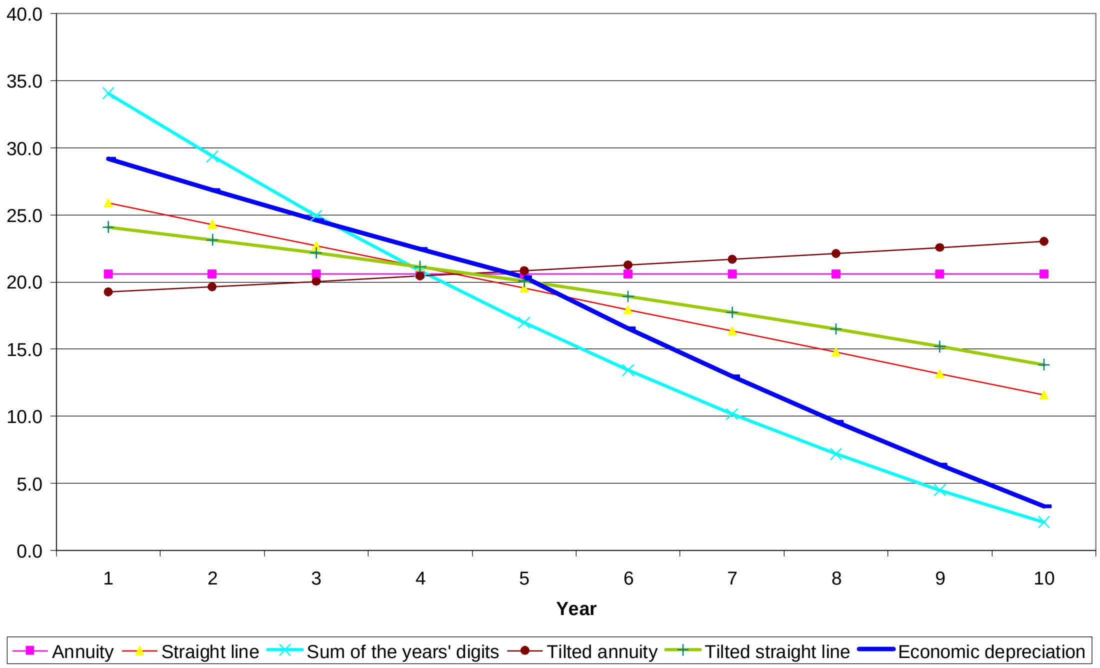
**Table A.3**
**Main Copper Cable (Gradual): Economic Depreciation Assumptions**

| | | |
|---|---|---|
| **Asset life** | **10** | **years** |
| **Investment cost** | **100** | **$** |
| **Asset price trend** | **2.0%** | **p.a.** |
| **Starting operating cost as % of investment** | **6.5%** | |
| **Operating cost trend (first 5 years)** | **5.0%** | **p.a.** |
| **Operating cost trend (years 6 to 10)** | **10.0%** | **p.a.** |
| **Operating cost trend (years 11 to 20)** | | |
| **Operating cost trend (years 21 to 30)** | | |
| **Operating cost trend (years 31 to 40)** | | |
| **New asset operating cost trend** | **2.0%** | **p.a.** |
| **Output volume trend (first 5 years)** | **-7.5%** | **p.a.** |
| **Output volume trend (years 6 to 10)** | **-12.5%** | **p.a.** |
| **Output volume trend (years 11 to 20)** | | |
| **Output volume trend (years 21 to 30)** | | |
| **Output volume trend rest of life** | | |
| **Cost of capital** | **15.9%** | |

A comparison of the profile of annual capital charges given economic depreciation with those generated by the use of different accounting depreciation methods is provided in Figure A.3 below.

It can be seen that, for main copper cable, an annuity does not provide a good proxy for the annual capital charge given economic depreciation and that it substantially understates the capital charge in the early years of the asset's life. None of the accounting methods of depreciation closely approximates to economic depreciation and an annuity does at least perform better than a tilted annuity.

**Figure A.3**
**Main Copper Cable (Gradual): Comparative Annual Capital Charge**




### A.4.4. Main Copper Cable (Sharp)

The assumptions used in the economic depreciation model given the “sharp” scenario are shown in Table A.4 below.

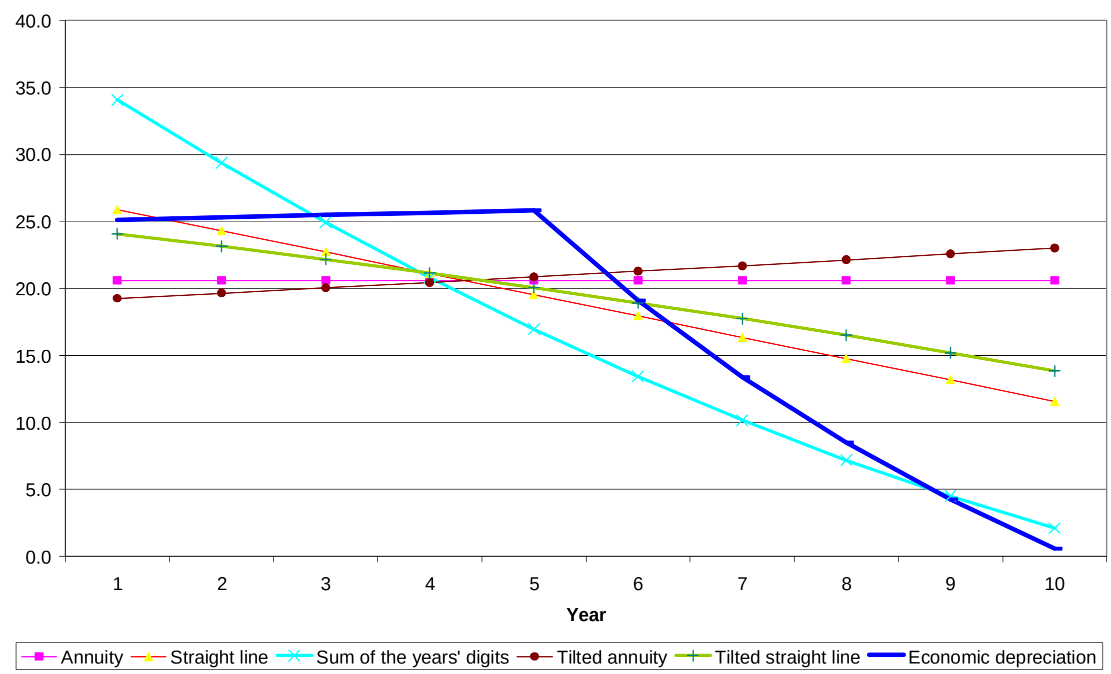
**Table A.4**
**Main Copper Cable (Sharp): Economic Depreciation Assumptions**

| | | |
|---|---|---|
| Asset life | 10 | years |
| Investment cost | 100 | $ |
| Asset price trend | 2.0% | p.a. |
| Starting operating cost as % of investment | 6.5% | |
| Operating cost trend (first 5 years) | 2.0% | p.a. |
| Operating cost trend (years 6 to 10) | 10.0% | p.a. |
| Operating cost trend (years 11 to 20) | | |
| Operating cost trend (years 21 to 30) | | |
| Operating cost trend (years 31 to 40) | | |
| New asset operating cost trend | 2.0% | p.a. |
| Output volume trend (first 5 years) | -1.0% | p.a. |
| Output volume trend (years 6 to 10) | -20.0% | p.a. |
| Output volume trend (years 11 to 20) | | |
| Output volume trend (years 21 to 30) | | |
| Output volume trend rest of life | | |
| Cost of capital | 15.9% | |

For these assumptions, the comparison between economic depreciation and different types of accounting depreciation is provided in Figure A.6.

Again, for main copper cable it can be seen that an annuity does not provide a good proxy for the annual capital charge given economic depreciation and that it substantially understates the capital charge in the early years of the asset's life. The shortfall is, however, somewhat smaller than under the gradual scenario. A tilted annuity is again the worst performing method of accounting depreciation.

**Figure A.4**
**Main Copper Cable (Sharp): Comparative Annual Capital Charge**




## A.4.5. Distribution Duct (Gradual)

Telstra's distribution duct (i.e. duct in the distribution network) is assumed in the TEA model to have a 30 year life and is depreciated accordingly.

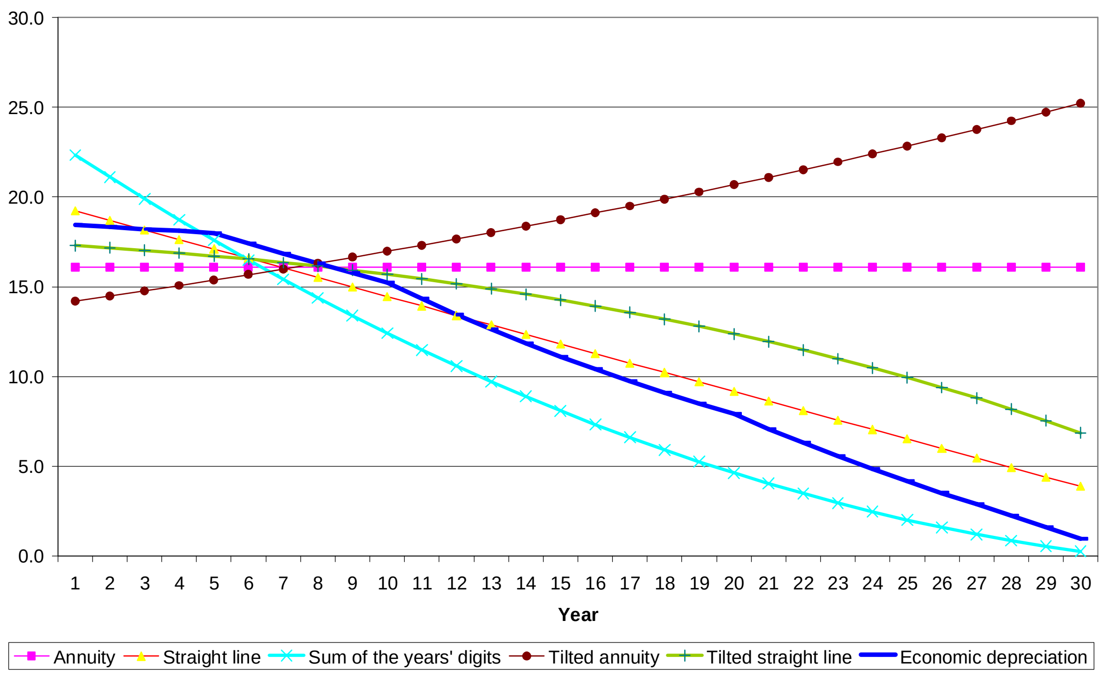
The assumptions used in the economic depreciation model under the gradual scenario are shown in Table A.5 below. As before, the same asset life, asset price trend (where appropriate) and WACC are used for the accounting depreciation methods.

