Final report for Optus

ULLS: review of the ACCC draft decision

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0 Executive summary

Our review of the Analysys fixed network cost model has revealed a number of issues which we believe lead to an over-estimation of ULLS service costs.

Capital costs in both the access and core network models are dominated by the duct and trench cost categories. As these capital costs contribute strongly to the calculated service cost, we have investigated them in detail and identified irregularities in both the unit costs used and the way that trench and duct costs are combined to form per-metre installed trench costs. These problems with unit costs and modelling methodology lead to over-estimation of total capital costs in both the access and core network models.

Another key factor that affects service costs is the extent to which the costs of building the network can be shared with other operators, services and utilities. Clearly, an efficient operator would seek to share costs whenever possible and this should be taken into account in the cost modelling. Although the Analysys model does implement some sharing between access and core networks, our comparison with similar network cost models shows that this sharing is not as extensive as it should be and that service and utility sharing are not implemented. Once again, this leads to an over estimation of the ULLS service cost.

Our analysis of the factors used to calculate the annualised capital costs in the model's tilted annuity formula has also identified a number of areas of concern which, we consider, lead to inflated ULLS service costs. In particular these are:

- the asset lives of the key duct and copper cable asset categories in the access model are under-estimated
- the model assumes a negative price trend for installed copper cable, which is not supported by actual price trends of copper cable and the costs of cable installation

- the price tilt adjustment factor in the tilted annuity calculation should be customised to reflect the increasing value of access duct and cable assets.

Finally, our investigation of modelling issues reported by Telstra has revealed a serious error in the Visual Basic code that dimensions main cable sizes. Correcting this results in a very significant reduction in the ULLS cost estimate.

We estimate that the cumulative impact of the identified modelling issues is an over-estimation of ULLS costs by over 20%.

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1 Introduction

1.1 Study context

On behalf of Optus, Network Strategies has reviewed key aspects of the Analysys fixed network cost model[1] ("Analysys model"), commissioned by the ACCC to inform the estimation of the cost of providing declared fixed line services.

This study was commissioned by Optus, however the views expressed within this report are entirely those of Network Strategies.

1.2 Structure of the report

There are five main sections in the report covering:

- capital expenditure in relation to network elements (Section 2)
- operational expenditure in relation to network elements (Section 3)
- network sharing (Section 4)
- other parameters and assumptions (Section 5)
- our conclusions (Section 6).

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[1] Analysys (2009) *Fixed LRIC model documentation – Version 2.0*, model documentation for the ACCC, August 2009.

2 Network elements: capital expenditure

Capital and annualised costs for the access and core networks are calculated by the Cost.xls spreadsheet. The unit costs for access and core network equipment are held in the worksheets UnitCost.Access and UnitCost.Core respectively.

2.1 Access network costs

The distribution of total capital costs calculated for access network components by Cost.xls is illustrated in Exhibit 2.1 below.

Cost category	Proportion of total capital cost
Duct	46.3%
Pits	21.7%
Copper cable	20.4%
Copper joints	4.8%
Fibre	0.6%
Business overheads	1.9%
Other CAN and wireless	4.3%

Exhibit 2.1: Access network proportion of capital cost by equipment category [Source: Network Strategies]

As the bulk of costs are allocated to duct, pits and copper cable, we have focussed our investigation on these cost categories. We note that the other capital costs in the access network model appear reasonable, based on Network Strategies' database of telecommunications equipment pricing for the Asia Pacific region.

We have identified a number of problems with the access network duct cost category, and these are detailed in Section 2.1.1 below. Optus has previously submitted to the ACCC on

the capital costs of pits in the model.[2] Optus noted that, due to the materials used, pit prices in the model are too high. At this point we have no further information to expand on the observations made in that document.

In its current configuration, the Analysys access model appears to use only 100 pair distribution and 400 pair main copper cables, although cable costs are provided for a range of other cable sizes.

Based on Network Strategies' database of copper cable prices, which includes data from Europe and the Asia Pacific, the full range of copper cable costs in the access model appear consistent with what we expect for the per-metre costs of cables, inclusive of furniture and installation (hauling).

2.1.1 Access network duct cost category

The unit cost per metre of the "duct" cost category is made up of a combination of trench costs, installation of guard wire and duct material and placement costs. Installation of guard wire is a simple per-metre cost whereas both trenching and duct costs vary with the number of ducts being installed.

Trenching costs

The cost per metre of providing a trench for the installation of ducts is dependent on both the technology used to provide the trench and the number and size of ducts being installed. Typically, a contractor will use the most cost effective trenching technology available. The choice of technology is affected by terrain and surface type, with the most cost effective being direct burial of duct or cable using ploughing techniques. The cost of trenching

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[2]   Optus (2009) *Submission to Australian Competition and Consumer Commission on the Analysys cost model for Australian fixed network services*, Public Version, March 2009.

varies from below AUD10 per metre[3] for ploughing in easy terrain to over AUD150 per metre for breaking and re-instating some city roads.

Access network trench costs in the Analysys model (UnitCost.Access rows 11 to 22) vary only according to the numbers of ducts being deployed, as illustrated in Exhibit 2.2 below.

Number of ducts	Trench cost per metre (AUD)
1 to 4 ducts	$30
6 to 8 ducts	$60
12 to 16 ducts	$120
20 to 28 ducts	$240

Exhibit 2.2: *Model relationship between trench cost and numbers of ducts [Source: Analysys]*

The Analysys model does not attempt to vary trenching costs according to terrain, so we assume that the per-metre costs are weighted averages across all terrain types. The model and documentation do not provide sufficient information to confirm this assumption.

We believe that the treatment of trench cost and duct numbers is unusual, particularly the cost relationship between cost per metre and numbers of ducts installed. In our experience of collecting data from operators for regulatory cost modelling purposes, contractor pricing for providing a trench is often based on a fixed cost per metre of providing a single duct trench with an additional variable trench rate of 5% to 10% of the base price per metre for each additional duct to be installed. Such pricing reflects the contractor costs, which include costs of salaries, equipment and gaining access to sites which are largely independent of the numbers of ducts to be installed. Although it is possible that a standard trench is dug sufficiently wide and deep to allow one to four ducts to be installed without incremental trenching costs being incurred, this would be very inefficient. It is also highly unlikely that the trenching cost would double if the duct count rose from four to six, as predicted by the model.

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[3] Analysys comment in the UnitCost.Core worksheet in Cost.xls notes that the cost for ploughed trench is AUD9.20 per metre for the PoC-LAS trench.

In addition to standard trenching, the model calculates the trenching costs for ploughed trench (UnitCost.Access rows 37 to 48). However, instead of reducing trenching costs to reflect the use of low cost technology, the model removes the costs of ducting. This appears to be an error in the modelling of ploughed trenching costs as we would expect cable or pre-ducted cable to be direct buried at a much lower per-metre rate (less than AUD10 per metre).

