Contestable market asset valuation for the unbundled local loop

A report for Optus

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1. Executive summary

1. CEG has been asked by Optus to provide advice in relation to the ACCC's use of an optimised replacement cost approach to put an 'economic value' on Telstra's copper local loop network for the purpose of setting unbundled local loop service (ULLS) prices for the next three years.

2. We discuss in this report the merit of contestable market principles for asset valuation. We question the objective of pricing (and the ability to price) in a manner which mimics competitive market prices for service that do not have cost structures which allow for competition. Nevertheless, we conclude that if one adopts a contestable market approach to asset valuation then a *quid pro quo* of assuming the network is built in the current context (which may mean higher costs for less accessible 'rights of way') is that the new entrant can fully optimised for new technology, network design, service quality, and capacity.

3. Our advice is that the correct implementation of an optimised replacement cost asset valuation based on contestable market principles will value the existing copper network equal to the forward looking costs a new entrant would expect to incur in building a network based on the most efficient technology. We further advise that the contestable market paradigm *requires* the estimated value of the existing network to be adjusted downwards (upwards) for the value of any greater (lesser) service quality that would be offered by the new entrant's optimised network.

4. We have used the Analysys Fixed Network Cost Model to estimate the costs that would be incurred by a hypothetical new entrant deploying fibre to the premise technology based on a point–to-point network architecture. This involved some modifications to the model as the Analysys model deploys a copper to the home in its base case for the optimised replacement cost valuation of the copper network and calculation of ULLS prices. With our modifications we calculate the total cost for a new entrant fibre access network to be around $32.9 billion which is around $3 billion less than Analysys estimates for a copper to the premise access network deployment. Based on this, we estimate an adjusted *Zone A* ULLS cost of $17.08 per month in 2009, down from the Analysys base case of $21.61 per month (a reduction of 21%).

5. Based on a range of data sources including incremental investments in next generation access networks, market prices for super-fast broadband, and willingness to pay studies, we have calculated a conservative estimate of the additional value created by a fibre to the premise deployment (over the existing copper network) of between $10 billion and $15 billion. Adjusting our new entrant fibre asset valuation above, we reduce the copper network valuation to between $22.9 billion and $17.9 billion, to arrive at an adjusted *Zone A* ULLS price of $11.78 per month and $9.13 per month.

6. We note that as fibre networks become viable for ubiquitous deployment (that is, the business case means that deployment of fibre becomes economic to all existing customers of the copper network) this will necessarily imply a zero contestable market asset valuation for the existing copper network.

7. As we have noted previously, continual revaluation of assets at optimised replacement costs may achieve cost recovery in an expectational sense, but the level of compensation will be highly volatile due to inevitable errors in forecast future input prices (such as copper and fibre).[1] However, if we step outside the contestable market paradigm and seek to compensate the incumbent for the fair value of past investments then this may be achieved by estimating asset values based on existing technologies (such as copper). However, if this is done then the *quid pro quo* discussed above does not apply and higher costs associated with late entry have no economic merit and will likely lead to cost over-recovery. The appropriate calculation of cost associated with late entry (eg, trenches) would need to take into account the circumstances that existed at the time of copper network deployment (eg, open trenches, free access to easements).

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[1] CEG, *Reform of Part XIC: Regulatory Certainty - Increasing regulatory certainty for telecommunications assets in Australia*, Report for Optus, June 2009.

2. Introduction

8. Where possible, competition is generally the preferred means to organise economic activity. Competition between suppliers delivers benefits to consumers in the form of lower cost, higher value goods and services. Where competition is not possible, say because there is natural monopoly, regulators have a desire to mimic the outcomes, or at least pursue the desirable properties, of competitive markets. In a truly competitive market, prices would be set equal to the forward-looking costs of a new entrant who is operating at efficient scale. In reality no market is perfectly competitive and prices will commonly be set above or below this level of costs.[2]

9. The telecommunications local loop is far from competitive. If it was reasonably competitive (or at least contestable), then there would be little reason for regulating. Certainly, there would be no reason to regulate in a fashion that would mimic the prices that would result if they were not regulated. Nevertheless regulators seek to set prices 'as if' the services provided by the local loop were competitive. They do this by 'assuming away' entry barriers and transaction costs associated with acquiring customers – they assume the market is perfectly contestable.

10. The thought experiment to arrive at a value for regulated assets is necessarily circular because we are seeking to arrive at an asset value based on hypothetically competitive market prices, but in reality prices are set by the regulator based on some asset value which it determines.[3] This circularity is resolved by valuing assets based on an estimate of the forward-looking costs that would be incurred by a hypothetical new entrant. In infrastructure markets such as local loop telephony, pricing based on forward-looking costs requires existing assets to be valued (and re-valued) based on the modelled costs a hypothetical new entrant would expect to incur. As the market for local loop telephony is far from competitive, the new entrant is necessarily 'hypothetical' as is its ability to contest the market.

11. The typical thought experiment is of a market which is perfectly contestable. That is, the market exists such that a new entrant (if they did enter) could fully displace the incumbent (acquire all of its customers) if it is more efficient than the incumbent. Of course in reality, this would not be possible - a new entrant would face transaction costs in acquiring customers, face asymmetries in knowing what prices to offer if there are multiple prices, and almost certainly face a competitive response from the incumbent who has a sunk network which never needs to be replaced in one go (so its

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[2] For example, where new entrants will take time to reach an efficient scale prices will tend to be set above new entrant costs even in a growing market. Alternatively, prices may be set sustainably below this level of costs, eg, where declining industry demand and sunk costs lead to competition on the basis of avoidable cost for *existing* players rather than costs for a new entrant).

[3] The asset valuation represents the current value of future expected cash flows. The value depends on the future prices that can be charged in the market.

short term revenue requirement to stay in business would allow very low pricing in response to a competitor).

12. Whilst necessarily hypothetical, there must be some reality to the decision making of a new entrant – they must build a network capable of delivering services to customers at their actual locations. However, an entrant building a new network is unconstrained by legacy decisions of the incumbents with regard to technology choice (eg, copper), location of equipment, service quality decisions, and capacity choices. At the same time, a new entrant may face higher costs than were previously incurred by the incumbent due to less accessible 'rights of way' – easements, trenches, and the like. If one adopts a purely forward looking hypothetical new entrant test then a *quid pro quo* of assuming the network can be fully optimised for new technology is that the optimisation must take place in the current context (eg, where trenches would have to be dug through existing driveways rather than in 'greenfields' property developments as was the case when the current trenches were dug).

13. It is sometimes argued that the objective of the thought process is to reveal the 'economic value' of the asset in a competitive market. This economic value is argued to achieve efficient *build/buy* signals to a new entrant who had the option of using the existing asset or bypassing the existing network by building their own infrastructure. A price based on this asset valuation is the maximum price that would prevent *network-wide bypass of the existing network*.