## Table A.5
## Distribution Duct (Gradual): Economic Depreciation Assumptions

| | | |
|---|---|---|
| Asset life | 30 | years |
| Investment cost | 100 | $ |
| Asset price trend | 2.0% | p.a. |
| Starting operating cost as % of investment | 0.3% | |
| Operating cost trend (first 5 years) | 2.0% | p.a. |
| Operating cost trend (years 6 to 10) | 5.0% | p.a. |
| Operating cost trend (years 11 to 20) | 7.5% | p.a. |
| Operating cost trend (years 21 to 30) | 12.5% | p.a. |
| Operating cost trend (years 31 to 40) | | |
| New asset operating cost trend | 2.0% | p.a. |
| Output volume trend (first 5 years) | -2.5% | p.a. |
| Output volume trend (years 6 to 10) | -5.0% | p.a. |
| Output volume trend (years 11 to 20) | -7.5% | p.a. |
| Output volume trend (years 21 to 30) | -10.0% | p.a. |
| Output volume trend rest of life | | |
| Cost of capital | 15.9% | |

A comparison of the profile of annual capital charges given economic depreciation with those generated by the use of different accounting depreciation methods is provided in Figure A.5 below.

## Figure A.5
## Distribution Duct (Gradual): Comparative Annual Capital Charge




For distribution duct it can be seen that, in the early years of the asset's life, an annuity understates the annual capital charge based on economic depreciation, although the understatement is nowhere near as large as in the case of main network copper cable (see above). A tilted annuity again performs worse than any other accounting methodology in the early years of an asset's life.

### A.4.6. Distribution Duct (Sharp)

The assumptions used in the economic depreciation model given the "sharp" scenario are shown in Table A.6 below.

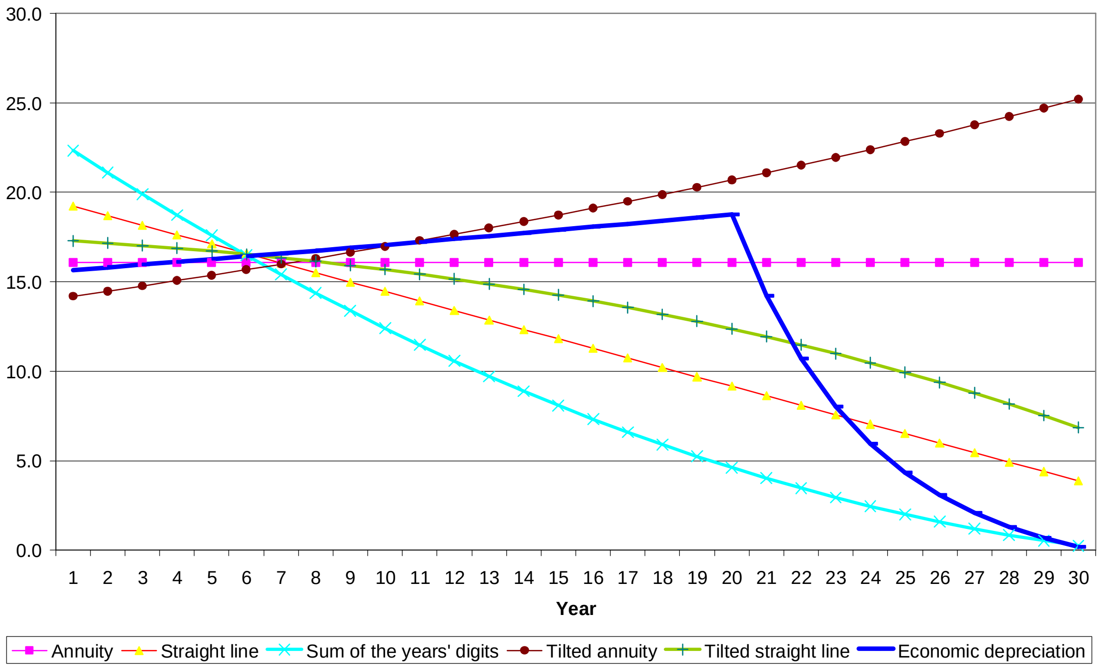
**Table A.6**
**Distribution Duct (Sharp): Economic Depreciation Assumptions**

| | | |
|---|---|---|
| Asset life | 30 | years |
| Investment cost | 100 | $ |
| Asset price trend | 2.0% | p.a. |
| Starting operating cost as % of investment | 0.3% | |
| Operating cost trend (first 5 years) | 2.0% | p.a. |
| Operating cost trend (years 6 to 10) | 2.0% | p.a. |
| Operating cost trend (years 11 to 20) | 2.0% | p.a. |
| Operating cost trend (years 21 to 30) | 10.0% | p.a. |
| Operating cost trend (years 31 to 40) | | |
| New asset operating cost trend | 2.0% | p.a. |
| Output volume trend (first 5 years) | -1.0% | p.a. |
| Output volume trend (years 6 to 10) | -1.0% | p.a. |
| Output volume trend (years 11 to 20) | -1.0% | p.a. |
| Output volume trend (years 21 to 30) | -25.0% | p.a. |
| Output volume trend rest of life | | |
| Cost of capital | 15.9% | |

For these assumptions, the comparison between economic depreciation and different types of accounting depreciation is provided in Figure A.6.

For distribution duct, it can be seen that, in the early years of the asset's life, an annuity provides a very close proxy for the annual capital charge given economic depreciation.

**Figure A.6**
**Distribution Duct (Sharp): Comparative Annual Capital Charge**




## A.4.7. Distribution Copper Cable (Gradual)

Telstra's distribution copper cable (i.e. copper cable in the distribution network) is assumed in the TEA model to have a 20 year life and is depreciated accordingly.

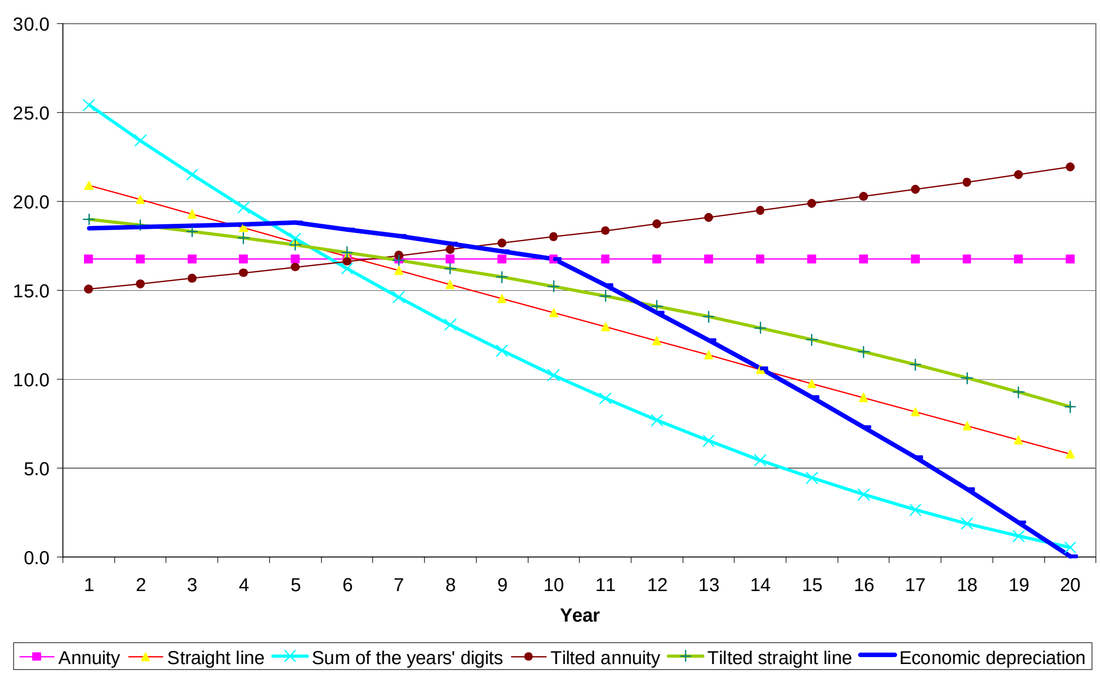
The assumptions used in the economic depreciation model under the gradual scenario are shown in Table A.7 below. As before, the same asset life, asset price trend (where appropriate) and WACC are used for the accounting depreciation methods.

## Table A.7
## Distribution Copper Cable (Gradual): Economic Depreciation Assumptions

| | |
|---|---|
| Asset life | 20 years |
| Investment cost | 100 $ |
| Asset price trend | 2.0% p.a. |
| Starting operating cost as % of investment | 6.5% |
| Operating cost trend (first 5 years) | 2.5% p.a. |
| Operating cost trend (years 6 to 10) | 5.0% p.a. |
| Operating cost trend (years 11 to 20) | 7.5% p.a. |
| Operating cost trend (years 21 to 30) | |
| Operating cost trend (years 31 to 40) | |
| New asset operating cost trend | 2.0% p.a. |
| Output volume trend (first 5 years) | -1.0% p.a. |
| Output volume trend (years 6 to 10) | -2.0% p.a. |
| Output volume trend (years 11 to 20) | -5.0% p.a. |
| Output volume trend (years 21 to 30) | |
| Output volume trend rest of life | |
| Cost of capital | 15.9% |

A comparison of the profile of annual capital charges given economic depreciation with those generated by the use of different accounting depreciation methods is provided in Figure A.7.

## Figure A.7
## Distribution Copper Cable (Gradual): Comparative Annual Capital Charge




For distribution copper cable, it can be seen that, in the early years of the asset's life, an annuity understates the annual capital charge given economic depreciation, although the understatement is nowhere near as large as in the case of main network copper cable (see above).

### A.4.8. Distribution Copper Cable (Sharp)

The assumptions used in the economic depreciation model given the "sharp" scenario are shown in Table A.8 below.

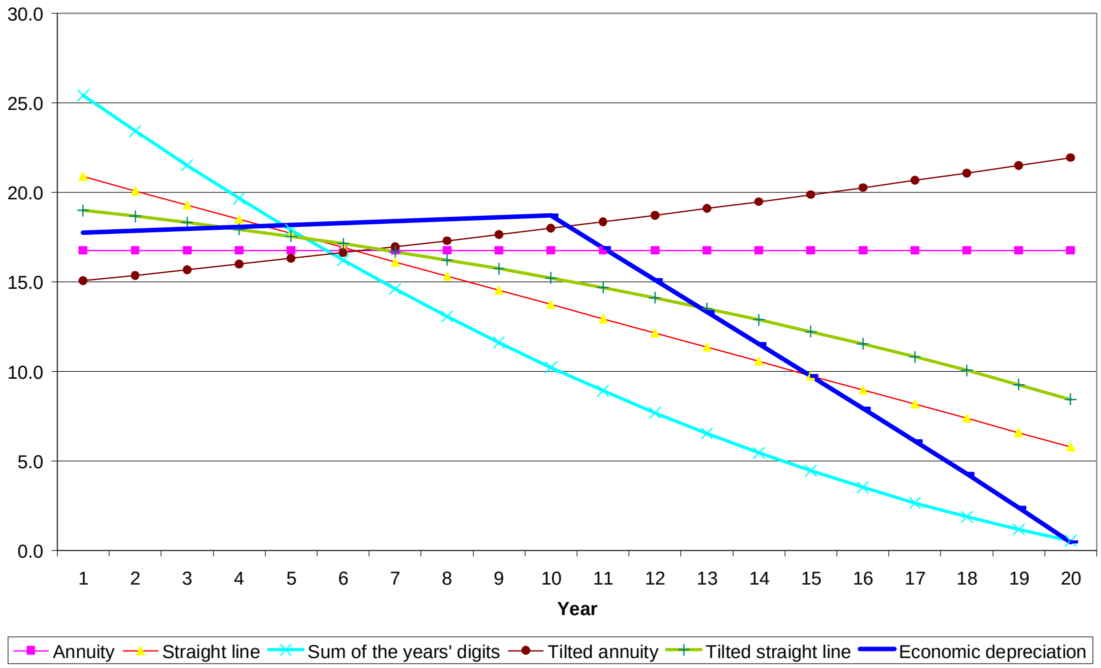
**Table A.8**
**Distribution Copper Cable (Sharp): Economic Depreciation Assumptions**

| | | |
|---|---|---|
| Asset life | 20 | years |
| Investment cost | 100 | $ |
| Asset price trend | 2.0% | p.a. |
| Starting operating cost as % of investment | 6.5% | |
| Operating cost trend (first 5 years) | 2.0% | p.a. |
| Operating cost trend (years 6 to 10) | 2.0% | p.a. |
| Operating cost trend (years 11 to 20) | 7.5% | p.a. |
| Operating cost trend (years 21 to 30) | | |
| Operating cost trend (years 31 to 40) | | |
| New asset operating cost trend | 2.0% | p.a. |
| Output volume trend (first 5 years) | -1.0% | p.a. |
| Output volume trend (years 6 to 10) | -1.0% | p.a. |
| Output volume trend (years 11 to 20) | -6.5% | p.a. |
| Output volume trend (years 21 to 30) | | |
| Output volume trend rest of life | | |
| Cost of capital | 15.9% | |

For these assumptions, the comparison between economic depreciation and different types of accounting depreciation is provided in Figure A.8.