Proxy cost models (such as the FCC's Hybrid Cost Proxy Model – HCPM) are capable of determining the most cost effective trenching option for a route, given the allowable technologies and the numbers of ducts or direct buried cables to be installed. Clearly, where ploughing is permitted, it is significantly more cost effective to plough in the equivalent of a single duct at less than AUD10 per metre than to open a trench at AUD30 per metre. If, for some reason, a large number of ducts must be installed on a rural or low density route, opening a trench may be more cost effective.

In reality, where ploughing is permitted, we do not believe that an efficient operator would lay multiple ducts (such as the model's two duct standard for IEN routes), opting instead to plough in a high capacity fibre cable. We believe this to be a far more efficient and modern approach, and have observed this in recent long haul link installations, such as the FX Networks fibre network[4] in New Zealand's North Island and similar links in Asia.

Duct costs

In our experience, the per-metre cost of duct consists of a number of factors as described in Exhibit 2.3 below. The cost estimates for duct and chamber components in Exhibit 2.3 are based on Network Strategies' database of equipment and installation costs sourced from operators in the Asia Pacific region and Europe. Where possible, these are cross-checked against modelled costs in publicly available data, particularly the PTS (Swedish regulator) Hybrid cost model[5]

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[4]   See http://www.fx.net.nz.

[5]   Available at http://www.pts.se/sv/Bransch/Telefoni/SMP---Prisreglering/Kalkylarbete-fasta-natet/Hybridmodellen/Oversyn-av-hybridmodellen.

Cost factor	Description
Duct material cost	For a 100mm PVC duct, this is typically AUD5.50 per metre, depending on the quantities being purchased. The PTS Hybrid cost model calculates SEK28 per metre for standard duct which equates to around AUD4.36 per metre (based on the purchasing power parity rate[6]).
Duct handling cost	To physically place the duct in the trench typically costs less than AUD2.00 per metre. The PTS model assumes that the cost of duct placement is included in the material cost.
Chamber material cost	Chamber costs vary considerably between large feeder chambers shared by a number of ducts to small distribution chambers. Depending on the materials used, the costs vary from around AUD5 000 for a large chamber to AUD1 200 for a small one
Chamber installation cost	Installation costs are likely to vary between AUD3 000 and AUD1 500 depending on the size of the chamber. Chamber costs in the PTS model are scaled by numbers of pairs jointed and include full material, installation and jointing costs. Although difficult compare, fully installed and jointed chambers of the sizes used in the Analysis model vary from around AUD2 300 to AUD14 500 at the current PPP rate[7]
Distance between chambers	Feeder chambers are normally located relatively close at distances of 125 to 150 metres. Chambers in the distribution and low density/rural areas can be up to 200 metres apart.

Exhibit 2.3:   *Typical duct cost factors [Source: Network Strategies, PTS]*

The per-metre cost of duct in the model varies according to the number of ducts being deployed on a route, as illustrated in Exhibit 2.4 below.

Number of ducts in trench	Cost per duct per metre (AUD)
1 or 2	$29.00
4	$18.38
6 and above	$15.00

Exhibit 2.4:

Modelled duct costs

[Source: Analysys]

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[6]   Purchasing power parity (PPP) conversion rate SEK to AUD is 6.4170. Source: World Bank.

[7]   Note that the PTS model does not specifically state the costs of jointing, but the manhole costs appear consist of a fixed cost of around AUD2 200 and a variable installation/jointing cost of around AUD14 per pair. This leads to very high costs for 10 000 pair manholes, but we note that the PTS access model never provisions manholes of more than a few hundred pairs.

On a one-duct route, duct costs AUD29 per metre. As the actual duct material and handling costs are likely to be less than AUD10 per metre, around AUD20 of this cost is attributable to chamber costs. At 150 metre chamber spacing, we estimate the installed chamber cost to be around AUD3 000[8], which appears reasonable.

On a two-duct route, the model states that each duct costs AUD29 per metre. Using the same reasoning as above, this, implies an equivalent chamber cost of around AUD6 000, which is far higher than we would realistically expect. Clearly, the incremental cost of the second duct should include the cost of its material and placement, plus a possible cost associated with installing a slightly larger chamber (although, in reality the smallest chamber has capacity for four ducts). If a generous incremental cost of AUD15 per metre is allowed for the second duct, the duct cost per metre for a two duct route falls to AUD22 per metre for each duct, which is more reasonable in our opinion.

Using the same cost calculation methodology, the model's current chamber cost for a four-duct route is around AUD5 600 and AUD5 400 for a six-duct route, which may be appropriate for these larger routes.

In addition to the error with chamber costs in the two-duct route calculation, a similar error has been made with one-duct road crossings. The road crossings simply use the one-duct route cost of AUD29 per metre. As demonstrated above, this rate includes a heavy loading for chambers which are not required for road crossings. Instead of chambers, road crossings terminate in pits, which are costed separately in the model. The correct rate for placing a duct in a road crossing trench should include only material and handling costs, which amount to less than AUD10 per metre.

2.2 Core network costs

The distribution of total capital costs calculated for core network components by Cost.xls is illustrated in Exhibit 2.5 below.

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[8] This estimate is based on the assumption that each 150 metres of duct costs includes sufficient overhead to cover the cost of the next chamber. In this case, AUD20 per metre for 150 metres equates to a total cost of AUD3 000.

Cost category	Proportion of total capital cost
Sites	8.4%
Duct	57.6%
Trench	7.5%
Fibre	4.8%
Network equipment	12.6%
Line cards	4.3%
Building services equipment	2.9%
Business overhead	1.9%

Exhibit 2.5: Core network proportion of capital cost by equipment category [Source: Network Strategies]

As was the case with the access model, we note that the combination of ducts, trenching and cable cost categories make up the bulk of the capital costs for the core model. We observe, however, that the 'duct' cost category in the core model does not include trenching costs, which are listed separately. As it does not include trenching costs, the fact that the duct cost category makes up almost 60% of a core network capital cost suggests that the proportion of costs due to duct may be overstated. This is likely to be due to the extensive use of conventional ducted transmission routes in the core transport network instead of direct buried cable or direct buried pre-ducted cable.

Overall, the unit costs for equipment and sites appear reasonable[9], but the problem identified for two-duct routes in the access model (described in Section 2.1.1 above) has been carried over from the access model into the core model. The core model simply assumes two ducts for all transmission routes and, as with the access network, duct costs are AUD29 per metre for each duct. The key problems with this assumption are:

- As the incremental chamber costs for a second duct are relatively small, the cost of the second duct should be significantly less than AUD29 per metre. The cost of the second duct should only cover incremental materials, placement and chamber costs, which we estimate at less than AUD15 per metre. This means that imputed chamber costs for two duct transmission routes are approximately twice as high as they should be.

