Report for the ACCC

Assessment of possible modifications to the Analysys cost model

Based on investigation of operator submissions

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Contents

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1 Executive summary

1.1 Introduction

The ACCC has requested that Analysys Mason investigates a selection of comments submitted by both Telstra and Optus as part of the consultation by the ACCC on six fixed-line wholesale services. This document is the report summarising our assessment of the issues and the potential impact of any revisions to the Analysys cost model. On agreement of the proposed changes, a change log (Excel based) will be finalised to accompany the revised model.

In addition to this report, Analysys Mason will prepare revised versions of the following deliverables for the ACCC:

- FLRIC report, FLRIC user guide, geoanalysis user guide and Visual Basic user guide
- Cost, Core and CAN modules (active modules)
- The Access – CODE workbook, all Access – DATA workbooks and the Cable gauge determination workbook (offline calculations).

1.2 Revising the model

We have first derived a "reference" version of the Analysys cost model, as described in Annex B. This has required the synchronisation of the version of the Analysys cost model submitted by Analysys Mason to the ACCC in June 2009 with that received from the ACCC in November 2009.

We have then considered the impact of changes to this model related to a number of operator comments. These issues concern both the active and offline calculations. Our initial recommendations for each of these issues are summarised below in Figure 1.1. We have revised a version of the model (v2.2) based on these recommendations.

Operator	*Issue*	*Description*	*Implemented change recommended*
Telstra	A	Use of too few customer locations	**No change:** misconception
Telstra	B	Over-estimation of LPGS–RAU cost re-allocated to the Core module	**No change:** misconception
Optus	C	Use of 100-pair for main cable	**No change:** misconception
Telstra	D	Omission of jointing to connect distribution/main cables to pillars	**Change:** Extra joints included, but unit costs of pillars/LPGS reduced
Telstra	E	Omission of joints to connect different cable gauges	**Change:** Extra pit and joint included wherever main cables change gauge
Telstra	F	Incorrect cost of 400 pair joints	**Change:** Input corrected
Telstra	G	Omission of assets required from between PB and DP	**Change:** Switches entered into the CAN module to include or exclude assets from the NTP to the PB and the PB to the SP
Telstra	H	Lack of correction of the CAN for additional IEN duct	**Change:** Trench distribution revised and trench/duct allocation to core revised
Telstra	I	Incorrect allocation of copper and fibre main cable costs	**Change:** Allocation of copper main network costs adjusted
Telstra	J	Cost allocations to dark fibre services	**Change:** Remove dark fibre
Telstra	K	Inconsistent dial-up forecast	**Change:** Dial-up forecast revised
Telstra	L	Impossible ploughing of large cables	**Change:** Only 1-duct or 2-duct routes are now un-ducted in the rural geotypes
Telstra	M	Omission of extra protection costs for buried cable	**Change:** Uplift cable costs for protection when un-ducted
Telstra	N	Not currently used	**No change**
Optus	O	Incorrect jointing of lead-ins to the distribution cable	**Change:** Jointing assets/costs revised
Telstra	P	Underestimation of the cost of the IEN	**Change:** DWDM assets reworked and ODFs/digital cross-connects added
Telstra	Q	Insufficient cable within road crossings	**Change:** Missing cable added in
Telstra	R	Inconsistent serving pit architecture	**Change:** Option 1 removed in CAN.xls
Telstra	S	Quantification of fibre jointing	**Change:** Fibre jointing included
Telstra	T	Under-dimensioning of pits in the CAN	**Change:** Visual Basic revised
Telstra	U	Wireless radius	**No change:** Input left at 25km

Figure 1.1: Summary of issues investigated by Analysys Mason [Source: Analysys Mason]

1.3 Impact of changes

Each change has an effect on the final service costs. Figure 1.2–Figure 1.7 below illustrate the impact of each model change on the reference model for the following services in 2010:

- ULLS in Zones A and B
- WLR in Zones A and B[1]

[1] This is excluding the core network costs related to the line card and transmission to the point of handover

- PSTN OTA
- LCS.

Note that the second bar, labelled “UP” on the graph, illustrates the impact on the reference model when both the cable gauge distribution and geoanalysis inputs have been updated.

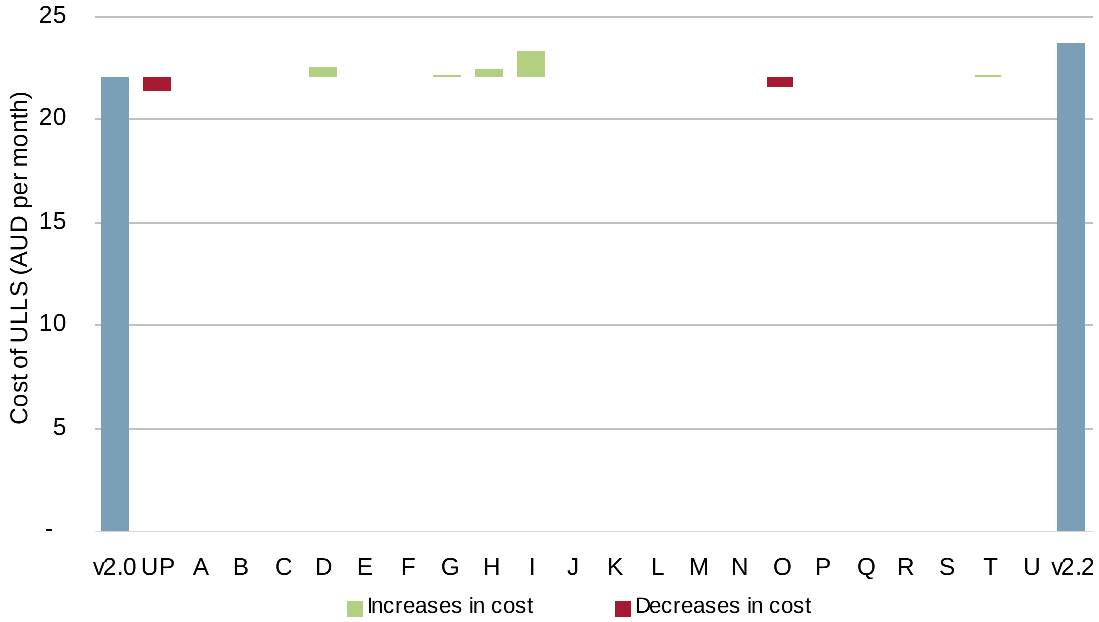

Figure 1.2: *Impact of changes on ULLS in Zone A [Source: Analysys Mason]*

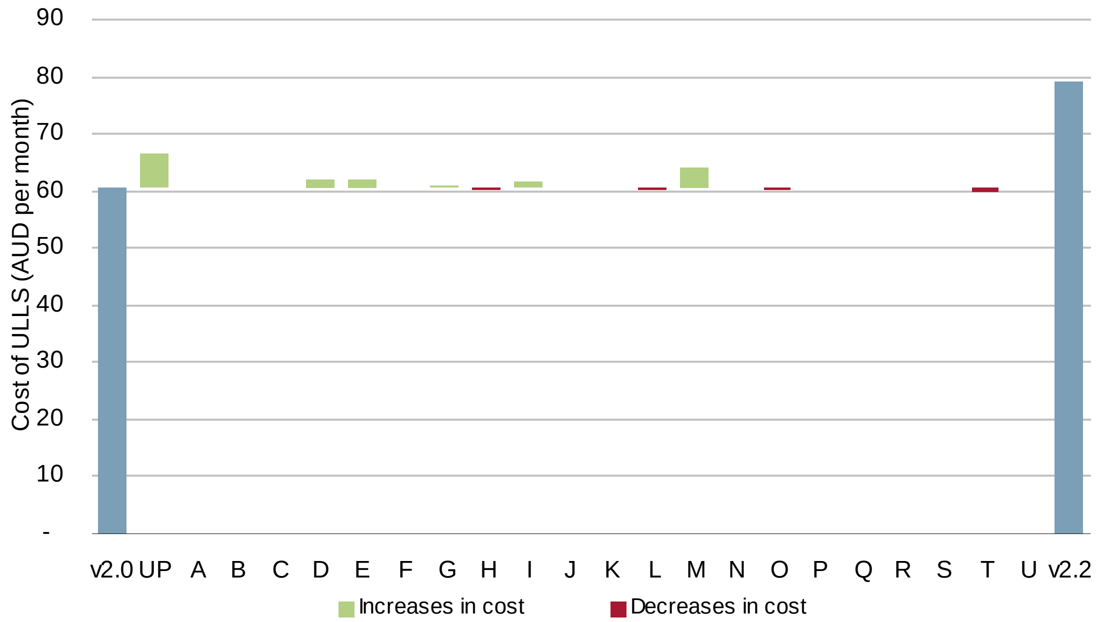

Figure 1.3: *Impact of changes on ULLS in Zone B [Source: Analysys Mason]*

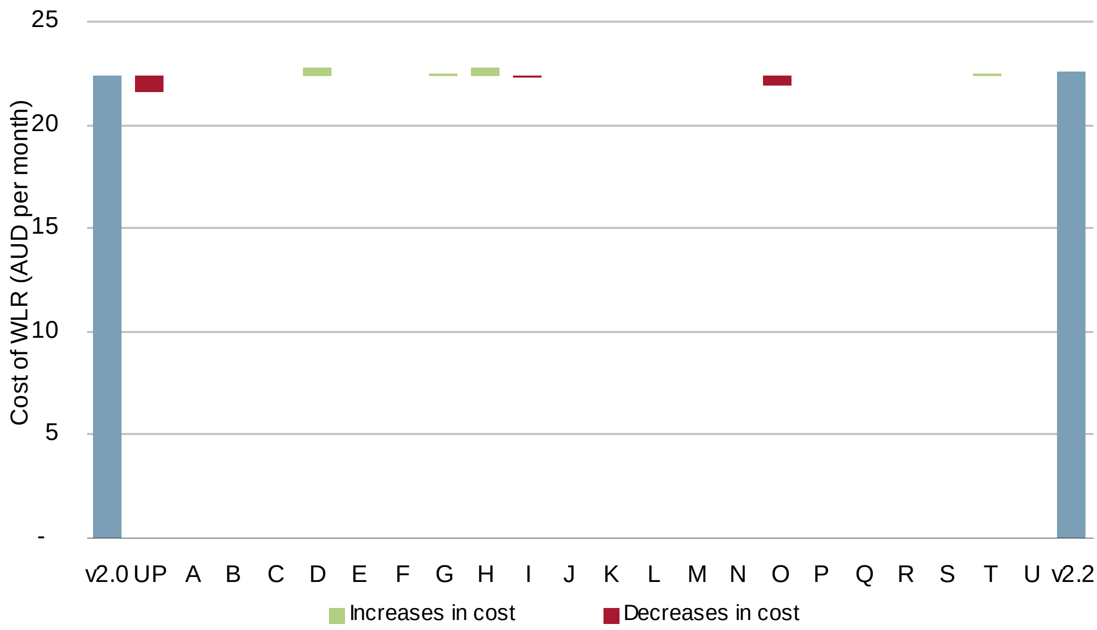

Figure 1.4: Impact of changes on WLR in Zone A [Source: Analysys Mason]

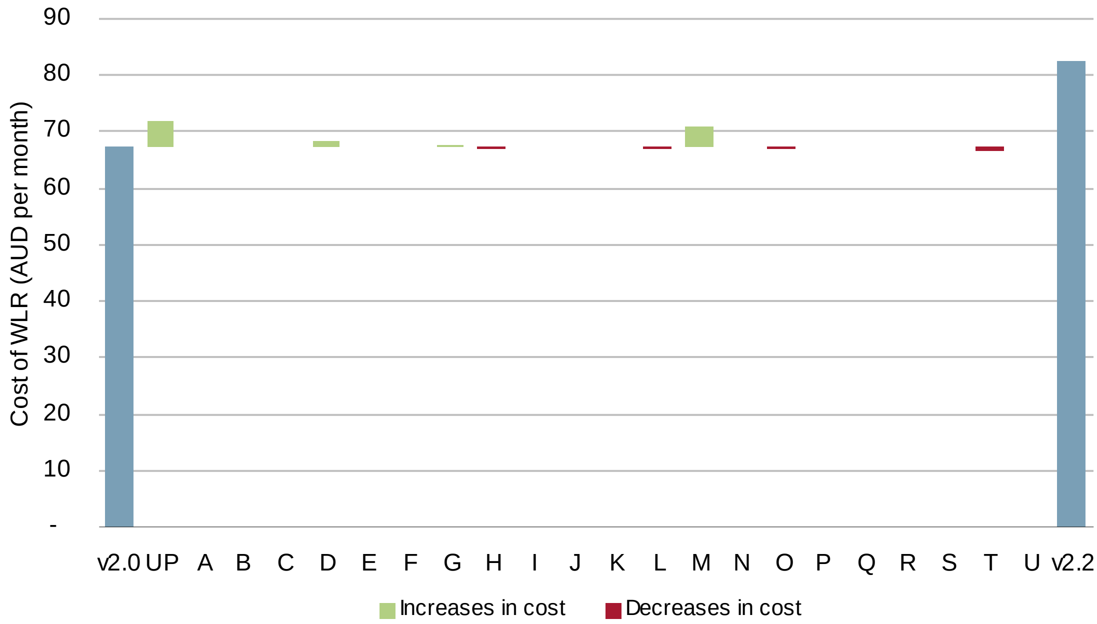

Figure 1.5: Impact of changes on WLR in Zone B [Source: Analysys Mason]

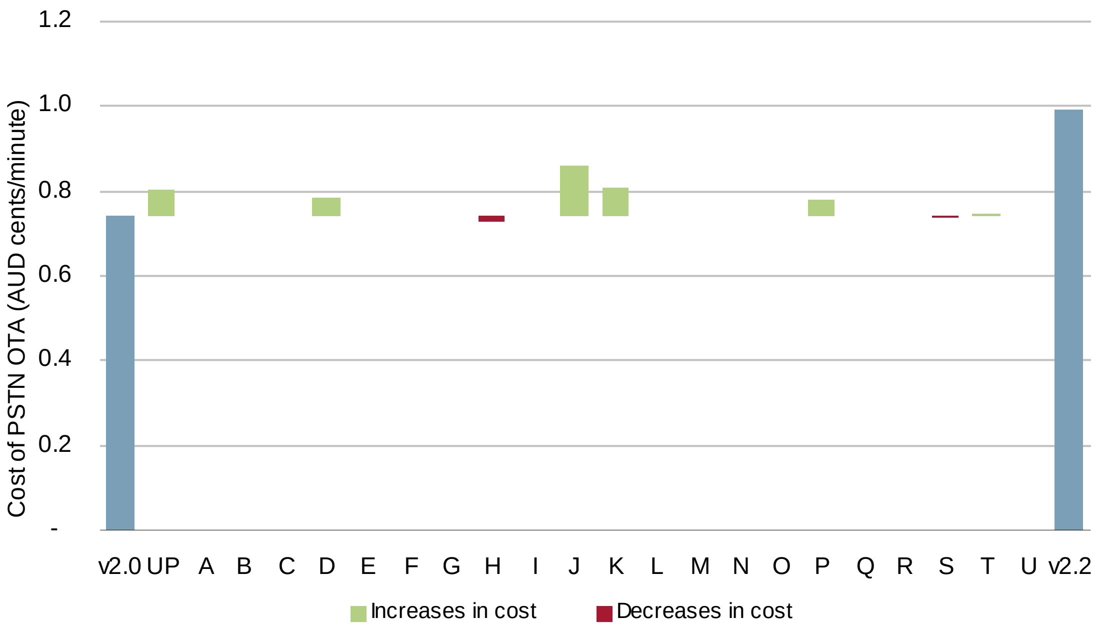

Figure 1.6: Impact of changes on PSTN OTA [Source: Analysys Mason]

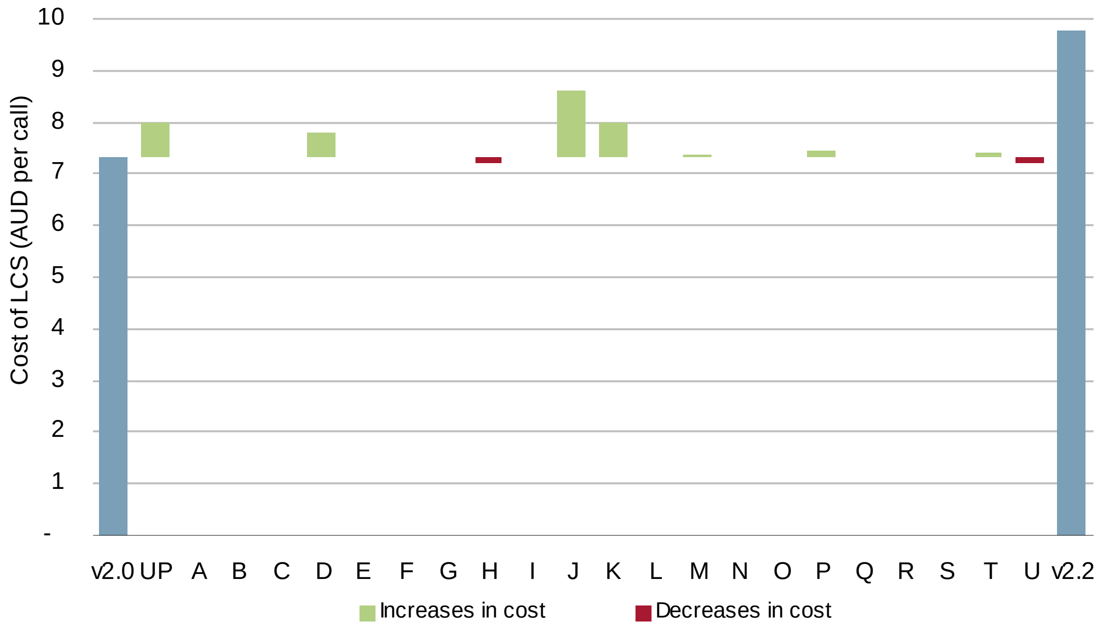

Figure 1.7: Impact of changes on LCS [Source: Analysys Mason]

We note that the costs for ULLS/WLR services in Zone B have increased significantly. This is partly due to the changes made in the model, but is also affected by us making a full refresh of the geoanalysis inputs from both *Access – CODE.xls* and *Cable gauge determination.xls*: this was not fully completed when the ACCC finalised its own version of the cost model.

We note that as well as the update to the reference model, the two changes which contribute most to the increase in Zone B prices are:

- Issue L: Impossible ploughing of large cables
- Issue M: Omission of extra protection costs for buried cable.

The relevance of these changes is discussed below in Sections 4.9 and 4.10 respectively.

1.4 Other potential revisions

Analysys Mason has identified several other inputs which could be revised, although they are not directly related to operator comments. These are:

- Reducing the pit costs, which appear very high for the P9/PF20/PF28 assets when compared with those illustrated on Page 77 of the public TEA Model User Guide.

- Reducing the number of duct deployed in the IEN to 1 per route, on the basis that 1 duct is sufficient for IEN fibre.

- Relaxing the requirements for the cable gauge calculation, so that we only use ISDN service requirements when 0.64mm/0.9mm distribution cable starts to be deployed. This effectively means that 92% of copper SIOs can receive ADSL, compared with 96% of copper SIOs in the Version 2.0 model.

If these changes are made, then the costs of ULLS, WLR, PSTN OTA and LCS all fall, as shown below in Figure 1.8.

Service	*Zone*	*Version 2.0*	*Version 2.2, without additional changes*	*Version 2.2*
ULLS charge per line per month	A	22.06	23.70	21.75
WLR charge per line per month	A	22.34	22.60	20.79
ULLS charge per line per month	B	60.56	79.12	60.71
WLR charge per line per month	B	67.38	82.66	64.50
PSTN OTA per minute	—	0.0074	0.0099	0.0089
LCS per call	—	7.32	9.77	8.65

Figure 1.8: Comparison of costs (AUD) of declared services [Source: Analysys Mason]

In v2.2 of the model that Analysys Mason have provided to the ACCC, these three changes have been made.

2 Introduction

On 21 August 2009, the ACCC released its draft pricing principles and indicative prices to industry for consultation for six fixed-line wholesale services. The consultation period ended on 9 October 2009 and several operators submitted comments. In particular, submissions from Telstra and Optus outlined issues they believed they had identified in the Analysys cost model, which influenced the indicative prices. These issues are summarised in Figure 2.1 below.