It can be seen that, near the beginning of the asset's life, an annuity slightly understates the annual capital charge using economic depreciation and it continues to do so over the next 10 years.

**Figure A.8**
**Distribution Copper Cable (Sharp): Comparative Annual Capital Charge**




## A.5. Conclusion

In assessing how well different methods of depreciation approximate economic depreciation in the present context, it is the early years of each asset's life that are relevant. This is because the prices of ULLS have been reset by the ACCC at regular intervals (3 years or less).

The assets considered in Section A.4 represent the bulk of the CAN. For these assets, in the first 3 years of their life, an annuity either closely proxies or understates the capital charge given economic depreciation. Hence its use will tend overall to understate economic depreciation. Furthermore, in every case an annuity more closely approximates economic depreciation than a tilted annuity.

An annuity performs well with longer-lived assets (e.g. duct) but less well with those CAN assets that have relatively short lives (e.g. main copper cable). Whether a "gradual" or "sharp" output deceleration and operating cost acceleration scenario is used does not greatly affect its performance, suggesting that the overall conclusion is not sensitive to the precise output and operating cost assumptions that are used in the economic depreciation model.

The finding that an annuity outperforms a tilted annuity for all the assets considered above might at first sight appear surprising, given that a tilted annuity is widely advocated as taking changing circumstances into account. However, a tilted annuity only reflects new asset price changes. It does not take output volume and operating cost changes into account. This is an important weakness because, in reality, output from CAN assets can be expected to decline over time due to technological obsolescence (e.g. substitution of fixed lines by mobile phones or wireless access), declining productivity, or stranding of assets due to loss of market share or customer relocation. Similarly assets tend to become more expensive to maintain as they become older.

If volumes and operating costs are assumed to remain unchanged, while new equipment prices increase, the asset concerned will have an expected infinite life because revenues will continue to grow while costs remain flat. This, however, is inconsistent with the assumption of finite asset lives (and indeed with experience).

Given rising asset prices, the existence of a finite asset life means that either output falls over the life of the asset or operating costs increase or both. Put another way, the things that cause the asset to cease to be economical at some future point in time are not taken into account by a tilted annuity when, as is the case here, asset prices are increasing.[105]

[105] The only way that a tilted annuity can exactly replicate economic depreciation in these circumstances is if there is no output or operating cost change until the final minutes of the asset's life when there is a sudden massive reduction in output volume and/or increase in operating costs. However, duct and copper cable do not normally suffer cataclysmic failure of that type.

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## B.4. Witness Statements

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Statement of [redacted], dated 12 August 2008. In the matter of an undertaking dated 3 March 2008 lodged by Telstra Corporation Limited with the Australian Competition and Consumer Commission in respect of Unconditioned Local Loop Service ("the access undertaking").

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# Appendix C. Letters of Instruction

This appendix contains the 9 letters of instruction I have received:

- Letter of instruction dated 22 May 2008
- Letter of instruction dated 26 June 2008
- Letter of instruction dated 7 July 2008
- Letter of instruction dated 22 August 2008
- Letter of instruction dated 1 September 2008
- Letter of instruction dated 4 September 2008
- Letter of instruction dated 26 September 2008
- Letter of instruction dated 7 October 2008
- Letter of instruction dated 18 November 2008

MALLESONS STEPHEN JAQUES

By Courier

Mr Nigel Attenborough
NERA Economic Consulting
15 Stratford Place
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UNITED KINGDOM

22 May 2008

David Healey
Direct line
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Partner
Agata Jarbin

Dear Mr Attenborough

**Telstra Efficient Access Cost Model ("the TEA Model")**

We act for Telstra Corporation Limited ("**Telstra**").

**Background**

Telstra relies upon the TEA Model in the context of an ordinary access undertaking given to the Australian Competition and Consumer Commission ("**ACCC**") pursuant to Division 5 of Part XIC of the *Trade Practices Act* 1974 ("**TPA**") in relation to the ULLS ("**the Undertaking**"). Telstra may also rely on the TEA Model in any legal proceedings relating to the Undertaking. An extract of the relevant part of the TPA is included at tab 1 of the enclosed folder of documents.

The TEA Model is an engineering cost model that has been developed by Telstra to calculate the efficient cost of providing the unconditioned local loop service ("**ULLS**") over Telstra's customer access network ("**CAN**").

**The Regulatory Regime**

Part XIC of the TPA makes provision for a telecommunications access regime whose object, as set out in Division 1 (section 152AB), is to promote the long term interest of end-users of carriage services.

Division 2 of Part XIC provides for the declaration of certain listed carriage services. Once a service has been declared, the access provider is subject to certain access obligations as specified in Part XIC and access to the declared service must be provided to access seekers. The terms and conditions of access can be the subject of agreement between the parties. If there is a dispute, the terms may be arbitrated by the ACCC.

Pursuant to section 152BS a carrier or carriage service provider can give to the ACCC an access undertaking by which the carrier or carriage service provider undertakes to comply with the terms and conditions specified in the undertaking in relation to the applicable standard access obligations. Section 152BU (2) requires that after considering an access undertaking submitted to it, the ACCC must accept or reject the undertaking. Where the ACCC accepts an access undertaking, any arbitral determination made by it which is inconsistent with the terms of the accepted undertaking will be of no effect to the extent of the inconsistency.

ULLS is a service declared by the ACCC pursuant to Part XIC of the TPA. The ULLS service is described in the service declaration dated 28 July 2006, a copy of which appears at tab 2 of the enclosed folder of documents.

Essentially ULLS provides access seekers with the use of the copper based wire between the network boundary point at the end user's premises and a point of interconnection located at or associated with a customer access module (which can be located at Telstra's exchange building or somewhere between the exchange building and the end user customer). Currently, however, the ULLS is only acquired by access seekers from the exchange building. Telstra owns the largest CAN in Australia and, by operation of the service declaration, it is required to provide ULLS to access seekers.

Section 152AH of the TPA sets out statutory criteria which the ACCC must take into account when assessing whether to accept an undertaking, being:

(a) whether the determination will promote the long-term interests of end-users of carriage services or of services supplied by means of carriage services;

(b) the legitimate business interests of the carrier or provider, and the carrier's or provider's investment in facilities used to supply the declared service;

(c) the interests of all persons who have rights to use the declared service;

(d) the direct costs of providing access to the declared service;

(e) the operational and technical requirements necessary for the safe and reliable operation of a carriage service, a telecommunications network or a facility;

(f) the economically efficient operation of a carriage service, a telecommunications network or a facility.

Section 152AB of the TPA also provides that:

> (1) In determining whether a particular thing promotes the long-term interests of end-users the ACCC must have regard to the extent to which the thing is likely to result in the achievement of the following objectives:
>
> (a) the objective of promoting competition in markets for listed services [of which ULLS is one];

(b) the objective of achieving any-to-any connectivity in relation to carriage services that involve communication between end-users;

(c) the objective of encouraging the economically efficient use of, and the economically efficient investment in:

(i) the infrastructure by which listed services are supplied; and

(ii) any other infrastructure by which listed services are, or are likely to become, capable of being supplied.

(2) In determining the extent to which a particular thing is likely to result in the achievement of the objective referred to in paragraph (1)(a) above, the ACCC must have regard to the extent to which the thing will remove obstacles to end-users of listed services gaining access to listed services.

(3) In determining the extent to which a particular thing is likely to result in the achievement of the objective referred to in paragraph (1)(c) above, the ACCC must have regard to the following matters:

(a) whether it is, or is likely to become, technically feasible for the services to be supplied and charged for, having regard to:

(i) the technology that is in use, available or likely to become available; and

(ii) whether the costs that would be involved in supplying, and charging for, the services are reasonable or likely to become reasonable; and

(iii) the effects, or likely effects, that supplying, and charging for, the services would have on the operation or performance of telecommunications networks;

(b) the legitimate commercial interests of the supplier or suppliers of the services, including the ability of the supplier or suppliers to exploit economies of scale and scope;

(c) the incentives for investment in:

(i) the infrastructure by which the services are supplied; and

(ii) any other infrastructure by which the services are, or are likely to become, capable of being supplied.

(4) For the purposes of paragraph (3)(c) above, in determining incentives for investment, the ACCC must have regard to the risks involved in making the investment.

(5) The objective of any-to-any connectivity is achieved if, and only if, each end-user who is supplied with a carriage service that involves communication between end-users is able to communicate, by means of that service, with each other end-user who is supplied with the same service or a similar service, whether or not the end-users are connected to the same telecommunications service.

The ACCC has said that access prices for declared services should, in general, be based upon the Total Service Long Run Incremental Cost (plus an allocation of common costs) ("**TSLRIC+**") of providing the service.[1]

**Report**

Telstra has instructed us to request you to prepare an expert report expressing your opinion as to the following questions:

(a) what are, among economists, commonly accepted as the essential attributes of a TSLRIC + model;

(b) to what extent does the TEA Model embody the attributes of a TSLRIC+ model as identified by you in response to (a) above; and

(c) assuming that appropriate variable inputs are used in the TEA Model, will the TEA Model produce a reasonable estimation of the TSLRIC+ of supplying the ULLS.

For that purpose, please find enclosed the following:

1 an extract of the relevant portion of Part XIC of the TPA and the ULLS service declaration;

2 a copy of the ACCC's:

(a) Access Pricing Principles – Telecommunications, a guide, July 1997;

(b) Unconditioned Local Loop Service - Final Pricing Principles, November 2007; and

(c) Draft Indicative Prices for ULLS.

[1] ACCC, *Access Pricing Principles – a guide, July 1997* at 28

These documents set out the ACCC's view as to the principles that should be applied when setting a price for ULLS.