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[9] Based on Network Strategies' database of equipment and installation costs sourced from operators in the Asia Pacific region and Europe.

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- Chamber locations on a long transmission route should be further apart than the chamber spacings in an access feeder or distribution route. The spacings should relate to the distances fibre cable can be hauled or blown into duct. The reduced number of chambers will lead to further reductions in the duct cost category.

- Where a large proportion of a transmission route is ploughed cable or pre-cabled duct, chamber costs are minimised or eliminated. The chamber costs in the 'duct' cost category should therefore only apply to the proportion of the transmission route which is installed using conventional trenching.

2.3   Conclusions concerning modelled capital costs

We have tested the effects of the identified capital cost issues on the Band 2 ULLS price calculated by the model for 2009, and the results are detailed below.

2.3.1 Duct cost correction

To correct for the inflated cost of the second duct in two duct routes, we reduced the duct per metre costs from AUD58 to AUD44 in Cost.xls, UnitCost.Access worksheet. We also reduced the duct cost for road crossings from AUD29 to AUD15[10].

Making these changes reduced the calculated Band 2 and Zone A ULLS prices calculated for 2009 by 2.6% and 2.7% respectively.

2.3.2 Access network ploughed trench cost correction

To correct the modelled cost of ploughed trenching where it is permitted in the access network, in Cost.xls, sheet UnitCost.Access, we reduced the per-metre costs of ploughing a one-duct route and a one-duct road crossing from AUD30 to AUD10 per metre[11].

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[10]   On the UnitCost.Access sheet, by changing the value in cell G19 from 58 to 44, cell G21 from 29 to 15, and cell G32 from 58 to 44.

Surprisingly, this change marginally increased the Band 2 ULLS price by 0.2% and reduced the Zone A price by 0.3%, indicating what is likely to be a modelling error for further investigation.

2.4   Conclusions and recommendations

Our study of modelled capital costs indicate that costs in the key 'duct' cost category are overstated. This is partly due to the actual equipment costs being higher than we expect and partly due to the methodology used to construct the duct plus trench cost being in error. We believe that the assumption that trenching costs rise at a breakpoint between four and six ducts on a route is due to a misinterpretation of data concerning the costs of chambers, which typically have breakpoints at these duct numbers.

Ploughed trenching costs are clearly in error and our test to set these to a more realistic level has revealed a probable error in the modelling which should be further investigated. We consider that this error most likely leads to an overestimation of the ULLS cost calculated by the model.

We recommend that the costs for two-duct routes and road crossings be adjusted in the manner we have described in Sections 2.3.1and 2.3.2 respectively and that the ploughed trench issue is investigated.

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[11]   On UnitCost.Access worksheet, by changing cells E46 and E47 from 30 to 10.

3 Network elements: operational expenditure

3.1 Opex assumptions

The Analysys model determines opex as an assumed percentage of the capex costs estimated by the model, The base rates for opex as a percentage of capex are shown in Exhibit 3.1 below.

Capex cost categories	Opex as % of capex
Access network	
Duct and pits (including trenching)	0.21%
Cable	2.93%
Other CAN – terminations and tie cables	0.02%
LPGS – pair gain systems	3.16%
Radio	4.63%
Core network	
Switching	6.49%
Transmission	3.24%
Data equipment – ISDN, DSL etc	5.70%
Satellite equipment – earth stations etc	8.61%
Other core - IN, billing and provisioning	8.40%

Exhibit 3.1: *Base rates for opex as a percentage of capex [Source: Analysys]*

We refer to these as the 'base opex percentages' as the model changes some of these rates in its annual cost calculation, depending on the year of calculation and the assumed price tilts for equipment types. An example of the changes to the base opex rates for year 2009 is provided in Exhibit 3.2 below.

Capex cost categories	Opex as % of capex for 2009
Access network	
Duct and pits (including trenching)	0.21%
Cable – pillars and joints	2.93%
Cable – copper	2.97%
Cable – fibre	3.55%
Other CAN – terminations and tie cables	0.02%
LPGS – pair gain systems	3.16%
Radio – base stations and microwave	4.63%
Radio – CPE radio and satellite	5.13%
Business overhead	32.45%
Core network	
Switching – buildings, building services and other electronics	6.49%
Switching – switch block and processors	7.18%
Transmission – trench and duct	3.13%
Transmission – microwave and DWDM	3.37%
Transmission – ports and multiplex	3.58%
Transmission – fibre cable	3.92%
Data equipment – ISDN, DSL etc	5.70%
Satellite equipment – earth stations etc	8.61%
Other core – IN, billing and provisioning	8.40%
Business overhead	125%

Exhibit 3.2: *Opex as a percentage of capex for fixed network cost categories in year 2009 [Source: Analysys]*

It can be seen from Exhibit 3.2 that the application of price tilts creates opex sub categories within the base capex cost categories. Where a capex price trend is negative, the opex as a percentage of capex is higher than the base rate in Exhibit 3.1 (such as fibre in the core transmission cost category) and for positive price trends, the opex as a percentage of capex is lower than the base rate (such as core transmission trench and duct).

The effect of these calculations is to ensure that the absolute opex dollar amount is constant for each of the years included in the model. This approach seems reasonable as it is unlikely that a network's operational cost will vary considerably with asset value, particularly for electronic assets with significantly negative price tilts.

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3.2 Comment on opex assumptions

In general the opex assumptions and calculation of opex costs in the model are within the ranges we expect and have observed and used in similar models. However, there is an issue with opex implementation in the core model that should be reviewed.

The issue relates to our observation in Section 2.2 that duct costs make up a surprisingly large proportion of the core network capital costs. As opex is calculated as a percentage of capex, the duct cost and its corresponding opex assumption have a significant effect on the total amounts of opex calculated for the core.

We note that, in the core network, duct is included in the 'transmission' cost category instead of having its own duct/trenching category (as it has in the access model). The effect of including duct in the transmission category is that it inherits the opex percentage that applies to electronic equipment such as SDH line systems, multiplexers, microwave and DWDM systems. We consider that the transmission opex rate is appropriate for electronic equipment, but not appropriate for duct and trenching. Instead, the core model should implement a trench/duct cost category and apply an opex assumption which is consistent with that implemented in the access model. Referring to Exhibit 3.1 above, trench/duct opex in the access model is calculated at a rate of 0.21% of capex, whereas the rate is currently 3.24% in the core model.

To test the effect of reducing the opex rate for trench and duct in the core model, we altered the appropriate cells in Cost.xls, UnitCost.Core[12].

As expected, this had no effect on ULLS Band 2 or Zone A pricing, but more surprisingly, it also had no effect on WLR pricing. On further investigation, it appears that the only core network capital assets that pass identifiable costs on to the access service pricing calculation are site costs and some switching equipment costs.