14. Within this framework we ask what would be the forward-looking costs incurred by a new entrant bypassing the existing network to serve final customers and how would this network constrain pricing of the existing network. An unavoidable complication in this analysis is the potential for differences in service quality between the existing network and the network deployed by the new entrant. If there is no difference in service quality then we would conclude that the maximum (contestable market) revenue from of the existing network is equal to the cost of the new network (consistent with the hypothetically contestable market logic there is zero economic surplus to the new entrant). This is expressed in the equation below:

$R_{old} = R_{new} = C_{new}$; where

$R_{old} =$ the present value of revenues from the old asset in perpetuity[4]
$R_{new} =$ the present value of revenues a new entrant would require in perpetuity[5]
$C_{new} =$ the present value of expenditures a new entrant would incur in perpetuity[6]

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[4] Including any revenues earned post replacement of part or all of that old asset in the future;

[5] Including any revenues earned post replacement of part or all of that new asset in the future;

[6] Including any expenditures on replacement of part or all of that new asset in the future;

15. Under the contestable market logic, as soon as R_{old} exceeds the cost of a new asset (C_{new}) a new entrant is able to sign up all of the existing customers on the same or lower prices (Pareto gain to customers) and enter the market – completely displacing the incumbent.

16. Now, consider the situation where the service quality of a new entrant's asset is different to (e.g., higher than) the service quality with an old asset. Here we know that in a contestable market R_{old} must be less than C_{new} in order to forestall entry. That is, in a contestable market you can't charge the same price for an inferior product. Rather, in a contestable market a firm would have to charge a price that was lower than the price (cost) of a new entrant by an amount that was equal to the value customers placed on the higher service quality provided by the new entrant.

17. In other words, if we simply apply the same logic as applied where service quality is assumed to be the same then we arrive at the following conclusion:

> *A new entrant could sign up all of the existing customers by offering prices that never exceeded the incumbent's prices plus the additional value of service provided by the new entrant (providing a Pareto gain to customers). This means that R_{old} cannot exceed the cost of a new asset less the higher consumer value from a new asset.*

18. It follows that with differences in service quality the maximum (contestable market) revenue is equal to the cost of the new network less the additional value created by the new network:

$$\mathrm{R}_{old} = C_{new} - (V_{new} - V_{old)})$$

19. In this report we consider the case of a hypothetical new entrant deploying a fibre to the premise (FTTP) network and what that would imply for the value (and hence 'contestable market' revenues) of the existing copper to the premise (CTTP) customer access network. We use the Analysys Fixed Network Cost Model (FNCM) to calculate the cost a new entrant would incur if it were to deploy a fibre to premise network in Australia (C_{new}). Then, we estimate the incremental value to consumers of services that could be delivered by fibre versus copper (in its current configuration) $(V_{new} - V_{old)}$.

20. In relation to a FTTP deployment we have worked with Dr Murray Milner (see Milner Consulting Report) to conclude that a new entrant considering a 'greenfields' deployment would likely deploy a fibre to the premise network using a combination of passive optical network and point to point fibre network for residential and business customers respectively. Due to constraints in the Analysys model estimate the cost of

a point to point network deployment (which would be expected to be more costly than a passive optical network).

21. We investigate the incremental value difference between fibre and copper networks in three ways, including using:

    i. Estimates of the incremental ‘brownfields’ investments local loop incumbents are willing to commit to upgrade their networks to super-fast broadband speeds;
    ii. Survey data on the additional willingness of consumers to pay for super-fast broadband over high-speed broadband; and
    iii. Direct price premiums observed in markets in which super-fast broadband over fibre is provided in competition with high-speed broadband over copper using DSL technology.

3. The hypothetically contestable market

22. The regulation of access to monopoly infrastructure such as the copper local loop network is justified on the grounds that unregulated competition will harm the efficient operation of related markets and reduce incentives for efficient consumption of the services of the network and investment in the network. Left unregulated, prices will be set above cost (at monopoly levels) and investment in downstream markets will be deterred (due to expropriation risks). Regulation in this context serves the standard objectives of regulation which are to promote competition, efficiency in the use of existing infrastructure, and efficient investment in new infrastructure.

23. The objectives of promoting competition and efficiency are often conflated with the objective of mimicking competitive (or contestable market) prices. Whilst downstream competition and efficiency would be promoted if the regulated infrastructure was not a natural monopoly, it is not necessarily the case that that these objectives will be achieved when regulation seeks to mimic competitive prices in the context where industry cost functions mean competition infeasible. For example, efficient use of existing infrastructure will be promoted if prices equal short-run marginal costs. In addition, the price which encourages efficient bypass is one that is no greater than the avoidable costs of providing those services on the existing network (that is, the cost of operating and maintaining the existing network). However, such prices are likely to be far less than the 'forward looking efficient cost' of building an optimised replacement network by a new entrant – the so-called competitive (or contestable market) prices.

24. The ACCC describe its reasoning for valuing existing assets based on forward looking costs follows:

> *The ACCC has valued the copper CAN at optimised replacement cost for TSLRIC+ access pricing because it considered that estimating TSLRIC+ requires assets to be valued at their economic cost. The* ***forward looking nature of optimised replacement costs is argued to better capture economic costs*** *than either backward looking historic costs or current costs. This is because forward looking replacement costs reflect the ongoing efficient costs of providing a service, which is no more than a firm could expect to recover* ***in a contestable market.***
>
> *...*
>
> *For the indicative prices in this document the ACCC proposes to rely on the TSLRIC+ pricing principle of a forward-looking approach to sunk asset valuation without a deduction for depreciation (that is, re-valuing the existing sunk network at its optimised replacement cost). As noted above, this approach was originally adopted because it was thought that there was more potential for bypass of telecommunications infrastructure than other regulated infrastructure (e.g. gas*

> *pipelines) and therefore* ***a forward-looking approach was implemented to create efficient build or buy signals****.*
>
> *Given that some fixed network telecommunications infrastructure has the features of an enduring bottleneck, one of the main rationales for TSLRIC+ (to send efficient build-or-buy signals) may no longer be appropriate beyond this set of pricing principles and indicative prices. Indeed, in the event of a significant change in the regulatory environment during the term of these prices the ACCC would be open to reconsidering the prices and pricing principles.*
>
> *..*
>
> *Despite the concerns outlined above, the ACCC intends to adopt a TSLRIC+ principle for the pricing for the six fixed network services for the period from 1 August 2009 until 30 June 2012. [emphasis added]*

3.1. What is the nature of contestability assumed?

25. The supply of services over local loop infrastructure is not contestable. There are significant barriers to entry in the market, most notably economies of scale and scope, which prevent sufficient infrastructure competition. This is an important fact. If it were not true, and we believed that the conditions allowed for competition, or at constraints from a potential contestant for the market, then there would be significantly fewer reasons for regulating at all.

26. With the objective of mimicking contestable market conditions, regulators 'assume away' the elements of the market which prevent true contestability. Most importantly, regulators assume that the market is contestable on an 'all or nothing basis'. That is, in considering the post entry unit costs that would be incurred by the new entrant they assume that the new entrant could fully displace the incumbent on a network-wide basis. On the basis of this assumption regulators are able to assume a new entrant could acquire all the incumbent's customers if the new entrant's costs were less than the incumbent's revenues.

27. This exaggerated concept of contestability effectively assumes away economies of scale as a barrier to new entrants contesting the market. It also assumes away transaction costs which are a significant real world barrier to entry. It (unrealistically) requires that:

    a. A new entrant would know what price/quality combination that each and every customer is currently purchasing from the incumbent; and

    b. A new entrant would be able to get all customers to focus on and take a new offer, even if it is only marginally better than their existing offer (and may be no better for some customers).

28. In reality transaction costs would defeat any attempt to capture the entirety of the market. If, in reality, a new entrant would be lucky to serve one in every two households then their unit trenching costs would be double the costs assumed for a new entrant serving the entirety of the market. Therefore the unit cost constraint imposed on the incumbent by the threat of entry would be significantly higher than what is calculated in forward-looking cost estimates.