3 a copy of all of the documents lodged by Telstra with the ACCC to date in relation to the Undertaking, including:

(a) a user manual for the TEA Model; and

(b) the documentation for the TEA Model which explains the operation of the TEA Model by reference to each of the calculations by which it estimates the cost of providing ULLS.

4 a copy of the TEA Model; and

5 a copy of the Guidelines for Expert Witnesses in Proceedings in the Federal Court of Australia.

If it would assist you to review previous decisions of the ACCC and/or the Australian Competition Tribunal in relation to other cost models these can be accessed via the ACCC's website (www.accc.gov.au) and the Australian Competition Tribunal's website (www.competitiontribunal.gov.au).

**Guidelines for Expert Witnesses**

In preparing your report you should review and comply with the Federal Court of Australia's *Guidelines for Expert Witnesses*. Please let us know if you have any questions in relation to those guidelines or your obligations under them.

**Confidentiality**

Certain data in the TEA Model and in the enclosed submissions to the ACCC are confidential to Telstra. Before you use the Model or read the submissions at tabs 9, 13 or 14, please sign and return to us the enclosed confidentiality undertakings. Anyone else who will have access to the TEA model or submissions for the purpose of assisting you in relation to this matter (other than secretarial or administrative staff) should also sign undertakings in those terms and return them to us. We will be grateful if you could email to us a scanned copy of the competed undertakings before sending the original to us.

Please do not hesitate to contact David Healey on +61 2 9296 2187 if there is any other information that you require for the purpose of preparing your report.

Yours faithfully

Mallesons Stephen Jaques

MALLESONS STEPHEN JAQUES

Mr Nigel Attenborough
NERA Economic Consulting
15 Stratford Place
London W1C 1BE
United Kingdom

26 June 2008

**By email**
**nigel.attenborough@nera.com**

Dear Mr Attenborough

**Telstra Efficient Access Cost Model**

We refer to our letter of instruction dated 22 May 2008 and your email dated 13 June 2008 seeking further instructions.

We respond to your email as follows, adopting your paragraph numbering:

1 The file "TEA-Data-V1.0-mdb" is included in version 1.0 of the TEA Model which we provided to you under cover of our letter dated 22 May 2008. This file can be found in the folder tilted "Data" which should be located in the same folder where the model has been installed on your computer.

2 In addition to re-dimensioning the cable sizes in the distribution network the TEA Model uses optimised cable routes. That is, where two or more cable routes (conduits) exist between two network structures, only the shortest of those possible routes is used to calculate the length of the cable between them.

3 The distribution network is separated as between distribution areas that are either wholly or partially provisioned with copper and distribution areas ("**DAs**") that are wholly provisioned with fibre. The ULLS version of the TEA Model is designed to estimate the cost of ULLS only. The cost estimated by the Model excludes DAs that are wholly provisioned with fibre because pursuant to the service description for ULLS, fibre is not capable of supporting ULLS. However, the model does take into account the fact that the main network that connects non-ULLS DAs to the exchange sometimes shares the same main network assets used to service ULLS DAs. The distribution network is discrete for each distribution area and therefore no allowance is made for sharing in the distribution network between fibre and copper routes.

4 We will revert to you shortly with further instructions in relation to paragraph 4 of your email.

Yours faithfully

David Healey
Solicitor
Direct line +61 2 9296 2187
Email david.healey@mallesons.com

Agata Jarbin
Partner

# MALLESONS STEPHEN JAQUES

Mr Nigel Attenborough
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7 July 2008

David Healey
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Partner
Agata Jarbin

Dear Mr Attenborough

**Telstra Corporation Limited**
**TEA Model**

We refer to our letters of instruction dated 22 May and 26 June 2008, and your email dated 29 June 2008.

In your email you asked us to explain why some fibre costs are included in the "Investment Summary" and "Annual Cost Summary" worksheets of the TEA Model. We are instructed that the TEA Model calculates the per line cost of the main network by dividing main network cost (including both the copper and fibre components of that cost) by the total number of lines in all distribution areas ("**DAs**"), being those that are fibre fed (and therefore not capable of supporting ULLS) and those that are copper fed. This approach is explained at paragraph 264 on page 50 of the TEA Model Documentation.

We **enclose** a copy of the ACCC's Discussion Paper in relation to Telstra's ULLS undertaking, which identifies the matters on which the ACCC seeks submissions from interested parties. You may find that paper of assistance in preparing your report.

We will provide further instructions in relation to the other question raised in your email in due course.

Yours faithfully

Mallesons Stephen Jaques

Encl

# MALLESONS STEPHEN JAQUES

Mr Nigel Attenborough
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15 Stratford Place
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United Kingdom
**By email**

22 August 2008

Christopher Rogers
Direct line
+61 2 9296 2344

Partner
Agata Jarbin

Dear Mr Attenborough

**Telstra Corporation Limited**
**TEA Model**

We refer to our previous letters of instruction in this matter.

On 8 July 2008 the ACCC wrote to Telstra informing it of certain errors which it identified in version 1.0 of the TEA Model. On 6 August 2008 Telstra provided to the ACCC version 1.1 of TEA Model which addressed the issues identified by the ACCC and incorporated some other minor changes.

We enclose, for the purpose of preparing your expert report, copies of the ACCC's letter dated 8 July and Telstra's response dated 6 August 2008 and its enclosures:

1 version 1.1 of the TEA Model;

2 a document explaining the changes made between versions 1.0 and 1.1 of the TEA Model;

3 a revised version of the "TEA Model Documentation, and

4 addendum to the "TEA Model Documentation".

We have not included a copy of the base data file for version 1.1 of the TEA Model with this letter. We will send a copy of the base data file to you on CD under separate cover shortly.

Yours faithfully

Mallesons Stephen Jaques

Encls.

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**By email**

1 September 2008

Christopher Rogers
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Partner
Agata Jarbin

Dear Mr Attenborough

**Telstra Corporation Limited**
**TEA Model**

We refer to our letter of instruction dated 25 August 2008.

We enclose the statements of [redacted] and [redacted] in relation to the calculation of the indirect overhead applied in the TEA Model. These statements were inadvertently omitted from the material provided to you under cover of our letter.

Yours faithfully

Mallesons Stephen Jaques

Encls.

MALLESONS STEPHEN JAQUES

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4 September 2008

Chris Rogers
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Agata Jarbin

Dear Mr Attenbrough

**Telstra Corporation Limited**
**TEA Model**

We refer to our previous letters of instruction in relation to your review of the TEA Model.

For the purpose of preparing your report, we enclose:

1 a report prepared by Ovum Consulting for the ACCC in relation to the TEA Model;

2 a report prepared by Marsden Jacob Associates for the Competitive Carriers Coalition which has been submitted to the ACCC in relation to the TEA Model.

Yours faithfully

Mallesons Stephen Jaques

Encls

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# MALLESONS STEPHEN JAQUES

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**By Email**

26 September 2008

Emma Wanchap
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Partner
Agata Jarbin

Dear Mr Attenborough

**Telstra Corporation Limited**
**TEA Cost Model**

We refer to our previous letters of instruction in relation to your review of the TEA Model and your emails dated 1 September 2008, 9 September 2008 and 23 September 2008. In response to those emails we are instructed that you should make the following assumptions for the purposes of preparing your report.

**Fibre leased lines**

The Unconditioned Local Loop Service (**"ULLS"**) is:

> "*...the use of unconditioned communications wire between the boundary of a telecommunications network at an end-user's premises and a point on a telecommunications network that is a potential point of interconnection located at or associated with a customer access module and located on the end-user side of the customer access module.*"[1]

Therefore where a distribution area (**"DA"**) is fed exclusively by fibre no ULLS can be provided from the exchange in that DA. Thus in calculating the costs of ULLS, the TEA Model eliminates equipment and lines connected in those DAs from the cost of the distribution network. Where a DA is fed by both copper and fibre, the TEA Model includes costs of the distribution network as if it were a copper fed DA.

In relation to fibre-fed DAs, a description is set out at pages 27 and 28 of Telstra's response to the ACCC's discussion paper dated 12 August 2008 (Tab 7 of Volume 2 of your brief). In summary:

---

[1] Australian Competition and Consumer Commission website, Unconditioned Local Loop Service, http://www.accc.gov.au/content/index.phtml/itemId/764827

> *"As described in paragraph 144 of the TEA Model Documentation, to account for this sharing the TEA model estimates the costs of the entire Main Network for each Exchange, including both fibre routes and copper routes. These total costs are then divided by all CAN lines in each exchange to develop on average Main Network cost per line.*
>
> *This approach assures that the cost of the main coble network are shared proportionately by all DAs in each ESA, irrespective of whether they are fibre fed or copper fed. A consequence of this approach to sharing main network costs is that a small proportion of optical fibre, multiplexing and fibre termination costs are allocated to ULLS. Conversely, some amount of copper ULLS main network costs are spread over the fibre-only fed DAs. This is expected to offset the effect of some part of the fibre costs being shared. The important consideration is that the costs of trenching, conduit and placement for the Main Network are shared equitably amongst all CAN lines in the ESA."*

We are further instructed that the TEA Model accounts for building terminals fed by fibre (including all fibre leased lines) in the main network costs.

Aside from some rare instances of fibre to the home installations, which are likely to be captured in the fibre-fed DAs, there is no fibre in Telstra's distribution network.

**Sharing duct and trench between the distribution network and Inter Exchange Network ("IEN")**

We are instructed that there is no sharing of trenching and conduit between the IEN and distribution network in Telstra's network.

The description of the TEA Model's approach to sharing between the IEN and the CAN is set out at pages 26 and 27 of Telstra's response to the ACCC's discussion paper dated 12 August 2008 (Tab 7 of Volume 2 of your brief).

> *"It is assumed that 10% of trenches and conduit in the main network are shared by main and IEN cables. Telstra expects that this estimate over states the actual extent of trench sharing ..."*

The cost offset has been made only against the main network to simplify the model.

Please also note that the extent of actual sharing between the distribution and main networks is measured and included in the model (approximately 6% of distribution trench length is shared with main). Further details are set out at paragraph A.1.2 on page 1 of the enclosed submission entitled "Modifications in v1.2 of the TEA Model".

**Sharing of trench and duct with third parties in the main network**

A description of the TEA Model's approach to sharing between Telstra and third parties is set out at page 28 of Telstra's response to the ACCC's discussion paper.

In summary:

> *"The TEA Model subtracts from the annualised CAN cost the annual revenue received by Telstra from service providers for leased conduit space. Telstra does not record whether the lease conduit space is in trenches reserved for the IEN, the CAN or shared between them. Telstra's records also do not specify the band in which the leased conduit is located. Hence, Telstra allocates the least revenue between the bands. Only those revenues allocated to the Band 2 CAN are deducted from the cost of ULLS Band 2 lines."*

Other than shared trenches in new estates, this conduit leasing revenue adjustment is the only sharing adjustment made in the TEA Model to account for third party sharing. The adjustment is made to the annual aggregated network costs. It is not applied separately to the main or distribution networks. For the reasons set out in the statement in relation to trench sharing filed with the ACCC on 12 August 2008, there are no other practical opportunities for sharing with third parties.