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[12]   On UnitCost.Core worksheet, by altering the following cells in column E from 3.24% to 0.21%: rows 469, 470, 475, 476, 501, 502, 538, 539, 587 and 588.

3.3 'Other' opex cost category

We note that the 'other' opex cost category appears to have been created as a catch-all for the network's peripheral systems required for provisioning, service creation, service activation and billing. Although the Intelligent Network (IN) is typically a service creation and implementation platform, it is often at least partially integrated with the switching system. As a general rule, we would expect that it may be more appropriate to associate the IN with the switching processor cost category for the purposes of opex calculation rather than peripheral customer management and billing systems.

We recommend that core network IN assets are transferred to the switching processor category and that the 'other' opex cost category be renamed to 'provisioning and billing' to avoid confusion.

3.4 'Total' opex category

The base opex percentage rates by category (as described in Exhibit 3.1) are contained within the Recon worksheet of Cost.xls[13] and are referenced by cell formulae in the calculation of the opex assumptions by network element as described above. These particular values in sheet Recon are inputs.

In addition to the individual opex categories this sheet includes 'Total' opex percentages for both core and access, which appear to be pasted input values rather than results calculated by the model. If the values for the individual opex categories are modified, the value for 'Total' opex remains unchanged. The cell contents do not appear to be used elsewhere within the model.

We note that the ACCC cites this figure within its draft pricing principles[14], so there is a risk that this number will not be revised if any of the opex inputs are amended.

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[13]   On sheet Recon of Cost.xls, core opex is found at the named range Opex_prop, and access opex at Opex.prop.CAN.

[14]   Australian Competition and Consumer Commission (2009) *Draft pricing principles and indicative prices for LCS, WLR, PSTN OTA ULLS, LSS*, August 2009, Appendix 2.

To avoid a potential source of error, we recommend that the value be explicitly calculated by the model, so that it reflects changes to the opex assumptions. Alternatively the value should be removed from the worksheet.

3.5   Conclusions and recommendations

Our investigation of opex methodology and rates in the model indicates that it is largely in line with our observation of similar regulatory models of modern networks. Although it has no effect on ULLS pricing, we recommend that the duct and trench opex in the core model are adjusted in the manner we have described. This change will be important if the model is used to estimate core network costs for other purposes, such as service costing or termination rate calculations.

We also recommend that for clarity:

- core network IN assets are transferred to the switching processor category and that the 'other' opex cost category be renamed to 'provisioning and billing' to avoid confusion
- the purpose of the 'total' opex cost category be either clarified, removed from the modelling or calculated explicitly.

4 Network sharing

4.1 Sharing in the ACCC model

Sharing involves the same equipment or other costs being used in different networks or parts of networks. The cost sharing with the most impact on the network is typically trenching, with in some instances ducts and even cables also being important.

There are four different types of sharing:

- distribution and main networks
- access and IEN
- inter-service sharing
- inter-utility sharing

Each of these types is explained and studied in more detail below.

4.1.1 Distribution and main network sharing

The distribution and main network sharing refers to sharing within the access network. Typically the main network will not be routed on its own unique path, but will share a route with the distribution network that feeds customers on the path between the local exchange (LE) and the pillar.

Typically the distribution and main cables will share trenches (but not ducts), with almost the entire lengths of main cables using trenches that also contain distribution cables, and costs being shared equally between the distribution and main networks.

There is no distribution and main network trench sharing implemented in this model (see Visual Basic routine 'ApplyDijkstraForPillarClusters' in 'Access – CODE.xls').

4.1.2 Access and IEN

Analysys has assumed a 4km zone around the LEs in which the access network trenches are able to support sharing with the IEN. Within this area, the IEN incurs no trenching costs. Analysys has performed a sensitivity study on the effects of varying the buffer size, showing the level of incremental core network outside of the CAN sharing zone ('core.xls', worksheet 'In.Nodes'). There seems to be no real justification for choosing the value of 4km apart from it being a 'reasonable distance' (Model Documentation[15], section 7.11.6).

Where the IEN and CAN share trench, 50% of the trench costs are allocated to the IEN (set in 'Cost.xls', sheet 'Inputs.Access', cell C230).

The model is only moderately sensitive to the sharing between the IEN and CAN, with the ULLS varying by about 4% when shared trench cost allocation is varied between 100% allocated and 0% allocated to the IEN.

4.1.3 Inter-service sharing

Inter-service sharing is the sharing of trenches – and other costs – between the PSTN and data networks. It would be very unusual for the PSTN and data networks to use different routes and hence separate trenches. It is also likely that a degree of higher level of sharing is possible, such a sheath sharing (that is, the networks will use different fibres in the same cable). In an NGN, the networks will be multiplexed onto the same data streams.

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[15] Analysys (2009), *Fixed LRIC model documentation version 2*, August 2009; referred to as "Model Documentation' in this document.

The Analysys model includes the ability to model inter-service sharing on the IEN at a number of levels:

- data stream sharing ('Core.xls', sheet 'CostAlloc.Core', column X): this has generally not been used.
- sheath sharing ('Core.xls', sheet 'In.Network', rows 133–136'): the model implements one fibre for other services for each fibre used for PSTN/ISDN/xDSL.
- duct sharing on the IEN ('Core.xls', sheet 'CostAlloc.Core', columns F and G): in general there is no sharing at this level.

Inter-service sharing in the IEN has very little effect on the cost of ULLS because ULLS costs generally do not include the IEN.

4.1.4 Inter-utility sharing

Inter-utility sharing is the sharing of trenches between the operator and other operators or utilities. For a greenfields deployment, it is expected that there will be scope for the operator to coordinate with other utilities leading to a high level of trench sharing, particularly in the IEN.

This model does not include any inter-utility sharing; inter-utility sharing on the IEN would have little effect on the ULLS cost, but inter-utility sharing on the CAN would have a similar effect to CAN/IEN trench sharing.

4.2 Sharing modelled by other jurisdictions

We have examined a number of TSLRIC models from other jurisdictions to:

- illustrate typical practices with respect to implementing different types of sharing
- compare the levels of access/core network sharing to check the validity of using 4km as the buffer size.

In our experience, opportunities for network sharing are to some extent country dependent, making comparisons with models from overseas jurisdictions difficult. However, comparing the types of sharing implemented in these models is a valid test for completeness. Also, differences in geography can be taken into account when comparing the levels of sharing implemented.

For this study, we have provided comparisons based on three recent cost models with relevant publicly available information:

- the New Zealand Commerce Commission's core and access network modelling for the calculation of universal service costs
- the Hybrid Long Run Incremental Cost Model developed for the Swedish regulator (PTS)
- the Hybrid Long Run Incremental Cost Model developed for the Danish regulator.

For each of the above models we have examined the implementation of sharing and its implication for the Analysys model.