29. In addition, the concept of contestability assumes away any competitive response from the incumbent who has an existing network made up of large irreversible investments – they are assumed to find it not worthwhile to continue to compete using the existing network.[7] In reality, a potential new entrant would not enter based on the prices the incumbent charges pre entry but rather based on the prices the incumbent is expected to charge post entry. With long lived and sunk assets the incumbent is likely to charge much lower prices post entry and the potential new entrant would factor this into their entry decisions (ie, would not be enticed to enter by the incumbent pricing above new entrant costs because they would expect prices to fall below their costs post entry).

30. Of course, the above discussion is just another way of saying that there is a need for regulation because, in the real world, there is no potential new entrant that constrains the incumbent's prices to reflect the costs of a new entrant.

3.2. How much reality should be assumed in the contestable market?

31. The purpose of regulation is, in part, to prevent the incumbent exploiting their market power to the detriments of economic efficiency. It would therefore be illogical to include in the new entrant costs being modelled precisely the same barriers to entry (in terms of high transaction costs of winning customers and resulting inefficient scale post entry) that create the need for regulation in the first place.

32. However, if the objective is to calculate a realistic estimate of the unit cost of a new entrant who did not face such barriers to entry then the modelled costs must take into account the realities faced by a new (late) entrant in building a competing network. These would include the technical requirements to provide services to the customers in their actual locations and the technical constraints of building a network in the physical environment in which the network would be built (eg, roads, bridges, rivers, lakes, etc). Of course, no model (whether it be of the incumbent's network or a hypothetical new entrant's network) can fully capture these technical details and assumptions will provide either an under or over estimate of the actual costs that have been or would be incurred.

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[7] This outcome requires an extreme assumption that the existing network is one indivisible asset which is replaced at one point in time. In reality, this is far from the truth – the existing network is made up of many network elements with different lives. The revenue requirement for the incumbent to stay in business is to cover the future costs of replacing individual network elements as they wear out which would be far less than that required to replace a single network asset in one year.

33. In addition, a new entrant coming late to the market would face higher costs associated with less (more costly) accessibility to rights of way – including footpaths, easements, roads, etc. Of course, while a late new entrant will tend to have higher costs than the incumbent in some regards (eg, needing to dig through driveways that did not exist when the incumbent laid its network) the flipside of this is the flexibility a new entrant has in relation to choice of technology, location of network equipment (subject to planning rules) and trenching/cabling topography (again subject to planning rules) in building the customer access network. Most importantly, the new entrant would have the option of using the most efficient technology. One of the objectives of using contestable market pricing (asset valuations) is to ensure that future prices reflect the most efficient technology choices. Restricting technology choice would defeat the objective of promoting pricing based on forward-looking costs.

34. Unavoidably in these circumstances the new entrant's technology choice may lead to differences in service quality between the incumbent's network and the new entrant's potential network. This outcome is a common feature of real life contestable markets in which pricing for existing technologies is (adversely) affected by new (higher quality) technologies. For example, the advent of higher quality Blue-Ray disc recordings of movies has reduced the price that can be charged for Digital Video Disc recordings of movies. Similarly, the second hand price of a functioning black and white TV would likely be negative (ie, the owner would need to charge to remove it) due to the higher quality available from colour TVs (and the same may be true of colour cathode ray tube TVs now that plasma and LED screens provide higher picture quality).

35. It might be argued that the complication of service quality differences can be avoided by modelling the cost of a new entrant providing the same technology or a different technology providing the same quality of service. However, even if this were possible (which is unlikely to be strictly possible) this is tantamount to protecting the incumbent from potential asset revaluation due to technological change lowering cost and improving service quality. If this is done then it would be inconsistent to have higher costs of 'rights of way' and not 'greenfields' technology choices and network design. If the incumbent is to receive a higher asset valuation because a new entrant incurs costs that the incumbent did not (eg, digging through driveways that weren't there when the incumbent laid its network) then the *quid pro quo* must also be that the incumbent receives a lower valuation if the new entrant would supply higher quality services using technology (eg, fibre in trenches) that the incumbent did not have access to at the time it laid its network.

36. Protecting the incumbent from optimisation, whether it be through holding technology constant or protecting network locational decisions (ie, scorched node) is inconsistent with the contestable market hypothetical. Hence, if we are to 'step outside' that logic then there is no logic in using forward-looking costs as we are no longer mimicking any realistic behaviour of a new entrant.

37. It might also be argued that pricing based on new technologies (with higher service quality) would ensure that those technologies are never built. This would be wrong. Valuing the existing technology on the basis of new technologies will only ever ensure that new assets are not inefficiently put in place due to the monopoly pricing of the existing asset.

38. From a social perspective it is only efficient for new entry with higher quality service to displace the incumbent when the incumbent's asset is worthless factoring in the new technologies available (ie, when customers would be better off paying for an entirely new asset with higher service potential than continuing to use the existing asset). It would not be in the interests of end-users to actually encourage bypass before this point because of the large (socially wasteful) fixed costs of building a new network which could be avoided by giving access to the existing network. In any event, as we have noted, the contestable market logic lives in a fictitious world in which the local loop is contestable. Of course in reality, the market is not at all contestable and prices would have to be very, very high to encourage true bypass.

3.3. Constraint on pricing in a hypothetically contestable market

39. Within this framework we ask what would be the forward-looking costs incurred by a new entrant bypassing the existing network and how would this hypothetical network constrain pricing of the existing network. This describes the 'economic value' of the asset in a perfectly contestable market (ie, a contestable market where the new entrant will acquire all of the incumbents customers if they can beat the incumbents prices and the new entrant does not face transaction costs in acquiring locating and acquiring those customers). A price based on this asset valuation is the maximum price that would prevent *network wide bypass of the existing network* in a perfectly contestable market.

40. Within this framework we ask what would be the forward-looking costs incurred by a new entrant bypassing the existing network to serve final customers and how would this network constrain pricing of the existing network. An unavoidable complication in this analysis is the potential for differences in service quality between the existing network and the network deployed by the new entrant. If there is no difference in service quality then we would conclude that the maximum (contestable market) revenue from of the existing network is equal to the cost of the new network (consistent with the hypothetically contestable market logic there is zero economic surplus to the new entrant). This is expressed in the equation below:

$R_{old} = R_{new} = C_{new}$; where

$R_{old} =$ the present value of revenues from the old asset in perpetuity[8]

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[8] Including any revenues earned post replacement of part or all of that old asset in the future;

R_{new} = the present value of revenues a new entrant would require in perpetuity[9]
C_{new} = the present value of expenditures a new entrant would incur in perpetuity[10]

41. Under the contestable market logic, as soon as R_{old} exceeds the cost of a new asset (C_{new}) a new entrant is able to sign up all of the existing customers on the same or lower prices (Pareto gain to customers) and enter the market – completely displacing the incumbent.

42. Now, consider the situation where the service quality of a new entrant's asset is different to (e.g., higher than) the service quality with an old asset. Here we know that in a contestable market R_{old} must be less than C_{new} in order to forestall entry. That is, in a contestable market you can't charge the same price for an inferior product. Rather, in a contestable market a firm would have to charge a price that was lower than the price (cost) of a new entrant by an amount that was equal to the value customers placed on the higher service quality provided by the new entrant.

