Response to TERA questions regarding the Chorus UCLL and UBA models

30 years

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1 Introduction

Analysys Mason was commissioned by Chorus to provide modelling and consulting services related to the New Zealand Commerce Commission's Unbundled Copper Local Loop (UCLL) Final Pricing Principle (FPP) and Unbundled Bitstream Access (UBA) FPP review.

In December, 2014 Chorus submitted models developed by Analysys Mason to the Commerce Commission for its consideration. These included:

- a hybrid bottom-up model using Chorus' actual asset counts (as a proxy for the forward looking asset count) in order to calculate the element based TSLRIC of UCLL (the 'UCLL model')
- a bottom-up model for electronics with actual asset counts for civil works (km of digging/km of fibre) and actual numbers of nodes (number of customer sites, cabinets and exchanges). We call this "bottom-up with actual asset count for civil works", or the "UBA model"
- the supporting opex model.

TERA has been asked to review these models by the Commerce Commission. TERA issued questions regarding these models on 20th January 2015[1].

This document contains our responses to those questions. The responses are grouped under the same headings used by TERA:

- Section 2, Access
- Section 3, Core, and
- Section 4, Opex

Figure 1.1 and Figure 1.2 list key documents and materials referred to in this document.

Figure 1.1: Documents referred to in this report [Source: Analysys Mason, 2015]

Title	No. of pages	Short name	URL
TERA Model Documentation (public version)	135	TERA Model documentation	http://www.comcom.govt.nz/dmsdocument/12784
Phase 2b UBA - Model user guide Nov CC 2014-11-29	30	Chorus UBA Model user guide	http://www.comcom.govt.nz/dmsdocument/12788
Phase 2a UCLL - Model user guide CC 2014-11-29	27	Chorus UCLL Model user guide	http://www.comcom.govt.nz/dmsdocument/12789

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[1] TERA's Ref: 2014-20-DB-ML – BU models

Title	No. of pages	Short name	URL
Draft pricing review determination for Chorus' unbundled copper local loop service	208	Draft determination on UCLL	http://www.comcom.govt.nz/dmsdocument/12771

Figure 1.2: List of modelling materials referred to in this report [Source: Analysys Mason, 2015]

Title	Short name	URL
UBA Model CC - Public version Or Chorus UBA TSLRIC model 4 December 2014 PUBLIC	Public Chorus UBA model	Provided to Commission in December 2014
UBA Model CC - Restricted version	RI Chorus UBA model	Provided to Commission in December 2014
UCLL full Model CC - Public version Or Chorus UCLL TSLRIC model 4 December 2014 PUBLIC	Public Chorus UCLL model	Provided to Commission in December 2014
UCLL full Model CC - Restricted version	RI Chorus UCLL model	Provided to Commission in December 2014

2 Access

2.1 Could you describe what is included in the asset "lead in"?

There are two lead-in assets in the UCLL model. One represents standard residential lead-ins ("Lead in (copper), standard (new development)") to a single dwelling unit (SDU). The second ("Lead in (copper), standard (new commercial)") represents the *additional* costs of providing a lead-in to commercial units or multi-dwelling units (MDU).

One 'Lead in (copper), standard (new development)' is assumed for each of the 2.1 million connected subscribers in New Zealand:

- This cost includes the supply and installation of all passive infrastructure *between the distribution point (DP) and the external termination point (ETP) at the SDU occupied by the subscriber*[2]. This therefore includes the supply and installation of all poles, ducts, cabling and reinstatement
- Where the subscriber premises is part of an MDU (e.g. office block, shopping centre, apartment block) this represents the cost to supply and install all passive infrastructure *between the building frame in the MDU and the ETP located at the dwelling of the subscriber*. This includes internal ducts and wiring

The additional costs for deploying lead-ins for MDUs are represented by the **[RI:]** building frames associated with the "Lead in (copper), standard (new commercial)" asset:

- This includes the additional costs of providing the passive infrastructure within an MDU or commercial unit (e.g. office block, shopping centre, apartment block) except for the building distribution frame (BDF) which is modelled separately. These costs include additional MDU and Right of Way (RoW) cabling[3], as well the supply and installation of poles, ducts, cabling and reinstatement.

The ETP, DP and building frames themselves (at MDUs) are not included in the lead-in asset and are modelled separately.