**Derivation of network support asset factor for "Network Buildings"**

We are instructed that the network support assets are assigned to specific asset categories in the Regulatory Accounting Framework ("RAF") reports filed by Telstra with the ACCC. The total amounts of network support assets allocated to each account in the RAF, including accounts relating to network buildings were identified. The amounts allocated to the CAN related accounts were extracted from this data for the purposes of calculating the indirect cost factors applied in the TEA Model.

Of the [redacted] of total support assets [redacted] was assigned or allocated to CAN related asset accounts in the RAF.

**Inclusions in "Product and Customer Costs"**

We are instructed that in calculating the indirect and overhead cost factors "Product and Customer Costs" are expenses involved in supporting external wholesale activities, such as wholesale services sold by Telstra to external access seekers, and internal wholesale activities, such as notional wholesale services supplied by Telstra to its retail business units. These activities are as follows:

- Marketing;
- Sales;

- Operator Services;
- Customer Support;
- Billing;
- Bad Debt Expenses;
- Interconnection Costs:
- International Settlement Costs; and
- Other Product Expenses.

"Intangible Costs" are expenses associated with the following wholesale and internal asset items:

- Patents and Trademarks;
- Licences; and
- Goodwill.

All retail associated costs have been excluded from these expenses and asset items.

Please do not hesitate to contact us if you have any further queries.

Yours faithfully

Mallesons Stephen Jaques

MALLESONS STEPHEN JAQUES

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**By Email**

7 October 2008

Emma Wanchap
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Partner
Agata Jarbin

Dear Mr Attenborough

**Telstra Corporation Limited**
**TEA Cost Model**

We refer to our previous letters of instruction.

**Fibre Lines**

Please assume that all business premises outside of fibre fed distribution areas are main fed.

**Inclusions in "Product and Customer Costs"**

We are instructed that the only marketing and sales costs included in the Product and Customer Costs are marketing and sales costs relevant to ULLS. Any retail type costs have been excluded from these categories..

The Intangible Costs (eg internal asset items, patents and trademarks and goodwill) only include wholesale costs as retail costs have been excluded. These costs are allocated across all wholesale products generally based on these products' revenue.

Please do not hesitate to contact us if you have any further queries.

Yours faithfully

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MALLESONS STEPHEN JAQUES

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**By Email**

18 November 2008

Christopher Rogers
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Partner
Agata Jarbin

Dear Mr Attenborough

**Telstra Corporation Limited**
**TEA Cost Model**

We refer to our previous letters of instruction in relation to your review of the TEA Model.

**Routes provisioned with more than one conduit**

The default cost results from version 1.2 of the TEA Model show that 99% of the total distribution conduit length and 97% of total distribution conduit investment are for routes with a single conduit. Therefore please assume for the purpose of your report:

(a) that no more than 1% of total aggregate conduit route length contains more than one conduit; and

(b) no more than 3% of the total network investment cost is attributable to conduit routes containing more than one conduit.

**Fibre leased lines and the per line cost calculation**

In order to determine the per line cost for the main network, the fibre leased lines are assumed to be voice line equivalents and are counted according to the size of the building terminal block which they serve.

**Network Strategies Review**

We enclose a copy of a review of the TEA Model version 1.1 undertaken by Network Strategies. Please review this document for the purpose of preparing your report.

Please do not hesitate to contact us if you have any further queries.

Yours faithfully

Mallesons Stephen Jaques

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# Appendix D. Curricula Vitae

## D.1. Nigel Attenborough


### Nigel Attenborough

Director

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### Overview

Nigel Attenborough has a BA in Economics from Cambridge University, an MSc in Energy Economics with Distinction from the University of Surrey and an MBA from Kingston Business School, where he won the BPP prize.

Since joining NERA in 1991, Nigel has undertaken and directed a wide range of projects for telecommunications companies, regulatory authorities and government departments in Europe, Africa, Asia, Australasia and South America. These have involved a whole variety of regulatory matters including market definition and the analysis of competition, the impact of liberalisation, assessment of different regulatory regimes, development of regulatory strategy, pricing strategy, the setting of price caps, tariff rebalancing, price discrimination and price squeezes, universal service, number portability and allocation and spectrum management and allocation. He has extensive experience of the construction of LRIC models of interconnection costs, accounting separation, efficiency comparisons, licence valuations, demand forecasting and financial and price cap modelling, cost benefit analyses and economic impact studies.

Nigel has also testified as an expert witness on: the valuation of BT for the purposes of setting business taxes, the setting of mobile termination rates in Australia; two cases involving the estimation of damages in relation to the delayed start up of and restricted access to submarine cables; the estimation of damages relating to breach of a telecommunications revenue sharing contract in Poland; the estimation of damages resulting from the loss of a mobile telecoms licence in a middle eastern country; and the existence of a price squeeze and the related damages in a case involving mobile phone operators in Belgium.

Prior to joining NERA in 1991, Nigel worked for 5 years at BT, latterly as the head of regulatory economics and competition policy. He provided directors and senior managers with advice and analyses on economic issues relating to regulation and pricing, and also managed teams responsible for policy development and analysis of fair trading and competition issues and for dealings with Oftel on matters relating to financial regulation. Earlier he was an economic adviser to the Department of trade and Industry and to the Monopolies and Mergers Commission.

## Qualifications

| | |
|---|---|
| **1988-90** | **KINGSTON BUSINESS SCHOOL**<br>MBA: Winner of BPP prize |
| **1980-83** | **UNIVERSITY OF SURREY**<br>MSc in Energy Economics: Pass with Distinction |
| **1968-71** | **TRINITY COLLEGE, CAMBRIDGE**<br>B.A. Economics |

## Career Details

Time working in telecommunications industry: 22 years
Time working as telecommunications consultant: 17 years

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|---|---|
| **1997 - present** | **NERA ECONOMIC CONSULTING, LONDON**<br><u>Director of NERA and Head of NERA's European Telecommunications Practice</u> |
| **1994** | <u>Associate Director</u> |
| **1991** | <u>Senior Consultant</u> |
| **1990** | **BRITISH TELECOM**<br><u>Manager, Economics and Fair Trading</u> |
| **1988** | <u>Manager, Pricing and Regulatory Analysis</u> |
| **1986** | <u>Economist/Senior Commercial Analyst</u> |
| **1981** | **DTI**<br><u>Economic Adviser</u> |
| **1978** | **DUNLOP LTD**<br><u>Corporate Planning Department (secondment)</u> |
| **1976** | **MONOPOLIES AND MERGERS COMMISSION (secondment)**<br><u>Senior Economic Assistant/Economic Adviser</u> |
| **1972** | **DTI**<br><u>Economic/Senior Economic Assistant</u> |
| **1971** | **ARTHUR YOUNG**<br><u>Articled Clerk</u> |

## Project Experience

### Expert witness

- Expert evidence in a case where Belgacom, the largest Belgian mobile operator, is being sued by the other operators for implementing a price squeeze and depriving them of customers. The case involves assessing whether there has been a price squeeze and, if so, what is the value of damages (2008);

- Expert evidence in an Austrian arbitration case while involves estimation of damages resulting from breach of a revenue sharing contract relating to the Polish long distance telecommunications backbone (2008);

- Expert evidence in a case involving the estimation of damages resulting from the loss of a mobile telecommunications licence (2007-8);

- Expert evidence in ICC arbitration case regarding the value of damages suffered by FLAG as a result of being prevented from accessing VSNL's submarine cable landing station in Mumbai (2006-7);

- Expert evidence in connection with AJC's claim for losses to be recovered from its insurance policy as a result of delay to launch of cable that resulted from accidental damage (2005-6);

- Expert evidence in connection with judicial review of the ACCC's decision regarding the appropriate mobile termination rate in Australia. Evidence covered how costs should be derived and prices set (2004-5);

- Expert evidence to the Lands Tribunal on behalf of Valuation Office Agency (UK) which, among other things, involved constructing a detailed future cash flow model for BT, as part of producing a rating valuation for BT (1999-2000);

- Appearance before Monopolies and Mergers Commission on behalf of T-Mobile (1998);

- Presentation of T-Mobile's case to Ofcom during an investigation into unfair cross subsidisation (1998);

- Expert evidence on damages caused by the failure of equipment used by an international reseller (1997).

### Costing studies

- Review and assessment of Telstra's cost modelling methodology for unbundled local loop services (2008);

- Assessment of BT Openreach's relative efficiency using econometric techniques for Ofcom (2007);

- Construction of LRIC cost model for mobile operator in Pakistan. Results of modelling are to form part of submission to regulatory authority (2007);
- Review and critique of the regulatory authority's mobile LRIC model for Netcom, the Norwegian mobile operator (2006 and 2007);
- Development of methodology for top-down LRIC model for an Italian mobile operator and advice on its implementation (2006 and 2007);
- Construction of bottom-up fixed network and mobile network LRIC models for the Oman telecommunications regulator (2006);
- Development of bottom-up mobile LRIC model for an Italian mobile operator (2005/6);
- Construction of bottom-up fixed network and mobile network LRIC models for the Malaysian communications regulator, MCMC (2005);
- Review of mobile bottom-up LRIC model built for the Romanian telecommunications regulator, on behalf of Orange Romania (2005/6);
- Comparative efficiency assessment of KPN, for the Dutch regulator, OPTA (2005)
- Review of a fully allocated cost model developed by a Israeli mobile operator to estimate its costs of different types of mobile call (including interconnection traffic) and development of top-down LRIC model to estimate mobile termination costs (2004);
- Comparative efficiency assessment of BT's fixed network services, for Ofcom (2004);
- For Korea Telecom, development of bottom-up LRIC model of its access network in a representative sample of areas in order to measure universal service costs (2004);
- Advice to the Chinese Academy of Science on how to construct top down and bottom up LRIC models of the costs of terminating calls on fixed and mobile networks (2003);
- Assessment of the efficiency of NTT West and NTT East for MPHPT, the Japanese Ministry of Communications, (2003);
- Support and assistance to a major European communications operator in its development of a top-down LRIC access cost model (2003);
- For KTF, the Korean mobile operator, the construction of a large LRIC interconnection model for 2G and 3G services (2002);
- Updates of the bottom-up LRIC model of KPN's network costs for OPTA, the Dutch telecoms regulator (2002 and 2003);
- Assessment of comparative cost efficiency for a large European telecommunications operator (2002);
- Assessment and advice on redevelopment of a cost allocation model for a major European cable TV operator (2002);
- Developing a model of the impact of a cost based wholesale access product in the UK for Centrica Telecommunications (2002);