Operator	*Issue*	*Description*	*Relevant module(s)*	*Reference in submission*[2]	
				July 2009	*October 2009*
Telstra	A	Use of too few customer locations	Misconception	Issue 13	Issue 15
Telstra	B	Over-estimation of LPGS–RAU cost re-allocated to the Core module	Misconception	Issue 6	—
Optus	C	Use of 100-pair for main cable	Misconception	—	Section 5.5
Telstra	D	Omission of jointing to connect distribution/main cables to pillars	Cost	Issue 1	Issue 1
Telstra	E	Omission of joints to connect different cable gauges	Cost	Issue 10	Issue 2
Telstra	F	Incorrect cost of 400-pair joints	Cost	Issue 2	Issue 3
Telstra	G	Omission of assets required from between PB and DP	Cost	Issue 5	Issue 5
Telstra	H	Lack of correction of the CAN for additional IEN duct	Cost	Issue 7	Issue 8
Telstra	I	Incorrect allocation of copper and fibre main cable costs	Cost	Issue 4	Issue 11
Telstra	J	Cost allocations to dark fibre services	Cost	Issue 8	Issue 12
Telstra	K	Inconsistent dial-up forecast	Cost	—	Issue 13
Telstra	L	Impossible ploughing of large cables	Cost	Issue 11	Issue 14
Telstra	M	Omission of extra protection costs for buried cable	Cost	Issue 12	—
Telstra	N	Not currently used	—	—	—
Optus	O	Incorrect jointing of lead-ins to the distribution cable	Cost	—	Section 5.4
Telstra	P	Underestimation of the cost of the IEN	CAN, Cost	—	Issue 9
Telstra	Q	Insufficient cable within road crossings	CAN, Cost	Issue 5	Issue 6
Telstra	R	Inconsistent serving pit architecture	CAN, Cost	—	Issue 7
Telstra	S	Quantification of fibre jointing	Offline	Issue 9	Issue 4
Telstra	T	Under-dimensioning of pits in the CAN	Offline	Issue 3	Issue 10
Telstra	U	Wireless radius	Offline	Issue 16	Issue 16

Figure 2.1: Summary of issues investigated by Analysys Mason [Source: Analysys Mason]

2 Telstra provided two submissions to the consultation in July and October 2009. Optus provided a single submission in October 2009.

In previous work with the ACCC, Analysys Mason has identified three tiers in the cost model, namely the Cost module, the CAN/Core modules and the offline calculations, as shown below.

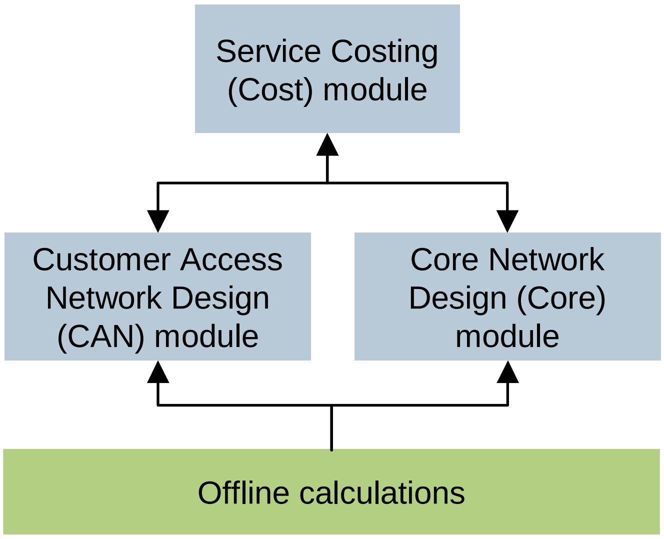

Figure 2.2: High-level structure of the Analysys cost model [Source: Analysys Mason]

We have investigated these issues following this structure. Therefore, the remainder of this document is laid out as follows:

- Section 3 explains issues A–C, which are misconceptions on the part of the operators rather than errors in the model
- Section 4 describes our investigations of issues D–O, related to the Cost module
- Section 5 describes our investigations of issues P–R, related to the CAN and Core modules
- Section 6 describes our investigations of issues S–U, related to the offline calculations

The report includes a number of annexes containing supplementary material:

- Annex A summarises the documents referred to in this report
- Annex B summarises the changes made in order to arrive at the reference model used as a basis for comparison in investigating the various issues
- Annex C summarises the adjustments made to the version 2.0 model in order to arrive at our version 2.2 model.

3 Misconceptions

This section provides our treatment of issues A–C, which are misconceptions of the model.

3.1 Issue A: Use of too few customer locations

3.1.1 Quoted issue (Telstra October submission, pages 66–67)

> The Analysys Model identifies customer locations by reference to the G-NAF database. Analysys itself has acknowledged that the G-NAF database has addresses that are invalid. Analysys has then sought to remove erroneous locations and has determined that there are 9.8 million valid locations. The Analysys Model however, only uses 8 million of those locations.
>
> Telstra submits that there are two problems with the Analysys Model as follows:
>
> (a) the ACCC should used data of actual locations. These actual locations are identified in Telstra's TEA Model; and
>
> (b) if the ACCC does not want to use actual locations, it should, at least, use the 9.8 million locations identified by Analysys.

3.1.2 Discussion

We believe that the nature of the misconception arises from the use of the terms "address" and "location." In our terminology, several addresses (i.e. postal delivery points) can be within a single location (i.e. building).

Our processing of the G–NAF is described in Annex A of the FLRIC report. There are 12.59 million addresses in the G–NAF in total. These 12.59 million addresses are then sifted in several steps in order to remove invalid or duplicated entries. In particular, we remove addresses:

- labelled as aliases
- not lying within a land parcel
- with a confidence of 0 and a reliability of 3
- labelled as lots, but sharing a land parcel with at least one other entry not labelled as a lot.

After the sifting process is complete, 9.78 million addresses remain (some addresses are not removed in rural areas using these rules due to the scarcity of the geodata). Each address is then assigned a particular level of demand.

The next step is then described on page 163 of the FLRIC report and involves extracting the final locations to be used in the model by aggregating the addresses by their G–NAF coordinates. In particular, we state that:

G–NAF entries have therefore been grouped by the latitude and longitude of their G–NAF. Since these are decimals, Microsoft Access cannot group these accurately. Therefore, the entries have been grouped using the nearest whole number of the original longitudes/latitudes multiplied by 50 000. This is equivalent to grouping any coordinates that lie within approximately 3m of each other. ***Demand is aggregated to locations.*** *Given that the grouped coordinates may differ very slightly, the average values at a locations are calculated.*

The query in Microsoft Access used to complete this step (albeit for one ESA) is described in Section 3.2.6 of the geoanalysis user guide.

Telstra's comment that our modelling only uses 8 million locations (implying that some locations are lost) is erroneous. Instead, we aggregate the 9.78 million addresses by their coordinates into 7.93 million unique locations (same as the 8 million quoted by Telstra) and aggregate the demand.

As an example, if there are five address entries, each with 2 units of demand, within 1 metre of each other, then this final step derives a single location representing these address entries. This location:

- has 10 units of demand
- is defined as having coordinates equal to the average of those of the five address entries.

The source of the misconception may be that we refer to the database as the Location and Demand Database, but the database itself contains address entries. In order to extract locations for use in the model, we use the step described above to aggregate the address entries to unique locations.

3.1.3 Analysys Mason's recommendation

Telstra's comment is a misconception and requires no changes to the model. It follows that, according to paragraph 60 in the Telstra October submission, the Analysys cost model is already complying with option (b) of the operator's comment.

The above section can be used to inform operators that the claimed error is unfounded, and can be used by the ACCC in any discussions on this issue. In addition, we also note that the G–NAF is the best geocoded address database of Australia that is commercially available. We doubt whether Telstra would be willing to submit its location database for implementation into a publically consultable cost model: however, the ACCC could still suggest this to Telstra.

3.2 Issue B: Over-estimation of LPGS–RAU cost re-allocated to the Core module

3.2.1 Quoted issue (Telstra July submission, pages 7–8)

> There is an error in the calculation of the proportion of trench, conduit, pits and manholes attributable to LPGS>>RAU in the ACCC's model. For example, the allocation for Geotypes 5 is 3.5% of the total amount in the CAN (Cost.xls, Inputs.Access, cells H133), when the maximum proportion of total CAN trench that can be used for LPGS>>RAU fibre is 0.89%.
>
> The model does not route main cable directly from pillars/LPGS to the LE; rather, it snakes main cable through distribution trench back to the LE. The model places trench and conduit between adjacent distribution areas to connect two sets distribution trenches together thereby enabling main cables to wind their way from one distribution area to the next all the way back to the LE. The model calls this trench and conduit which connects distribution trenches together 'incremental Pillar/LPGS>>LE trench. This incremental trench is directly attributable to main cable (i.e. it is not used by the distribution network.).
>
> The incremental trench length for Pillar/LPGS>> LE in Geotype 5 is 1.00 M metres (CAN.xls, Access, cell I131). The total trench length for Geotype 5 (with the exception of road crossings and PB>>DP/serving pits which are not used by main cable and are not allocated to Core) is 28.06 M metres (CAN.xls, Access, I114 – I115 – I122). Consequently the ratio of Pillar/LPGS>>LE incremental trench length to total trench length for Geotype 5 is 3.56%. However, LPGS accounts for only 6.30% of the total Pillars and LPGS in Geotype 5 (CAN.xls, Access, I53/I49); so only 6.3% of the 3.56% of CAN trench length directly attributable to main cable in Geotype 5 is attributable to LPGS>>RAU (the rest is attributable to Pillar>>LE). This means 0.22% of the total incremental CAN trench length is attributable to incremental LPGS>>RAU.
>
> In addition to the incremental trench length for Pillar/LPGS>>LE, main cables also share the use of distribution trench. Distribution trench in the model is labelled DP>>next node and FDP>DP. Consequently, some portion of the DP>>next node and FDP>>DP trench length is attributable to main cable, including LPGS>>RAU fibre. Since LPGS>>RAU fibre, copper main cable and copper distribution cable are each placed in separate duct, all trench shared by LPGS>>RAU fibre will have a minimum of 2 ducts (i.e. one for distribution cable and one for fibre main cable) and generally a minimum of 3 ducts (i.e. one for distribution cable, one for fibre main cable and one for copper main cable). Consequently, LPGS>>RAU fibre can never reside in CAN trench which only has a single duct. Further, since 93.5% of the total Pillars/LPGS are Pillars, and Pillars and LPGS follow common routes to the LE, the preponderance of LPGS>>RAU fibres, which use CAN trench, are placed in trench along side of copper main cables as well as copper distribution cables and, therefore have a minimum of 3 ducts.

Since only 6.96 M metres of total CAN trench length in Geotype 5 contains two or more ducts (CAN.xls, Access, Sum of I161 through I169), this is the maximum length of CAN trench conduit that LPGS>>RAU fibres can share. Further, 1.00 M metres of this trench is incremental Pillar/LPGS>>LE trench, which has already been directly attributed to main cable. Consequently, 5.96 M metres is the maximum length of trench in Geotype 5 with duct capacity capable of supporting main cable, including LPGS>RAU fibres, that has not previously been allocated to the main network. (Since the preponderance of LPGS>>RAU fibre resides in trench with at least 3 ducts as explained above, a better estimate of the maximum length of trench with sufficient duct capacity to support LPGS>>RAU fibre is only 2.27 M metres. Nevertheless the more conservative estimate of 5.96 M metres is used in this analysis.)

Assuming 100% of the 5.96 M metres of trench in Geotype 5 with 2 or more ducts (i.e. trench with sufficient duct capacity to support main cable) is shared between distribution and main cable, 21.24% of the total CAN trench would be shared between main and distribution cable (with the exception of road crossings and BP>>DP/serving pits which are not shared with main cable or allocated to Core). A 50% allocation of this trench and conduit to the main network would amount to 10.62% of total trench/conduit length. Since 6.3% of main cable is LPGS>>RAU fibre, the maximum additional allocation of CAN trench to the core network for sharing between LPGS>>RAU fibre and the distribution network (FDP>>DP and DP>>next node trench/conduit) is 0.67% (10.62%*.063).

The maximum amount of total CAN trench in Geotype 5 (with the exception of road crossings and BP>>DP/serving pits which are not shared between main and distribution or allocated to Core) which can be allocated to the Core due to LPGS>>RAU fibre trench use is 0.89%. This is the sum of that portion of total CAN trench attributable to directly assigned incremental Pillar/LPGS>>LE trench (0.22%) and that portion of total CAN trench attributable to sharing between LPGS>>RAU fibre and distribution cable (0.67%). This is much smaller than the model's allocation of 3.5%.

The example given for Geotype 5 is equally applicable to the other Geotypes, some of which mistakenly have allocations of CAN trench/conduit to the Core for LPGS>>RAU fibre as high as 21%.

3.2.2 Discussion

Telstra offers an eight-paragraph discussion in its July submission explaining that the calculation of duct used to support LPGS–RAU links is over-estimated, through critiquing outputs derived using the Visual Basic in the Access CODE workbook by using other output values of the analysis. We believe Telstra's analysis is incorrect due to a misunderstanding of the outputs that it has used.

Our methodology is outlined in Section 6.2 of the FLRIC report, where we state that:

"The allocation of associated costs of the LPGS backhaul is informed by the geoanalysis, where the distance of duct designated as being used just for LPGS backhaul is calculated as a percentage of total duct distance."

This cost allocation is then applied in the Cost module, before the allocation of duct/trench costs from the CAN to the Core as a result of the IEN sharing the CAN routes.

Our allocation considers the **duct** deployed for LPGS–LE links throughout the **entire CAN**, whereas Telstra appears to attempt to use **trench** in its perception of the **distribution** and **main networks** separately. Telstra's approach requires a number of assumptions, which appear to be questionable. These include:

- **Paragraphs 3–6**: The proportion of nodes in a geotype that are LPGS can be used as a proxy to determine the main network costs attributable to pillars (even though LPGS require, on average, longer trench routes back to the LE).
- **Paragraph 5**: That all incremental pillar/LPGS>>LE trench has more than 1 duct.
- **Paragraph 6**: That all routes with more than 1 duct is fully shared between the distribution and main cables, even though second ducts can be deployed for point-to-point fibre as well.

In Paragraph 3 of its submission, Telstra states that the ratio of incremental pillar/LPGS>>LE (i.e. main network-only) trench to total trench length is 3.56%. However, the pillar/LPGS>>LE duct as a proportion of total duct length would be significantly higher. Telstra then states that:

"*LPGS accounts for only 6.30% of the total Pillars and LPGS in Geotype 5 (CAN.xls, Access, I53/I49); so only 6.3% of the 3.56% of CAN trench length directly attributable to main cable in Geotype 5 is attributable to LPGS>>RAU.*"

This is implicitly assuming that the mix of pillars and LPGS can be used to determine the mix of pillar–LE duct and LPGS-LE duct i.e. effectively that pillars and LPGS are homogeneously distributed throughout an ESA. Since LPGS are by design deployed more remotely, the average distances between LPGS and LE are larger than those between pillars and LE.

In Paragraph 4 of its submission, Telstra states that LPGS–LE routes will generally have "a minimum of 3 ducts (i.e. one for distribution cable, one for fibre main cable and one for copper main cable)". Again, by the nature of the deployment of LPGS more remote from the exchange location, this argument does not appear reasonable for the outlying routes, which will not contain a duct for copper main cable. This misconception arises again when it is stated that "93.5% of the total Pillars/LPGS are Pillars, and Pillars and LPGS follow common routes to the LE."

In Paragraph 5 of its submission, Telstra states that "5.96M metres is the maximum length of trench in Geotype 5 with duct capacity capable of supporting main cable, including LPGS>RAU fibres, that has not previously been allocated to the main network." This is calculated as the total amount of CAN trench with more than one duct, less the incremental pillar/LPGS>>LE trench.

This is assuming that all incremental pillar/LPGS>>LE trench has more than 1 duct. This is certainly an over-estimate, since it is only those incremental routes closer to the LE that will contain more than 1 duct (in order to carry both multiple pillar–LE 400-pair cables and LPGS–LE fibre cables).

In Paragraph 6 of its submission, Telstra assumes that "100% of the 5.96 M metres of trench in Geotype 5 with 2 or more ducts (i.e. trench with sufficient duct capacity to support main cable) is shared between distribution and main cable." This ignores the fact that a significant number of second ducts can also be deployed in the distribution network for point-to-point fibre, so this percentage is likely to be less than 100%. Telstra also uses its assumption that the proportion of nodes deployed that are LPGS correlates to the proportion of trench cost attributable to LPGS.

3.2.3 Analysys Mason's recommendation

We note that Telstra did not bring up this issue in its October submission.

We further note that Telstra's methodology is much more complicated than our approach using duct metres and does not rely on assumptions such as those given above. Moreover, any correction would most likely cause further confusion. We are confident that our algorithms treat this issue with an in-depth analysis of the duct deployed on each link. Therefore, we do not believe that any changes should be implemented and this allocation should be left unchanged.

We do note that Telstra's response does identify that LPGS>>RAU links will likely be deployed in trench with more than 1 duct. Though not explicit, this point raises a small issue of adjusting the cost allocation because routes with 1 duct have a higher cost per metre per duct than routes with 2 ducts. This is likely to have a small effect, but may be an issue raised by operators at a later date.

The above section can be used to inform operators that the claimed error is unfounded and can be used by the ACCC in any discussions on this issue.

3.3 Issue C: Use of 100-pair for main cable

3.3.1 Quoted issue (Optus Confidential Attachment 3, page 44)

> 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 and Telstra's network architecture rules, 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').

> 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').

3.3.2 Discussion

Network Strategies, the author of this report for Optus, states that according to Figure E.2 in the FLRIC reports, the model uses 100-pair cables to dimension the main cables between pillars and RAUs in a non-tapered network. This is a misinterpretation of the seventh line in this table, which says "Main cable size in non-tapered network = 100 pairs". We note that the second line of the same table clearly states "Capacity of cable from the pillar to RAU = 400 pairs. " This is due to the use of the term "main" in Australia to mean the network between pillars and exchanges. In the seventh line of Figure E.2, "main cable" is intended to mean "principal cable" i.e. the one that is mainly used.

We have reviewed the TEA network design rules document[3] cited by Network Strategies. This document treats the distribution network (i.e. from DPs/pits back to the pillar) separately from the main/feeder network (i.e. from pillars back to the exchange/RAU).

Distribution network

The beginning of Section 3.2 of the TEA network design rules document clearly states that, for the distribution network:

The model is to use a 100 pair non tapered cable architecture.

Analysys Mason has reflected this in the cost model, as described in Section 5.3.2 of the FLRIC report, with the DP–pillar network described in particular on page 58. The "main cable size" is 100-pair, with the option of using a "minor cable size" at the extreme ends of the distribution network. However, we set this minor cable size to zero, so 100-pair is used throughout this part of the network.

3 *Access Network Dimensioning Rules: Long run incremental costing model input*, 3 March 2008, downloaded from http://www.accc.gov.au/content/item.phtml?itemId=812449&nodeId=8b95bf704cfc3eedff2347a7c30a3928&fn=ULLS%20Undertaking%20%20-%20Engineering%20rules.pdf

Main/feeder network

Telstra uses several cable sizes in the TEA model for the main network, as shown in the table in Section 3.3.2 of the TEA network design rules document. The sizes used are 100-pair, 200-pair, 400-pair, 800-pair, 1200-pair and 2400-pair. A tapered architecture is deployed, as shown in the figure in Section 3.1.1.2 of the TEA network design rules document.

The Analysys cost model makes the simplifying assumption that discrete 400-pair cables are used back from each pillar to the RAU. In particular, we do not include smaller cable sizes in the main network, contrary to the comment made by Network Strategies.

3.3.3 Analysys Mason's recommendation

Network Strategies has misunderstood our cabling deployment rules in the distribution and main networks, most likely due to a misconception of the use of the word "main" in Figure E.2 in the FLRIC report. The distribution network should be (and is) modelled with 100-pair cable. The main network should be (and is) modelled with 400-pair cable.

The above section can be used to inform operators that the claimed error is unfounded, and can be used by the ACCC in any discussions on this issue.

4 Cost module issues

This section describes our investigations of issues D–O, related to the Cost module.

4.1 Issue D: Omission of jointing to connect distribution/main cables to pillars

4.1.1 Quoted issue (Telstra October submission, page 50)

> The Analysys Model fails to include "joints" for connecting copper main cables and copper distribution cables to a pillar or large pair gain system (LPGS)… By contrast, the ACCC has accepted in its model that joints are required to connect the other end of the main cable to the remote access unit (RAU) and the other end of the distribution cable to the distribution point (DP).

4.1.2 Discussion

We note that the cost of these joints were intended to be included in the unit cost of the pillar/LPGS. However, since joints are predominantly labour-related, it is reasonable to capture them separately from the asset hardware. Disaggregating costs is dependent on having access to reasonable information, whether costs are supplied by stakeholders or come from benchmark sources.