43. In other words, if we simply apply the same logic as applied where service quality is assumed to be the same then we arrive at the following conclusion:

> *A new entrant could sign up all of the existing customers by offering prices that never exceeded the incumbent's prices plus the additional value of service provided by the new entrant (providing a Pareto gain to customers). This means that R_{old} cannot exceed the cost of a new asset less the higher consumer value from a new asset.*

44. It follows that with differences in service quality the maximum (contestable market) revenue is equal to the cost of the new network less the additional value created by the new network:

$$\mathrm{R}_{old} = C_{new} - (V_{new} - V_{old}) \qquad \text{Contestable market valuation equation}$$

45. In the following sections we consider the case of a hypothetical new entrant deploying a fibre to the premise (FTTP) network and what that would imply for the value (and hence 'competitive market' revenues) of the existing copper to the premise (CTTP) customer access network. Then we estimate the incremental value to consumers of services that could be delivered by fibre versus copper (in its current configuration) $(V_{new} - V_{old})$.

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[9] Including any revenues earned post replacement of part or all of that new asset in the future;

[10] Including any expenditures on replacement of part or all of that new asset in the future;

4. Cost of greenfields FTTP

46. This section uses the Analysys' Fixed Network Cost Model (FNCM) to calculate the cost a new entrant would incur if it were to deploy a fibre to premise network in Australia (C_{new}).

47. Although the Analysys model has features that allow it to be modified to represent a FTTP implementation, it has not been designed with such an implementation in mind. With any model of such complexity, it is not possible to expect that every input parameter will be able to be freely varied without affecting the operation of the model. This constrains the extent to which it is possible to estimate the cost of an FTTP build using the Analysys model.

48. As described in the Milner Consulting report, there are two primary architectures for FTTP implementations: point-to-point (P2P) access using active ethernet over fibre; and passive optical networking (PON).[11]

49. A P2P network involves the deployment of point-to-point fibre (typically a single pair) to every location in an area from a central office or exchange. That is, each premise is provisioned with its own dedicated fibre capacity which is not shared with any other network users. This deployment provides a very high level of capacity to every user but is consequently not the least expensive architecture for a FTTP network.

50. PON is a less expensive fibre architecture than P2P because it allows the sharing of fibre capacity between users. Unlike P2P, where each premise has a dedicated connection to the central office, in a PON deployment capacity is shared between 30 to 60 users through the use of an optical splitter. This reduces the cost of fibre and duct space required for backhaul to the office but restricts the capacity available to an average of 70 Mbps for each user if the splitter is fully utilised (but more if some users are idle).

4.1. Alterations made to Analysys' input parameters

51. In the context of the Analysys model the P2P deployment is easier to achieve because it requires a less radical adjustment to the structure of the network assumed by Analysys in its default deployment. We discuss below the changes that should be made to the model in order to capture the salient features of a FTTP network and indicate which changes we have been able to implement within the Analysys model.

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[11] Milner Consulting, *Using the ACCC Analysys Model for Modeling Fibre to the Premise*, October 2009, pp. 7-10 (hereafter 'Milner report'.

4.1.1. Provisioning point-to-point fibre to every premise

52. By default, the Analysys model provisions a point-to-point fibre cable to every premise with a demand for 40 or more services. The parameter that determines the minimum demand at which fibre is provisioned is an input to the model and can be changed by the user. A P2P implementation would typically require that a point-to-point fibre cable be provisioned to every premise and so this parameter should be set to 1.

53. Although making this change does allow for the provisioning of fibre to every premise, it does not entirely remove copper from the network. Copper is central to the Analysys model and the placement of trenches is linked to the deployment of a copper pair. Accordingly, the model continues to provision a copper pair to every premise regardless of the extent of fibre capacity that has been provisioned. It is necessary to remove these vestigial copper cables after the model run and manually re-size the pits at DPs to remove the copper cable and ducts that are not required.

54. The centrality of copper extends to the costing modules of the Analysys model, whereby the spreadsheets link the extent of trenching to the number of 'copper SIOs', amongst other linkages. The complete absence of 'copper demand' coming up from the access network generates errors in some of the spreadsheet formulae and these had to be adjusted to ensure the operation of the model. A complete description of the changes made to achieve the results in this report is provided at Appendix A below.

55. Furthermore, we note that the fibre network estimated by adjusting this parameter is perfectly tapered in terms of fibre cable usage. This is unlikely to be a realistic assumption and results in less cable being provisioned than would be deployed in a modestly tapered network. An adjustment has been made to total cable distances estimated in the model to account for this.[12]

56. Changing this parameter has some implications for the structure of the network designed by Analysys' algorithms, and the change generates some errors in the VBA code. After the adjustments described at Appendix A, results are able to be derived for 202 of the 219 sample ESAs. We consider this a sufficient sample for the purposes of this report.

4.1.2. Premise fibre deployment

57. Analysys' base assumption is that each location that is served by fibre will be connected point-to-point with the exchange with six fibre pairs. The Milner Consulting report states that the typical configuration for a P2P implementation will be a single

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[12] The total fibre pair length estimated by the model are set equal to the total copper pair length that was estimated by the model, adjusted to account for the fact that a pair of fibre can supply a location of any demand whilst a pair of copper is required for a single SIO.

pair of fibres deployed to each location.[13] We have therefore amended this assumption in the model.

58. The assumption of six pairs per cable is not critical to the operation of the Analysys model and altering it does not generate any errors. This change is considered further when costing the quantity of fibre cable in the network.

4.1.3. Changing duct fibre capacity

59. Although Analysys' model provisions some fibre, it has been configured to focus on the build costs of a copper network. This is reflected in the choice of duct assumptions, which provide for 100 fibre cables, each of six pair capacity, to fit into the base duct at a cost of $30 per metre for the duct. The same duct can also accommodate up to 400 copper pairs.

60. The Milner Consulting report indicates that for a fully tapered network a base duct size might accommodate 144 fibre cable and 6 4mm micro tubes with the micro tubes containing lead-in cable to feed through the DP to the FDPs.[14] However, the structure of the cable and duct input assumptions for the Analysys model make it necessary to abstract from the existence of micro tubes (although these can be included in costs). We have assumed a base duct size of 144 fibre pairs.[15]

4.1.4. Pit spacing

61. The maximum distance between DPs, or pit spacing, in urban areas is set at 100 metres in Analysys' copper implementation of its model. For a fibre implementation, it is possible to place pits further apart because the fibre can be blown through tubes of up to 1km, whereas copper can only be hauled over shorter distances and at much higher cost as discussed in section 4.2.2 below. We have adopted a revised maximum DP spacing of 250 metres.[16] This change does not generate any errors in the Analysys model.

4.1.5. DP capacity

62. As described in the Milner Consulting report, an optimal deployment of P2P might allow up to 12 premises per DP cluster, since provision this configuration can be provisioned with 12 4mm micro tubes to the DP. The current assumption in the

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[13] Milner report, p. 8

[14] Milner report, p. 17

[15] This is less tapered than suggested by the Milner report but reduces the number of links that exceed the maximum duct size.

[16] Milner report, p. 22

Analysys model is that the capacity of each DP cluster is 4 services, meaning that at most there can be 4 premises per DP cluster, and less if any have a demand greater than 1.

63. Whilst it is possible to change the input assumption for DP capacity to 12 services, this generates a number of errors in the Analysys model that were not able to be straightforwardly resolved. We therefore retain the base assumption of a DP capacity of four. This is unlikely to significantly affect our final cost estimate because it is not possible to explicitly represent the deployment of the micro tubes in the Analysys model, the optimisation of which would generate the main efficiencies from implementing the revised assumption.