- Validation of costs underlying Eircom’s reference interconnection offer for ODTR, the Irish telecoms regulator (2001);
- Construction of bottom-up LRIC models for fixed and mobile networks for CMC, the Communications Commission in Malaysia (2001);
- Construction of a new bottom-up LRIC model of KPN’s network, for OPTA, the Dutch regulatory authority (2001);
- Advice to the Irish regulator (ODTR) on the reconciliation of the results of bottom-up and top-down models for the incumbent’s costs (2001);
- Construction of unbundled local loop cost model of Deutsche Telekom, for Mannesmann (2000);
- Review of Telecom Italia’s estimate of its unbundled local loop charges and its access deficit, for the Italian Telecommunications Authority (2000);
- Advice to the Italian Telecommunications Authority on the definition of an accounting system based on current costs (2000);
- Construction of a bottom-up LRIC model of Eircom’s network, for ODTR, the Irish regulatory authority (2000);
- Construction of a bottom-up LRIC model of Swisscom’s network, for Bakom, the Swiss regulatory authority (1999);
- Estimate of the costs of different elements of Eircell’s GSM network, for Esat Digifone, the Irish mobile telephone operator (1999);
- Interconnection cost study, involving the construction of a bottom-up LRIC model, the review of a top-down embedded direct cost model and the reconciliation of the results, for OPTA, the Dutch regulator (1998 and 1999);
- Estimation, using a hybrid bottom-up and top-down methodology, of LRIC for network and retail services, for Singapore Telecom (1997);
- Construction of a bottom-up model of Telstra’s call conveyance and access networks, for the Australian Competition and Consumer Commission (1998 and 1999);
- Estimation of LRIC of France Telecom’s conveyance and access networks, for a group of new entrants in France (1998);
- Advice on bottom-up modelling of interconnection costs for NTT in Japan (1999);
- Estimation of the fully allocated, historic costs of terminating calls on Vodafone and Cellnet’s mobile networks, for a UK new entrant fixed network operator (1996);
- For O.tel.O, estimation of LRIC for Deutsche Telecom’s network Services using a bottom-up model (1997);
- Advice to OFTEL on the methodology and development of bottom-up and top-down models of BT’s access and call conveyance network, and reconciliation of the results of the two different approaches (1996 and 1997);

- Estimation of the costs of interconnection and individual services for a regional UK operator and advice on accounting separation and cost allocation (1994);
- Estimating individual service costs for Telefónica in Spain and for the Ministry of Economics in Argentina (1995);
- Modelling the costs of two UK new entrants (1995 and 1996);
- Modelling interconnection and universal service obligation costs for a major European operator (1995);
- Defining and estimating long run incremental costs in the UK (for retail services and for interconnection) using top-down and bottom-up methodologies for Oftel, the UK regulator (1992);
- Modelling the costs of different means of accessing telephone customers, for a UK operator (1995);
- Study of the costs of different mobile telecommunications networks for an Australian operator and, more recently, for a UK operator (1993);
- Study, for a major UK utility, of the costs of outsourcing its telecommunications requirements (1994).

**Regulation**

- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Assistance to Belgacom Mobile in abuse of dominance case brought by the Belgian competition authority (2008);
- Development of new licensing regime in UAE, for the Telecommunications Regulatory Authority (2007);
- Assessment of the case for licensing MVNOs in Israel and the need for mandated access terms if such licensing occurred, for the Minstry of Communications (2007);
- Advice and analysis for a Norwegian mobile operator on the basis for setting mobile termination charges and support to them in their negotiations with the Norwegian regulatory authority (2006 and 2007);
- Study for Vodafone on the rationale for and development of a model (using econometric estimates of price elasticities) to estimate the value of a network externality surcharge on interconnection charges in African countries (2006 and 2007)
- Advice to Wind in Italy on a variety of regulatory issues including bundling, issues raised by next generation networks, fixed and mobile interconnection charges, cost modelling and accounting separation (2006 and 2007);
- Advice to T-Mobile in Hungary on the development of MVNOs in Europe, the factors leading to success or failure, when regulation is necessary, the circumstances under which

access terms should be mandated and the current circumstances in Hungary and their implications for MVNO development (2006);

- Report setting out the arguments relating to deregulation of broadband services and estimation of the potential benefits from doing so in four European countries using detailed input-output analysis, for a major European operator (2005/6);
- Report for UK mobile operator on the impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Advice and analysis for BT in assessing Ofcom's proposals for a modified price squeeze test for broadband services (2004);
- Market definition and assessment of competition in all the main communications markets in Malaysia for MCMC, the Malaysian regulatory authority (2004);
- Various studies for Ofcom, the UK regulator, including:
  - construction of model of BT's OSIS costs (2006);
  - identification of possible new uses for certain parts of the radio spectrum and assessment of the respective costs and benefits, in consortium with Red-M, Cardiff University, Roke Manor and BAE (2005/6);
  - estimation of the costs and benefits of allocating particular parts of the radio spectrum to different uses (2004);
  - assessment of the comparative efficiency of BT's network business (2004);
  - assessment of the comparative efficiency of Kingston Communications (2003);
  - construction of a model for assessing the potential profitability of firms renting exchange lines from BT (2003);
  - assessment of the profitability and efficiency of the UK mobile operators (2001);
  - assessment of the efficiency of BT (2000);
  - cost-benefit analyses of the introduction of number portability and equal access into the UK (1993 and 1995);
  - an analysis of BT's incremental costs and, more recently, a separate series of studies looking at existing models for measuring incremental costs of access and call conveyance and how their results can be reconciled (1992, 1996 and 1997);
  - evaluation of telecommunications provision in Wales and its impact on economic development (1992);
  - analysis of the UK and North American markets for resale (1994);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);
- Advice to the Rwanda government on various aspects of the liberalisation of Rwandatel (2003);

- Study for the World Bank of the comparative effectiveness of regulation in different African countries and the implications for future policy (2003);
- Advice and recommendations to CMC in Malaysia on the scale and possible methods of funding the losses made on line and local call services (2002);
- Advice to ComReg, the Irish regulator, on market definition and assessment of dominance in the context of determining which retail services should be subject to price cap regulation (2002);
- Development of a performance contract with the incumbent operator to address the unmet demand and extend the network for the Egyptian Telecommunications Authority (2000);
- Estimation of Telefonica's universal service obligation costs (2000);
- Advice and recommendations to MCMC in Malaysia on the provision of universal service and the measurement and funding of the costs involved (2000);
- Review of Telecom Italia's estimate of its universal service obligation costs, for the Italian Telecommunications Authority (1999, 2000 and 2001);
- Advice on radio spectrum policy in France for the Ministry of Industry (1999);
- Arguments for and against the introduction of mobile number portability and carrier selection and their application in 8 European countries, for Vodafone Airtouch (1999);
- Advice on the regulatory framework and priorities that should apply given the privatisation of the Bahamas Telecommunications Corporation (1998);
- Assistance to Botswana Telecommunications Authority in the development of a performance contract with BTC, and development of regulatory principles and guidelines for telecommunications prices (1998); A cost-benefit analysis of the introduction of mobile network number portability in Hong Kong, for OFTA (1998);
- Advice to Botswana Telecommunications Authority on the development of a strategy to enable it to meet its mandate (mission statement, organisational structure, staff qualifications, outsourcing needs, funding strategy) (1998-99);
- For DG XIII of the European Commission, study of the regulatory and legal issues associated with the creation of a regulatory authority at the level of the European Union (1997);
- Advice on development of costing system and price setting for OSIPTEL, the Peruvian regulatory authority (1996 and 1997);
- For DG XIII of the European Commission, study examining the implementation and impact of the Open Network Provision (ONP) in Member States (1996);
- Advice and recommendations to the Argentine Ministry of Economics on institutional restructuring of telecommunications regulation (1995);
- A study of the implications of EU telecommunications regulation for a major broadcasting company (1995);

- For a French mobile telecommunications operator, a comparative study of the regulation of fixed wireless local loop services in different countries (1996);
- Advice and analysis for CWC in formulating its strategy in the face of different possible future regulatory scenarios (1998);
- Advice on who should pay what for the costs of number portability, for Oftel in the UK and Optus in Australia (1996).

**Liberalisation**

- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Assessment of the interconnection and retail service costs and access deficit of Batelco, the Bahamas telephone company, and their implications, as part of the preparation for future privatisation and liberalisation (2003);
- Advice to the Algerian Ministry of Telecommunications on the introduction of competition in the mobile market via the award of a second GSM licence (2001);
- Analysis of the development of competition in the mobile market and the implications for regulation for the Greek regulatory authority (2000); For Vodafone Airtouch, an assessment of the state of mobile telephone competition in 8 European countries (1999);
- Analysis of the Greek mobile telecommunications market, including analysis of the state of competition and the development of a model to facilitate international mobile tariff comparisons, for EETT, the Greek telecommunications regulator (1999);
- Advice and analysis relating to feasible liberalisation options given the privatisation of the Bahamas Telecommunications Corporation (1998);
- Development of a framework for assessing whether a market is competitive, for regulatory purposes, for a group of new entrants in the UK (1996);
- Modelling the impact of various EU liberalisation measures on Portugal Telecom and examining the effectiveness of a number of alternative strategic responses (1996);
- Advice to Energis on its response to the DTI's consultative document on the liberalisation of UK international telecommunications services (1996);
- Forecasting the development of the UK telecommunications market and the share of different operators for a group of new UK operators (1995);
- Analysing and modelling the potential impact of liberalisation, and the sustainability of existing tariff structures in a competitive environment for Telefónica de España (1993).

**Interconnection (for costing studies – see above)**

- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Assessment of interconnection cost benchmarking carried out by the NZ Commerce Commission on behalf of Vodafone NZ (2005/6);

- Review of fully allocated current cost mobile network cost model, used for estimating call termination charges, for an Italian operator (2005);
- Expert witness in judicial review of ACCC's decision on mobile termination charges (2004 and 2005);
- Report for UK mobile operator on impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Review of mobile network cost model, used for estimating call termination charges, for an Italian operator (2004);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);
- Provided advice to the Chinese Academy of Sciences on bottom-up and top-down LRIC cost modelling for fixed and mobile networks (2003);
- Advice on the desirability and feasibility of multiple year price controls for interconnection services and interconnecting leased lines for OPTA, the Dutch regulator (2002);
- Advice on the feasibility and design of a local interconnection roll out policy for OPTA, the Dutch regulator (2002);
- Advice and support to OFTEL in connection with the UK Competition Commission inquiry into charges for calls to mobile phones (2002);
- Advised Telefonica Centroamerica (in Guatemala) in a conflict with the fixed operator about fixed and mobile termination rates. The main focus was the issues affecting the cost of termination on fixed and mobile networks and the implications (2002) for interconnection charges;
- Advice to the Malta Communications Authority on the development of a strategy relating to the implementation of cost based accounting systems in the telecommunications sector (fixed and mobile) (2001);
- Analysis of existing LRIC cost models in Germany, for Mannesmann (2000);
- Regular advice on interconnection charges and cost accounting systems, for a variety of entrants in the UK, including CWC, Scottish Telecom, Worldcom, AT&T and Energis (1991-2001);
- Advice to One2One (now T-Mobile UK) in connection with the MMC inquiry into the price of calls to mobile phones (1998);
- Advice to Esat Digifone on the costs of interconnection, including benchmarking the price of terminating fixed calls on mobile networks and vice versa (1998);
- Advice to Telefonica on how its interconnection costs might be expected to differ from those specified in the benchmarks issued by the European Commission (1998);
- Advice to TeleDanmark on how its interconnection costs might be expected to differ from those of BT (1998);

- Study of the implications of a possible new interconnection charging regime for a regional UK operator (1998);
- Analysis, for Portugal Telecom, of the structure and level of interconnection charges, and the method by which they are set, in 14 European and non-European countries (1996);
- Study of the economic impact of a change in the UK system for determining international interconnection charges, for a new UK operator (1995);
- Advice to a major Asian telecommunications operator on number portability, interconnection and access deficit charges and universal service issues (1995);
- An assessment for Telecom Eireann of different interconnection charging options (1993);
- Helping a new UK operator to negotiate its terms and conditions of interconnection (1992).