As a general principle, we note that in developing bottom-up cost models, disaggregation of cost components should improve model transparency and understanding of specific costs associated with the component. In contrast, disaggregation increases the requirement for individual inputs, usually leading to a burden on contributing stakeholders. In developing the model, Analysys has tried to strike a reasonable balance, though this has been influenced by more recent development of Telstra's TEA model for access costing. While we have introduced more detailed assets, a fundamental issue remains of sourcing reasonable input costs from stakeholders.

Telstra's explanation of the issue is not entirely consistent with that in the Lordan CAN report[4]. In paragraph 7.30, this states:

…if a 400 pair main cable is to be connected to a 900 pair pillar a joint will be required between the 400 pair cable and four 100 pair cables which can then be inserted into the pillar."

---

4 http://www.accc.gov.au/content/item.phtml?itemId=897201&nodeId=d2402ec40949a9b33539f229c9cf2d02&fn=Lordan%20Report%20regarding%20CAN%20Architecture%208%20Oct%202009.pdf

This implies a deployment as shown below in Figure 4.1.

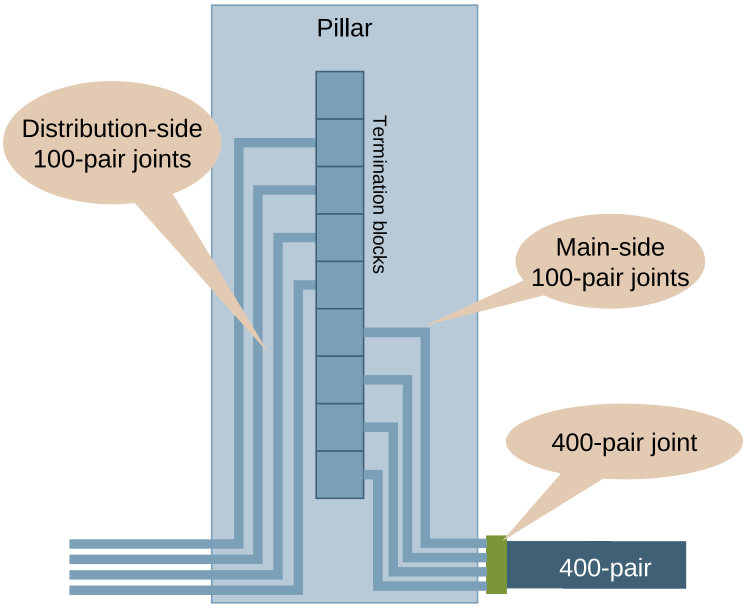

Figure 4.1: Deployment of jointing in a pillar implied by the Lordan CAN report [Source: Lordan CAN report]

Therefore, Telstra's proposed modification to add in a 400-pair joint for each pillar/LPGS is not quite sufficient. In reality, Lordan highlights that the 400-pair joint effectively splits the 400-pair cable out into four 100-pair cables, which are then each jointed with a 100-pair joint onto the frame inside the pillar/LPGS. This is necessary because a 400-pair cable is too thick to move around within the pillar/LPGS housing. Correspondingly, we can reduce the capex of the pillar/LPGS by the cost of one 400-pair joint and four 100-pair joints on the main cable side. This change has a negligible impact on the model.

We also acknowledge Telstra's statement that there are distribution-side 100-pair joints not explicitly included in where the 100-pair cables enter the pillar/LPGS. As with the main cable joints, these were presumed to implicitly be captured in the pillar/LPGS unit costs. There are several approaches with regard to incorporating these joints, which affects the disaggregation of jointing costs from the original pillar cost. We summarise these below, in order of increasing number of extra joints (and hence cost to be adjusted for):

	Description of approach	*Consequence*	*Drawbacks*
0	Do nothing: restate that the model includes the cost of jointing in the costs of the pillar/LPGS	Joints do not appear explicitly in the model	Less transparent
1	Set the extra joints equal to the demand served by the pillars/LPGS	100-pair cables are not fully jointed	Could be argued to be unrealistic
2	Set the extra joints per pillar equal to the average demand served per pillar, rounded up to the nearest 100	100-pair cables are fully jointed: Telstra's proposed approach	Understates cases where cables enter pillar from multiple directions[5]
3	Derive active pairs as a proportion of all pairs entering copper nodes in the Access – CODE workbook	Includes cases where cables enter pillar from multiple directions	Requires jointing of a large amount of intentionally over-provisioned copper in 100-pair cables. Is also more complicated to implement.

Figure 4.2: Options for including extra joints in the distribution network [Source: Analysys Mason]

It is worth highlighting that the difference between Approach 1 and Approach 3 is whether one joints only the downstream demand at the time of analysis or all downstream pairs available. As pillars were intended to provide flexibility for unknown demand changes, then they therefore intentionally accommodate some spare capacity. This suggests that some work will be required at the pillar when provisioning a new line and not all main and distribution cables are necessarily connected onto fully provisioned paths. Our proposal is that Approach 2 presents a reasonable middle path. This is consistent with Telstra's proposed solution.

The number of extra joints required by geotype for each approach are shown below in Figure 4.3.

5 For example, suppose we have a pillar serving 360 lines. Assuming full utilisation of 100-pair cable, this requires 4 cables. However, suppose the cables enter the pillar from opposite directions, one serving 210 lines and the other 150 lines. Then, the former requires 3 cables and the latter 2, meaning 5 are required in total.

Geotype	Approach 1	Approach 2	Approach 3
1	33 930	39 600	46 827
2	26 813	27 900	36 137
3	1 939 495	2 290 400	2 700 943
4	2 746 502	2 814 300	3 950 274
5	1 695 681	2 086 200	2 479 657
6	452 616	524 400	709 902
7	266 120	387 200	432 420
8	166 150	184 200	217 824
9	38 865	43 800	38 325
10	865 851	1 430 200	1 496 903
11	681 762	905 200	874 619
12	734 930	1 070 100	936 054
13	335 314	375 900	438 550
14	18 646	42 000	19 091
15	–	–	–
16	–	–	–
TOTAL	**10 002 676**	**12 221 400**	**14 377 527**
Average joints per copper cluster	224	273	321

Figure 4.3: Additional copper pair cable joints by geotype for each approach [Source: Analysys Mason]

Implementing Approach 2 leads to an average of 2.73 extra 100-pair joints required per copper cluster (pillar and LPGS), which corresponds to a jointing cost of AUD656. Hence, this cost should also be disaggregated from the benchmark pillar cost.

Including the adjustments for Approach 2 leads to a marginal reduction in the cost of ULLS by approximately AUD0.01 in Zones A and B. This is a result of the pillar/LPGS cost being disaggregated for all geotypes by the same amount (i.e. AUD656), when in reality the reduction due to distribution cable joints will vary by geotype. However, the original unit costs of these assets did not vary by geotype and we believe that this should still be case.

4.1.3 Analysys Mason's recommendation

We propose to implement Approach 2 since it presents a reasonable middle path of our alternatives, is consistent with Telstra's proposed solution and only requires amendments to the active modules.

4.2 Issue E: Omission of joints to connect different cable gauges

4.2.1 Quoted issue (Telstra October submission, page 51)

> The Analysys Model acknowledges that different gauges (or thickness) of cable will need to be connected together. In order to connect cables of different gauges, a pit or manhole is required to access the cables which are to be connected and a joint is required to connect the cables… The Analysys Model does not take account of the need for a joint and a manhole or pit to enable the two cables to be connected.

4.2.2 Discussion

We consider the supposed omission of joints in the two levels of network (distribution and main). We first highlight that no joints are missed in the distribution network, since our calculations assume that a pillar cluster only contains one gauge (a clearly conservative assumption). Although this is not made explicit in the documentation, it is implied in Figure 7.2 of the geoanalysis user guide. We have added a sentence to the user guide to make this more explicit.

As is shown in Figure 7.2, the main cable is assumed to be made up of at most two gauges of cable. For the main cable, we have explored three approaches:

- **Approach 1:** Make no correction
- **Approach 2**: Include extra higher gauge main cable
- **Approach 3**: Add in an extra joint and pit.

Approach 1: Make no correction

In the existing solution of adjusting cable gauge for loop length, a conservative assumption is used for the distribution network that if the longest loop requires a thicker gauge, then all distribution cables in the entire pillar cluster are upgraded to the thicker gauge, rather than just the relevant cables. It could be argued that this over-estimates thicker gauge cabling in the distribution network and may over-compensate for the missing joint and pit. This can be quantified by considering the sampled pillar clusters from *Cable gauge determination.xls*. In particular:

- 1808 main cables require more than one cable gauge across all geotypes, meaning that 1808 400-pair joints (and pits) would be omitted
- 582 clusters are deployed with 0.64mm/0.9mm gauge cable, totalling 2307km of 0.64mm gauge cable and 3948km of 0.9mm gauge cable.

Figure 4.4 below compares the annualised cost of the extra pits/joints versus the incremental annualised cost of deploying the thicker gauge cables in the distribution network.

Asset	*Volume*	*Unit cost*	*Total cost*	*Cable (gauge)*	*Volume(m)*	*Unit cost*	*Total cost*
P9 pit	1808	519.6	939 435	100-pair (0.4)	17 559 874	1.28	22 455 320
400-pair joint	1808	107.1	193 654	100-pair (0.64)	2 307 068	1.95	4 489 664
				100-pair (0.9)	3 947 817	3.28	12 951 095
				Total	23 814 758		39 896 080
				100-pair (0.4)	23 814 758	1.28	30 453 979
Cost of extra assets			**1 133 088**	**Incremental cost of all thicker gauge**			**9 442 102**

Figure 4.4: Annualised cost comparison for gauge-related assets [Source: Analysys Mason]

Since all 100-pair cable in a pillar cluster is upgraded, rather than just that for those loops requiring thicker gauge, it is likely that the incremental cost of the thicker gauge is heavily over-stating what is actually required.

Approach 2: Include extra higher gauge cable

Main cables are jointed at least every 500m in the model. If a gauge change is required between two such joints, then the higher gauge can be (conservatively) assumed to extend to the joint furthest downstream, as shown in Figure 4.5 below.

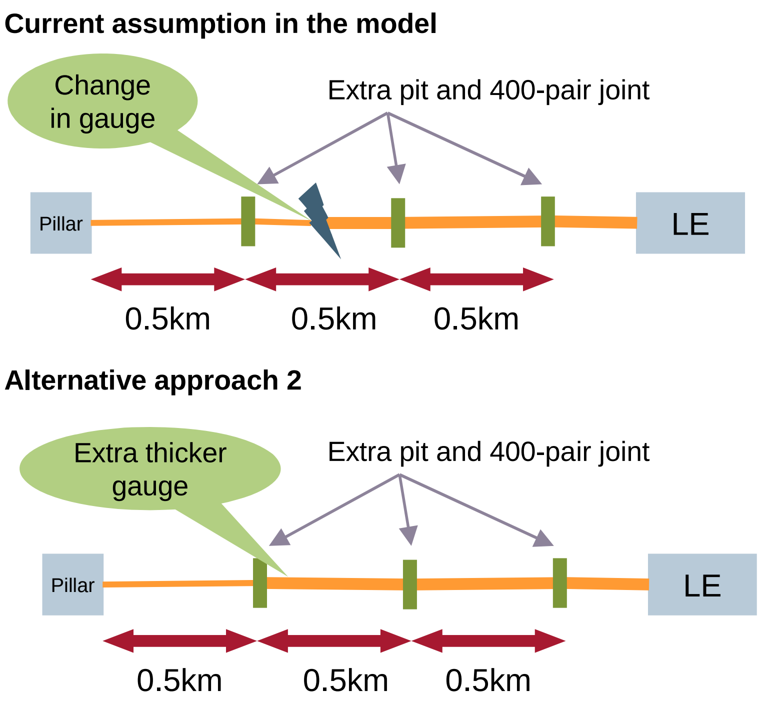

Figure 4.5: Inclusion of extra thicker gauge main cable [Source: Analysys Mason]

We have revised the formulae in a version of *Cable gauge determination.xls* to use this more conservative assumption, allowing a revised gauge distribution to be calculated and used in the Cost module.

This leads to a 0.94% increase in 0.64mm 400-pair gauge cable and a 4.66% increase in 0.9mm 400-pair gauge cable deployed across all geotypes. This increases the ULLS cost in Zone A by approximately AUD0.07 and AUD0.03 in Zone B.

Approach 3: Add in extra joints and pit

Using the information from *Cable gauge determination.xls* as to what proportion of pillars require two main cable gauges, we can deploy an extra joint and pit at this proportion of pillars, as shown in Figure 4.6 below.

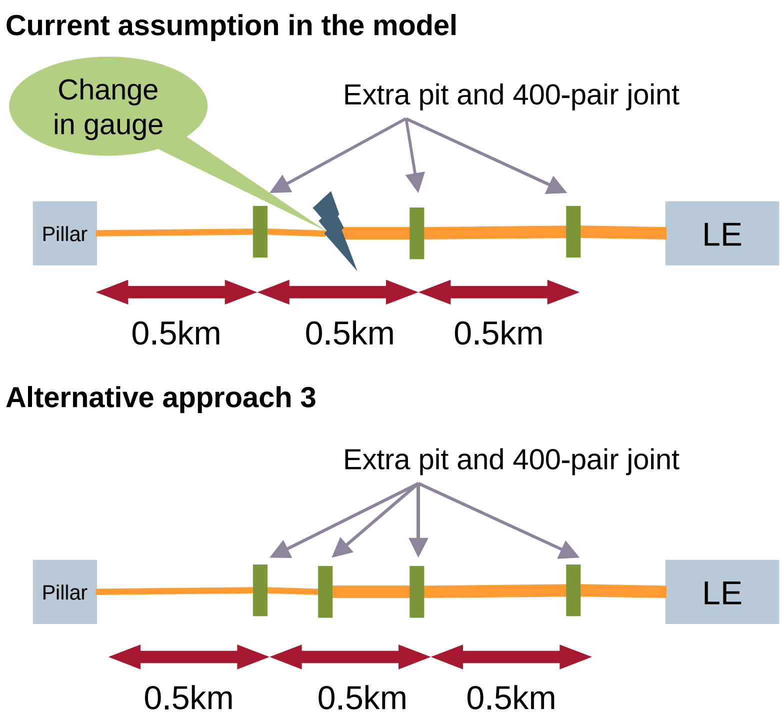

Figure 4.6: Inclusion of an extra pit and joint [Source: Analysys Mason]

The additional distance-based pits are assumed to follow the same distribution of pit size as other pits and a full 400-pair joint is added in as well. This increases the service costs in Zone A by approximately AUD0.02 and less than AUD0.01 in Zone B.

4.2.3 Analysys Mason's recommendation

We recommend the use of Approach 3 on cost principles. At the engineering level, we note that the declared principles of the cost model would lead to implementing Approach 2.

Using Approach 3, an extra pit for each change in main cable gauge adds less cost into the access network than adding in more thicker gauge cable. We note that the cost of the former is AUD1320 for a P5 and a 400-pair joint, whereas the cost of thicker gauge cable is AUD35 per metre for

0.64mm gauge and AUD63 per metre for 0.9mm gauge. Even an extra hundred metres of cable is significantly more expensive than the extra pit/joint.

We would also highlight again that the ACCC could make less conservative assumptions in *Cable gauge determination.xls*, by accepting a quality of service equivalent to ISDN at an earlier stage in the cable gauge calculation (i.e. after 0.6mm is deployed in the distribution network, as we have no evidence that Telstra has planned its access network for more than ISDN.). Such a decision could be influenced by the availability of DSL services over the existing access network. Currently, the ADSL signal loss criterion is used to ensure that as many loops as possible can receive ADSL: the ISDN criterion is only used to ensure that all remaining loops can at least receive ISDN-level services. Allowing ISDN-level at an earlier point would reduce the amount of thicker gauge cable deployed in the network.

4.3 Issue F: Incorrect cost of 400 pair joints

4.3.1 Quoted issue (Telstra October submission, page 52)

> The Analysys Model uses 400 pair copper cables in constructing the main copper cable network but only takes into account the cost of jointing 100 pair copper cables. All 400 pairs need to be jointed.

4.3.2 Discussion

This is a formula error on the *UnitCost.Access* worksheet in the Core module, with cell G12 having the value 100. This effectively means that only 100 pairs are jointed in each 400-pair cable. The value should be changed to 400. This increases the cost of ULLS by approximately AUD0.06 in Zone A and AUD0.02–0.03 in Zone B.

4.3.3 Analysys Mason's recommendation

The formula should be corrected.

4.4 Issue G: Omission of assets required between PB and DP

4.4.1 Quoted issue (Telstra October submission, page 53–54)

> While the customer is responsible for the trenching and other costs on his or her side of the property boundary, the trenching and conduit between the DP and the property boundary

form part of the distribution network – they are dug at the same time as the distribution cable trenches and not on a customer by customer basis at the time of connection.

In his expert report, Nigel Attenborough (Attenborough Report, which is at Submission Supporting Documents, Volume 1, Document 1.2) notes that exclusion of lead-ins is not standard practice and is likely to lead to a significant understatement of costs. He states that a more appropriate methodology would involve: including lead-in costs; subtracting new service and reconnection fees; annualising the resulting capital costs; adding operating expenses; and dividing by 12 to get monthly costs. He concludes (at paragraph 4.17) that by not following this procedure:

"…the Analysys Model has understated the costs that need to be recovered in the ULLS monthly charge. The cost understatement is likely to be substantial given the large number of customer lines involved. I am unaware of any other regulator who has used an access network cost model which excludes the cost of lead-ins. In my view it is not a reasonable approach for a regulator to take."

4.4.2 Discussion

We understand this issue is a result of the ACCC decision to exclude these costs from its own version of the model used in the draft pricing principles paper. The assets that should be excluded according to the ACCC and Telstra are shown below in Figure 4.7.

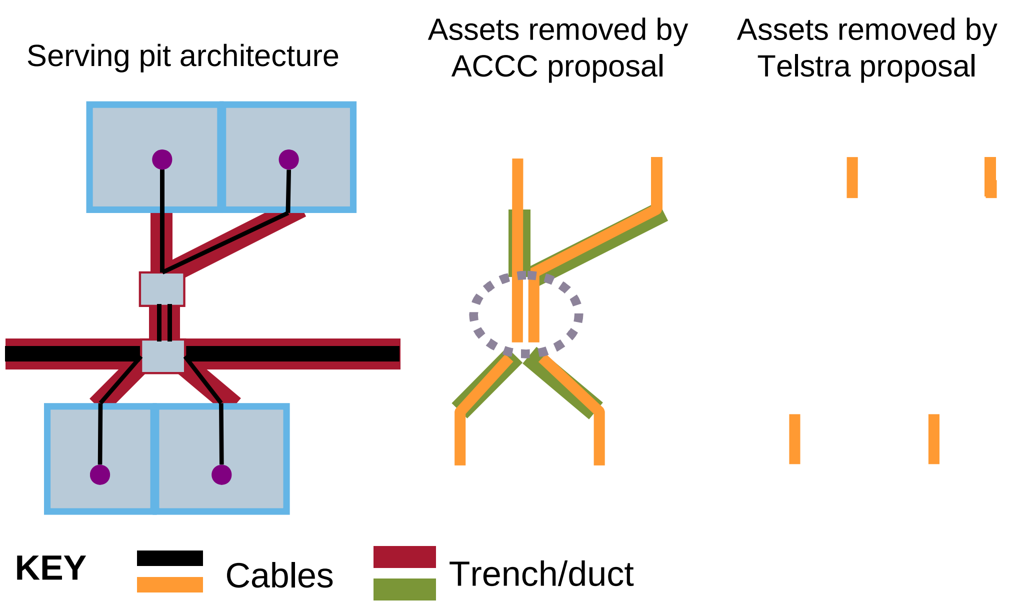

Figure 4.7: Lead-in assets that should be included/excluded [Source: Analysys Mason]

In particular, we understood that the ACCC wanted to remove the cable and trench assets from the serving pits to the NTP. This was implemented by the ACCC by setting the costs of the “Duct: 1 (PB >> DP/ Serving pit)” and “Copper lead-in: 2” assets to zero. We note that this did not remove the lead-in cables larger than 2-pair, but removed the 2-pair cables in the road crossings. Based on our understanding of connection charges, cables within road crossings to the “across road” serving pits remain with Telstra. Therefore, we propose that these cable assets be kept in the Cost module. It is more consistent to exclude the necessary assets in the CAN module, rather than de-activate the costs. Therefore, we have added switches to the Cost module to remove the lead-in assets if desired (i.e. all cables from the serving pit to NTP), so that the unit costs do not need to be set to zero. Assets from the NTP to the property boundary (PB) and from the PB to the serving pits can be switched on/off separately.