4.1.6. Pillar capacity

64. Pillar capacity in the Analysys model is effectively 360 services, which reflects a fully loaded capacity of 400 and utilisation of 90%. We retain this assumption for a P2P deployment, but the number of pillars decreases in this implementation since it is driven by demand that is served by copper (but pillars are still provisioned because the model assumes that a single copper pair continues to be laid to every premise).

65. The ideal implementation of a PON deployment in the Analysys model would be to reduce the capacity of a pillar to around 30 services and assume the placement of a fibre splitter at these points. Point-to-point fibre cables above the pillar could be reduced in number to reflect the splitting ratio.

66. However, it appears that the model is highly sensitive to changes to pillar capacity. We were not able to achieve any model outputs at capacities of 30 or 60 due to errors arising in the VBA code. Some ESAs provided output at 100, but not enough to provide a significant sample. Accordingly, it is not likely to be possible to use the Analysys model as it is currently configured to model a PON network, although the costs could be inferred by reference to those for the P2P network.

4.2. Revised cost assumptions

67. In combination to changes to the structure of the network, it is also necessary to adopt changes to unit costs to better reflect a large scale fibre deployment. We have adjusted unit costs for:

- ducts;
- fibre cable;
- jointing; and
- customer premise equipment.

68. We discuss the details of these amendments below.

4.2.1. Ducting costs

69. The Milner Consulting report indicates that ducting costs assumed by Analysys for a copper network are very high in the context of a fibre-only deployment, and that the base cost of ducting for a fibre network would be considerably lower under the revised duct size assumptions.

70. We have utilised the duct inputs provided by Milner Consulting, summarised in Table 1 below. This table does *not* provide alternative costs for the same ducts assumed by Analysys, but rather redefines the relevant ducts and provides costs appropriate for these altered assumptions, whilst holding trenching costs constant. As discussed in section 4.1.3 above, the base duct capacity is sufficient to contain 144 fibre pairs and 12 4mm micro tubes.

Table 1: Alterations to Analysys duct costs ($/metre)

Duct size	Trench cost	Guard wire	Duct cost copper	Total cost copper	Duct cost fibre	Trench cost fibre
Duct 28	240	1.35	400	641	111	352
Duct 24	240	1.35	360	601	97	339
Duct 20	240	1.35	300	541	78	319
Duct 16	120	1.35	240	361	66	187
Duct 12	120	1.35	180	301	53	174
Duct 8	60	1.35	120	181	33	95
Duct 6	60	1.35	89	150	30	92
Duct 4	30	1.35	74	105	20	52
Duct 2	30	1.35	58	89	11	43
Duct 1	30	1.35	29	60	9	41

Source: Analysys, Milner Consulting

4.2.2. Fibre cable

71. Analysys' base cost for fibre cable is $1.60 per metre for cable consisting of six fibre pairs. Whether this is appropriate for isolated fibre links, as modelled in the copper network, is arguable. This unit cost is a significant overestimate of costs when considering a fibre-only deployment.

72. Milner Consulting estimates that the cost of a 144 fibre cable is $5.71 per metre, which includes blowing costs of $0.20 per metre.[17] This translates to a cost per fibre pair of $0.08 per metre, which is the appropriate unit for calculation.

73. We note for comparison that Analysys assumes a cost of $8.03 per meter for 100 copper pair cable of 0.40mm gauge, which is the main size of non-tapered cable provisioned in the network. Coincidentally, this is equivalent to $0.08 per copper pair.

74. However, Analysys also assume that higher gauge cable is required for geotypes where greater link distances are required. This adjustment is not required for fibre cable. Also, one would expect a greater distance of copper to be provisioned in a copper deployment than fibre in a P2P deployment because a single pair of fibres can effectively serve a very high level of demand, whereas each SIO requires an additional copper pair.

4.2.3. Jointing

75. The cost structure for jointing in an FTTP deployment is likely to be significantly different from that assumed by Analysys for a copper deployment. Specifically, the unit cost for a fibre pair joint is lower than for a copper pair ($40 against the $162 assumed be Analysys) but there are no economies to be gained from joints with higher capacities and accordingly high capacity fibre joints are more expensive than their copper equivalents.

76. It has not proved possible to use the Analysys model to directly estimate fibre joint costs. This is because the model is configured to estimate the number of joints and their size according to the copper requirements. Indeed, Analysys specifically states that it does not consider fibre jointing costs because they are not significant to the copper deployment.[18]

77. The Milner Consulting report estimates that the total cost of fibre jointing in a P2P implementation would be in the range of $0.7b to $1.0b, compared to the Analysys estimate of $1.4b for copper joints. We have applied the upper bound of this range at the costing stage of the Analysys model.

4.2.4. Customer premise equipment

78. The Analysys model includes cost assumptions for customer premises equipment for both copper and fibre connections. The total connection cost for a 2-pair socket is $14, whereas a fibre connection is $696.

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[17] Milner report, p. 21

[18] Analysys, *Fixed LRIC Model Documentation*, August 2009, p. 57

79. As noted in the Milner Consulting report, these numbers do not seem to be comparable, since the fibre termination costs will certainly include a modem and other equipment that are not included in the copper termination cost. A comparable cost for equipment that provides the same function in a fibre network as the socket assumed by Analysys for the copper network is $40.[19]

4.3. P2P implementation

4.3.1. Estimated build cost for P2P

80. Adopting the parameters and costs described above, a total build capex for the access network is estimated to be $32.9 billion, compared to $35.8 million under copper-only assumptions. This build costs includes the full cost of terminating fibre equipment, estimated by Analysys at $696 per premise. With the revised assumption of $40 per premise, the total build cost is $26.9 billion.

81. Table 2 below shows the build-up of changes at a less aggregated level that lead to this overall result.

Table 2: Breakdown of costs changes from copper to P2P

Category	Change	Percentage change
Customer premise equipment	+$6.1 billion	+4,448%
Copper cable	-$7.3 billion	-100%
Fibre cable	+$3.3 billion	+1,510%
Ducts	-$2.4 billion	-15%
Pits	-$1.1 billion	-14%
Joints	-$0.7 billion	-41%
Other	-$0.8 billion	-38%
Total	**-$3.0 billion**	**-8%**

Source: CEG analysis

82. The reduction in expenditure on copper cable is self evident, since in a fibre deployment there is no requirement for any copper cable in the network. It has been replaced by a lower amount of expenditure on fibre because, as explained above:

- fibre is cheaper to deploy per pair, on average over the geotypes, since copper requires higher gauges in lower density areas whereas fibre does not; and

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[19] Milner report, p. 23

- fewer metres of fibre pair are required in the network than copper pair because a strand of fibre is capable of carrying the demand of a large number of premises, whereas a single copper pair may only be used for one premise.

83. The large increase in customer premises equipment is calculated on the assumption that Analysys' assumed cost of $696 per premise is utilised. As the Milner Consulting report explains, this figure is not comparable to the functionality of the termination equipment assumed for copper.[20]

84. Ducting costs decrease in the FTTP implementation. As described in the Milner Consulting report, the ducting of fibre is considerably cheaper than copper on a same-capacity basis and this result was not unexpected. Whilst the overall trench network is approximately the same as for the copper deployment, more ducts of the minimum size were able to be deployed and fewer ducts of larger sizes.[21]

85. No changes were assumed to pit unit costs, although modestly fewer pits are required due to the increase in pit spacing to 250 metres. As was the case with ducting, more pits of the smallest size are utilised and this has the effect of reducing total pit costs by 14%.