2.2 Could you describe what is included in the asset "aerial route"?

The aerial route asset includes the cost of:

- **[RI:**
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-   **]**

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[2]   Specifically, this refers to the SDU rather than the edge of the building since these differ where the subscriber premises is part of an MDU.

[3]   Sometimes referred to as "glue infrastructure"

To be completely clear: this includes the cost of poles on both sides of the road where poles on both sides are required.

The aerial route assets do not include the cables themselves which are represented as separate assets.

2.3 What is the distance between poles assumed to assess "aerial route" metric cost?

In calculating the unit cost (per metre) of aerial cable route an average separation of 40 metres between poles is assumed.

2.4 Why is the aerial "Aerial Asset counts multiplier" not applied to distribution points?

The aerial asset counts multiplier increases the number of aerial route assets and decreases the number of underground route assets to alter the proportion of distribution route to 20% aerial and 80% underground.

The number of distribution points is based on the number in NetMap and represents the number required to serve the current demand. Distribution points are driven by subscribers rather than by the deployment type therefore the distribution points are not affected by this multiplier.

2.5 Could the difference between the number of premises [R I :   ] and the number of lead-ins [R I :   ] be explained? If the lead-in deployment is driven by the actual demand, then the number of premises shall also be consistent with the actual demand.

Please see also response to 2.1 for distinction between the types of lead in.

There are [R I :   ] lead-ins input to the model, each representing the dwelling unit of one subscriber[4]. This is multiplied by [R I :   ] (the Optimised Asset Counts Multiplier) to reach [R I :   ] lead-ins in *FullNw*.

This is an error. The 'Optimised Asset Counts Multiplier' should not have been applied to this asset as the optimised network is still obliged to serve all locations.

2.6 What are the drivers of the route optimization multipliers (from [RI: %] for cables, to [R I :   %] for infrastructure)? We cannot find an explanation for any of the used rates, including the 10% additional efficiency adjustment.

The 'Optimised Asset Counts Multiplier' is based on previous very simple top-down estimates of the potential level of optimisation for certain assets, based on assumptions about the cost/volume relationships and an estimated level of current over-provision.

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[4] See *LinkedIn*, Cell R32

The 'Additional efficiency asset count multiplier' is a miscellaneous adjustment, as explained by Chorus in its presentation to investors on 2nd December 2014[5].

The 'Aerial Asset Counts Multiplier' is discussed in the response to 2.7.

2.7 Why is the "proportion of distribution network that is aerial" (20%) not used in the modelling? It seems that 21% of distribution routes are aerial. However, no link seems to be made with the 20% aforementioned input parameter.

[RI:

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2.8 Could the calculation of the length of the access cables and trenches be explained?

The length of routes (aerial and underground) are based on Chorus' NetMap system which records the actual routes deployed, as reported in Chorus' response to Q6.14.1 (c). The assets are then divided between the modelled assets[7] using the asset sharing/route allocation matrix process described in the UCLL model user guide (in section 3.2.2). This process excludes the share of assets in the network whose cost is non-Chorus or attributed to the core. It also divides the assets between technical services based on:

- the logical position in the network that each route is tagged with in NetMap,
- the level of demand for each technical service in each Exchange Service Area (ESA).

Chorus' NetMap system also records which cables are deployed in each segment of route. We used this information to determine the length of cables in the network[8]. As with the trench, cabling was then divided into the modelled assets using the asset sharing/route allocation matrix process.

Please note that the lengths of trench and cable in the model account for the share of trench that each technical service is responsible for. This accounts for sharing of trench or cable sheath between services. Therefore, since some services (such as core-related services) are out of scope of

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[5]   https://www.chorus.co.nz/file/56796/Modelling-slide-pack-2-Dec-2014.pdf

[6]   Cell E35, *Output* sheet of the UCLL model

[7]   These can be mapped to technical services and hence actual Chorus products.

[8]   We added uplifts where applicable, since a cable is not exactly the same length as the route it is deployed on. These uplifts accounted for aerial sag and overlap required at joints. The uplifts are specific to the type of cable (distribution, feeder; copper, fibre) and deployment type (aerial, underground).

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the UCLL model, the total length of trench and cable in the UCLL model is less than the actual volume deployed in the network.

2.9 How has the number of cabinets been derived? Chorus model includes 8,831 cabinets whereas the number of cabinets included in ComCom model is 10,471. The number of cabinets included in ComCom model is based on the figures provided by Chorus during the data collection phase.