Correcting the inclusion/exclusion of the assets from the two serving pits to the NTP increases the cost of WLR/ULLS by approximately AUD0.10 in Zone A and AUD0.25 in Zone B in both 2010 and 2012. This increase is due to 2-pair cable within the road crossings being included, whereas previously this asset was excluded by setting the 2-pair lead-in cable cost to zero.

Alternative to asset exclusion

Telstra proposed an alternative approach where the assets removed as described above are bypassed, but compensated by including connection and reconnection revenue netted off the annualised cost. In preliminary discussions with the ACCC, we agreed that any treatment of revenues should be kept external to the model. This would require an understanding of Telstra’s connection revenues over the lifetime of the network, for which the data is likely to be fragmentary.

4.4.3 Analysys Mason’s recommendation

We have included new inputs in the *Scenario* worksheet of the Cost module so that three sets of assets can be excluded or included on a separate basis. In particular:

- all trench from the PB to the SP can be excluded by setting cell E37 to zero
- all cables between the NTP and the PB can be excluded by setting cell E39 to zero
- all cables between the PB and the serving pit (SP) can be excluded by setting cell E38 to zero.

The ACCC can now determine whether each set of assets asset should be included or excluded from the Analysys cost model. We note that these inputs do not determine whether cables within the road crossing are excluded or included: these cables are always included.

4.5 Issue H: Lack of correction of the CAN for additional IEN duct

4.5.1 Quoted issue (Telstra October submission, page 57)

> The Analysys Model assumes that IEN and CAN cables can both be placed in the same trench. The model, however, uses a trench size that only allows enough space for CAN cables. It therefore fails to account for the additional trench costs required to dig a trench large enough to fit both IEN and CAN cables.

4.5.2 Discussion

Telstra's approach is to split the IEN 2-duct requirements evenly by geotype and CAN trench size based on the level of CAN/IEN sharing (18%). We have considered both this and a similar approach, which allocates IEN 2-duct across the trench sizes in the CAN based on the level of CAN/IEN sharing by geotype. These two approaches are summarised below in Figure 4.8.

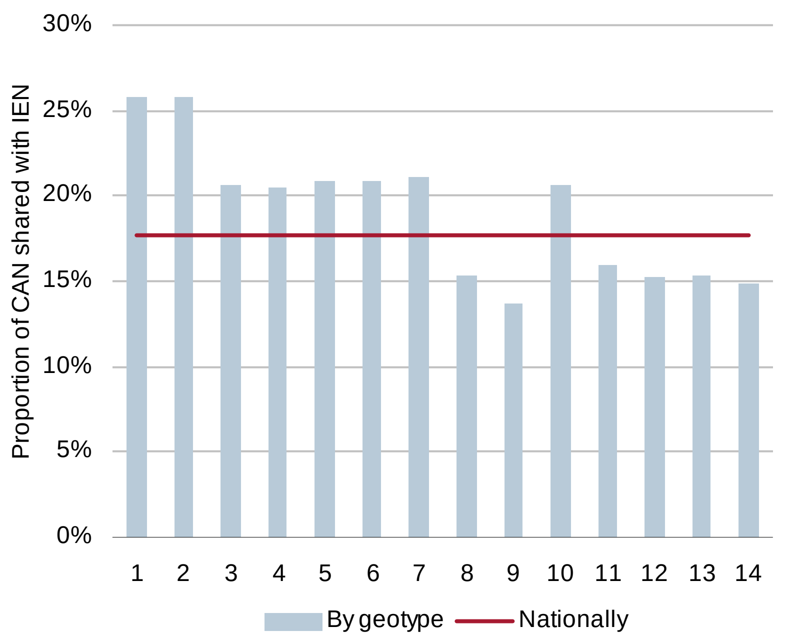

Figure 4.8: Comparison of level of CAN/IEN-sharing nationally and by geotype [Source: Analysys Mason]

As can be seen above, Telstra's approach of a national level of sharing hides the imbalance of the level of sharing between Zones A and B. Therefore, we believe it is appropriate to derive IEN/CAN-sharing by geotype.

We believe that Telstra's approach to incorporating the extra duct into the model is reasonable. Effectively, for each geotype, the approach upgrades:

- 100% of 18% = 18% of CAN routes with 1-duct trench (excluding road crossings and serving pit trenches) to 4-duct

- 100% of 18% = 18% of CAN routes with 2-duct trench to 4-duct
- 100% of 18% = 18% of CAN routes with 4-duct trench to 6-duct
- 100% of 18% = 18% of CAN routes with 6-duct trench to 8-duct
- 50% of 18% = 9% of CAN routes with 8-duct trench to 12-duct
- 50% of 18% = 9% of CAN routes with 12-duct trench to 16-duct
- 50% of 18% = 9% of CAN routes with 16-duct trench to 20-duct
- 50% of 18% = 9% of CAN routes with 20-duct trench to 24-duct
- 50% of 18% = 9% of CAN routes with 24-duct trench to 28-duct.

The five largest ducts increase in size in steps of four ducts. Only 9% of these are upgraded since, statistically, 50% of them will contain two or more empty ducts. None of the four smallest duct sizes can have two empty ducts. Our approach follows the same upgrade principle, except that we use our IEN/CAN-sharing percentages calculated by geotype. The new duct distributions of the combined IEN/CAN network are compared with the original distribution below for both zones in Figure 4.9.

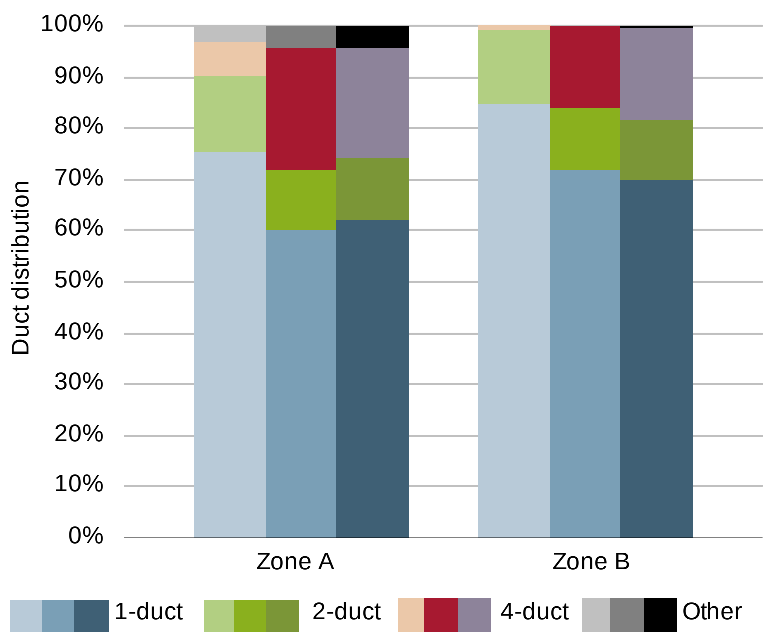

Figure 4.9: Distribution of CAN trench (a) before any adjustment, (b) using Telstra's suggested adjustment using national IEN/CAN sharing and (c) our approach using IEN/CAN sharing by geotype [Source: Analysys Mason]

Both approaches drastically increase the amount of 4-duct trench deployed in the network. This is because a significant proportion of 1-duct and 2-duct trench requires two more ducts, meaning that 4-duct is deployed. Although our approach deploys slightly longer routes with more duct in Zone A, it deploys shorter routes with more duct in Zone B.

Telstra's approach to adjusting the pit distribution is also based on the proportion of IEN trench sharing with the CAN. We have implemented an analogous approach using our sharing percentages by geotype. These change the pit distribution as shown below in Figure 4.9.

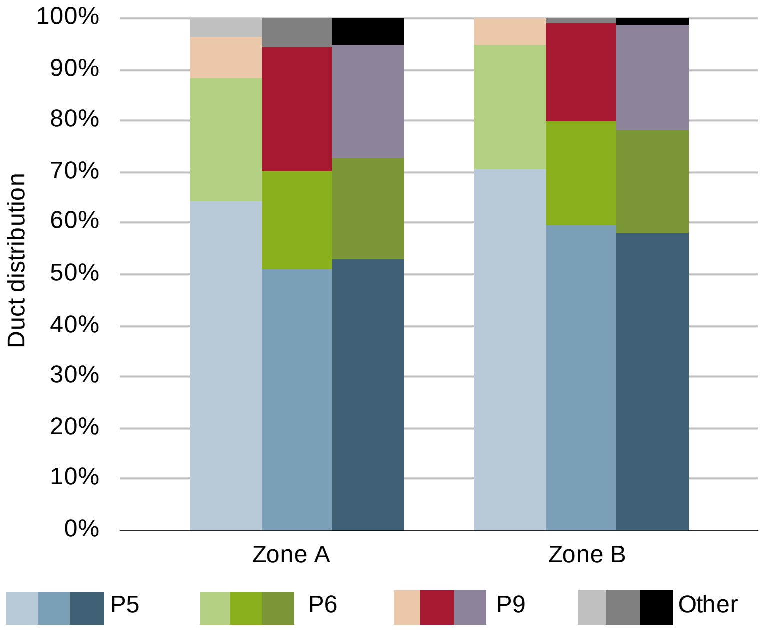

Figure 4.10: Distribution of CAN pits (a) before any adjustment, (b) using Telstra's suggested adjustment using national IEN/CAN sharing and (c) our approach using IEN/CAN sharing by geotype [Source: Analysys Mason]

The effect is to drastically increase the number of larger pits deployed in the network, effectively since P9 pits must be deployed in place of any P5/P6 pits deployed where the IEN duct shares the CAN trench.

We have built in two sets of options for the ACCC. These are to:

- calculate the IEN/CAN sharing percentages on either a national or geotype basis
- deploy either one or two ducts for the IEN.

This revised CAN duct and pit network is then fed into the Cost module. Section 7.11.7 of the FLRIC report and Section 6.13 of the FLRIC user guide describe how we previously determined the cost savings arising from the use of CAN trenches by duct used for the IEN. We allocate a proportion of the CAN trench cost to the IEN. This allocation is derived as the combination of the following:

- volume of IEN duct deployed in the CAN as a proportion of total duct deployed (CAN+IEN)
- proportion of cost attributable to just trenching for the 'trench and duct' CAN asset type, from the *UnitCost.Access* worksheet
- proportion of cost saved to be allocated to the IEN, assumed to be 50%, meaning that the CAN and IEN share the benefit of using trench deployed for the CAN.

Given that our new calculation now derives a fully integrated IEN/CAN duct/pit network, we are now able to use a simpler allocation, which is just the volume of IEN duct deployed in the CAN as a proportion of total duct deployed (CAN+IEN).

Incorporating this change increases the cost of ULLS/WLR in Zone A by AUD0.45, but reduces the cost of ULLS/WLR in Zone B by approximately AUD0.60. Increases in cost are due to the increase in 4-duct and P9 assets, but this is compensated by the total number of duct metres required falling, as we are now actively using empty ducts in the CAN for the IEN.

We have also run the model deploying only one duct for the IEN: this reduces the cost of ULLS/WLR in Zone A by AUD0.30 and in Zone B by approximately AUD1.20.

4.5.3 Analysys Mason's recommendation

We recommend implementing our version of the change. The ACCC can decide whether it believes it is more appropriate to deploy either 1 or 2 ducts for the CAN. This input can be changed on the *Scenario* worksheet of the Cost module. The upgrade proportions for pits and ducts can be changed in cells C269:D287 on the *Inputs.Access* worksheet of the Cost module.

4.6 Issue I: Incorrect allocation of copper and fibre main cable costs

4.6.1 Quoted issue (Telstra October submission, page 62)

> The Analysys Model does not properly determine the unit cost of CAN services because it contains a mismatch between the annual cost and the services in operation used in the calculation. The model builds a network comprised of copper, fibre, wireless, and satellite components, then removes the investment in those components (fibre, wireless, and satellite in the case of ULLS), but does not remove from the unit cost calculation those SIOs served by the excluded network components.
>
> The unit cost of ULLS is the annual capital costs and expenses associated with provisioning the CAN in those areas where ULLS is available divided by the total SIOs of CAN services in those same areas. If the ACCC is correct in using an approach in which the price of ULLS should be based upon the cost of provisioning the CAN irrespective of the technology deployed, the unit cost of ULLS and WLR is annual capital costs and expenses associated with provisioning the CAN in all areas divided by the total SIOs of CAN services in all areas – that is, there should be no excluded cost.
>
> Whichever approach one takes in the calculation of the cost of ULLS, the Analysys Model is wrong. The Analysys Model does not include all costs associated with provisioning the CAN; it excludes the cost of all fibre, wireless and satellite plant and equipment. Further, the Analysys Model divides the annual cost of the subset of CAN plant and equipment, which it leaves in the calculation of unit cost, by the SIOs of all CAN services, even those served exclusively by the excluded equipment. (Some CAN services are served partially by the excluded equipment and partially by copper; and many are served end to end by the excluded equipment.) This error results in an understatement of unit cost, because it either understates the annual cost of the CAN (the numerator in the unit cost calculation), or

overstates the demand for CAN services (the denominator in the unit cost calculation) depending upon whether one intends to include all types of technology in the cost calculation, or one intends to cost an all copper network.

4.6.2 Discussion

Telstra argues that we allocate the costs of copper main cables across all lines rather than just those lines using these copper main cables, which reduces the contribution of main cable costs to the ULLS service (since ULLS cannot be offered for SIOs that are LPGS-fed). We note that the costs of fibre cable feeding LPGS ("fibre main cable") are excluded from the costs of access due to our definition of the access network (which ends at the equipment side of the LPGS or MDF). Telstra's issue could also be taken to extend to the allocation of costs of pillar–RAU copper cable jointing and pillars. Telstra argues that the model should either:

(1) Include costs of fibre main cable and allocate across the total of pillar-fed and LPGS-fed demand

(2) Separately allocate the copper main cable costs to pillar-fed demand and fibre main cable costs to LPGS-fed demand.

Our current implementation is similar to the first option, except that fibre main cable costs are allocated to the core network and not as access costs: this is illustrated below in Figure 4.11.

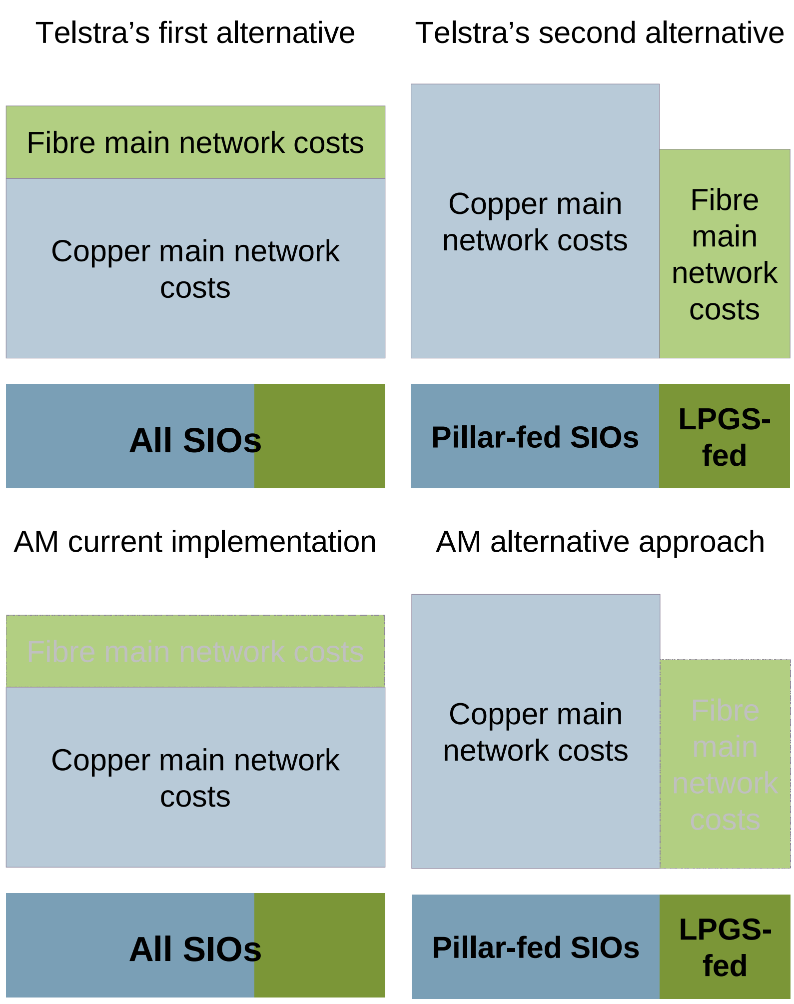

Figure 4.11: Cost allocation options for the main network as access network assets [Source: Analysys Mason]

The Cost module does not distinguish between pillar-fed and LPGS-fed access lines. However, the outputs of the geoanalysis includes the proportion of SIOs (by geotype) that are fibre-fed versus LPGS-fed versus pillar-fed. Given the expanded explanation by Telstra, we believe that we can now adjust for the issue, by refining the cost allocation rules in the *Dem.In.Access* worksheet in the Cost module.

We have refined the access network routeing factors (which are by asset and service) for the copper main network assets (copper pillars, copper main cables and pillar–RAU jointing). These inputs allow the routeing factors to vary by geotype for the ULLS service. For each geotype, we divide the routeing factors by the proportion of SIOs that are pillar-fed in that geotype. This means that more cost from the copper main network assets is allocated to ULLS rather than WLR and the other services, on the basis that these other services use both the copper and fibre main network, whereas ULLS can only use the copper main network.

This has required enhancements to calculations on the *TA.Access* and *Dem.In.Access* worksheets. A checksum has also been included to ensure that all relevant costs are recovered by the service volumes (cell E163 on the *TA.Access* worksheet). A correct cost allocation should lead to a checksum value of zero.

This change has the impact of increasing the costs of ULLS by approximately AUD1.25 in Zone A and by AUD1.15 in Zone B. Meanwhile, the cost of WLR decreases by approximately AUD0.10.

4.6.3 Analysys Mason's recommendation

We recommend implementing this change. However, should the ACCC not wish to implement this change, then it can be easily de-activated in the model, since it is driven by two sets of input cells (A8:A37 and A46:A146) on the *Dem.In.Access* worksheet in the Cost module. By setting the latter cells to zero, the routeing factors will be applied exactly as before.

4.7 Issue J: Cost allocations to dark fibre services

4.7.1 Quoted issue (Telstra October submission, page 63–64)

> The Analysys Model allocates core network costs between fibres used for "identified services" and those used for "other services". In the original version of the Analysys Model, the "other services" category was described as "dark fibres", but in the final version the title was changed with no explanation of the services which fall within this category and which would use the dark fibres.
>
> Telstra has reviewed the list of identified services defined in section 3.1 of the Analysys documentation and confirms that the list includes all services of which Telstra is currently aware. Telstra has also reviewed the list of "other services" and cannot identify any "other services" from which it would derive revenue and therefore for which it would build network. The result is to allocate 33% or 50% of the trench costs (depending on the layer of the network modelled) to fibres for which there is no known revenue: in effect, these significant costs are allocated "into the ether".
>
> The allocation of costs to unknown services is contrary to both economic and network deployment principles. It is unreasonable to allocate the costs of dark fibres to unknown future services. The network deployment standards used by Telstra are explained in the Statement of [C–I–C], at Submission Supporting Documents, Volume 1, Document 1.12.
>
> In his expert report, Nigel Attenborough states that both sound cost modelling principles and the practice in other jurisdictions is not to allocate costs to unknown services. He states (at paragraph 5.10) that such a practice leads to under-recovery of costs:
>
> "Since these services do not actually exist and therefore no revenue is received from them, these costs are not recovered. This is not an appropriate allocation practice because it does not allow full recovery of costs. If a company is unable to recover its costs, it will make a loss and this is not a sustainable situation."

4.7.2 Discussion

This was an issue raised during the industry workshops. It was explained that cost allocation to a dark-fibre service could be easily removed by adjusting the input parameters for dark fibre. In particular, by setting the cells In.Network!H133:H136 to zero in the Core module.

Removing this service loads costs onto other core services, including voice. Setting these inputs into the model increases voice traffic costs by approximately 17%, DSL line rentals by approximately 30% and transmission hub services by approximately 50%.

It is worth noting that during the industry workshops, the availability of a duct rental service was highlighted. Currently, no costs are allocated to this service in our version of the model, though the service does exist. Investigating a reasonable implementation of this service may be an option for the ACCC. However, populating assumptions will be dependent on the ACCC having access to information (directly or via industry consultation).