**Pricing**

- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Advice and analysis for Vodafone in Germany on the setting of mobile termination rates and the underlying costs (2006);
- Support for UPC in justifying its analogue cable TV tariffs to the Dutch Competition Authority (NMa) (2005);
- Development of interconnection price benchmarking system which takes operator and country differences into account for two German mobile operators (2005);
- Development of financial model for setting price cap for SingTel fixed network services, for IDA, the Singapore regulator (2004);
- Assistance to UPC in the construction of a cost model and the use of its output to justify its prices for analogue cable TV services (2003 and 2004);
- Construction of detailed financial models of NTT West and NTT East for the purpose of setting price caps for switched services and leased lines for MPHPT, the Japanese Ministry of Communications (2003);
- Advice on the desirability and feasibility of multiple year price controls for interconnection services and interconnecting leased lines for OPTA, the Dutch regulator (2002);
- Market analysis, efficiency assessment, construction of a financial model and economic advice to ODTR, the Irish regulator, as part of the process of setting a new retail price cap (2002);
- Advice to a European regulator on the development of pricing structures for voice and Internet traffic, and the impact of pricing on competition (2001);
- Construction of a model and forecasts of the revenue, cost and capital expenditure of KPN to estimate the appropriate value of X in the price cap formula for retail telephone service prices, for OPTA, the Dutch telephone regulator (1999);

- § Construction of a UK mobile price index for OFTEL, the UK telecommunications operator (1999);
- § Advice to Telecom Italia about the acceptability and justification of volume discounts (1999);
- § Advice on feasible tariff rebalancing and price controls in Botswana for the Telecommunications Authority (1999);
- § Advice on the impact and effectiveness of price regulation in the UK and US, for NTT in Japan (1997);
- § Advice on pricing strategy to Orange (1997);
- § Analysis of telephone tariffs in Argentina and recommendations regarding future rebalancing options to Ministry of Economics (1995);
- § The development of a pricing strategy model for CWC (1994);
- § Development of business planning models for several new UK operators (1994-1997);
- § Advice to NTL on a wide range of regulatory issues including its price cap review (1991-1996);
- § At various times, advice, analysis and modelling work relating to the review of BT's price cap, for Mercury, the cable TV operators and a number of regional new entrants (1992 and 1996);
- § Analysis for and advice to Telefonica on the arguments for and benefits of tariff rebalancing (1993);
- § Study of the economic impact (including economic efficiency and welfare implications) of a tariff rebalancing programme by Telecom Eireann (1993);
- § Assessment of the possible existence of predatory pricing and cross-subsidisation in the leased lines market, for a UK new entrant (1991);
- § Assessment of transfer pricing issues and pricing policy for Royal Mail (1991).

**Mobile telecommunications (for costing studies – see above)**

- § Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- § Development of demand models for mobile communications in South Africa and their application to assess the size of network externalities (2006/7);
- § Estimation of price elasticities of mobile services for a group of European mobile operators (2005);
- § Report for UK mobile operator on impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- § Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);

- Construction of a LRIC interconnection model for use in Korea to determine the costs to be charged by KTF for the mobile market (2002);
- Advice to KTF on strategic issues (2002);
- In a consortium with BNP Paribas, NERA was selected to advise the Algerian Ministry of Communications on the allocation of a 2G license in Algeria. NERA also provided advice on the valuation of the spectrum (2001);
- Advice as part of a 'due diligence' exercise for PwC India (2001) on behalf of ICICI, who needed to evaluate the potential for funding SCL's (the cellular mobile telephone services provider) expansion and refinancing plans;
- Advice to Ben, a Dutch mobile operator, on the level of call mobile termination charges (2001);
- Construction of bottom-up LRIC models for GSM 900 and GSM 1800 mobile networks for CMC, the Communications Commission in Malaysia (2001);
- Assessment of the economic impact of the UK mobile market for the MTAG (mobile telecommunications advisory group) (2000);
- Analysis and advice to a European operator on the introduction of mobile communications in a subterranean rail network (2000);
- Advice to the Italian Ministry of Communications on the procedures and design of the 3G auction (2000);
- For Vodafone Airtouch, an assessment of the state of mobile telephone competition in 8 European countries (1999);
- Construction of a UK mobile price index, for OFTEL, the UK telecommunications regulator (1999);
- Arguments for and against the introduction of mobile number portability and carrier selection and their application in 8 European countries, for Vodafone Airtouch (1999);
- Analysis of the Greek mobile telecommunications market, including analysis of the state of competition and the development of a model to facilitate international mobile tariff comparisons, for EETT, the Greek telecommunications regulator (1999);
- Advice to One 2 One in connection with the MMC inquiry into the price of calls to mobile phones (1998);
- Advice to Esat Digifone on the costs of interconnection, including international benchmarking of the price of terminating fixed calls on mobile networks and vice versa (1998);
- A cost-benefit analysis of the introduction of mobile network number portability in Hong Kong, for OFTA, the telecommunications regulatory authority (1998);
- Advice on pricing strategy to Orange (1997);
- Estimation of the fully allocated, historic costs of terminating calls on Vodafone and Cellnet's mobile networks, for a UK new entrant fixed network operator (1996);

- Study of the costs of different mobile telecommunications networks for an Australian operator (1993).

**Licence applications**

- Construction of valuation model (using DCF model of detailed revenue and cost projections based on network roll out plan) for 2nd mobile licence in Algeria for the Algerian Ministry of Communications (2001);
- Development of UPC's business plan in support of its participation in the auction for LMDS licences in Switzerland (2000).
- Advice and inputs into the business and investment plans of Bouygues Telecom, and estimate of the impact on employment and GDP, when it bid for and won the third GSM licence in France (1994);
- Advice and inputs into the business and investment plans of Airtel, and estimate of the impact on employment and GDP, when it bid for and won the second GSM licence in Spain (1995).

**Other projects relating to business plans and forecasting**

- Expert evidence in a case involving the estimation of damages resulting from the loss of a mobile telecommunications licence (2007-8);
- Advice and analysis for VOA in connection with the state aid investigation mounted by the European Commission in connection with the way that the rating assessment of BT had been carried out (2006);
- Expert witness for insurance company regarding assessment of damages relating to delay in completion of trans-oceanic submarine cable (2004);
- Construction of a model and forecasts of the revenue, cost and capital expenditure of KPN to estimate the appropriate value of X in the price cap formula for retail telephone service prices, for OPTA, the Dutch telephone regulator (1999);
- Estimation of employment effects for TIW in respect of its bids for mobile telecommunications licences in Romania, Hungary and the Czech Republic (1997 and 1999);
- Expert assessment of a damages claim relating to the losses incurred by a telecommunications reseller as a result of the failure of its switching equipment (1997);
- Estimation of the impact on employment of liberalising postal services in the UK and France, for UPS (1996).
- Modelling the impact of various EU liberalisation measures on Portugal Telecom and examining the effectiveness of a number of alternative strategic responses (1996);
- Forecasting the development of the UK telecommunications market and the share of different operators for a group of new UK operators (1995); Designing an investment appraisal system for Slovak Telecom and SPT Prague (1995);
- Assistance to Torch Telecommunications in constructing its business plan (1994);

- Estimation of employment effects and advice and analysis in respect of business and investment plans and for the consortia which won the PCN licence in France and the second GSM licence in Spain (1994 and 1995);
- Analysing and modelling the potential impact of liberalisation, and the sustainability of existing tariff structures in a competitive environment for Telefónica de España (1993).

## Publications

"Money, Oil and the Sterling Roller-Coaster: An Examination of the Causes of Recent Exchange Rate Changes", MSc Dissertation, *University of Survey*, 1983.

"Employment and Technical Change: The Case of Microelectronic-Based Production Technologies in UK Manufacturing Industry", *Government Economic Service Working Paper* No.74, Department of Trade and Industry, London, 1984.

"Government Regulation and the Development of Public Terrestrial Mobile Communications", MBA Dissertation, *Kingston Business School*, May 1990.

"Economic Effects of Telephone Price Changes in the UK", with Robin Foster and Jonathan Sandbach, *NERA Topics No. 8*, London, September 1992.

"Regulation of Competitive Telecommunications Markets", *NERA Topics No 12*, London, September 1993.

"Pricing and the Development of Competition in UK Telecommunications", published by *Datapro International*, April 1994.

"Measurement and Funding of USO Costs: Some Brief Concluding Thoughts" in "USO in a Competitive Telecoms Environment", *Analysys Publications*, February 1995.

"Are Three to Two Mergers in a Market with Entry Barriers Necessarily Problematic?" with Fernando Jimenez and Gregory Leonard, *European Competition Law Review*, October 2007.

## Presentations

"Privatisation and Competition: The Impact on BT", paper Presented to *CPC Conference*, Amersham, May 1991.

"What do Users want from the Regulators", Paper presented *to Networked Economy Conference*, Paris, March 1992.

"Local Loop Competition: The Key Regulatory Issues", paper presented *to 5th Economist Telecommunications Conference*, Vienna, September 1993.

"Pricing and the Development of Competition in UK Telecommunications", paper presented to *AIC Conference on Regulation and Infrastructure*, London, December 1993.

"How should Interconnection Charges be Set?", paper presented to *IIR Conference on Negotiating Interconnection Agreements*, London, April 1994, and also October 1994.

"Regulation and the Development of Competitive City Telecommunications", *AIC Conference on City Telecoms Networks*, London, October 1994.

"Measurement and Funding of USO Costs: Some Brief Concluding Thoughts", paper presented to a *Symposium on USO in a Competitive Telecoms Environment*, Magdalene College, Cambridge, December 1994.

"Telecommunications Liberalisation in the UK", paper presented to *IBC Conference on Competition in Asia's Telecom Markets*, Hong Kong, June 1995.

"Economic and Accounting Issues Relating to Interconnection Charges", paper presented to *IBC Interconnection Conference*, London, September 1995.

"Analysis of Proposed EC Interconnection Directive", paper presented *to IIR Cable Telephony Conference*, London, January 1996.

"Using Incremental Costs for Interconnection Charging" paper presented to IIR Interconnection '96 Conference, London, January 1996.

"Funding of Universal Service and Local Access Costs in the UK", *Vision in Business Conference on Costing and Accounting of Interconnection*, London, January 1996.

"Establishing a Regulatory Regime that Promotes Fair Competition", *IIR Conference on Telecoms Regulation*, London, April 1996.

"Liberalisation and Competition in International Services", *AIC Conference on International Telecoms Pricing and Facilities*, London, October 1996.

"Interconnection Charges: Where have we Come from and Where are we Going?", SMi *Conference on Practical Strategies for the Negotiation of UK and European Interconnection Charges*, London, October 1996.

"Economic Aspects of Interconnection Agreements", *AIC Seminar on Interconnection Agreements*, Frankfurt, October 1996.

"Employment Impact of Postal Services Liberalisation", *Satisfying Consumer Needs in the Global Village: The Postal Challenge,* Global Panel, The Hague, December 1996.

"Setting Interconnection Charges: An Evaluation of the Alternatives", *IIR Interconnection '97 Conference,* London, February 1997.

"Impact of Regulation on Profitability of Telecommunications Investments: The Case of Cable Television Networks", *Aspectos Juridicos de Las Telecomunicaciones,* Instituto de Fomento Empresarial, Madrid, March 1997.