86. Changes in joint costs were not estimated using the model, as explained at section 4.2.3 above. We note that the assumption of total joint costs of $1.0 billion is at the upper end of the Milner Consulting range, and is high compared to the $0.4 billion cost that would be required if a $20 joint were deployed for each point-to-point fibre pair in the network.[22]

87. The large decrease in the category comprising 'other' is mainly derived from excluding the costs associated with copper pillars and LPGS equipment.

4.3.2. Estimated ULLS price for P2P

88. The greatest cost increases for the P2P deployment, relative to the Analysys copper deployment, are experienced in relation to customer premise equipment. However, this category of costs is not included in the calculation of the ULLS price. Adjusting the allocation of ULLS costs to include fibre (but not termination) and holding the cost of

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[20] Milner report, p. 23

[21] However, we note that the deployment of the very largest duct sizes increases significantly in the fibre deployment. This appears to be generated in the Analysys model through the provisioning of links of very high capacity close to the RAU. There is likely to be an algorithmic error in determining the capacity of these links since we note, in some examples, the number of fibre cables provisioned are sufficient to serve almost twice the number of locations that exist in the ESA. We therefore consider that the model is likely to have overestimated the number of very large ducts required.

[22] Following the cost noted in the Milner report, p. 22

the core network constant,[23] we estimate an adjusted network average ULLS price of $20.33 per month, down from the base case of $28.29 (by 28%). ULLS prices by band are shown in Table 3 below.

4.3.3. Geographic range in ULLS prices

89. The geographic range of ULLS price outcomes by band are shown in Table 3 below. We note that the fibre implementation has a particularly large effect in areas of lower density. This is due to the costs of high gauge copper and LPGS systems required in a copper deployment that are not required in the FTTP implementation.

Table 3: Base case ULLS price comparison with P2P, 2008/09

Network	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	Average
Copper	3.29	20.04	33.52	51.86	28.29
P2P	3.20	16.05	24.27	32.52	20.33

Source: CEG analysis using Analysys model

90. Table 4 indicates the total capex, excluding business overheads, estimated for the P2P deployment. As we describe above, the capex for the core network is held constant from the copper base and is not an outcome of CEG's modelling.

Table 4: Total access network capex, 2009 to 2012

$ billion	2009	2010	2011	2012
Copper deployment	35.8	36.0	36.2	36.4
P2P deployment	32.9	32.7	32.6	32.5

4.4. PON implementation

91. The Milner Consulting report states that:[24]

> *"Industry best practice identifies PON as having about 15% cost reduction relative to Point-to-point fibre architectures"*

92. This provides a baseline from which to assess the build costs of a PON deployment. As described at section 4.1.6 above, changes to pillar capacity that allow a reasonable

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[23] The cost of the core network is held constant because errors are generated in the core results through the absence of copper assets. This is described in further detail at Appendix A.

[24] Milner report, p. 24

representation of a PON deployment are not able to be implemented in the Analysys model due to errors arising in the VBA code.

93. If a 15% cost reduction flowed through to prices, this suggests that the ULLS price for a PON deployment would be approximately $17.28 per month, averaged across the network on the basis of the $20.33 per month price for P2P estimated above.

5. Incremental value of high-speed broadband

94. A new entrant's FTTP network would be capable of delivering 'super-fast' broadband speeds (or bandwidth) far in excess of the 'high-speed' services that are possible over existing copper networks. In and of itself faster speed broadband is of little value to most broadband users. It is only when this greater (and more symmetric) bandwidth allows new services to be delivered will a greater willingness to pay for super-fast speeds be observed. Both the passive architecture and active electronics deployed in the FTTP network will affect the bandwidth of the services offered by the network. They will also affect the nature of access competition that is feasible.

95. We approach the task of estimating the incremental value of the super-fast broadband that would be delivered by a hypothetical new entrant in three ways:

- Firstly, we consider data on the cost of a 'brownfields' upgrade of copper networks to provide super-fast speed broadband (either FTTN or FTTP) that have or are likely to be undertaken as a proxy for what incremental value investors believe they can capture from super-fast broadband customers. That is, if a network has been or is about to be upgraded, then we assume the incremental cost of this upgrade is a proxy for the incremental value that it provides consumers;
- Secondly, we consider survey evidence of customer's additional willingness to pay for super-fast broadband. We consider adjustments to this survey data to take into account the ability of a new entrant to capture willingness to pay through price discrimination only it is capable of; and
- Thirdly, we consider prices that are offered in overseas markets, the United States, for super-fast broadband (ie, broadband speeds which are not achievable on copper networks) and the premiums which are achieved for these services over and above prices for high-speed broadband.

5.1. Broadband speed and service potential

96. Broadband is a term without a clear and consistent definition. It may be used simply to describe bandwidth in excess of that capable by dial-up internet. Some more precise definitions are applied, for example, by the Federal Communications Commission (FCC) in the United States which adopts a definition of 2 Mbps. In this report we make a distinction between 'high-speed' broadband and 'super-fast' broadband though we are not specific about what precise ranges of bandwidth this might cover. We use this distinction to draw a line between what speeds many users have today with xDSL technologies over copper (with demands and prices we can observe) and what speeds will be possible over FTTP (with demands and prices that do not exist in the Australian market today).

97. The ‘speed’ or bandwidth of a broadband data services is only important to end-users in so far as it determines what incremental services and applications can be offered.[25] Greater speed creates greater convenience for some uses. For example, the time taken to download or upload large files, such as movies, can be greatly reduced by higher speeds. These higher speeds will be more highly valued the more time critical is the information that needs to be exchanged. Some uses and applications may be extremely time critical or indeed be needed in real time.

98. There are varying views on the potential for the development of new applications that demand the capabilities of an FTTP network. Some subscribe to a ‘build it and they will come’ philosophy. At present internet protocol television (IPTV) appears to be the key service driver for the construction of fibre networks to residential premises, though this may change in the future.

5.2. Incremental cost of super-fast broadband deployment

99. A reliable estimate of the value consumers place on super-fast broadband over and above high-speed broadband can be derived from what capital investors are willing to make in upgrading existing networks or building new networks to provide super-fast broadband. By definition, the amount they are willing to invest is equal to what value they expect to capture for providing higher quality services.

100. In the United States, Verizon reported at the time of its fibre to the premise network rollout it expected a capital expenditure US$700 per home passed (and more per home actually connected). Critically, Verizon would *only* have spent this if Verizon believed that the present value of all future benefits consumers perceive for the additional service quality (relative to service over copper) exceeds this amount per home passed such that Verizon could recover its costs of US$700 per home passed.

101. If we assume the same per household valuation exists in Australia then we have US$5.5 billion valuation of extra service potential, or $7 billion Australian dollars.[26] Of course, there will likely be additional consumer value to the customers above and beyond this level because the US$700 per household passed:

- Is an underestimate of the actual costs Verizon would incur because it does not include customer connection costs (which were expected to be an extra US$650 per household);

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[25] We use the term speed and bandwidth to capture the many dimensions of quality of service that will allow more applications to be offered over the fibre network. For example, the commitment of a service to a minimum bandwidth can be more important than the maximum (or burst) speed of a service for some applications.