4.2.1 Sharing in the New Zealand Commerce Commission TSO model

The New Zealand Commerce Commission has developed a detailed network model for its TSO (telecommunications service obligation) proceedings. This uses a similar philosophy to the Analysys Fixed Network Cost Model developed for the ACCC: it is a forward-looking cost model of an efficient operator. Network Strategies has considerable experience with the TSO model, which uses the FCC's HCPM (Hybrid Cost Proxy Model) and CostQuest's CostPro to model the access network and IEN, respectively.

The TSO model includes access/core sharing, inter-service sharing and inter-utility sharing. It does not include distribution/feeder sharing.

Access/core network sharing

Sharing between the access and core networks was implemented by including a 'structure sharing' factor which is a percentage of the whole of the structure (trench, duct and poles) costs that are shared. However the values used – which vary between cable deployment types and population density – are not published and thus are not disclosed.

Inter-service and inter-utility sharing

The Commission has determined that the following average levels of sharing with non-PSTN services occurs in practice:[16]

- metro: 15%
- urban/suburban: 4.19%
- rural: 3.51%.

Note that these are levels of sharing that occur in practice, and do not necessarily reflect the sharing that would be achieved by an efficient operator building a modern equivalent asset greenfields network.

The TSO model implements the following inter-utility sharing in the access network:

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16   Commerce Commission (2005), *Determination for TSO Instrument for Local Residential Service for period between 1 July 2002 and 30 June 2003*, 24 March 2005, paragraph 309, available at http://www.comcom.govt.nz//IndustryRegulation/Telecommunications/TelecommunicationsServiceObligations/ContentFiles/Documents/Public-TSO-Determination-02-03.pdf.

Density (population per square mile)	Buried	Underground	Aerial
0 (rural)	100%	100%	100%
5 (rural)	100%	100%	100%
100 (rural)	100%	100%	100%
200 (rural)	100%	100%	50%
650 (suburban)	100%	100%	50%
850 (suburban)	100%	70%	50%
2550 (urban)	100%	70%	50%
5000 (urban)	100%	70%	50%
10 000 (metro)	100%	55%	35%

Exhibit 4.1:   *Access network sharing – percentage of structure cost allocated to operator [Source: Commerce Commission[17]]*

These percentages refer to the percentage of the structure (trench, ducts, poles, etc) costs that are allocated to the operator. For example, 50% means the costs are equally shared with other utilities. 'Buried' refers to ploughed cable, and is not shared. 'Underground' is ducted and 'aerial' uses poles.

The TSO model implements inter-service sharing in the core network (IEN) by halving the costs allocated to the PSTN (further reducing the costs allocated to the operator)[18]. There is no inter-service sharing in the access network.

4.2.2 Network sharing in the Swedish Hybrid Model

The Hybrid Long Run Incremental Cost Model developed for the Swedish regulator (PTS)[19] is a combined top-down and bottom-up model that consists of several inter-related models that cover the core network, the access network and co-location facilities.

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17   *Ibid*, paragraph 375

18   *Ibid*, section A15.21.

19   Available at http://www.pts.se/sv/Bransch/Telefoni/SMP---Prisreglering/Kalkylarbete-fasta-natet/Hybridmodellen/Oversyn-av-hybridmodellen/.

Core network sharing

The core network includes both trench sharing and electronics sharing (between services). There are three types of trench sharing: sharing with the access network, sharing with other utilities[20] and sharing between the transport network layers[21].

The access/core network sharing uses a similar philosophy to that of the ACCC model:

[…] Therefore an efficient network might share this [access network] duct and trench with the core network. Only in out of town areas would the duct be used purely for the core network transmission.

Thus sharing is 100% in town areas, similar to the ACCC model's buffer.

The model assumes the following percentage sharing:

	Remote subscriber switch (RSS) links	LE–LE links	LE–TS (transit switch) links	TS–TS links
Access	41%	41%	41%	41%
Utilities	5%	5%	5%	5%

Exhibit 4.2: *Swedish Hybrid model core network sharing [Source: PTS]*

These proportions refer to the percentage of the trenches that are shared with the access network or with other utilities, respectively.

The trench sharing is generally much lower in the ACCC model:

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20   PTS (2008), *Hybrid Model Documentation v 5.1*, 24 April 2008, section 3.10, available at
        http://www.pts.se/upload/Ovrigt/Tele/Prisreglering/hybrid-model-v5-1-documentation-080424.pdf.

21   *Ibid*, 3.11.8.

	LE Model	PoC level	LAS level	TNS level	Overall
Access	33%	43%	30%	12%	34%

Exhibit 4.3: *ACCC model core network sharing [Source: Analysys[22]]*

We acknowledge that the population density of rural Australia is different from that of Sweden, so the sharing of the longhaul transport links may not be comparable. However this does show that that the level of sharing in the ACCC model may be low and the size of the buffer should perhaps be raised.

We note that the buffer may be varied in the range of zero to 5km. This appears to correspond to the expected range of copper main and distribution cable around a local exchange (a diameter of 5km limits total copper loop length to about 7km, which is a standard PSTN design limit). On this basis, choosing a buffer limit of 4km appears to be an arbitrary decision and the buffer should be increased to its maximum of 5km.

If we calculate the overall level of sharing in the ACCC model with a buffer size of 5km, and exclude the TNS level (long haul) sharing, the level of sharing is increased to 42% – comparable to the Swedish model – supporting our contention that 5km is a more suitable buffer size.

The sharing between the different layers of the hybrid model core network includes sharing between the remote-local exchange transport and the transit and local to transit routes. This sharing includes about 10% of the total remote-local exchange network[23]. Sharing within the core network does not affect the price of ULLS.

In the hybrid model in general, sharing allocates the costs equally between the shared networks, although sharing with other utilities allocates 70% of the cost to the operator and 30% to the other utilities.

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[22] Source: Model Documentation, figure 7.35.

[23] Source: PTS Hybrid Model, sheet 'I_trenching'.

Access network sharing

The access network includes sharing with the core network, sharing with different services and other utilities[24].

The sharing with other utilities varies by geotype and by utility (SMP[25] telecoms, SMP cable TV, other cable TV, electricity, water and 'other'). The proportion of sharing is normally 5%, except for sharing with 'other' in all areas and with cable TV in the most rural of geotypes it is 0%, presumably because cable TV does not extend to those areas.

The model also assumes 10% drop mini-duct sharing with other utilities in all geotypes and 1% with other SMP telecoms in the more urban geotypes.

4.2.3 Network sharing in the Danish Hybrid Model

Like the Swedish model, the Hybrid Long Run Incremental Cost Model developed for the Danish regulator (IT-og Telestyrelsen, or National IT and Telecommunications Agency (NITA))[26] is a combined top-down and bottom-up model. It also includes sharing at a number of levels.

Core network sharing

The core network considers two types of trench sharing: sharing with the access network and sharing with other utilities[27]. The levels of sharing are 50% with the access network and 5% with other utilities[28], which is higher than what we observe in the Analysys model.