4.7.3 Analysys Mason's recommendation

We recommend removing the provisioned dark fibre from the model, so no costs are allocated to other fibre services. In addition, we have set the proportion of cost allocated to other duct services to be zero as well in our v2.2 model. If the ACCC have data available on either Telstra's revenue from duct rental, or on the length of duct that is currently rented in Telstra's network, then the parameters in cells E11:E14 can be populated to apportion an appropriate level of cost onto other duct services. For example, if it is determined that Telstra rent a total of *x* km of duct, then the inputs could be set to the ratio of *x* and the total duct metres in the IEN (both standalone and that shared with the CAN). Alternatively, if it is determined that Telstra gain a certain amount of revenue from duct rental, then these proportions can be set so that a similar (but lower) level of cost is allocated[6].

4.8 Issue K: Inconsistent dial-up forecast

4.8.1 Quoted issue (Telstra October submission, page 64)

> The Analysys Model calculates a forecast decline rate for the number of dial up internet users (SIOs) that is inconsistent with actual historical decline rates. The rate adopted by the ACCC is not therefore based on any actual evidence of historical decline rates.
>
> While the ABS and the Telstra data show a drop in the number of dial up SIOs of around 30% between June 2008 and June 2009, the ACCC's forecast decline at a rate of between

6 The amount of cost allocated to other duct services can be found in cells E111:G111 of the Results worksheet of the Cost module

12.4 to 17.8 or at approximately half the rate of the ABS or Telstra SIO decline rate. The rates adopted by the ACCC are not therefore reasonable as they are not based on actual historical rates.

Further, the forecast decline in the total number of internet dial up minutes in the Analysys Model is also inconsistent with both historical trends and Telstra's actual figures of total internet dial up minutes for 2008/09. The assumptions used in the Analysys Model in relation to dial up internet are therefore unreasonable.

The effect of these unreasonably high dial-up traffic assumptions is to decrease the costs of OTA and LCS by between 3 and 10% for the 2007/08 to 2011/2012 years.

4.8.2 Discussion

Telstra refers to ABS data in its submission regarding dial-up subscriber forecasts. However, our forecasts are not driven by dial-up SIOs, so this data is less relevant to our forecasts. However, it is nonetheless the case that Telstra has a material comment regarding the decline in dial-up services that should be inspected.

Data on dial-up downloads are also provided on the ABS website.[7] The total data volumes for a selection of three-month periods over the last three years are shown below in Figure 4.12. These are the periods for which the ABS has collected and published data from its surveys.

7 http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/8153.0Jun%202009?OpenDocument

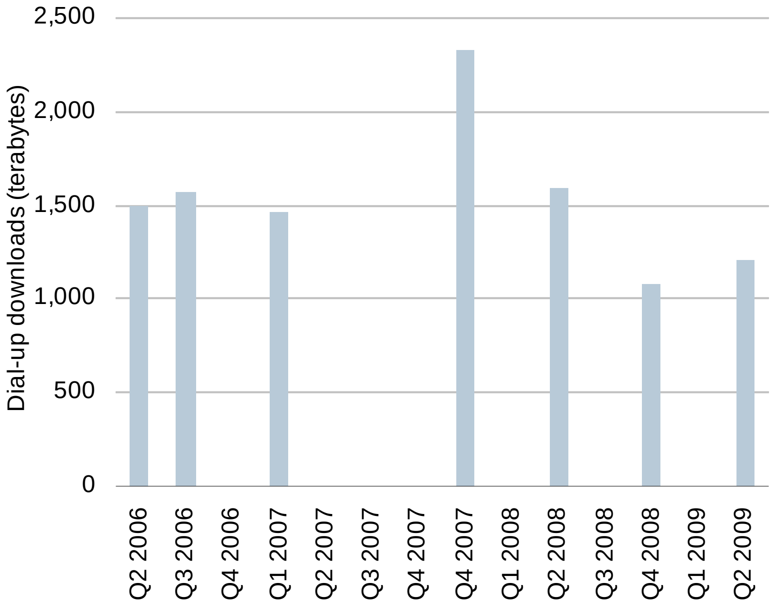

Figure 4.12: Total dial-up traffic in Australia for 3-month periods between 2006 and 2009 [Source: ABS]

There is a clear decline from 2007 onwards in the traffic volumes, which should be reflected in the model. Calculating compound annual growth rates (CAGR) gives values of:

- 35% between Q4 2007 and Q2 2009 (18 months)
- 24% between Q2 2008 and Q2 2009 (12 months).

Telstra indicates in its submission that there is a steep decline in traffic between 2007 and 2009, which can be reflected by an early exponential curve using a 24% CAGR. A comparison of the original model, the Telstra forecast and our proposed revised forecast is given below in Figure 4.13.

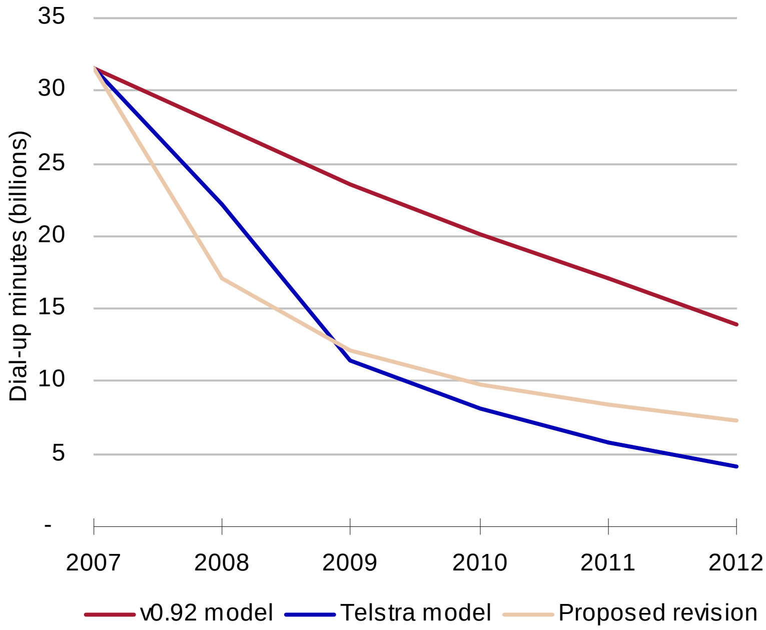

Figure 4.13: Comparison of dial-up forecasts [Source: Analysys Mason, Telstra]

Our revised forecast uses existing functionality in the model and better reflects the trend in traffic indicated by Telstra, although it under-estimates dial-up traffic in 2008.

It increases the cost of PSTN OTA from approximately AUD0.0060 to AUD0.0065 and the cost of LCS from approximately AUD6.00 to AUD6.55.

4.8.3 Analysys Mason's recommendation

We recommend that the ACCC implements our new forecast.

4.9 Issue L: Impossible ploughing of large cables

4.9.1 Quoted issue (Telstra October submission, page 65)

> The Analysys Model assumes that cables that are greater than 100 pair in size can be ploughed. They cannot. The reasons for this are set out at in the statement of Craig Lordan (Lordan No. 1 Report), which is at Submission Supporting Documents, Volume 1, Document 1.10.
>
> Because cables greater than 100 pair cannot be ploughed, they need to be put in trenches. The Analysys Model therefore needs to be adjusted so that it no longer assumes ploughing for cables greater than 100 pair in size.

4.9.2 Discussion

The use and cost implications of "ploughed cables" in rural areas has led to a number of points raised by operators. Ploughed cables are currently used only in geotypes 8, 9 and 11–14, but not for road crossings or trench to the property boundary. The proportion of routes that have more than 2 ducts are 5% in geotype 11 and 0–3% in the other five geotypes.

The differentiation of rural trench costs from urban trench cost was relevant for the access cost modelling and has been described as "ploughed". However, the current cost inputs remove the cost of ducting in trenches in rural areas but retain the same cost for digging the trench. We note the cost inputs do neglect the necessary protection of cable if directly laid in trench without duct protection, which is reflected in Issue M. The current cost input structure provides lower costs for rural deployments through neglecting ducts rather than use lower trenching costs such as ploughing (this rural trench cost input can be varied). We have re-labelled "ploughed cable" as "un-ducted trench."

A more realistic deployment scenario could be to recognise:

- ducted trench in heavily cabled routes
- direct burial of cable with no need for duct
- ploughed burial of cable with no need for duct and reduced cost per trench metre.

However, this may be considered too significant a change for industry from previous approaches following consultation. It should also be noted that we do not have realistic data to quantify the asset volumes in these cases. It may be that the ACCC is better informed of these issues following the release of the Band 3 TEA model. Therefore, we propose to use only the first two of the above (although open trench will also be incorporated into these options).

If we only duct those routes identified as requiring more than 1 duct in the rural geotypes (8–9, 11–14), then the costs in Zone B increase by approximately AUD3.60. If we take a more aggressive assumption that we duct those routes requiring more than 2 ducts, then the cost of ULLS/WLR decreases by approximately AUD0.35 in Zone B compared with the reference model. This slight decrease in ULLS/WLR costs is due to the fact that these inputs are also used in the calculation determining how much of the cost of the CAN is transferred from the access network to the core network due to IEN/CAN route sharing.

Since cables for different purposes are placed in different ducts, it is most likely that rural routes with 1 duct will contain one or more 100-pair distribution network cables or a 400-pair main network cable. Two ducts, however, will contain a number of 100-pair distribution network cable and/or a 400-pair main network cable as well.

4.9.3 Analysys Mason's recommendation

The outcome of this change is linked to that of Issue M. If the cost of protected cable is included in the model, then we believe that it is reasonable to un-duct all routes requiring 1 or 2 ducts. To do this, we have set cells P130:AE141 on the *UnitCost.Access* worksheet in the Cost module to 0%, leaving W138:X139 and Z138:AE139 at 100%.

If the ACCC would like to be more conservative, then the proportion of 2-duct trench that is un-ducted in the rural geotypes (cells W138:X138 and Z138:AE138) can be reduced to somewhere between 0% and 100%. We note a concern is the extent to which 400-pair cable is being deployed in un-ducted routes. Using our geoanalysis, we have been able to derive the proportion of 1-duct routes and 2-duct routes in rural geotypes that contain a duct for 400-pair cables. These values are summarised below in Figure 4.14.

Geotype	*Total trench meters*		*Of which contains 400-pair cable duct*		*Proportion*	
	1-duct	*2-duct*	*1-duct*	*2-duct*	*1-duct*	*2-duct*
8	263 876	29 075	2 977	10 258	1.1%	35.3%
9	53 809	2 313	645	1 350	1.2%	58.4%
11	756 180	113 288	4 528	14 361	0.6%	12.7%
12	1 678 828	289 248	2 878	17 598	0.2%	6.1%
13	1 530 262	268 378	–	198	–%	0.1%
14	158 635	9 297	–	–	–%	–%

Figure 4.14: Identification of duct routes containing 400-pair cables [Source: Analysys Mason]

We would also recommend that the ACCC investigates input unit costs for trenching. For example, the ACCC could undertake a comparison between the average trench/duct costs per metre in the Analysys cost model and the TEA Band 3 model.

4.10 Issue M: Omission of extra protection costs for buried cable

4.10.1 Quoted issue (Telstra July submission, page 12)

> When cable is directly buried into the ground it is susceptible to damage from the elements. Consequently, grease filled Cellular Polyethylene Unit Twin (CPFUT) cable should be provisioned for direct buried routes.
>
> The ACCC's model assumes that the same standard cable is installed in conduit and direct buried.

4.10.2 Discussion

This is an issue that does not appear to be recognised explicitly in FLRIC models in Europe (i.e. Denmark and Sweden, which are public models), but has been brought up in other countries such as New Zealand.[8] We have included calculations that derive the amount of lead-in[9]/distribution/main cable in un-ducted trench that requires protecting. We have also included inputs to calculate protected cable costs as a mark-up of normal cable costs. This mark-up is then blended into the capex costs by cable size and geotype.

The only reference costs we have been able to identify for CPFUT cable are from Page 77 of the public TEA Model User Guide.[10] For each of the four cable sizes that are stated, the unit cable cost is between 30% and 33% higher than that of the equivalent cable in the Analysys cost model. We have blended this mark-up into the overall unit costs of the cables in the Analysys cost model (i.e. including haulage, delivery and handling) to derive a mark-up for the total cost of each cable. This final cost mark-up varies between 3% for 0.4mm 2-pair cable and 27% for 0.9mm 400-pair cable.

Including protected cable costs in the model leads to an increase in costs for ULLS/WLR of approximately AUD0.08 in Zone A and AUD5.60 in Zone B. However, this assumes that all trench in the rural geotypes is un-ducted.

If we combine this change with those for Issue L (i.e. where only routes requiring 2 or fewer ducts are un-ducted), then we get an increase in costs for ULLS/WLR of approximately AUD5.20 in Zone B, as a result of including the cost of protected cable for only cable in un-ducted trenches.

4.10.3 Analysys Mason's recommendation

Telstra does not consider this an issue in its October submission (presumably since it does not want to be put in a position to submit data on the associated costs to the ACCC). This could be an argument to not include any mark-up for protected cable.

However, the outcome of this change is linked to that of Issue L. If the cost of protected cable is not included in the model, then few or no routes should be un-ducted (as the cables deployed are not sufficiently resilient for direct burial). However, if protected cable is included, then we believe that it is reasonable to un-duct all routes in rural geotypes requiring 1 or 2 ducts.

If the ACCC would like to be more conservative, then the proportion of 2-duct routes that are un-ducted can be reduced to between 0% and 100%.

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8 http://www.comcom.govt.nz/IndustryRegulation/Telecommunications/TelecommunicationsServiceObligations/ContentFiles/Documents/AAStelecomaccessEngineeringDesignRules0.PDF

9 This is all ducted and hence does not need protecting.

10 http://www.accc.gov.au/content/item.phtml?itemId=812448&nodeId=0c74f41386b8409cd52c1a8e9856c22e&fn=TEA%20model%20user%20guide.pdf

We believe that our mark-up of 30% for the cost of protected cable material is reasonable. This mark-up can be altered in cells K54:K82 of the *UnitCost.Access* worksheet in the Cost module.

We have also determined the mark-ups for CPFUT cable of 0.64mm and 0.9mm gauge using confidential unit cable costs provided by the ACCC from the Band 3 TEA Model. The percentage differences between the cable costs are shown below in Figure 4.15.

	TEA model cable costs per metre as a multiple of the equivalent cost in the Analysys cost model		
Cable (pairs)	*0.4mm gauge*	*0.64mm gauge*	*0.9mm gauge*
10 pairs	[C–I–C]	[C–I–C]	[C–I–C]
30 pairs	[C–I–C]	[C–I–C]	[C–I–C]
50 pairs	[C–I–C]	[C–I–C]	[C–I–C]
100 pairs	[C–I–C]	[C–I–C]	[C–I–C]

Figure 4.15: Comparison of cable costs between the Analysys cost model and the TEA model [Source: Analysys Mason, Telstra]

As can be seen above, a mark-up of [C–I–C] appears to be more appropriate for 0.64mm gauge, whilst [C–I–C] appears reasonable for the 10/30-pair 0.9mm gauge cables.

4.11 Issue N: Not currently used

4.12 Issue O: Incorrect jointing of lead-ins to the distribution cable

4.12.1 Quoted issue (Optus Attachment 3, page 42)

> 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. 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.

4.12.2 Discussion

The point Optus raises is plausible. When a 50-pair cable is used to connect a building but only 40 active pairs are required, then potentially only 40 pairs are jointed. This also leaves an additional 10 pairs free in the distribution network. Telstra may claim otherwise.

To implement Optus's suggested change, we have derived the average number of pairs connected per location for each cable size. This can be done using existing information from the CAN module. In addition, we have identified that the measure of joints and the joint unit cost were inconsistent in the model.

We have also identified a separate issue mismatching assets and unit costs. The measure of joint asset volumes was equal to the number of copper SIOs (approximately 10.0 million), whereas the unit cost for each joint asset was per cable to be jointed. We have revised this so that the measure of joint assets is the number of locations that require a cable to be jointed, and the unit cost for each joint asset is per cable to be jointed, assuming an average number of pairs to be jointed.

This difference in annualised cost with respect to the original and revised approaches is illustrated for geotype 1 in Figure 4.16 below:

Original assets (will full jointing)	*SIOs to joint*	*Average pairs to joint per location*	*Unit annual cost per location (AUD)*	*Total annual cost (AUD)*
Joints: 2	18 427	2.00	21.73	400 376
Joints: 10	11 840	10.00	22.95	271 741
Joints: 30	2342	30.00	26.01	60 910
Joints: 50	1322	50.00	29.07	38 426
Total	**33 930**			**771 454**
Revised assets (with only necessary jointing)	*Locations to joint*	*Average pairs to joint per location*	*Unit annual cost per location (AUD)*	*Total annual cost (AUD)*
Joints at DP: 2-pair cable	11 184	1.65	21.67	242 395
Joints at DP: 10-pair cable	1277	9.27	22.84	29 163
Joints at DP: 30-pair cable	93	25.04	25.25	2 361
Joints at DP: 50-pair cable	37	35.53	26.86	999
Total	**12 591**			**274 919**

Figure 4.16: Comparison of annualised jointing costs in geotype 1 [Source: Analysys Mason]

As can be seen above, the cost is dramatically reduced for geotype 1, since the bulk of the cost is associated with the locations served by smaller (2-pair and 10-pair) cables.

The impact is to reduce the cost of WLR/ULLS by approximately AUD0.35 in Zone A and AUD0.45 in Zone B in 2010. The reductions in cost in 2012 are approximately AUD0.75 in Zone A and AUD1.30 in Zone B.

4.12.3 Analysys Mason's recommendation

The ACCC should certainly include the correction of the jointing costs. We also believe that Optus's comment is reasonable and should be implemented.

5 CAN module and Core module issues

This section describes our investigations of issues P–R, related to the CAN and Core modules.

5.1 Issue P: Under-estimation of the cost of the inter-exchange network (IEN)

5.1.1 Quoted issue (Telstra October submission, page 59)

> The Analysys Model creates a transmission network with a cost of $145 million but the model and accompanying documentation provides scant detail on the design and equipment and other cost elements for that modelled core network. Essentially, the Analysys Model provides an aggregated cost figure and it is impossible for Telstra to break the figure down to consider and verify how it was derived. The lack of detail and transparency in the core network component of the Analysys Model contrasts with the greater detail in other parts of the model The core network represents a significant component of the Analysys Model costs. The lack of detail is a material omission and a matter in relation to which Telstra is entitled to an opportunity and sufficient information to enable it to make informed submissions in the draft IPP Determination process. This is especially so in light of the ACCC's expectations of Telstra detailed below.

5.1.2 Discussion

In the September Telstra RFI, Telstra requested:

"that you provide us with a detailed list of the specific equipment (including the quantity of equipment) which comprises the "Assets" listed on the UnitCost.Core tab of the Cost.xls module in column D and included in the "Basic equipment cost" in column F of that worksheet...Please note that the above request is limited to those assets categorized as either ***transmission*** *or* ***satellite*** *equipment in Column B of the worksheet (i.e. UnitCost.Core, Cost.xls)"*

There are 107 assets under these categories in the v2.0 model. Of these, 56 are deployed in the modern network. Of these, the November Attenborough report considers 30 (and these 30 are the electronic components of fibre-transmission systems). We note that, according to Table 1 of the November Attenborough report, the total investment of AUD145 million referred to by Telstra only refers to these 30 transmission assets. The other 26 assets relate to core network trench/fibre/duct, microwave transmission, satellite and submarine link ports. We illustrate the 56 assets below in Figure 5.1.