The number of cabinets in the UCLL model is based on the number of cabinets recorded in NetMap. Each cabinet type recorded in NetMap was treated differently according to its function:

- FTTP cabinets **[RI:]** were excluded since they are not relevant to the modelled copper access network

- Wireless equipment shelters **[RI:]** are included in the model but listed with the wireless assets rather than alongside the other cabinets due to the differing functionality **[RI:]**

- Building Frames **[RI:]** are added to the building frames recorded elsewhere in NetMap[9] and are therefore included in the model within **[RI:]**.

- The remaining cabinets are those related to the copper access network **[RI: content of Fig 2.1]**:

Type (asset #)	National count
[RI:]	[RI:]
[RI:]	[RI:]
[RI:]	[RI:]
[RI:]	[RI:]
[RI:]	[RI:]

Figure 2.1: Main cabinet types in the UCLL model [Source: Analysys Mason, 2014]

The final number of cabinets in the model is also subject to a 10% reduction due to the 'Additional asset count multiplier'. This reduces the numbers in Figure 2.1 to those TERA have quoted as totalling **[RI:]**. It is quite possible that this 10% reduction is not realistic in this case.

2.10 How has the number of manholes in Chorus model been derived?

The number of manholes and pits is based on NetMap records. These have been distributed between technical services using the same distribution as has been used to perform the same split for routes between technical services. This is the distribution of routes calculated through the asset sharing/route allocation matrix process described in the UCLL model user guide in section 3.2.2.

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9 Building frames in NetMap are recorded either as a CT or as a cabinet.

2.11 How has the length of the SLUBH in Chorus model been derived?

The length of fibre feeder trench and cable to active cabinets which we understand to be analogous to what TERA refer to as "the length of SLUBH" is calculated in the same way as all of the other trench and cable lengths, as described in our response to 2.8 and in the UCLL model user guide (in section 3.2.2).

The volume of fibre feeder trench and cable passed to the UBA model is the full length of trench and cable in the fibre feeder as recorded in NetMap with a proportion removed to account for sharing with either the core (e.g. interexchange) or the distribution (e.g. UCLL) layers.

In other words, some of the relevant trench length between the exchange and active cabinets is allocated to other services - including services not present in the TERA model (specifically, copper feeder to active cabinets).

2.12 How have been set the asset lives of "UG Route in distribution" and "aerial route" in Chorus model? What are the exact assets that are included in these two categories?

The Distribution Cable route assets (159-161, 163-165) have an asset life of 20 years. Distribution cables are assumed to be direct buried and therefore the route asset cannot have a lifetime that is longer than the cable it contains.

The underground route asset represents the cost of digging a trench and reinstating the surface. The cost of supplying and installing the ducts and cables are represented separately as part of the duct and cable assets.

The asset lifetime for the Distribution and Feeder Cable route assets (155-157,172-174) are set to 14 years. This is in line with the Chorus Fixed Asset Register and Chorus' response to Q6.19.6a[10].

The definition of the aerial route assets is given in response to question 2.2.

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[10] See Q6.19.6 a) response FINAL.csv; row 84 for "Access Cu Cable Overhead"

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3 Core

3.1 The core model is using geotypes. Has the modelled inventory been reconciled with Chorus real inventory?

We have done a comparison, but because our UBA model is bottom-up for the active electronics, our asset counts (inventory) are often lower than the actual Chorus asset counts.

3.2 Could you detail how cables and trenches are allocated to the different services in the core network model?

Feeder and distribution cables and trenches are calculated in the access (UCLL) model and, still within the access model, they are allocated between UCLL and services considered in the UBA model. Cables and trenches allocated to the UBA model are passed on from the access model to the core (UBA) model. Within the core model, the costs of these assets are allocated in proportion to the total bandwidth of each of the services that use these assets based on estimates of service bandwidth requirements.

3.3 Is the model able to isolate the RBI cabinet related-costs?

No, the core model is not able to isolate RBI cabinets at the moment, although we could make changes to the model (e.g. a parallel copy without those cabinets) to allow such a calculation.

3.4 How many cabinets in Chorus model (not in Chorus real inventory) are located in the RBI areas?

Our cabinets are at the same locations as those of Chorus. We do not know how many of the cabinets in the core model are in RBI areas, because they are not currently tagged in this way in the model as previously discussed in point 3.3.