[26] Converted to Australian dollars using PPP of 1.33 based on World Bank data for 2008.

- It is unlikely that Verizon would embark on this investment if it only expected to just recover its costs (ie, it is likely that Verizon expected to earn some economic rents on its investment); and
- Even if Verizon expected to only just recover its costs from consumers it is likely that consumers would still retain some additional surplus above and beyond what they paid for the service.

102. With these factors in mind the value of additional service quality from an FTTP network in Australia is more likely to be in the vicinity of $15 billion than the $7 billion estimate derived above.

103. We note that as fibre networks become viable for ubiquitous deployment (that is, the business case means that deployment of fibre becomes economic to all existing customers of the copper network) this will necessarily imply a zero contestable market asset valuation for existing copper networks. This is true, by definition. In colloquial terms, if the economics of a fibre to the premise deployment make sense then it means that the existing copper network is essentially worthless.

5.2.1. Fibre to the node in Australia

104. Whilst a fibre to the node network will not provide the same service quality as fibre to the premise, there have been strong indications from parties of willingness to invest large amounts of capital. For example, Telstra originally proposed to Government a $5.7 billion fibre to the node network deployment (made up of $3.1 billion from Telstra and $2.6 billion from Government) to deploy a network capable of 6 Mbps. Telstra indicated that an additional contribution from Government of $2.1 billion would allow services of around 12 Mbps for 98% of the population.[27] Assuming Telstra would not make any further contribution, the total incremental capital cost would have been $7.8 billion.

105. This figure provides substantial support to the relevance of the fibre to the premise figures from the United States. Whilst a fibre network has not actually been deployed in Australia, the barriers to such a deployment are likely unrelated to the economics of the network and are more related to advantages parties have to 'hold up' such deployments.

5.3. Price premium for super-fast broadband

106. Another way to observe the incremental value of super-fast broadband is to look at the prices that subscribers are paying for such services. Of course the value of super-fast

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[27] Telstra (2005) *The Digital Compact and National Broadband Plan*, dated 11 August. Viewed at: www.telstra.com.au/abouttelstra/investor/docs/tls339_briefingpaper.pdf 4 October 2009.

broadband services will be in excess of the price paid because at prevailing prices at least some consumers will be able to capture consumer surplus (by paying a price that is less than their willingness to pay - unless there is perfect price discrimination).

107. In the United States, Verizon offers a fibre to the premise service which it brands ‘FiOS’. Verizon also offers high-speed broadband services over its copper network using digital subscriber line (DSL) technology. Verizon reports prices which discriminate on download (and upload) speed for both its high-speed and its super-fast (FiOS) broadband services. These are reported in Table 5 below.

Table 5: Verizon FiOS internet plans (unbundled on 1-year agreement)

	Price per month ($US)
High-speed	
1 Mbps download / 384 Kbps upload	19.99
3 Mbps download / 768 Kbps upload	29.99
7.1 Mbps download / 384 Kbps upload	42.99
Super-fast	
15 Mbps download / 5 Mbps upload	54.99
25 Mbps download / 15 Mbps upload	69.99
50 Mbps download / 20 Mbps upload	144.95

Source: Verizon website viewed 8 October 2009

108. Unfortunately, Verizon do not report the number of customers on each plan. Verizon does report average revenue per user (ARPU) in excess of US$135 per month for its 3.1 million FiOS customers, though this would include revenue from FiOS television and bundled telephony. Nevertheless the raw broadband pricing data gives a reasonable indication of the premium FiOS can charge for super-fast broadband. For example, the premium between the mid-speed high-speed plan (3 Mbps) and the slowest super-fast broadband pan (15 Mbps) is $33.25 per month or $400 per annum (in Australian dollars).[28] Similar the premium between the fastest high-speed plan (7 Mbps) and the mid-range super fast plan (25 Mbps) is around $35.90 per month or $430 per annum (in Australia dollars). The smallest premium is between the fastest high-speed plan (7 Mbps) and the slowest super-fast plan (15 Mbps) is $16 per month or $191 per annum. It may be that not all customers would be willing to pay this premium – Verizon report a penetration rate of around 28% for FiOS internet services at present (although this is growing at a fast rate).

109. Based on this data we could make a conservative estimate in which we assume that at most 30% of Australia’s 7.8 million premises valued super-fast broadband at premium of between $200 and $400 per annum each. This would suggest a premium of

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[28] Converted to Australian dollars using PPP of 1.33 based on World Bank data for 2008.

between $468 million and $936 million per annum in perpetuity. At a discount rate of 10%[29] this represents somewhere between $4.7 billion and $9.3 billion in incremental value for fibre over a copper network. This is a conservative estimate of the value of service potential differences because:

- It assumes that 70% of the Australian population place a zero value on the higher service quality they could receive from super-fast broadband. In reality these customers would place some positive value on this service potential;
- It assumes that this 70% figure is static over time – ie, that these customers never will place any value on the higher service potential of fibre;
- It assumes that the population and number of premises are static over time;
- It assumes that all Australians can receive high speed broadband over the copper network when, in reality, customers living a long way from the local exchange cannot receive high speed broadband of, for example, 7.1mbps even if they are willing to pay a large amount for it now. These customers would be able to be served by a new fibre network; and
- Of the 30% of customers who are assumed to value super-fast broadband (based on Verizon penetration figures) all of these customers are assumed to be paying exactly their valuation of the service (ie, none of them place an incremental value on the service that is more than the incremental price that they pay).

5.4. Survey data on willingness to pay

110. Given the nascent stage of fibre to the premise (or fibre to the node) deployment it is unsurprising that limited market pricing data is available on price differentials between super-fast and high-speed broadband (Verizon is an exception). However, in a recent survey on the consumer benefits of broadband Dutz, Orszag and Willig (2009)[30] collect data on survey respondents' willingness to pay for higher speed and super-fast broadband. Usefully for our analysis the survey asked consumers about their incremental willingness to pay for super-fast broadband over high-speed broadband. The survey asked:

> *"What is the MOST additional you'd be willing to pay PER MONTH for the following high-speed Internet services, above and beyond any existing or advertised price that you are actually paying, with the understanding that the service would not be available unless you paid this much:*

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[29] Roughly equal to the allowed cost of capital by the ACCC for regulated telecommunications networks.

[30] Dutz M., Orszag, J. and Willig, R. (2009) *The Substantial Consumer Benefits of Broadband Connectivity for U.S. Households*, Commissioned by the Internet Innovation Alliance.

> *1. Download speed of 100x Dial-up (5 Mbps or megabits per second), e.g. allowing a 2-hour 5GB high-definition movie to be downloaded in about 15 minutes*
>
> *2. Download speed of 1000x Dial-up (50 Mbps), e.g. allowing a 2-hour 5GB high definition movie to be downloaded in about 1.5 minutes".*

111. The survey data indicates that consumers on average were willing to pay an additional \$32 per month[31] for high-speed broadband (5 Mbps) over what they are currently paying and an additional \$42 per month for super-fast broadband (50 Mbps) over what they are currently paying. This puts a \$10 per month consumer valuation on super-fast broadband over and above the value of very-fast broadband (proxied here by willingness to pay for 5 Mbps). Of course, to the extent that a FTTP network would actually be upgrading some customers from even lower speeds than 5 Mbps this \$10 figure is an underestimate.[32]

112. If these numbers are translated to Australia's 7.8 million premises they would sum to a willingness to pay of around \$936 million per annum for super-fast broadband over high-speed broadband (as defined in the survey). At a discount rate of 10%[33] this represents around \$9.4 billion in additional willingness to pay for fibre over a copper network. As noted above, to the extent that a large number of customers can not receive 5 Mbps from the copper network this is an underestimate of the additional value of a fibre network serving all premises.