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[24]   PTS (2008), *Hybrid model documentation v5.1*, 24 April 2008, section 4.5.

[25]   Significant market power.

[26]   Available at http://en.itst.dk/interconnection-and-consumer-protection/lraic/lraic-on-fixed-network/lraic-hybrid-model-2008-1/.

[27]   IT- og Telestyrelsen (2005), *Report on the LRAIC Model: Revised Hybrid Model (version 2.3)*, December 2005, page 80, available at http://en.itst.dk/interconnection-and-consumer-protection/filarkiv-lraic/lraic-pa-fastnet/LRAIC%20Report%20on%20the%20Hybrid%20Model%20Version%202.3.pdf.

Shared trench costs are allocated equally between the shared networks, although sharing with other utilities allocates 70% of the cost to the incumbent and 30% to the other utilities.

For inter-core network sharing, the model assumes the different logical rings are actually part of the same physical ring, using sheath sharing (that is, different rings use different fibres in the same cable)[29].

Access network sharing

The access network includes sharing with the core network, sharing with different services and other utilities[30], which is similar to the Swedish model, including service and utility sharing types which are not considered in the Analysys model.

The level of sharing with other services and other utilities is defined firstly by the number of customers passed by the other services ('TDC[31]-owned Infrastructure'), other utilities ('TDC via agreements') and 'other'[32]. The number of customers passed is split between the four geotypes modelled (city, urban, rural 1 and rural 2) according to the proportions of the shared customers.

The model then calculates the length of trenches that are available for sharing, and thus using the actual sharing rates (100% sharing with TDC-owned infrastructure, 50% sharing with TDC via agreements, and 10% sharing with 'other') it calculates the actual lengths of shared trenches.

The actual lengths of shared trenches are about 30% of the total access network trenches.

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28   Core network model, 'I_Technical' sheet, rows 17 and 18.

29   Core network model, 'I_Share_Routes' sheet.

30   IT- og Telestyrelsen, *Report on the LRAIC Model: Revised Hybrid Model (version 2.3)*, December 2005, section 5.5.

31   Tele-Denmark Communications, the incumbent

32   Access network model, 'I_Share_Routes' sheet, rows 22–45.

4.3 Conclusion

Other relevant comparator models have included both inter-service sharing and inter-utility sharing in both the access and core networks, access/core sharing and sharing between different levels of the core network.

The Swedish and Danish models both include higher levels of access/core network sharing than in the ACCC model while the New Zealand Commerce Commission has not published the level of access/core sharing. The Swedish model's access/core sharing corresponds to the level in the ACCC model when a buffer size of 5km is used (after the inter-transit network has been removed). We recommend that, in line with accepted main/distribution copper line lengths, the buffer size is increased to at least 5km. Increasing the buffer size to 5km decreases both the Band 2 and Zone A ULLS costs by 0.3% which we consider to be a surprisingly small effect. Further investigation is required to determine whether this factor is being modelled correctly.

The models also include sharing with other services and utilities in the access network whereas the ACCC model has not included any such sharing. We recognise that the levels of sharing may not be directly comparable because of the extremely high levels of cable television deployments in Sweden and Denmark (which results in very high levels of inter-service sharing); we therefore recommend that inter-service and inter-utility sharing is included with inter-service sharing included at a lower level than in the other models examined.

NETWORK
STRATEGIES

5 Fixed network cost model: other parameters and assumptions

5.1 Asset lives

Asset lifetimes are one of the financial parameters that affect the tilted annuity annualisation of capital costs in the model. These lives are set to estimates of the economic life over which the asset is to be depreciated. In general, shorter lives lead to higher annual costs and therefore higher service cost estimates in this kind of modelling.

Network Strategies has reviewed the asset lives in the Analysys model and compared these with those for similar equipment proposed by the Irish regulator, ComReg[33], the Swedish PTS Hybrid Model[34] and lives we have used in operator and regulatory models in other jurisdictions. The review and comparison is summarised in Exhibit 5.1 below.

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[33]   ComReg (2009) *Review of the regulatory asset lives of Eircom Limited*, 11 August 2009.

[34]   PTS (2008), *Hybrid Model Documentation, v5.1*, April 2008.

Cost category	Analysys model	ComReg	PTS Hybrid Model	Other models
Access network				
Cable (all types)	20	20	25	19, 20
Duct & pits	35	40	40	50, 40
Pair gain systems	12	20		
Building terminations	25		20	16
MDF connections	20		15	16
Tie cables	15			16
Radio sites	20			45, 50
Radio equipment	12	10	15	10
Overheads	10			
Core network				
Buildings	50	40	30	55, 40, 50, 45
Network equipment	10	11	10	10, 15, 10, 15, 12
Line cards	5	10	10	10
Core equipment	20	10	10	25, 25, 25, 15, 12
Building equipment	15	5 - 25	10	
Copper	25	20	25	19, 20, 16
Fibre	25	20	20	25, 20, 20
Trench	40	40	40	20
Duct	40	40	40	50, 40
IT Systems	3	5		
Licenses	5			
Overheads	10			

Exhibit 5.1: *Asset life estimates (years) [Source: Network Strategies, Analysys, ComReg PTS]*

The asset lives sourced from ComReg and PTS have been recently updated (in 2009 and 2008 respectively) and are therefore an appropriate comparison as they incorporate analysis of modern asset lives. Overall, we conclude that the asset lives used in the Analysys model are roughly consistent with those used for modelling and for actual asset depreciation in other jurisdictions, with the exception of the asset lives for copper cable and duct in the access model, which may be too short.

Increasing the access network duct and copper asset life in Cost.xls, UnitCost.Access to match that of the core network (40 years and 25 years respectively)[35] reduces the Band 2 and Zone A ULLS prices calculated for 2009 by around 3.5% and 3.6% respectively.

We recommend that the asset lives of duct and access copper are adjusted in the manner described above.

5.2 Price tilts

Price tilts are used by the model in the tilted annuity calculation of annualised capital costs, in which the tilt is intended to represent the expected annual price change for each asset type. The tilts applied in the model are listed in Exhibit 5.2 below. For comparison, tilts from the recent (2008) updates of the Swedish PTS Hybrid Model[36] and the Danish regulator's (ITST's) Hybrid Model[37] are also listed.

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[35] On Unit Cost.Access worksheet, increase the asset life of all "cable" in the access model from 20 to 25 years and the asset life of all "duct" from 35 years to 40 There are numerous cells to change, in column I, from row 118 to row 196. The asset type is listed in column B.

[36] PTS (2008), *Hybrid Model Documentation, v5.1*, April 2008

[37] Available at http://www.itst.dk/samtrafikregulering/telepriser-pa-engrosniveau/lraic/lraic-priser/fastnet.