3.5 Could you explain why the length of core cables is significantly below the length of trenches allocated to the core network (see figures derived from the spreadsheet "NwDes" in the next table)

	Length (km)
Feeder cables	[RI:]
Feeder trenches	[RI:]
Core cables	[RI:]
Core trenches	[RI:]

Figure 3.1: Reproduction of 'Table 1 - Cables and

[Source: TERA, 2015]

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We agree there is an issue.

When the Commission refers to 'core cables' and 'core trenches', we interpret this to be cables and trenches in inter-exchange links in the UBA model.

It should be noted at this point that we follow a different approach for inter-exchange cables compared to that for inter-exchange trench and duct. The inter-exchange cable is dedicated to inter-exchange links[11]; we assume that inter-exchange cable is not shared with the access network. By comparison, the inter-exchange trench and duct includes both route used only in the core network, and route in the core network which is shared with the services modelled in the access model[12].

On further investigation, we have made two corrections to calculations in our analysis, relating to the use of the S98 data and NetMap data.

Data from S98 Q6.10.1 was used to calculate total cable sheath distance in the core network and split this between inter-exchange and inter-switch links. Upon review, we noticed an error in one of the formulas in our analysis which tagged whether cable sheaths were in the inter-exchange or in the inter-switch links, which was not implemented correctly in all cells. After correction of the formula, the *total* cable sheath distance in the S98 analysis remains unchanged but the *split* between inter-exchange and inter-switch links has changed. Before we had calculated **[RI:]** of interexchange and inter-switch cable sheath distance, respectively; this has been corrected to **[RI:]** of inter-exchange and inter-switch cable sheath distance, respectively.

Offline analysis of NetMap data provided the total route allocated to links in the core (inter-exchange and inter-switch). On review we have found that we had interpreted two outputs of the analysis as referring to two mutually exclusive route groups: the route located in access network areas allocable to the inter-exchange and inter-switch links due to sharing, and the route in the core network-only areas allocable directly to inter-exchange and inter-switch links. Upon revisiting the definition of the output from the offline analysis, we identified an issue with double-counting of route assets. Specifically, the route figure of **[RI:]** was previously thought to be only the share of inter-exchange and inter-switch links in the access network areas. This was in fact the total route allocable to inter-exchange and inter-switch links across both access-areas and core-areas. A further data point of **[RI:]** of core-only route was interpreted as being in addition to the first data point, when in fact it was a subset of the total figure. The previous calculation approach resulted in double-counting of core area-only routes. The calculation approach was corrected to ensure that the total of inter-exchange and inter-switch routes adds up to **[RI:]** only.

The split between inter-exchange and inter-switch has been determined using the revised data from the other correction described above. We note that there is a slight difference between the total distance from the S98 data **[RI:]** and the NetMap analysis **[RI:]**. To confirm, we have

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11   Cable distance is calculated from route data in S98 Q6.10.1 (provided in three files Q 6.10.1 Services and Bearers 13-5-14 (final).csv, Q 6.10.1 Sheath sections with bearer.csv and Q 6.10.1 sheath_display_route.zip).

12   Route assets allocated to the services in the core network are calculated from NetMap actual asset counts.

used the total distance (and therefore assets) from the NetMap analysis, but used the split between inter-exchange and inter-switch from the S98 analysis.

The resulting numbers are:

Feeder cables	**[RI:]**	**[RI:]**	
Feeder trenches	**[RI:]**	**[RI:]**	
Core cables	**[RI:]**	**[RI:]**	
Core trenches	**[RI:]**	**[RI:]**	

Figure 3.2: Original and corrected lengths for cable and trenches in the core network

[Source: TERA and Analysys Mason, 2015]

The net impact on the EUBA 0 cost per month per subscriber is a decrease of **[CI:]** on the starting EUBA 0 cost of **[CI:]**.

3.6 Could you explain why the results vary significantly from one year to another when changing the parameter "Model results year" (see results in the following table)?

Year	EUBA0
2014	**[CI:]**
2015	**[CI:]**
2016	**[CI:]**
2017	**[CI:]**
2018	**[CI:]**
2019	**[CI:]**

Figure 3.3: Reproduction of 'Table 2 - EUBA 0 costs per year' [Source: TERA, 2015]

The calculations are correct when the model results year is set to 2014. However, when the model results year is changed to later years, there is an error in the spreadsheet. We have identified and corrected this error, which we explain below.