In the November Attenborough report	*Not in the November Attenborough report*
LE: Ports: PoC-facing - PDH 2Mbps ports	LE-PoC: Fibre
LE: Ports: PoC-facing - PDH 8Mbps ports	LE-PoC: Trench
LE: Ports: PoC-facing - SDH STM-0 ports	LE-PoC: Duct
LE: Ports: PoC-facing - SDH STM-1 ports	PoC-LAS: Fibre
LE/AT1: SDH regenerator	PoC-LAS: Trench
PoC modern: Ports: LE-facing - PDH 2Mbps ports	PoC-LAS: Duct
PoC modern: Ports: LE-facing - PDH 8Mbps ports	LAS-TNS ring: Fibre
PoC modern: Ports: LE-facing - SDH STM-0 ports	LAS-TNS ring: Trench
PoC modern: Ports: LE-facing - SDH STM-1 ports	LAS-TNS ring: Duct
PoC modern: SDH multiplexer unit: POC-ring - STM-0	TNS-TNS ring: Fibre
PoC modern: SDH multiplexer unit: POC-ring - STM-1	TNS-TNS ring: Trench
PoC modern: SDH multiplexer unit: POC-ring - STM-4	TNS-TNS ring: Duct
PoC modern: SDH multiplexer unit: POC-ring - STM-16	Microwave towers
PoC common: Regenerators	Microwave hops
ADM: LAS-ring SDH add-drop multiplexer - STM-4	Microwave E1 links
ADM: LAS-ring SDH add-drop multiplexer - STM-16	Microwave E2 links
ADM: LAS-ring SDH add-drop multiplexer - STM-64	Microwave STM-0 links
LAS: Ports: Interconnection-facing - SDH STM-1 ports	Microwave STM-1 links
LAS/Regional Node: SDH regenerator	Microwave STM-4 links
ADM: TNS-ring SDH add-drop multiplexer - STM-64	Satellite earthstation
TNS: Ports: Interconnection-facing - SDH STM-1 ports	Satellite earthstation E1 link capacity
Core node common: SDH regenerator	Satellite earthstation E2 link capacity
Metro DWDM per element (Core node common)	Satellite earthstation STM-0 link capacity
Long Haul DWDM pt to pt system (Core node common)	Satellite earthstation STM-1 link capacity
Extended Long Haul DWDM pt to pt system (Core node common)	Submarine links - STM-64 ports
Ultra Long Haul DWDM pt to pt system (Core node common)	Submarine links - fibre distance
Metro DWDM per element (LAS)	
Long Haul DWDM pt to pt system (LAS)	
Extended Long Haul DWDM pt to pt system (LAS)	
Ultra Long Haul DWDM pt to pt system (LAS)	

Figure 5.1: Summary of transmission and satellite assets [Source: Analysys Mason]

We note that the Core module contains AUD15.7 billion of investment in all. This includes AUD11.0 billion that is related to fibre, trench and duct, and AUD0.3 billion that is related to business overheads.

The investment related to the 26 assets not included in the November Attenborough report is AUD30 million, excluding trench, duct and fibre investment. This includes microwave transmission, satellite and submarine link ports.

Telstra states that the size of the inter-exchange network has been significantly under-estimated. We note that Telstra's Regulated Accounting Framework (RAF) for the financial year 2006–07 indicates the total CCA capex associated with "2–1–50 Transmission Equipment - Primary Asset" to be [C–I–C]. Assuming that 2–1–50 is the relevant category, then the discrepancy (a factor of [C–I–C]) could be because this investment:

- relates to exactly those assets in Figure 5.1, in which case our modelled unit costs are too low
- relates to assets in addition to those in Figure 5.1. These assets may either be:
  - included in the Analysys cost model, but allocated to another cost category e.g. core network trench, other transmission nodes
  - excluded from the Analysys cost model.

We have taken a twofold approach to this issue:

- assessment of our unit costs and whether the asset definitions are consistent with those costs
- assessment of modelled assets and whether additional assets should be present.

Assessment of unit cost consistency

We have identified a number of issues with the definition of our DWDM assets. The November Attenborough report highlights this set of assets as being of interest, given the significant contribution to transmission costs. These issues are that:

- the unit costs are not consistent with the length of link defined in the model
- the unit cost of the Metro DWDM assumes a capacity of 4 wavelengths, whereas the unit dimensioned has a capacity of 16 wavelengths
- the number of DWDM units are effectively dimensioned for capacity twice (giving twice as many as units as are needed)
- the regenerator asset is intended to be representative of both SDH regenerators and DWDM amplifiers, when in fact a DWDM amplifier has a significantly higher cost than an SDH regenerator.

In order to address these issues, we have designed a new list of assets for the DWDM assets, as described below, with each wavelength running at STM–64:

- LAS-level metro DWDM uni-directional terminals, 4 wavelengths, capturing:
  - control equipment (processor and management)
  - multiplexing/de-multiplexing units
  - software licences
  - transponders
  - equipment housing (racks)
- LAS-level long-haul DWDM uni-directional terminals, 16 wavelengths, capturing:
  - control shelf and control equipment (processor and management)

  - amplifiers and adapters
  - multiplexing/de-multiplexing units
  - patchcords
  - software licences
  - transponders
  - equipment housing (racks)
- LAS-level long-haul DWDM amplifiers (deployed every 120km), capturing:
  - control shelf and control equipment (processor and management)
  - amplifiers and adapters
  - patchcords
  - software licences
  - equipment housing (racks).
- TNS-level equivalents of the above three assets.

These assets are deployed in a topology as shown below in Figure 5.2.

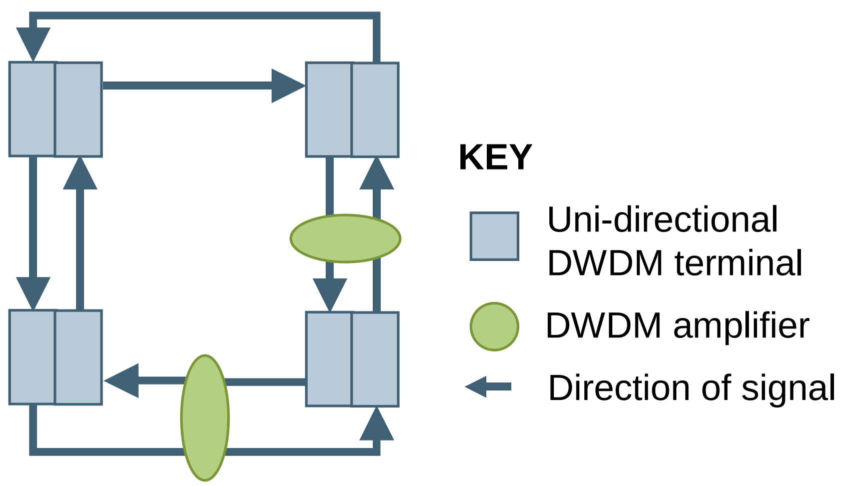

Figure 5.2: Illustrative deployment of DWDM equipment in a simple ring between four nodes [Source: Analysys Mason]

At both the LAS-level and TNS-level, a single-ring system uses Metro DWDM where all ring links are less than 80km long. Otherwise, a long-haul DWDM is deployed.

These six assets can be added into the Core module fairly easily, replacing the original assets.

The asset volumes and investment for both the original and revised DWDM deployments are shown below. The total investment in fact decreases.

Asset	*Unit capex (AUD)*	*Volumes*	*Capex (AUD)*
[SDH] regenerator (core node)	3 600	148	532 800
Metro DWDM per element (core node)	28 800	208	5 990 400
Long-haul DWDM system pt to pt (core node)	201 600	64	12 902 400
Extended long-haul DWDM pt to pt system (core node)	378 000	124	46 872 000
Ultra long-haul DWDM pt to pt system (core node)	604 800	16	9 676 800
Metro DWDM per element (LAS)	28 800	47	1 353 600
Long-haul DWDM pt to pt system (LAS)	201 600	11	2 217 600
Extended long-haul DWDM pt to pt system (LAS)	378 000	3	1 134 000
Ultra long-haul DWDM pt to pt system (LAS)	604 800	1	604 800
TOTAL			**81 284 400**

Figure 5.3: Capex investment (excluding installation) associated with original DWDM deployment [Source: Analysys Mason]

Asset	*Unit capex (AUD)*	*Volumes*	*Capex (AUD)*
DWDM amplifiers (core node)	70 000	97	6 790 000
Metro DWDM units (core node)	70 000	12	840 000
Long-haul DWDM units (core node)	355 000	58	20 590 000
DWDM amplifiers (LAS)	70 000	66	4 620 000
Metro DWDM units (LAS)	70 000	66	4 620 000
Long-haul DWDM units (LAS)	355 000	66	23 430 000
TOTAL			**60 890 000**

Figure 5.4: Capex investment (excluding installation) associated with revised DWDM deployment [Source: Analysys Mason]

We have reviewed the benchmark costs of the PDH/SDH assets for ports and regenerators and believe the values to be reasonable.

Assessment of assets in the Analysys cost model

We have reviewed the assets within the Core module. There are three main issues that could be contributing to Telstra's comment: asset omissions, asset volumes and asset classification.

► *Asset omissions*

The Core module of the Analysys cost model captures:

- node equipment terminals and ports

- fibre, trench and duct costs for the IEN
  - we note that Telstra has a category in its RAF for IEN cable (2-1-45 inter-exchange cables - Primary Asset), but does not appear to have a category for IEN trench/duct, unless these appear in "2-1-01 CAN Ducts & Pipes - Primary Asset"
- IEN accommodation within the "Site acquisition, preparation and maintenance" assets and other switching equipment/data equipment assets
- microwave, satellite and submarine assets.

We have identified that the ADM assets deployed at the PoC-level were being under-estimated and have corrected this error on the *NewDes.2.PoC* worksheet. This increases the investment for these assets by approximately AUD20 million.

We have also identified two possible omitted assets. These are:

- **Optical distribution frames (ODFs)**: these should be deployed wherever fibre is terminated. We have assumed that ODFs are deployed at every LE, PoC, LAS and TNS.

- **Digital cross-connects (DCX)**: these assets are deployed at aggregation nodes wherever multiple rings are terminated, to enable traffic to be translated onto the next part of the network.

These assets are now dimensioned in the model. The additional investment for both of these sets of assets is shown below.

Asset	*Unit capex (AUD)*	*Volume*	*Total capex (AUD)*
12-fibre ODFs (1 per LE)	1050	4642	4 874 100
48-fibre ODFs (1 per PoC and 1 per LAS)	2400	1411	3 386 400
96-fibre ODFs (1 per TNS)	4100	14	57 400
Total related to ODFs			**8 317 900**
DCX assets at PoC	—	—	21 076 800
DCX assets at LAS	—	—	19 200 000
DCX assets at TNS	—	—	40 480 000
Total related to DCX			**80 756 800**

Figure 5.5: Additional investment (excluding installation) from ODFs and digital cross-connects [Source: Analysys Mason]

Accordingly, we have refined our unit costs of the ADM units: the definitions of these assets are described in more detail in Section 7.7–7.9 of the FLRIC report.

► *Asset volumes*

The total volume of transmission assets calculated may not match those deployed by Telstra. It is difficult to understand if this is the case without calibration data from Telstra. Calibration data could include asset counts or system capacity (e.g. bandwidth available between core nodes).

Core asset volumes are driven by calculated bandwidth required, which is sensitive to services including xDSL subscribers and the transmission service. However, if these were to be increased it is likely to have little impact on voice services, instead allocating costs back to these xDSL transmission services.

Through improved documenting of assets and algorithms, Telstra and its advisers may be able to comment further on where they believe any differences to be.

► *Asset classification*

Comparison of high-level investment categories may result in some discrepancies, due to different categorisation. For example, the primary reference clock (PRC) and synchronization supply unit (SSU) are classified as switching equipment and would be used in the transmission network. However, this could not explain the significant differences claimed.

For the core network, 140 equipment asset types between exchanges have been modelled and have a total investment of more than AUD2 billion. The 30 assets listed in the November Attenborough report are only a subset of the Analysys cost model's IEN assets: other contributing costs are captured elsewhere (e.g. in the IEN building costs and data equipment).

5.1.3 Analysys Mason's recommendation

Telstra has not indicated what it perceives the margin of error to be, but inspection of Telstra's RAF indicates that the IEN investment in the Analysys cost model is out by a factor of [C–I-C]. The November Attenborough report implies our investment is out by a factor of 4–5. The latter also questions our DWDM assets, for which we can now provide a more transparent calculation in the revised model.

We recommend that the new DWDM asset lists (terminals and amplifiers) is incorporated and documented: Telstra can submit its own costs for these assets if it considers our own benchmarks to still be low. We also recommend that digital cross-connects and ODFs are included as new assets in the Core module. We have updated the main report and user guide, to document our changes and improve explanation of the approach implemented.

It would also be useful to understand what the ACCC knows about what is included in category "2-1–50 Transmission Equipment - Primary Asset" of Telstra's RAF, in order to understand whether there are cost components present that we currently capture in other core network assets. We believe that at least some relevant assets are being classified under other categories in the Analysys cost model.

5.2 Issue Q: Insufficient cable within road crossings

5.2.1 Quoted issue (Telstra October submission, pages 54–55)

> The network [in the Analysys model] is built on one side of the road with each distribution pit serving from one to four houses. The model provides for trenching and conduit for the cable from the distribution pit to the other side of the road but does not provision sufficient length of cable sheath to serve the homes on the opposite side.

5.2.2 Discussion

Telstra has identified that the calculation for final-drop cable in road-crossings is incorrect. Effectively, only one cable is provisioned in the road-crossing, whereas in some cases 2, 3 or even 4 cables will sometimes be required. We have corrected this error in the CAN module, in row 218 of the *Access* worksheet. We have determined the probabilities of each occurrence (in terms of number of cable road-crossings by size of DP cluster) in an additional table on the *In.Demand* worksheet. This table is shown below in Figure 5.6: we use the weighted-average number of road-crossing cables by DP cluster size to derive the cabling required.

Road-crossing cables required	*Number of locations in DP cluster*				
	1	*2*	*3*	*4*	*Isolated FDP*
0	50%	25%	12.5%	6.25%	50%
1	50%	50%	37.5%	25.0%	50%
2	–%	25%	37.5%	37.5%	–%
3	–%	–%	12.5%	25.0%	–%
4	–%	–%	–%	6.25%	–%
Total	**100%**	**100%**	**100%**	**100%**	**100%**
Weighted-average	0.5	1.0	1.5	2.0	0.5

Figure 5.6: Likelihood of each case (in terms of cable road-crossings by DP cluster size) [Source: Analysys Mason]

This has the effect of increasing the lead-in cable sheath by approximately 6% across the urban geotypes (Zone A), as shown below in Figure 5.7. It is important to note that this correction has no effect on the deployment in the rural geotypes (Zone B) since these ESAs do not use the serving pit architecture: every connected location has its own pit.

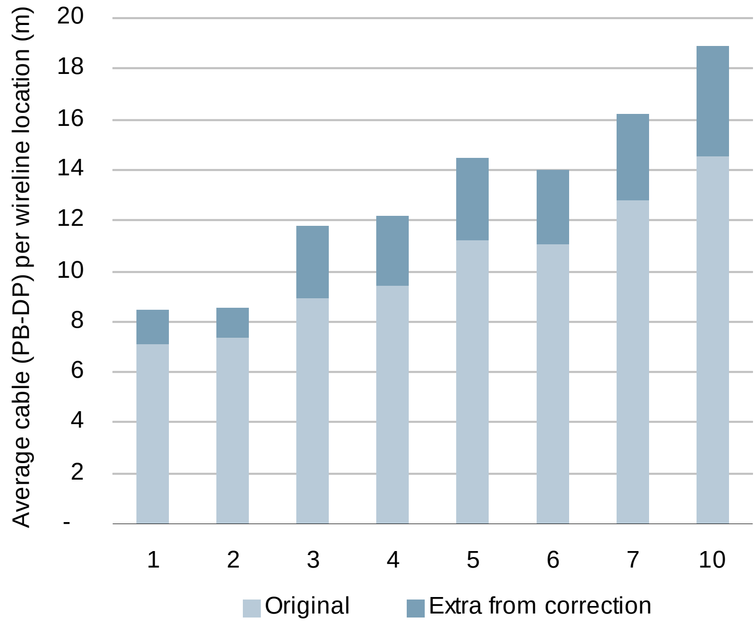

Figure 5.7: Increase in average cabling metres (property boundary to DP) for the Zone A geotypes [Source: Analysys Mason]

The reference model currently excludes lead-in cable, so making this correction standalone has no impact on the costs of ULLS/WLR.

In its July submission, Telstra suggests the "ave.copper.sheath.FDP.DP" metric had been removed. This was a misunderstanding since Telstra did not recognise the change in the serving-pit approach. For greater clarity, we have completely blanked out any rows in the CAN module that are now defunct (e.g. rows 213 and 219 on the *Access* worksheet) and made some refinements to labelling (e.g. we have reworded cell B12 on the *Access* worksheet to say "Property boundary >> DP" rather than "Property boundary >> FDP-DP", which may have been causing confusion. These improvements are documented in Annex C.

5.2.3 Analysys Mason's recommendation

This correction should be implemented.

5.3 Issue R: Inconsistent serving pit architecture

5.3.1 Quoted issue (Telstra October submission, page 56)

> The Analysys Model uses a design of access network and then adopts the calculations for the network assets required to serve all locations within Australia set out in a separate workbook called the 'geoanalysis and access network' module. This module, in turn, contains a detailed calculation of the network assets required to serve a sample of over 800

000 locations within Australia. The asset volumes required for this sample are then scaled up in order to determine the asset volumes required for a full nationwide deployment.

However, the Analysys Model utilises an access network design that is inconsistent with the network design used in the geoanalysis and access network module. The physical locations of key network structure points in the access network used in the Analysys Model are different from the locations of those same points in the geoanalysis and access network module. Despite this, the Analysys Model then relies on the costs calculated in the geoanalysis and access network module without regard to the difference in the access network design. The result is that the Analysys Model incorrectly calculates and underestimates the average distance from a property boundary to a serving pit used so that the cost of Serving Pit Architecture is wrong and the costs are underestimated.

5.3.2 Discussion

As described in Section 6.3 of the FLRIC report, the Analysys cost model now uses a serving pit architecture for DP clusters that includes road crossings, as shown in Figure 5.8 below.

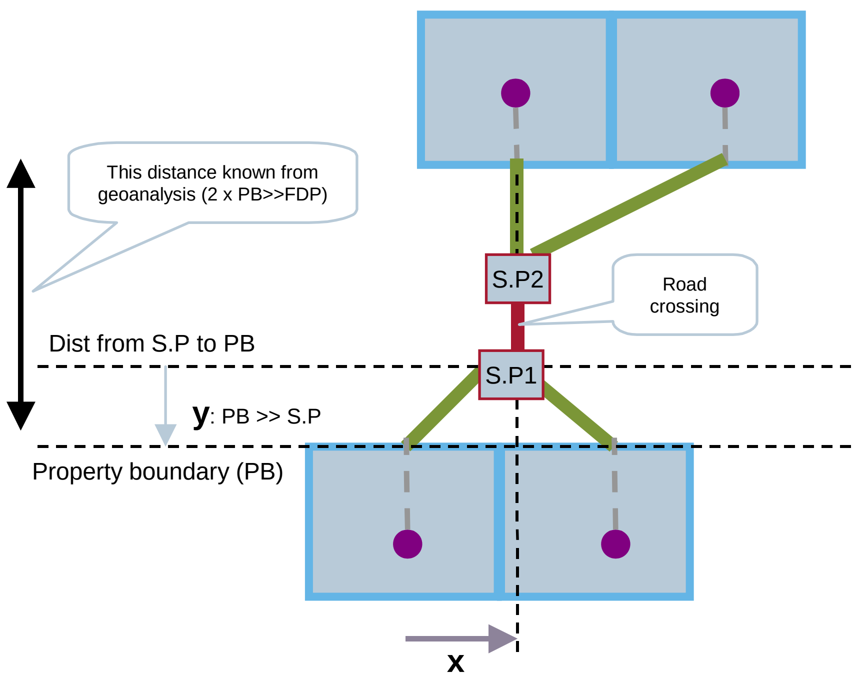

Figure 5.8: Structure of a DP cluster [Source: Analysys Mason]

The position of the first serving pit (S.P1) is assumed to be the location of the DP. In the revised CAN module released for the industry workshop, the interface allowed users to:

- Choose whether S.P1 was either at the central location of the DP cluster (‘Option 1’) or at the location in the DP cluster closest to the pillar (‘Option 2’).

- Choose the position at which the trench from the serving pits enters the property boundary (effectively changing the angle of the green lines above).

Telstra proposes that both of these options should be removed from the model.

We note that as part of the model finalisation, the geoanalysis was changed to place the DP at the location closest to the centre of the DP cluster, rather than the locations in the DP cluster closest to the pillar. This modelling assumption was documented in Section 5.3.1 of the FLRIC report, but we note that there were references in Figure 5.5 of the FLRIC report and Section 2.3.1 of the Visual Basic user guide that were not updated. These have been corrected in the revised versions of the documentation.

This change may not have been appreciated by industry when they raised the issue due to the late stage at which the revision was implemented. We would also note that the labels of both options listed in the CAN module are unclear: they effectively mean the same thing.

Hence, in the CAN module we have re-labelled:

- Option 1 to read "Assumes serving pits placed at the location in the DP cluster closest to the pillar: should be selected only in conjunction with revised geoanalysis".

- Option 2 to read "Assumes serving pits placed at the location in the DP cluster closest to the demand-weighted centre of the DP cluster: consistent with current set-up of geoanalysis."

This is to highlight Telstra's (valid) point that, strictly speaking, you cannot calculate both options in the CAN module with one set of geoanalysis outputs. This is because the average distances are likely to differ between the two options. The DP clustering structure implemented in the geoanalysis is consistent with Option 2 in the CAN module, which is used as the default.