Asset Type	Analysys model	PTS model	ITST model
Access network			
Building terminations	-0.71%	0.00%	0.00%
CPE	-5.00%	–	–
MDF	0.00%	0.00%	0.00%
Duct (including trenches)	+1.66%	+2.00%	+3.00%
Pits	0.00%	+1.00%	+2.00%
Copper cable	-0.71%	+6.00%	+6.00%
Joints	0.00%	–	–
Fibre cable	-9.20%	-5.00%	-10.00%[38]
Tie cables	-2.00%	–	–
Radio	0.00%	-8.00%	-8.00%
Core network			
Data (ISDN, DSL etc)	0.00%	-5.00%	-5.00%
Switching (processors etc)	-4.88%	-5.00%	-6.00%
Switching (infrastructure)	0.00%	-2.00% to +2.00%	-4.00%
Transmission (fibre)	-9.20%	-5.00%	-5.00%
Transmission (ports, MUX)	-4.88%	-5.00%	0.00%
Transmission (DWDM)	-2.00%	-5.00%	–
Transmission (radio)	0.00%	-8.00%	-8.00%
Transmission (duct & trench)	+1.66%	+2.00%	+3.00%
Satellite	0.00%	–	–
Other (IN & provisioning)	0.00%	-5.00%	–

Exhibit 5.2:   *Annual price change for modelled asset types [Source: Analysys, PTS, Danish National IT & Telecom Agency]*

Although the tilts in the Analysys model are generally within expected ranges, we consider that there are some anomalies which are highlighted by the comparison with the PTS and ITST tilts. The most important of these differences with respect to the calculation of ULLS costs is that the Analysys model has a small negative price tilt for copper cable, in comparison to the strongly increasing price trend predicted by the PTS and ITST tilts developed in 2008.

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[38]   Made up of -5% equipment and -5% installation cost tilts.

When considering copper tilts, it is important to note that the asset class is installed copper cable, and the per-metre cost includes copper metal cost, cable manufacture and cable installation. Copper metal costs rose sharply between 2003 and 2007 leading to rises in manufactured cable costs. Since 2008, the metal costs have been unpredictable[39], but are now stabilising and regaining a positive overall price trend. In addition from our inspection of contracted cable purchase agreements for carriers in the Asia Pacific region and Europe, we conclude that there have not been immediate or significant reductions in prices of telephony copper cable. Similarly, we have not observed reductions in the costs of installing copper cable.

On this basis, we estimate that a forward looking copper cable price should have a positive tilt to cover at least the increasing costs of metal and installation. Although we have difficulty justifying the +6% copper tilt in the Scandinavian models (which may be due to region specific cost increases), we expect that an appropriate, price tilt for copper cable in the Analysys model should be around +2%[40].

Changing this tilt in the access model[41] leads to a reduction of the Band 2 and Zone A ULLS price for 2009 of 2.4% and 2.5% respectively.

The other major anomaly which is apparent in Exhibit 5.2 is the lack of a negative price tilt for the capital costs of radio, IN and provisioning systems in the Analysys model. Although has little effect on the current service cost calculation, more appropriate tilts should be implemented to ensure accuracy if other aspects of the model are changed or the model is used for other purposes in the future.

We recommend that the model is adjusted to incorporate a more realistic price tilt of +2% for copper cable.

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[39]   http://www.theglobeandmail.com/globe-investor/us-economic-data-boosts-copper-prices/article1301473/.

[40]   See http://graphics.thomsonreuters.com/099/CMD_IMPCPR0909.gif for evidence of rising copper prices on the London Metal Exchange.

[41]   In Cost.xls, UnitCost.Access worksheet change the value in cells D404 to D430 from -0.71% to +2%.

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5.3 Tilt adjustment factor

The model currently incorporates a tilt adjustment factor which is a percentage value that is added to the price tilt of each asset type during the tilted annuity calculation. The rationale for including such a factor is to assist tilted annuity annualisation to reflect true economic depreciation more accurately in a market where the level of output of an asset is not fluctuating over time[42]. In its discussion of this topic in the context of development of its Hybrid cost model, PTS notes:

> For example, some operators have noted declines in the level of fixed voice traffic in recent years although it is unclear whether these declines are 'real' or reflect different ways in which traffic is provided (in particular, ADSL calls). If this issue arises in Sweden there may be a case for adding an additional 'tilt' to the tilted annuity formula although any such adjustment needs to be carefully considered[43]

In practice, PTS has not implemented a tilt adjustment factor in the 2008 version of its Hybrid cost model

Estimating an appropriate tilt adjustment factor requires knowledge of future markets and prices, which is generally not available. For example, one could assume that the decline of PSTN traffic implies decline of demand for assets in the PSTN CAN. In practice, this is unlikely to be the case, particularly for the key duct and last mile copper assets which can be used to deploy new high value services, whether over copper or through new fibre blown into existing ducts. In addition, we note that around one third of the world market for copper metal is supplied through scrap[44] demonstrating the ongoing value of recovered main and distribution cables.

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[42] We note that the default tilt adjustment value in the Analysys model of +2.5% for all cost categories is not an adjustment for inflation, which in an environment of positive inflation would work to make the price trends more negative. For example, with 2% annual inflation, equipment with a nominal price tilt of 0% would have a real price tilt of -2%. The tilt adjustment factor does not perform this action.

[43] http://www.pts.se/upload/Documents/SE/final_reconciliation_report_with_remarks_031010.pdf.

[44] http://www.forbes.com/feeds/reuters/2009/09/24/2009-09-24T113515Z_01_LB70717_RTRIDST_0_COPPER-SCRAP-ANALYSIS.html

The Analysys model currently implements a +2.5% tilt adjustment across all asset types in the CAN and core networks (although some documentation[45] states that it is a +3% adjustment). We believe that the increasing demand for, and value of, key CAN assets justifies a +3% adjustment, although this may not be the case for PSTN assets in the core network and other CAN assets such as pair gain and radio.

We recommend that a more appropriate implementation of the tilt adjustment would be:

- 0% tilt adjustment for all core network assets, as the value of many of these conventional PSTN assets is affected by reducing traffic volumes and revenues
- +3% tilt adjustment for CAN duct (including trenches) and copper
- 0% tilt adjustment for all other CAN asset types many of which are also PSTN specific.

When these adjustments are made to the current model[46], the Band 2 ULLS cost falls by around 2.1% and Zone A costs by 2.2%.

5.4 Cable joints

The model assumes that a cable is cut completely at each joint, and each pair reconnected ('Cost.xls', sheet 'UnitCost.Access', rows 106–112). However Telstra, and from our experience all other operators, do not cut cables completely at each joint: only pairs that are required are cut[47]. Therefore the model overestimates the cost of jointing.

We recommend that Analysys incorporates an adjustment to the numbers of pairs jointed (based on real network implementation data) as part of the model's network design rules.