The model results year directly affects the additional (demand related) tilt applied when calculating total annuity costs[13]. This additional tilt is a measure of the change of demand over the asset's lifetime. However, for certain assets with long lifetimes (e.g. trenches, ducts and manholes), when the model year parameter was set to 2015 or higher, the period over which demand growth was being calculated fell outside the period modelled[14]. In fact the end data point became a zero, which creates a negative tilt of -100%. Correcting this error (see here[15]) results in the EUBA 0 costs shown in Figure 3.4 below.

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[13]   See Section 3 in sheet 'MTAD' starting with cell H2845.

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14   The end date is 2065.

15   See Section 5 in sheet 'NwEleOut' starting with cell I1778, where the end year which was previously boundless needs to be limited to a maximum of year 2064, which is the last year for economic cost recovery. To do this the formula needs to change from previously being a simple addition of model results year and lifetime (i.e. end year is the sum of model results year and the asset lifetime) to be a maximum of the last year for economic recovery (i.e. if the start year plus asset lifetime is greater or equal to asset recovery end year, then end year is the last year for

Year	EUBA0 original	EUBA0 corrected
2014	[CI:]	[CI:]
2015	[CI:]	[CI:]
2016	[CI:]	[CI:]
2017	[CI:]	[CI:]
2018	[CI:]	[CI:]
2019	[CI:]	[CI:]

Figure 3.4: EUBA 0 costs per year in original model and after correction

[Source: TERA and Analysys Mason, 2015]

We confirm that the correction proposed does not affect the cost results for model results year 2014.

It should be noted that the EUBA 0 cost per month per subscriber shown in Figure 3.2 above does not include the correction of the inter-exchange asset calculations discussed previously in point 3.5.

3.7 Several layers of the core network seem to be modelled. Could you explain why the UBA services, that stops at the First Data Switch, has the same routing factors for inter-exchanges links than other services such as bitstream or HSNS services?

The scope of the UBA service in our core model is as follows:

- From the DSLAM to the first exchange, although the DSLAM might be located in the exchange, and
- From the first exchange to the first data switch (FDS) although the first data switch might also be in the first exchange.

We refer to the link between the first exchange and the first data switch as the "inter-exchange" link. We refer to the link between the first data switch and other switch locations as the "inter-switch" link. In our models, we model a fibre-only network for the inter-exchange links and exclude assets for inter-switch links from the cost analysis.

We have found that the definition of inter-exchange links in our access and core models agrees with the definition in the TERA models. Specifically, TERA state in their model documentation that inter-exchange links, referred to as "Core Exchange" links are at the '*Core network level, from the Exchange (ODF, MDF) to the first data switch (FDS)*'[16], which is in line with our definition.

In our core network, the UBA service ends at the first data switch by definition. However, other services (e.g. bitstream and HSNS services) also use the inter-exchange links in addition to UBA. As such, costs associated with inter-exchange links are attributed across all services that make use

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economic recovery; otherwise, as before, end year is the sum of model results year and the asset lifetime). Changes were made to the UBA model, sheet 'NwEleOut' section 5 cells I1778 to I2177. For example, in cell I1778, the formula used to be '=G1778+H1778' and now has now been corrected to '=IF((G1778+H1778)>=H559,H559-1,G1778+H1778)'. The corrected formula is then copied down the column up to and including cell I2177.

[16]   TSLRIC price review determination for the Unbundled Copper Local Loop and Unbundled Bitstream Access

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services, Model documentation, November 2014, Ref: 2014-20-DB-ML – BU models, page 135.

of the inter-exchange links. Therefore, services relying on the inter-exchange links have the same routing factors for inter-exchange links as the UBA services.

3.8 Could the calculation of the forecasts of the different copper services be explained and detailed? Is there a relationship of migration among the different services?

The calculation of demand levels for different copper services has been included in the UBA model documentation[17]. The demand forecasts include the following elements:

- Chorus' forecasts are used in a top-down approach in order to determine the penetration rate for four service types for voice and data for residential and business subscribers
- Forecasts of market share for these four service types take into account the competition provided by the coverage of non-Chorus networks, such as the HFC network, the non-Chorus LFC networks and mobile networks
- Further allocation of active lines from these four service groups into product groups and individual products also takes into account data from Chorus' internal forecasts
- The demand forecast accounts for migration of active lines across product groups and products during two stages of mapping of active lines:
  — When mapping active lines from service types to product groups, for example, some active lines in product groups are migrated across unbundling and bitstream services, and
  — When mapping active lines from product groups to individual products, for example, some active lines in a single product group are migrated across different broadband products.