Furthermore, we cannot identify any inconsistencies between selecting Option 2 and the geoanalysis with respect to the trench from the serving pits to the property boundaries. Hence, we see no reason to remove this functionality in the CAN module.

There are two approaches available to dealing with the position of the serving pits:

- remove Option 1 from the CAN module, so it cannot be used
- make small revisions to the Visual Basic to enable it to use both clustering structures and re-run the geoanalysis for both Options 1 and 2.

5.3.3 Analysys Mason's recommendation

We recommend deleting references to Option 1 in the CAN module and retaining Option 2. This sets the assumed positions of the serving pits, although the position of the entry point along the property boundary can still be adjusted using cells [CAN.xls]In.Demand!N76:Q76.

6 Offline calculation issues

This section describes our investigations of issues S–U, related to the offline calculations.

6.1 Issue S: Quantification of fibre jointing

6.1.1 Quoted issue (Telstra October submission, page 52)

> In response to Telstra's 31 July letter in which this error was pointed out, Analysys said that the cost of joints should be included in the cost of fibre. The Analysys Model however, does not do this because it costs all joints separately from cable costs, but the joints it costs do not include the fibre joints.

6.1.2 Discussion

As described in the FLRIC report, fibre-served locations in the Analysys cost model are those with more than 40 units of demand. For each such location, a point-to-point 6-fibre cable is deployed back to its parent pillar. In geotypes 1 and 2, a fibre ring is then deployed between these pillar locations. In all other geotypes, an individual fibre cable is linked back to the RAU directly from the pillar, following the same route as the copper cable back to the pillar.

Telstra continues to insist on including fibre joints in the CAN. According to Page 14 of Telstra's Annexure A, the Analysys model can be fixed by including fibre joints:

- where cables merge (which in our modelled topology only occurs on the fibre rings in geotypes 1 and 2)
- at pillars or LPGS
- at building terminals fed by fibre
- at the exchange
- where the fibre cable reaches a maximum distance between joints.

Confidential data in Telstra's October submission states that a joint should be deployed on fibre cable approximately every 200m. A document submitted to the ACCC by Mallesons Stephen Jaques entitled *Response to Cost Issues raised in the Optus DTCS, Exception Statement April*

2008,[11] states that Optus also stated this to be standard practice. However, the document goes on to say:

> "It should be noted that a joint every 200 metres is not required for the hauling and installation of the cable but is rather an option to enable additional building connections…From a technical perspective, it is my experience, that optic fibre cable can easily be installed for lengths of greater than 1000 metres without the requirement for a joint provided suitable hauling points are available."

In the Analysys cost model, pits are deployed at 100m intervals in the distribution network and 250m intervals in the main network, so suitable hauling points are available in our modelled topology. Given our point-to-point deployment, there should not be any need for frequent joints for additional connections.

In order to assess the magnitude of this issue in the model, we now model fibre architectures as shown below in Figure 6.1, and have chosen a hauling limit of 1000 metres.

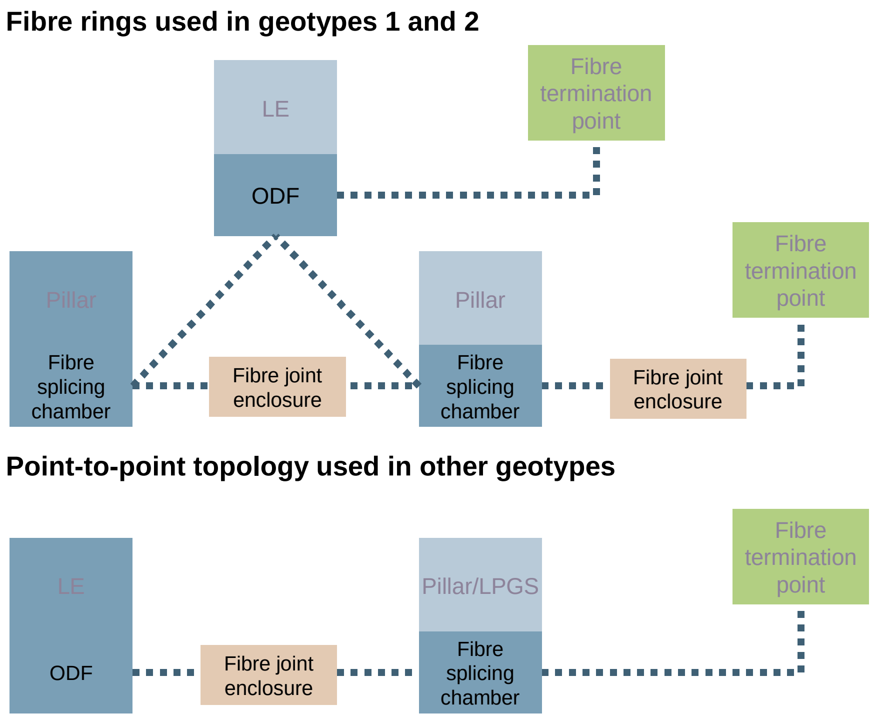

Figure 6.1: Modelled fibre architectures in geotypes 1/2 and otherwise; note that the "joint enclosure" is an asset deployed when the hauling distance limit is reached [Source: Analysys Mason]

This has required the following adjustments to the CAN assets in the model:

- For each wireline cluster in the Access DATA workbooks, we derive the number of fibre joints (i.e. not fibre sheath, but individual fibres) needed for fibre-served locations. We do this:

11 http://www.accc.gov.au/content/item.phtml?itemId=806890&nodeId=4f55bb3ccef6a2ee8aa6e476930bf5dd&fn=Telstra%20supplementary%20submission%20to%20ACCC%20discussion%20paper%20-%20Attachment%204%20-%20public%20version%20(July%202008)

  - from the building back to the pillar, assuming a distance limit of 1000 metres
  - from the pillar back to the LE, assuming a distance limit of 1000 metres
  - between the fibre ring links, assuming a distance limit of 1000 metres.

- We then derive the average number of fibre joints per km of fibre sheath in the Access – CODE workbook and apply these ratios in the CAN module.

- We modified the fibre splicing chamber asset in the CAN module:
  - originally deployed at every pillar in geotypes 1/2 and all LEs serving wired locations
  - now deployed at every pillar in geotypes 1/2 and every fibre-serving pillar elsewhere.

- We have introduced assets to the CAN module for:
  - fibre joints at the pillar/LPGS, driven by the number of fibre-served locations
  - distance-based fibre joints back to the LE
  - fibre connections to optical distribution frames (ODF) at every LE
  - fibre joint enclosures, deployed at distance-based fibre joint locations.

In addition, we have made adjustments to the costs associated with the CAN assets in the model.

- Since we originally stated that our fibre costs included the costs of jointing, we have reduced:
  - the unit costs of fibre sheath (6 fibres) from AUD1.60 to AUD1.50
  - the unit costs of fibre ring fibre sheath (60 fibres) from AUD5.98 to AUD5.60.

- We assume unit costs of AUD10.00 per fibre joint and AUD300 per fibre-joint enclosure.

- We have not included any extra costs for joints at the building terminal, since we assume that they are included in the cost of the building terminal. Similarly, we assume that the costs of joints at the LE are captured in the cost of the ODF.

We note that we calculate the distance-based joints on individual pillar–LE fibre cables and across all fibre cables within a pillar cluster: we note that the latter is a ceiling of the number of joints.[12]

Making these changes has a relatively small impact. It increases the cost of WLR by approximately AUD0.03 in Zone A and AUD0.10 in Zone B respectively.

6.1.3 Analysys Mason's recommendation

In order to highlight to Telstra the lack of impact, it may be easiest to incorporate these changes into the revised cost model. Given our previous position on fibre jointing, we believe it is justifiable to reduce the cost of fibre sheath from its current value.

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12 For example, suppose a pillar cluster has 4 fibre-served locations, each using a 0.8km-long cable back to the pillar. If the distance limit is 1km, then we assume that ROUNDDOWN((4 x 0.8)/1,0)= 3 full fibre cable joints are required, when in fact none are required.

The fibre jointing assumptions are linked directly to each Access DATA workbook from the Access CODE workbook. We have included a macro button on the *Inputs* worksheet in *Access – CODE.xls* to update the calculation of the fibre jointing assets using these inputs without re-running the geoanalysis in full. This macro opens each DATA workbook, refreshes the links and then re-calculates and saves the workbook. This macro takes less than ten minutes to run.

6.2 Issue T: Under-dimensioning of pits in the CAN

6.2.1 Quoted issue (Telstra October submission, page 60–61)

> A pit is an underground piece of equipment used to access joints and cables. The size of a pit is determined by the number of ducts in the pit and the number of links coming into the pit. Each pit must be large enough to accommodate both the number of ducts and the number of links into the pit. If a pit has six ducts and two links, it will need to be big enough to accommodate six ducts. Below is a diagram of a pit showing the number of ducts and links into the pit…
>
> …The Analysys Model does not size pits appropriately. In many cases, the chosen pit size is smaller than the Analysys Model states is required for the number of ducts or links coming into the pit. The Analysys Model has wrongly assumed the pit size can be based on an average when, in fact, pit size is determined by the total number of ducts or links.

6.2.2 Discussion

Telstra's statement that "each pit must be large enough to accommodate both the number of ducts and the number of links into the pit" is contradicted by its own TEA model documentation, as explained below. Telstra is also incorrect in stating that "the Analysys Model has wrongly assumed the pit size can be based on an average": no average pit size is calculated in the model.

After inspection of the Visual Basic, we have identified several issues with the calculation, although their nature is more complex than Telstra has stated. In particular:

- Telstra has misconceived the pit calculation, since it should not be dimensioned on the basis of total duct entering the location, but the most ducts entering one end.
- In the RURAL deployment, the first stated pit size can be over-estimated, since it is based on total ducts rather than the most entering one end of the pit.
- In both URBAN and RURAL deployments, the chosen pit size is sometimes smaller than intermediate decisions on what the pit size should be, which are also printed in the outputs.

- The number of ducts considered in the pit calculations is the number **needed**, when it should be the number **provisioned**.

We treat each of these issues in turn and then describe the combined impact of the changes.

Misconception of the pit calculation

Firstly, we note that in Telstra's own public TEA network design rules document,[13] the diagram on page 13 shows that Telstra's pits are dimensioned on the maximum number of ducts leaving one end, rather than the total number of ducts entering the pit. Figure 6.2 below illustrates part of this diagram.

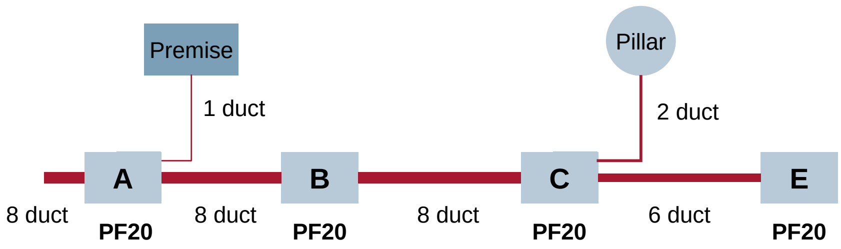

Figure 6.2: Part of the diagram in the TEA model documentation [Source: Telstra]

According to the adjacent table on page 13 of the Telstra document, a PF20 has a capacity of up to 12 ducts. This means 12 ducts at each end, otherwise larger pits would be required at A, B and C.

The pit calculation in the Analysys cost model also uses this basis, by attempting to quantify the maximum number of ducts entering the end of a pit**,** not the total number of ducts entering the pit. The trench network structure aggregates demand upstream back to the exchange as shown in Figure 6.3. Hence, at a DP, the maximum number of ducts required should either be the:

- maximum number of ducts in a link, which will be the upstream link
- total number of ducts less the maximum number of ducts in a link.

13 *Access Network Dimensioning Rules: Long run incremental costing model input*, 3 March 2008, downloaded from http://www.accc.gov.au/content/item.phtml?itemId=812449&nodeId=8b95bf704cfc3eedff2347a7c30a3928&fn=ULLS%20Undertaking%20%20-%20Engineering%20rules.pdf

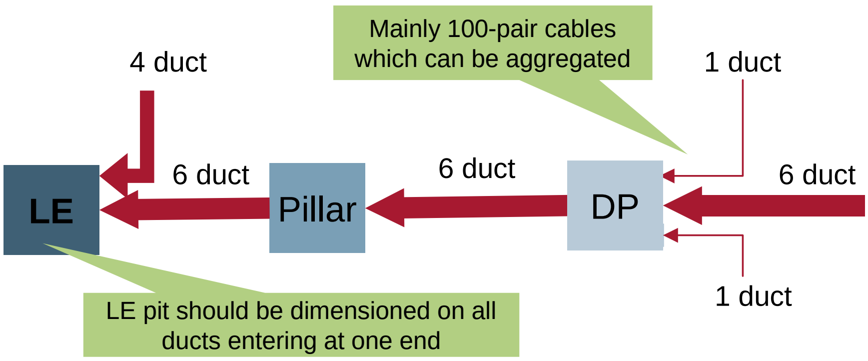

Figure 6.3: Layout of links via a pit [Source: Telstra]

The exception is the LE, which has no upstream links and hence its pit should be dimensioned on the total ducts across all links to the location. We have corrected this in the Visual Basic. Telstra's example of Bundanoon (BUND, ESA 8.4 in our sample), which uses our RURAL deployment, shows a case of an apparent error at an LE location (identified by Telstra on Page 64 of Telstra Annexure A), as shown below in Figure 6.4.

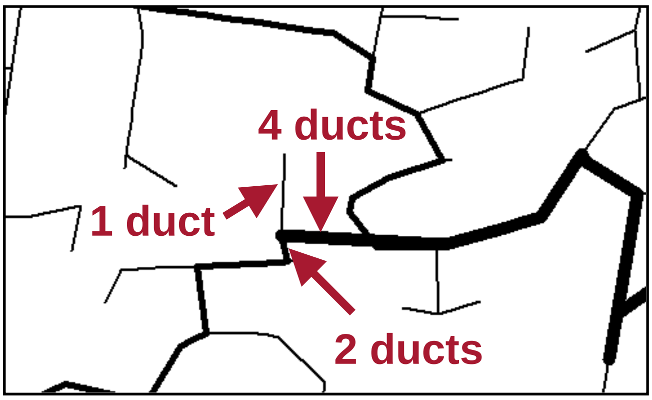

Figure 6.4: Duct deployed around the Bundanoon (BUND) exchange [Source: Analysys Mason]

As an LE, the pit for this location is now determined based on total ducts entering it.

Section 5.3.4 of our FLRIC report describes the pit calculation, but is imprecise. A more exact explanation would be to say that the pit deployed at a location is both:

- the smallest that can accommodate the number of ducts either entering the pit or leaving the pit
- the smallest that can accommodate the total number of links both entering and leaving the pit
- at least a P9 for a pillar location.

An example is also provided. This example should read that "a pillar which is the intersection of 3 links, with a maximum of 22 ducts entering one end would require at least a PF20 by the number of ducts, a P6 by the number of links and a P9 since it is a pillar. This means that a PF20 is deployed." We have amended the FLRIC report accordingly.

Error in the first pit size for the RURAL deployment

The Analysys cost model derives the pit for each DP location. In the Access – DATA workbooks, for each pit we print three sizes as stages in the derivation based on:

- maximum number of ducts **entering or leaving** the location
- number of links intersecting the location
- a final result, which checks whether the location is a pillar and hence needs at least a P9.

Hence, the third stage should always give the same or larger pit size than the previous two. Having examined the relevant Visual Basic for the RURAL deployment, we have identified that we are erroneously printing the pit required based on the number of ducts entering the location **in total**, rather than **one end**. This leads to the first pit size being over-estimated when printed. We have corrected this part of the Visual Basic.

Shortcomings in the calculation involving three or more links

The pit calculations work correctly for pits with two links or less: in particular, the third pit stage is always bigger than the first and second pit stages. We calculate the maximum number of ducts entering an end of the pit based on the maximum number of ducts in a single link. This is correct for two or fewer links. However, the decision is less clear with three or more links. We have corrected our calculation to ensure that it uses the greater of:

- the maximum number of ducts in a single link
- the total number of ducts minus the maximum number of ducts in a single link.

Previously, there were some cases where the first pit stage was larger than the third pit stage. For example, DP 104 in Roma Street (RASH, ESA2.4) has four intersecting links and is shown below in Figure 6.5.

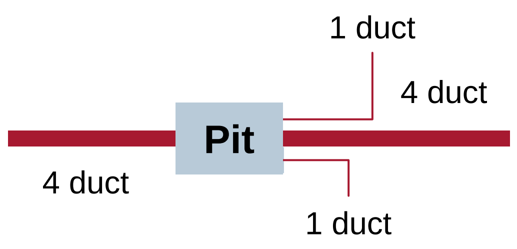

Figure 6.5: DP 104 in RASH ESA [Source: Analysys Mason]

The three pit stages are then derived as:

- a PF12 pit, since we take the maximum of 4 and 10-4=6, which is 6
- a P9 pit, since there are 4 links entering the location
- finalised as a P9 (after checking if it is a pillar location).

The PF12 should be taken in preference based on the maximum number of ducts. Following the corrections, the third stage is given as a PF12.

Use of provisioned duct rather than needed duct

This error is clearly demonstrated by Telstra's example in ESA 8.4, although the operator did not identify it. For the calculation of the LE location, the maximum number of ducts entering the LE is stated to be 3. However, the printed duct requirements for the trench network links show that this link has 3 ducts required, but 4 deployed (3 cannot be deployed according to our engineering rules).

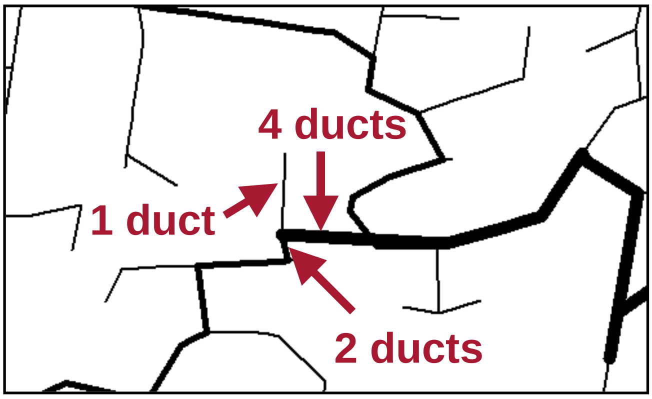

Figure 6.6: Duct deployed around the Bundanoon (BUND) exchange [Source: Analysys Mason]

We have corrected the Visual Basic to consider the deployed ducts in the calculation.

Impact of changes

We have re-run the geoanalysis following these changes. There is a move in the pit size distribution towards the larger pits in each geotype, as shown below in Figure 6.7.

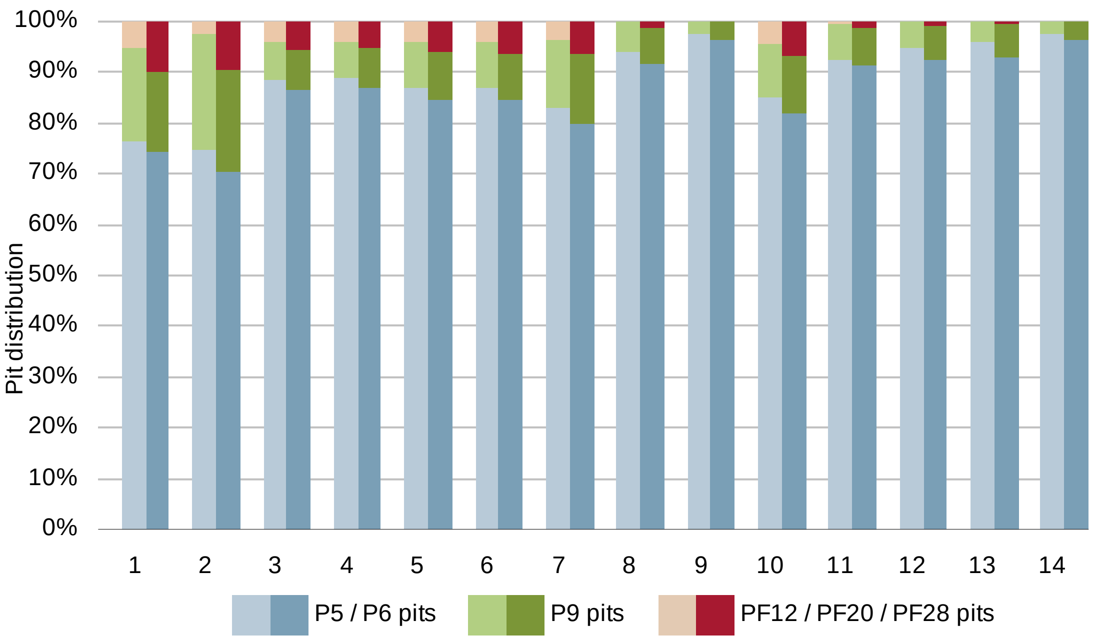

Figure 6.7: Change in pit size distribution by geotype [Source: Analysys Mason]

The impact is to increase the cost of ULLS/WLR by approximately AUD0.14 (0.6%) in Zone A. This is due to an increase in annualised pit costs of 4.5%.