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[31] In Australian dollars converted as above.

[32] A further complication with this study is that some people surveyed may already be receiving high-speed broadband and a few may already be receiving super-fast broadband (though we expect this number to be small).

[33] Roughly equal to the allowed cost of capital by the ACCC for regulated telecommunications networks.

6. Conclusion

113. We have derived the maximum (contestable market) revenue from the existing copper network as equal to the cost of the new network less the additional value created by the new network:

$$\mathrm{R}_{old} = C_{new} - (V_{new} - V_{old)})$$

114. Using the Analysys Model to estimate the costs that would be incurred by a hypothetical new entrant deploying fibre to the premise technology based on a point–to-point network architecture. This involved some modifications to the model. With our modifications we calculate the total cost for a new entrant fibre access network to be around $32.9 billion which is around $3 billion less than Analysys estimates for a copper to the premise access network deployment.

115. Based on a range of data sources including incremental investments in next generation access networks, market prices for super-fast broadband, and willingness to pay studies, we have calculated a conservative estimate of the additional value created by a fibre to the premise deployment (over the existing copper network) of between $10 billion and $15 billion. Adjusting our new entrant fibre asset valuation above, we reduce the copper network valuation to between $22.9 billion and $17.9 billion.

116. Table 6 below provides a summary of the implications of these results for ULLS prices.

Table 6: ULLS price based on new entrant cost with QoS adjustment 2008/09

Network	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	Average
$10 billion value	2.16	10.86	16.37	21.95	13.74
$15 billion value	1.70	8.52	12.84	17.22	10.78

Appendix A. Changes made to Analysys model to represent FTTP deployment

117. A number of modest changes to the structure of the Analysys model are necessary to permit the deployment of a FTTP network and its costing. Both the network deployment and the costing modules of the Analysys model rely upon the existence of copper assets to design the network and calculate and allocate costs. Several adjustments were required to reduce the dependency of the model on copper assets.

118. Sufficient changes have been made to the various model components so that costs for the customer access network can be derived. These changes are discussed below.

A.1. Changes to access network coding and output

119. In order to accommodate a potentially larger number of fibre cables than can be stored within a byte of data, all components of the user-defined type DuctCableStorer were dimensioned as integers.

120. After running the code using the assumptions described in section 4.1, a manual overlay of the results is required to remove the vestigial copper cable that the Analysys model continues to deploy in the network. An adjustment is required to pit sizes to account for the removal of this copper cable – this adjustment has been carried out based on the rules used within the Analysys model to dimension pit sizes initially.

121. In the “Access – Code” spreadsheet, rows 309 to 311 of the Summary sheet are amended so that these ratios of SIOs to copper assets do not refer only to copper SIOs (of which none remain in the model after the manual overlay), but also include fibre SIOs. This provides an input to the CAN module that allows for the correct calculation of trench distances in the network.

A.2. Changes to the costing modules

122. A number of changes to the Core and Cost modules are required to eliminate division by zero errors arising from the model’s assumption that copper assets and services based on these continue to exist in the network. These include:

- at ‘In Subs’ in the Core module, the number of addressable xDSL SIOs is manually changed so that there is at least one;
- at ‘In Demand’ in the Core module, the percentage of traffic carried using MSAN equipment for ADSL and SDSL are set to zero;
- at ‘Inputs Core’ in the Cost module, the distribution of line cards between platforms is set to zero; and

- at ‘Access’ in the CAN module, the formulae on rows 43, 47, 130 and 131 have been amended so that they do not only refer to copper SIOs and trench distances, but also fibre SIOs and trench distances.

A.3. Other cost adjustments

123. Two other adjustments to the Analysys model have been made to ensure that the outputs are reasonable. These are described below.

A.3.1. Core network held constant

124. The network costs estimated for the core network generate similar errors to those for the access network since these are also driven by equipment volumes and ratios based on the existence of copper infrastructure. Given that the focus of this report is on changes to the access network we have calculated prices by holding the costs of the core network constant at the default values in the Analysys model. We regard this assumption as reasonable and unlikely to give rise to significant error.

A.3.2. Adjustment for fibre tapering

125. As is described in section 4.1.1 above, the Analysys model assumes an unrealistically perfect tapering of fibre cable for costing purposes. This causes the total distance of fibre pairs in the network to be substantially less than the distance of copper pairs estimated in the copper deployment – at 37 million kilometres against 65 million kilometres for the copper network.

126. In order to bring this estimate to a more reasonable distance, the total distance of fibre pairs that is likely to be required is estimated at the same distance as copper pairs, adjusted for the ratio of the number of locations against the total demand, to reflect the fact that each pair of copper is associated with a services whereas a pair of fibre typically serves a location of any demand. Based on this adjustment, we estimate a total required distance for fibre to be 43 million kilometres, with 24 million kilometres of this underneath the pillar and 22 million kilometres above the pillar.

Appendix B. Formatted results

127. The appendix contains our results in a format requested by Optus. These results show the effect on the ULLS price if the price tilt of fibre were assumed to be -5%, rather than the -9.2% adopted by Analysys. We understand that Optus has empirical support from vendor data which indicates -5% is reflective of more recent and future trends in fibre costs. In the context of a tilted annuity, the higher the negative tilt the more depreciation is front-loaded, so one would expect reducing the magnitude of the tilt to lead to a decrease in the ULLS price.

Table 7: Total capex, excluding business overheads, 2009 to 2012

$ billion	**2009**	**2010**	**2011**	**2012**
CAN	32.551	32.536	32.536	32.550
Core	15.369	15.429	15.514	15.629

Table 8: Prices excluding core network mark-ups, 2009 to 2012

	Unit	**2009**	**2010**	**2011**	**2012**
Copper deployment					
ULLS (Zone A)	$/month	21.62	22.01	22.35	22.52
ULLS (Band 2)	$/month	20.04	20.39	20.71	20.87
WLR (Zone A)	$/month	22.35	22.73	23.07	23.24
WLR (Band 2)	$/month	20.26	20.61	20.92	21.08
P2P deployment					
ULLS (Zone A)	$/month	16.53	16.64	16.73	16.70
ULLS (Band 2)	$/month	15.54	15.65	15.74	15.71
WLR (Zone A)	$/month	22.86	23.08	23.22	23.18
WLR (Band 2)	$/month	21.35	21.58	21.72	21.68

Table 9: Value adjusted prices excluding core network mark-ups, 2009 to 2012

	Unit	2009	2010	2011	2012
$10 billion value					
ULLS (Zone A)	$/month	11.55	11.63	11.69	11.67
ULLS (Band 2)	$/month	10.86	10.93	10.99	10.97
WLR (Zone A)	$/month	15.97	16.13	16.22	16.20
WLR (Band 2)	$/month	14.92	15.07	15.17	15.15
$15 billion value					
ULLS (Zone A)	$/month	9.06	9.12	9.17	9.15
ULLS (Band 2)	$/month	8.52	8.57	8.62	8.61
WLR (Zone A)	$/month	12.53	12.65	12.72	12.70
WLR (Band 2)	$/month	11.70	11.82	11.90	11.88