3.9 Could you explain how the model determines the price profile for the real cost over five years?

Our core (UBA) model is a multi-year model. However the service costs are calculated for each year in isolation (based on the size of the network required in the selected year) using a modified tilted annuity depreciation (MTAD) calculation. Figure 3.5 shows the approach we follow in order to calculate the total economic cost by asset using MTAD.

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17   See Section 2.2.1 in Report for Chorus to provide to the Commerce Commission - Model user guide for UBA model 28 November 2014, Ref: 38598-482.

Figure 3.5: Calculation of total economic cost by asset in the Analysys Mason core (UBA) model using modified tilted annuity depreciation (MTAD) [Source: Analysys Mason, 2015]
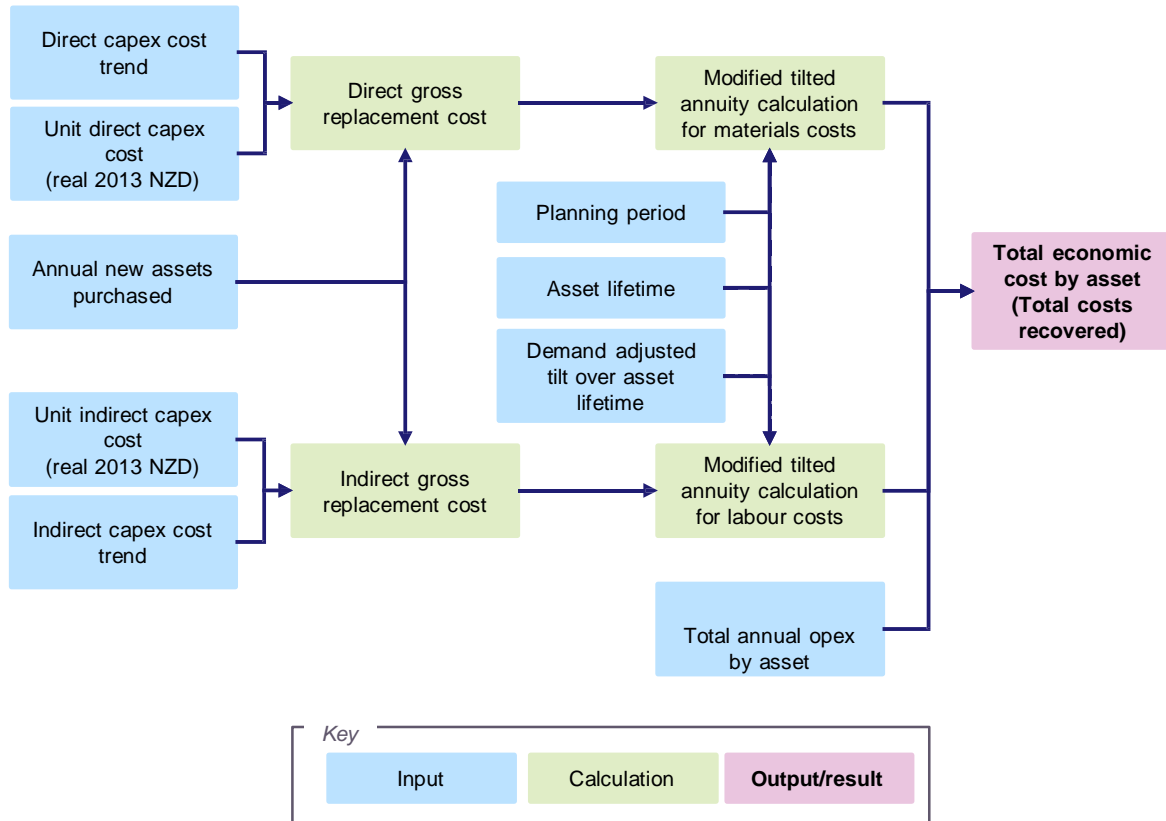
An annuity cost is calculated separately for direct (material) costs and indirect (labour) costs based on each year's gross replacement costs (GRC) and using the formula in Figure 3.6. MTAD considers the gross replacement costs and applies tilts for cost trends and demand in order to represent the annuity charge required to recover the costs given the changing level of demand[18].