A direct comparison of the impact on the costs in Zone B is not possible due to our inability to replicate the original geoanalysis results for geotypes 11 and 12 (this inconsistency is described in Annex B). However, we have established that there is an increase in pit costs of 8.9% (AUD25 million) in Zone B, which we would estimate would increase the costs of ULLS/WLR by no more than AUD1.

6.2.3 Analysys Mason's recommendation

The ACCC should incorporate the revised changes into the geoanalysis.

6.3 Issue U: Wireless radius

6.3.1 Quoted issue (Telstra October submission, page 66)

> The Analysys Model wrongly assumes that customers can be served by wireless without taking into account the topological barriers to wireless connection. If those topological barriers are taken into account less customers could be serviced by wireless than assumed by the Analysys Model. These issues are considered and explained in the report of Craig

Lordan (Lordan no. 2 Report) (Supplementary Supporting Documents, Volume 1, Document 1.11).

Analysys assumes that wireless technology is capable of reaching end-users within 25km of a fixed point. In reality however, and when the impacts of the environment, topography and multiple users are considered, the capability is more like 15km.

6.3.2 Discussion

The expert witness report cited by Telstra confirms that the current assumption of 25km for a voice-only service is acceptable. The proposed 15km radius is associated with a voice and broadband service, which may not be appropriate for the Analysys cost model in rural areas.

We have re-run the ACCC's version of *Access – CODE.xls* twice for the rural geotypes (8–9 and 11–14), once using a 15km radius of a wireless base station and once using our original 25km radius. This assumption primarily has an impact on the:

- Proportion of locations/SIOs served by each access technology, since the assumption is used in the copper-wireless decision.
- The wireless network deployed, since a smaller radius will require more base stations to achieve coverage of wireless-served locations.

The difference in the proportions of SIOs served by each access medium is shown in Figure 6.8.

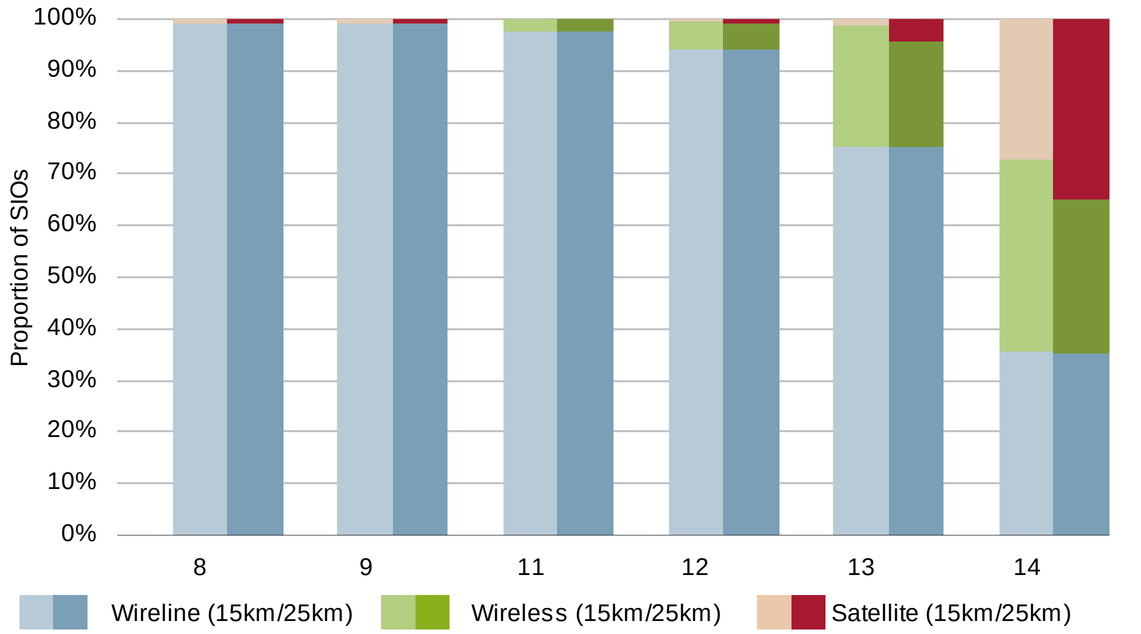

Figure 6.8: SIOs served by access technology in each rural geotype [Source: Analysys Mason]

The change in radius only fractionally affects the split of SIOs served by wireline and non-wireline technologies:

- geotype 14 moves the furthest, with a 0.3% shift in wireline SIOs
- geotypes 8 and 9 are unchanged
- geotypes 11–13 each move by less than 0.02%.

This means that the cost-based decision on whether to deploy copper or wireless is reasonably stable to changes in the radius of the wireless site. While this may appear to be counter-intuitive, it is an effect of the cost-based decision considering the incremental cost of another copper subscriber added to an existing cluster versus the cost of a new base station. The calculation would be more sensitive to changes in the relative costs of copper and wireless. We note that this is the intended behaviour of the algorithm.

However, there is a discernible change in the mix of SIOs served by wireless and satellite. This is because the average cost per SIO to be served by wireless has increased, since a single base station can now cover fewer locations. This makes satellite the more cost-effective option in more cases.

Although geotypes 8 and 9 are in Zone A, they are such a small proportion of SIOs in this zone that their updated inputs have a minimal impact on the costs of services (less than AUD0.005).

In order to compare the costs of our re-run versions of the rural geotypes, we have used a version of the reference model with updated cable gauge distributions and CAN module inputs from *Access – CODE.xls* for all geotypes. We have then compared this version of the model with one modified with the CAN and cable gauge inputs updated for 15km. The costs of ULLS/WLR in Zone B decrease, as shown below in Figure 6.9.

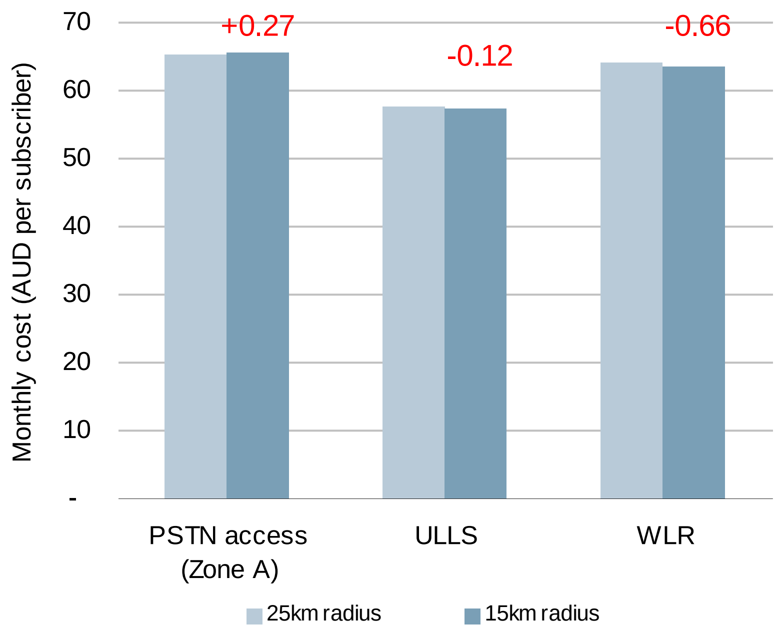

Figure 6.9: Differences in cost of services in Zone B in 2010 [Source: Analysys Mason]

This is due to the wireless access network shrinking in size, while the only increase in the satellite-related assets is the number of satellite CPEs (from 21 500 to 40 400). We have limited information on the number of PSTN lines provided over satellite, but believe it to be lower than 40 000. The choice between wireless and satellite is sensitive to the input costs for both assets.

It is worth highlighting that wireless connections, but not satellite connection, are considered as valid for WLR.

We note that the expert witness report provided by Telstra does confirm that the current assumption of 25km for a voice-only service is acceptable. The proposed 15km radius is associated with a voice and broadband service, which may not be appropriate.

6.3.3 Analysys Mason's recommendation

Decreasing the radius reduces the costs of ULLS/WLR, although it does increase the number of SIOs served by satellite significantly, which does not reflect reality. We would recommend against changing this input.

Annex A: Summary of relevant documents

A.1 Relevant documents submitted by operators

Operator	*Title of document*	*Date of submission*	*Size*	*Reference*
Telstra	An Expert Evaluation of the ACCC Cost Model and its Use in the Pricing of ULLS	Mar 2009	45	Telstra Harris report
Telstra	Remaining errors in the fixed network cost model commissioned by the ACCC	31 Jul 2009	13	Telstra July submission
Telstra	Draft pricing principles and indicative prices for LCS, WLR, PSTN, OTA, ULLS and LSS. Request for further information – ACCC/Analysys Cost Model	22 Sept 2009	1	Telstra request for information (RFI)
Telstra	Response to the ACCC's draft pricing principles and indicative prices for LCS, WLR, PSTN OTA, ULLS, LSS	9 Oct 2009	124	Telstra October submission
Telstra	Annexure D - Errors In The Analysys Model	Oct 2009	15	Telstra Annexure D
Telstra	Expert Report of Nigel Attenborough	Oct 2009	68	October Attenborough report
Telstra	Report regarding CAN Architecture	8 Oct 2009	56	Lordan CAN report
Telstra	Report regarding Wireless Networks	8 Oct 2009	48	Lordan Wireless report
Telstra	A Errors in the Analysys Model	12 Oct 2009	107	Telstra Annexure A
Telstra	CAN.xlsm	20 Oct 2009	-	Telstra CAN module
Telstra	Core.xlsm	20 Oct 2009	-	Telstra Core module
Telstra	Cost.xlsm	20 Oct 2009	-	Telstra Cost module
Telstra	Draft pricing principles and indicative prices for LCS, WLR, PSTN, OTA, ULLS and LSS.	29 Oct 2009	1	Telstra cover letter for modified Access – code workbook
Telstra	Access – Code.xls	29 Oct 2009	-	Telstra Access – CODE workbook
Telstra	Specific errors in the Analysys Model (3334691_1_full roll down all years.doc)	29 Oct 2009	11	Telstra full roll down
Telstra	Expert Report of Nigel Attenborough	6 Nov 2009		November Attenborough report
Optus	Optus Confidential Submission to ACCC in response to draft determination on Pricing Principles and Indicative Prices for Fixed Line Services	Oct 2009	103	Optus confidential submission
Optus	Final report for Optus - ULLS: review of the ACCC draft decision	9 Oct 2009	50	Optus confidential Attachment 3

Figure A.1: Summary table of submitted operator documentation [Source: Analysys Mason]

A.2 Relevant documents authored or sourced by Analysys Mason and the ACCC

Author	*Title of document*	*Date published*	*Pages*	*Reference*
Analysys	Fixed LRIC model documentation	August 2009	185	FLRIC report
Analysys	Fixed LRIC model user guide	August 2009	196	FLRIC user guide
Analysys	Instructions for key processes in geoanalysis for the fixed LRIC cost model	August 2009	57	Geoanalysis user guide
Analysys	Description of the Visual Basic used in the fixed LRIC model	August 2009	103	Visual Basic user guide
ACCC	Review of fixed line wholesale services pricing 2009-12	30 September 2009	2	ACCC response to Telstra RFI
Telstra	Access Network Dimensioning Rules: Long run incremental costing model input	3 March 2008	14	TEA network design rules document

Figure A.2: Summary table of submitted operator documentation [Source: Analysys Mason]

Annex B: Reference model

This section describes how we have derived the reference model against which we have compared the modifications for the issues brought up by the operators. In particular:

- Section B.1 describes the adjustments made to v0.92 of the Analysys cost model submitted to the ACCC by Analysys Mason in June 2009 to match it to the version used by the ACCC for the draft pricing paper.
- Section B.2 notes an omission that the ACCC appears to have made when updating the cost model for the draft pricing paper, in terms of the revised cable gauge distributions.

B.1 Synchronisation of model versions

On 13 November 2009, the ACCC provided Analysys Mason with its active version of the Analysys cost model. We note that this version does not appear to be completely consistent with the values published in the ACCC's *Draft pricing principles and indicative prices for LCS, WLR, PSTN OTA, ULLS, LSS*, dated August 2009. Running the ACCC's version of the model leads to the costs below, which are close to, but not exactly like those published.

Service (zone)	*Pricing year (modelled year)*	*Unit costs (AUD)/line/month*		*Delta (AUD)*
		ACCC model	*Pricing paper*	
ULLS (Zone A)	2009/10 (2010)	22.01	22.03	–0.02
ULLS (Zone B)	2009/10 (2010)	60.40	60.41	–0.01
WLR (Zone A)	2009/10 (2010)	22.73	23.26	–0.52
ULLS (Zone A)	2011/12 (2012)	22.52	22.54	–0.02
ULLS (Zone B)	2011/12 (2012)	61.69	61.70	–0.01
WLR (Zone A)	2011/12 (2012)	23.24	23.76	–0.52

Figure B.1: Comparison of unit costs from the ACCC's model and the principles paper [Source: Analysys Mason]

Analysys Mason has started with the version of the model submitted to the ACCC on 27 June 2009 (v0.92) and made the following changes to synchronise this with the ACCC model:

Workbook	*Worksheet/module*	*Cells references*	*Change*
CAN.xls	In.Access	E7:T183	Updated with the ACCC geoanalysis outputs
Core.xls	In.Subs	L5465	Hard-coded to 9564
Cost.xls	WACC	C10:H10	Revised Rf to 5.82% in 2007–8; 5.64% in 2009–12
Cost.xls	WACC	C11:D11	Revised Rp to 6% in 2007–8
Cost.xls	WACC	C13:D13	Revised be to 0.83 in 2007–8
Cost.xls	WACC	C14:D14	Revised e to 30% in 2007–8
Cost.xls	WACC	C15:H15	Revised Dp to 1.02% in 2007–8; 2.4% in 2009–12
Cost.xls	WACC	C16:D16	Revised I to 0.08% in 2007–8
Cost.xls	TA.Core	K11:K210	Revised to 2.5%
Cost.xls	TA.Access	F10:F90	Revised to 2.5%
Cost.xls	UnitCost.Access	E141, E149	Set to 0
Cost.xls	UnitCost.Access	E195, E196	Set to 0

Figure B.2: Changes made to v0.92 of the Analysys cost model to synchronise with the ACCC version of the model [Source: Analysys Mason]

We have then corrected the Core module by re-instating the SUMIF() formula in In.Subs!L5465 and setting L13 to 1 meaning that WLR is present in all geotypes. This modified version of the Analysys cost model (v0.95) is taken as the reference model.

B.2 Input inconsistencies

Based on our comparison of the version of the Analysys cost model sent to the ACCC in June and received from the ACCC in November, we have identified two inconsistencies in inputs that we have not synchronised in our reference model. These are described below and are between:

- the geoanalysis outputs in *CAN.xls* and *Access – CODE.xls*
- the geoanalysis and the cable gauge calculation.

Although, we have not addressed these in our reference model, the revised model submitted to the ACCC will have fully refreshed inputs.

B.2.1 CAN.xls and Access – CODE.xls

We have calculated our own version of the geoanalysis using the version of *Access – CODE.xls* provided to us by the ACCC, which assumes a LPGS limit of 6.9km. We have been able to reproduce the ACCC's output tables on the *Summary* worksheet of *Access – CODE.xls* with our version of the geoanalysis.

In order to keep the model consistent, the final output table on this worksheet of *Access – CODE.xls* should then be pasted into the *In.Access* worksheet of *CAN.xls*. However, the values for geotypes 11 and 12 in the ACCC's version of *CAN.xls* are not consistent with the equivalent table in *Access – CODE.xls*. We have been unable to reproduce the parameters in the ACCC's version of *CAN.xls* for these geotypes, meaning that some or all of the ESAs in these geotypes used different assumptions in their geoanalysis.

B.2.2 Cable – gauge determination.xls

We note that the ACCC re-ran the geoanalysis with an LPGS limit of 6.9km. The geoanalysis outputs were then updated in *CAN.xls*. However, it appears that the cable gauge distributions in *Cost.xls* were not updated using *Cable – gauge determination.xls*. The steps required to do this are documented in Section 7 of the Geoanalysis user guide.

Using the version of *Access – CODE.xls* provided by the ACCC, we have generated our own updated version of the Access – DATA workbooks and revised *Cable – gauge determination.xls* and *Cost.xls* accordingly. The LPGS limit of 6.9km leads to more LPGS, shorter copper loops and therefore less of the thicker gauges. Including the updated distributions leads to the cost of ULLS/WLR being reduced by approximately AUD1.20 in Zone A, but the cost of Zone B increases by AUD3–5.

Annex C: Model adjustments from v2.0 to v2.2

We have made a number of formula changes within the various modules of the model. These are summarised in the Excel workbook *Changes made to the Analysys cost model.xls*. which accompanies the revised model.

This annex describes the adjustments/updates made to the model in order to arrive at v2.2:

- Section C.1 describes the inputs that have been refreshed in the model
- Section C.2 describes the impact of a particular correction to the copper-wireless decision.

C.1 Inputs refreshed in the model

As part of the update of the model, we have:

- undertaken a full re-run of the geoanalysis using the revised version of *Access – CODE.xls* and the Access – DATA workbooks
- updated *CAN.xls* with the latest outputs from the geoanalysis
- refreshed *Cable – gauge determination.xls* using the revised Access – DATA workbooks and then updated *Cost.xls* with the refreshed gauge distributions.

C.2 Note on correction to the copper-wireless decision algorithm

At the start of this piece of work, we identified a flaw in the copper-wireless decision algorithm in the Visual Basic in the *WirelessAndSatellite* module of *Access – CODE.xls*. This required three changes as described below in Figure C.1.

References	*Description*
Line 1255	Changed "lngNumMembersCu(lComparison, lPillar) = lngNumMembersCu(lComparison, lMoveToThisPillar) + 1" to "lngNumMembersCu(lComparison, lMoveToThisPillar) = lngNumMembersCu(lComparison, lMoveToThisPillar) + 1"
Line 1268	Changed "If lCuClusterAssignedTo(lComparison, m) = lPillar Then" to "If lCuClusterAssignedTo(lComparison, m) = lMoveToThisPillar Then"
Line 1279	Changed "lCuClusterAssignedTo(lComparison, i) = lPillar" to "lCuClusterAssignedTo(lComparison, i) = lMoveToThisPillar"

Figure C.1: Changes made to the copper-wireless decision algorithm [Source: Analysys Mason]

This algorithm determined the distribution of locations served by the various access technologies (copper/fibre, wireless and satellite). Correcting this causes the distribution to slightly change in the six rural geotypes (8–9 and 11–14), as shown below in Figure C.2.

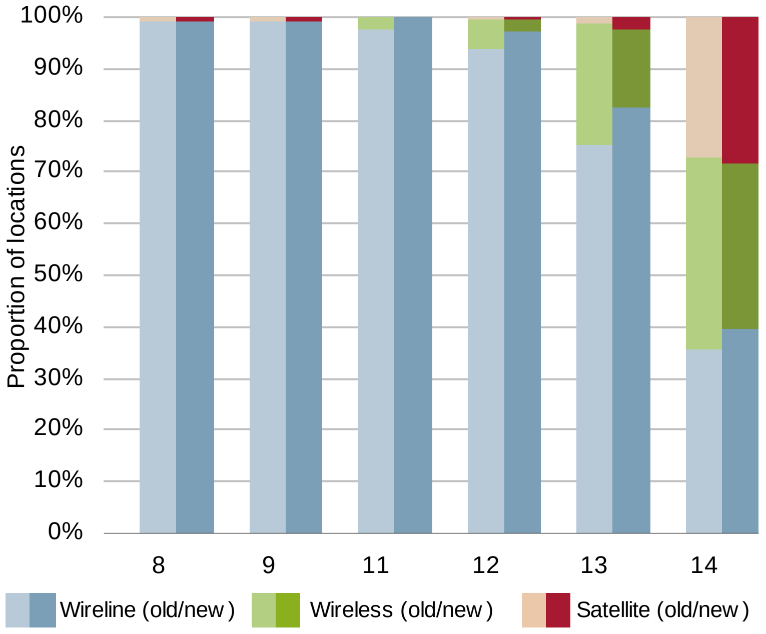

Figure C.2: Distribution of access technologies in geotypes using the copper-wireless decision following the correction of the error [Source: Analysys Mason]