"Long-run Incremental Cost and its Use for Setting Interconnection Charges", *Vision in Business Workshop,* Brussels, March 1997.

"Measurement of Universal Service Costs in Telecommunications", *Centre for Asia Telecoms Conference on Cost Allocation in Telecoms,* Singapore, April 1997.

"Current developments in Interconnection charging" *SMi Conference on Practical Strategies for the Negotiation of UK and European Interconnection Charges,* London, April 1997.

"How Should Interconnection Costs be Measured? *Vision in Business 4th International Interconnect Forum,* Brussels, September 1997.

"The Structure of Reform in Telecommunications Interconnection across Europe", *SMi Conference on UK and European Interconnection Charges,* Brussels, November 1997.

"International Interconnection Rates and Costs", *IBC 1997 International Forum on Interconnection,* Amsterdam, November 1997.

"Evaluation of Different Methods of Determining Costs and Setting Interconnection Charges", *IIR Interconnection Conference,* London, January 1998.

"Measurement of Interconnection Costs and Setting Interconnection Charges", *Institute of Telecommunications*, Warsaw, June 1998.

"Why Use Long-Run Incremental Costs?", *IIR Conference on Allocating Costs in the Telecommunications Industry*, London, July 1998.

"Regulation and Number Portability", *IIR Conference on Developing Effective Regulatory Strategies for Telecommunications Operators*, London, October 1998.

"Using Conjoint Analysis to Forecast Demand and Determine Telecommunications Pricing structures", *IIR Conference on Market Forecasting for Telecommunications Operators*, London, November 1998.

Issues Arising from the MMC Inquiry into Charges for Calls to Mobile Telephones in the UK", *European Mobile Telecommunications Regulation and Competition Law Conference,* Brussels, March 1999.

"Regulation of Number Portability and Carrier Pre-Selection", *IIR Interconnection '99 Conference,* London, March 1999.

"Bottom-Up LRIC Modelling: What Does it Involve and How Can it be Used", *Vision in Business Conference on LRIC and Cost Allocation for Interconnection Pricing,* Brussels, April 1999.

"Number Portability: Challenges and Solutions", *IIR Conference on Technical and Commercial Strategies for Telecoms Operators,* London September 1999.

"Control of Mobile Interconnection Prices", *European Mobile and UMTS Regulation and Competition Law Conference,* Paris, April 2000.

"How Regulatory Considerations Affect Business Plans", *Vision in Business Valuation and Bidding Strategies Workshop,* Paris, April 2000.

"Regulating Wholesale Services: The European Experience", *London Business School Conference on Regulating Wholesale Services Prices,* London, April 2001.

"Competing in a Regulated Telecommunications Environment", *Infocom 2001*, Budapest, May 2001.

"Regulation of Dynamic Industries", *BT Conference on "The New World Order in Regulation"*, London, September 2001.

"Cost Allocation and Recovery for New Services", *IIR Conference on Cost Control and Profitability in Telecoms*, London, October 2001.

"Applying LRIC to Fixed to Mobile Interconnection", *Vision in Business Conference on Network Cost Reduction in Telecoms,* London, November 2001.

"Applying LRIC to Fixed to Mobile Interconnection", *Vision in Business Conference on Network Cost Reduction in Telecoms,* London, April 2002.

"Cost Based Pricing for Mobile Termination", Vision in Business Conference on Mobile Regulation and Competition Law, Brussels, July 2003.

"Implications of Broadband Deregulation for GDP and Employment in Europe: Some Case Studies Using Input-Output Analysis", London Business School Regulatory Seminar, June 2006.

## D.2. Soren Sorensen


# Dr. Soren Sorensen

Senior Consultant

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Dr Soren Sorensen specialises in game theory and industrial economics and has particular expertise in auction design, bidding strategies and auction implementation.

As a Senior Consultant in NERA's Communications Practice, Dr Sorensen has been involved in the design and implementation of several auctions. Examples include implementation of an auction of FWA licenses for PTS, Sweden; design and implementation of an auction of natural gas for the Danish gas company DONG; design and implementation of an electricity procurement auction for Italian Acquirente Unico. During the majority of these auction projects, Dr. Sorensen has been involved in the development of software for analyzing bidding behaviour and software for processing bidding data. Other work include advice on bidding strategies in first-price auctions as part of the preparatory work for Ofcom's renewal of the Channel 3 Licence; advice on design of energy capacity auctions for US system operators; a study for the European Commission on the feasibility of auctioning airport slots using combinatorial auctions.

Soren has been involved two studies on Mobile Virtual Network Operators (MVNOs) for T-Mobile in Hungary and for the Ministry of Communications in Israel. Soren has also performed cost-benefit analyses for Ofcom, as part of Ofcom's Spectrum Efficiency Scheme. The analysis has covered scenarios where different wireless services would occupy either dedicated or shared spectrum. Other work in the telecommunications industry includes optimisation of telecommunications networks, and giving advice on network design algorithms. Most recently Soren has applied a merger simulation model to evaluation of welfare effects of different allocations of 900MHz spectrum (refarming) in the Spanish mobile market.

Dr. Sorensen is fluent in Danish and English and holds a PhD in economics from the University of Aarhus, Denmark, where he specialized in game theory and auction design. Dr. Sorensen has recently published part of his PhD thesis in Economics Letters.

## Qualifications

| | |
|---|---|
| **2002** | **UNIVERSITY OF AARHUS, DENMARK**<br>PhD in Economics |
| **2001** | **THE PENNSYLVANIA STATE UNIVERSITY, USA**<br>Visiting Student |

| | |
|---|---|
| **2000** | **EUROPEAN ECONOMIC ASSOCIATION**<br>Young Economist Award |
| **1998** | **UNIVERSITY OF AARHUS, DENMARK**<br>MSc in Economics (Cand.Oecon) |
| **1997** | **UNIVERSITY OF SOUTHAMPTON, UK**<br>MSc in Economics |
| **1995** | **UNIVERSITY OF AARHUS, DENMARK**<br>BA in Economics |

## Career Details

| | |
|---|---|
| | **NERA ECONOMIC CONSULTING, LONDON** |
| **2008 - present** | Senior Consultant |
| **2004 - 2007** | Consultant |
| **2003** | Analyst |
| | **OXFORD ECONOMIC RESEARCH ASSOCIATES** |
| **2002 - 2003** | Consultant |
| | **MINISTRY OF BUSINESS AND INDUSTRY, DENMARK** |
| **1998 - 1999** | Head of Section |

## Selected Project Experience

## Auction Projects

- Auction design for auction of gas storage capacity. Development of detailed rules for a simultaneous multiple-round clock auction. For DONG Energy, Denmark (2008);
- Advice on auction of ‘interruptible capacity’ in the gas market. In particular advice on multi-attribute auctions. For Wales & West Utilities, Wales (2008);
- Implementation and administration of simultaneous multiple-round clock auction of 3.6-3.8 GHz FWA spectrum licences. For PTS, Sweden (2007);
- Review of auction design for 2.6 GHz auction, with emphasis on software implementation issues. For PTS, Sweden (2007);
- Report on using auctions and other allocation mechanisms for allocating gas storage capacity. For DONG Energy, Denmark (2007);
- Design, implementation and administration of simultaneous multiple-round clock auction. For DONG Lager A/S, Denmark (2006);
- Bidding advice as preparation for Ofcom’s 1780-1785 MHz combinatorial auction. For COLT Communications, UK (2006);

- § Advice on auctioning WLL Licences. For the Italian Ministry of Communications, Italy (2005);
- § Advice on auctioning LMDS Licences. For the Italian Ministry of Communications, Italy (2004);
- § Design, Implementation and administration of electricity procurement auction. Simultaneous multiple-round clock auction. For Acquirente Unico, Italy (2004);
- § Report on bidding strategies in asymmetric first price auctions. Preparatory work for the allocation of Channel 3 licenses. For Ofcom, UK (2004);
- § Advice on implementation of 2.3-3.5 GHz auction. Simultaneous multiple-round clock auction. For Industry Canada, Canada (2003-4);
- § Comprehensive analysis of the existing centralised resource adequacy market model (CRAM). Evaluation of capacity market auction proposal. For PJM, NISO and ISO-NE, USA (2003-4);
- § Report on the feasibility of airport slot auctions. Analysis of practical as well as theoretical aspects of combinatorial auctions. For the European Commission (2003).

## Other Projects

- § Report on welfare effects of different allocations of 900MHz spectrum (refarming) in the Spanish mobile market, using a calibrated merger simulation model. For France Telecom, Spain (2008);
- § Review and assessment of Telstra's TEA cost model for unbundled local loop services. For Telstra, Australia (2008);
- § Report on development of a new licensing regime in the UAE. For the Telecommunications Regulatory Authority, United Arab Emirates (2007);
- § Assessment of the case for licensing MVNOs in Israel and the need for mandated access terms if such licensing occurred. For the Minstry of Communications, Israel (2007);
- § Cost benefit analysis for a study on licence exempt application-specific bands. For Ofcom under it's Spectrum Efficiency Scheme, UK (2006-7);
- § Advice on the development of MVNOs in Europe, the factors leading to success or failure, when regulation is necessary, the circumstances under which access terms should be mandated and the current circumstances in Hungary and their implications for MVNO development. For T-Mobile, Hungary (2006);
- § Cost benefit analysis for a study that addressed spectrum sharing as a method of improving spectrum efficiency. For Ofcom under it's Spectrum Efficiency Scheme, UK (2006);
- § Construction of bottom-up IP network LRIC cost model. For the Malaysian communications regulator MCMC, Malaysia (2005);
- § Network optimisation for a sample of Korean Telecom's access network, using minimum spanning tree algorithms on detailed GIS data. For Korean Telecom, Korea (2004);

- § Report on using network design algorithms for calculating the cost of local call conveyance in telecommunications networks. Network optimisation using minimum spanning tree and ring algorithms. For Singtel-Optus, Australia (2003);

## Publications

"Sequential Auctions of Stochastically Equivalent Complementary Objects", Economics Letters, 2006, Volume 91, Issue 3, pages 337-342.

"Optimal Sequential Auctions for Complements", NERA Working Paper, 2003.

Phd Thesis: "Aspects of Sequential Auctions for Complements and Agglomeration", Department of Economics, University of Aarhus, Denmark, 2003.

## Conference Presentations

Nordic Workshop in Industrial Economics, University of Copenhagen, 2003. "*Optimal Sequential Auctions for Complements*".

12th International Conference on game Theory, SUNY at Stony Brook, 2001. *"Declining Prices in Sequential Auctions for Complements"*

28th Annual Meeting of the European Association for Research in Industrial Economics, University of Dublin, 2001. *"Declining Prices in Sequential Auctions for Complements"*

Midwest Economic Theory Meeting, Penn State University, 2001. *"Industrial Agglomeration as a Governance Structure"*

5th Spring Meeting of Young Economist, Oxford University, 2000. *"Market Structure and Industrial Agglomeration"*

XV European Economic Association Congress, Free University of Bozen-Bolzano, 2000. *"Market Structure and Industrial Agglomeration"*

6th Spring Meeting of Young Economist, University of Copenhagen, 2000. *"A Comment on the European UMTS-Spectrum Auctions"*

## Languages

Dr. Sorensen is fluent in Danish and English and has a basic knowledge of German, Swedish and Norwegian.

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