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[45]   ACCC (2008), *Analysys cost model for Australian fixed network services*, Discussion Paper, December 2008

[46]   In Cost.xls TA.Core worksheet set values in cells K11 to K210 to 0%. In Cost.xls TA.Access worksheet, set values in cells F10 to F21 to 0%, F22 to F75 to +3%, F76 to F90 to 0%.

[47]   Telstra (2008), *Access Network Dimensioning Results: Long run incremental costing model input*, section 3.2.3, available on ACCC website.

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5.5 Incorrect main cable costing

In the default non-tapered setting, the model uses 100 pair cables to dimension the main cables (between pillars and RAUs). This is as noted by the documentation[48] and Telstra's network architecture rules[49], and verified in the model. The Visual Basic routines in the model, which calculate the network architecture, use 100 as defined in 'Access – CODE.xls' sheet 'Inputs', cell G64 (named range 'main.non.tapered.cable.size')[50].

However to cost the main cables the model incorrectly uses 400 pair cables. This error occurs because in 'Access – CODE.xls' sheet 'Summary', rows 397 to 406, the model refers to the 400 pair pillar capacity ('Inputs' sheet, cells O180–O193 – named range 'pillar.RAU.cable.capacity') rather than the 100 pair cable capacity ('main.non.tapered.cable.size').

We corrected the model so that the costs referred to the correct main cable size (by changing 'Access – CODE.xls', sheet 'Summary', rows 398–406 to refer to

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[48] Analysys (2009), *Fixed LRIC model documentation version 2*, August 2009, Figure E.2

[49] Source: Telstra (2008) *Access network dimensioning rules: long run incremental costing model input*, 3 March 2008.

[50] In particular, variable 'glMainNonTaperedCable' defined in function 'SetupPermanentConstants' and used in function "GetNonTapedCableSize".

'main.non.tapered.cable.size' instead of 'pillar.RAU.cable.capacity'[51]). This resulted in the 2009-10 ULLS cost for zone A (weighted average cost over bands 1 to 10, for the model scenario year 2010) to decrease from $22.01[52] to $19.51, a drop of 11%.

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[51] As the named range 'main.non.tapered.cable.size' is a single cell rather than the cell range of 'pillar.RAU.cable.capacity', the Excel TRANSPOSE() function in the cell formulas is not required and should be removed when making this adjustment. Also note that the cell formula in the relevant cells is an array formula – the entire range must be selected in order to modify the formula and then once the formula changes are complete, press Ctrl-Shift-ENTER to accept those changes. See Microsoft Excel help for more information on how to edit array formulas.

[52] The ACCC's proposed price is $22.03 (ACCC, *Draft pricing principles and indicative prices for LCS, WLR, PSTN OTA, ULLS, LSS*, August 2009). We did not rerun the network dimensioning routines (the 'Access-CODE.xls' Visual Basic subroutines) which may have resulted in the difference between the ACCC's price and our initial price of $22.01.

6 Concluding remarks

In the course of our review of the Analysys model we have identified a number of issues which we consider should be corrected or investigated further. In many cases, these issues have resulted in an over estimation of the ULLS cost. The key issues and their cost impacts are listed in Exhibit 6.1 below.

Model issue	Effect on Band 2 ULLS cost	Effect on Zone A cost
Access network 2 duct route cost error	-2.6%	-2.7%
Access network ploughed trench cost error	+0.2%	-0.3%
Core network duct opex	No change	No change
Increase access/core sharing buffer to 5km	-0.3%	-0.3%
Increase access model cable and duct access lives	-3.5%	-3.6%
Adjust copper cable price tilt	-2.4%	-2.5%
Review tilt adjustment for all asset classes	-2.1%	-2.2%
Incorrect main cable costs	-11%	-11%

Exhibit 6.1: *Summary of key modelling issues and their effect on ULLS costs [Source: Network Strategies]*

We estimate that the cumulative impact of these modelling issues is an over-estimation of ULLS costs by over 20%.

Capital costs

Our study of modelled capital costs indicate that costs in the key access and core network 'duct' cost category are overstated. This is partly due to the actual equipment costs being

higher than we expect and partly due to the methodology used to construct the duct plus trench cost being in error. We believe that the assumption that trenching costs rise at a breakpoint between four and six ducts on a route is due to a misinterpretation of data concerning the costs of chambers, which typically have breakpoints at these duct numbers.

Ploughed trenching costs for the access network are clearly in error and our test to set these to a more realistic level has revealed a probable error in the modelling which should be further investigated. We consider that this error most likely leads to an over-estimation of the ULLS cost calculated by the model.

Operational costs

Our investigation of opex methodology and rates in the model indicates that it is largely in line with our observation of similar regulatory models of modern networks. Although it has no effect on ULLS pricing, we recommend that the duct and trench opex in the core model are adjusted to the rate used in the access model. This change will be important if the model is used to estimate core network costs for other purposes.

Network sharing

Other relevant comparator models we have investigated include both inter-service sharing and inter-utility sharing in both the access and core networks, access/core sharing and sharing between different levels of the core network.

The comparator models include higher levels of access/core network sharing than in the ACCC model. We recommend that, in line with accepted engineering design for copper main/distribution line lengths, the buffer size in the Analysys model is increased to at least 5km. This will provide a more appropriate level access/core sharing, although given the very small effect this change has on ULLS costs, we have some concern that there may be an unfound error in the model's cost sharing calculation.

The other models studied also include sharing with other services and utilities in the access network whereas the ACCC model has not included any such sharing. We recognise that

the levels of sharing may not be directly comparable because of the extremely high levels of cable television deployments in other countries (which can result in very high levels of inter-service sharing); we therefore recommend that inter-service and inter-utility sharing is included with inter-service sharing included at a lower level than in the other models examined.

Asset lives

We conclude that the asset lives used in the Analysys model are roughly consistent with those used for modelling and for actual asset depreciation in other jurisdictions, with the exception of the asset lives for copper cable and duct in the access model, which appear to be too short and should be increased to 25 and 40 years respectively.

Price tilts

We estimate that a forward looking copper cable price should have a positive tilt to cover at least the increasing costs of metal and installation. Although we have difficulty justifying the +6% copper price tilt in the Scandinavian models we examined (which may be due to region specific cost increases), we expect that an appropriate, price tilt for copper cable in the Analysys model should be around +2%.

Tilt adjustment factor

We recommend that a more appropriate implementation of the tilt adjustment would be:

- 0% tilt adjustment for all core network assets, as the value of many of these conventional PSTN assets is affected by reducing traffic volumes and revenues
- +3% tilt adjustment for CAN duct (including trenches) and copper
- 0% tilt adjustment for all other CAN asset types many of which are also PSTN specific.

Incorrect main cable costing

Correcting the model so that the Visual Basic code refers to the correct main cable size and cost results in a very significant reduction (12%) in the ULLS cost estimate.