Figure 3.6: Formula for calculation on annual annuity cost for capital expenditure using modified tilted annuity depreciation [Source: Analysys Mason, 2015]

$$\text{Annual annuity cost} = \text{Gross Replacement Cost} \times (1 + \text{WACC})^{\frac{Planning\ period\ -\ 6}{12}}$$

$$\times \frac{\text{WACC} - (\text{Capex cost trend} + \text{additional tilt})}{1 - (((1 + (\text{Capex cost trend} + \text{additional tilt}))/(1 + WACC))^{asset\ lifetime})}$$

The total economic cost is calculated by adding opex to the annuity calculations for direct and indirect capex. Opex is calculated based on total required assets in the network in the selected year and no adjustment is included for planning periods.

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[18]   Note the tilt for cost trends is linked to the capex costs trends and tilt for demand is linked to the CAGR of technical services allocated to assets over the asset lifetime.

Total economic costs are divided into common costs and incremental costs. Incremental costs are then allocated by routing factors and network demand volumes to obtain TSLRIC per service unit (excluding common costs). An equi-proportional mark-up is applied to the TSLRIC per service unit to account for common costs.

3.10 Could the calculation of the length of core cables and the length of core trenches be explained?

This discussion supports the answer given to point 3.5 above. When the Commission refers to 'core trenches' and 'core cables', we interpret this to be trenches and cables in inter-exchange links in the core model. Calculation of inter-exchange assets are shown in Section 5 of the 'LinkedIn' sheet of our UBA model[19], and a discussion of the calculation approach is provided in the model documentation[20].

Calculation of inter-exchange assets distinguishes between calculation of fibre cables and cable joints, and calculation of trenches, ducts and manholes. Below, we discuss the approach taken in calculating each asset group in turn. Finally, an adjustment is made to the total inter-exchange assets in order to account for sharing.

3.10.1   Fibre cables

The inter-exchange cable is dedicated to inter-exchange links; we assume that inter-exchange cable is not shared with the access network.

We calculate the total distance of non-overlapping cable sheaths in the core network. We then divide the distance between inter-exchange and inter-switch links based on data from S98[11] (also discussed in detail in the model documentation)[20]. The inter-exchange cable assets assume deployment of a fibre-only network of length equal to the inter-exchange distance calculated (i.e. excluding inter-switch links).

The number of fibre joints is calculated, taking into account the actual proportion of buried and ploughed cable routes.

3.10.2   Trench duct and manholes

Calculation of inter-exchange trenches, ducts and manholes accounts for assets deployed in the core network and the share of the assets between services in the core and access networks is as follows:

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[19]   Calculation of inter-exchange assets is subject to the small changes discussed in point 3.5 as a result of correction to the way data from S98 and NetMap should be interpreted.

[20]   See Section 3.2.3 in Report for Chorus to provide to the Commerce Commission - Model user guide for UBA model 28 November 2014, Ref: 38598-482.

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- The total route *distance* in the core network is provided by NetMap. The share of route attributable to inter-exchange versus inter-switch route is determined using the same ratio as inter-exchange to inter-switch cable distance, as described above. The inter-exchange route distance is allocated to route types based on data on route types in that part of the network (e.g. rural vs. urban, proportion of aerial route, etc.).

- The total route *assets* allocated to the core network are calculated in the access (UCLL) model, before being linked to the core (UBA) model. The proportion of these assets attributable to inter-exchange links only (i.e. excluding inter-switch links) is calculated by using the same ratio as inter-exchange to inter-switch cable distances from above[19].

3.10.3 Adjustment for sharing

Finally, the total inter-exchange route assets are adjusted for sharing. Total inter-exchange assets are multiplied by a factor of 97.5%, which means that 5% of the inter-exchange assets are shared with other utilities[21].

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[21]   The access (UCLL) model also assumes 5% sharing.

4 Opex

4.1 Could the calculation of the OPEX in the Core model be explained?

The Chorus UBA Model user guide describes in section 3.2.4 which Operating costs inputs are used in the UBA model.

"The model has the following key opex inputs:

- Direct opex inputs (in 2013 terms), *AssetIn* sheet, column AV
  — Route assets have a direct input cost per metre per annum representing the annual cost of non-exchange rent, rates and similar costs
  — Chorus annual business overhead relevant to UBA and relevant to other services (in 2013) are input in this column. All such costs are allocated to all services in the model on the basis of an equi-proportional markup (EPMU) (ie both apply to all services, despite their notional labels as "UBA" and "other").
  — Product and customer IT relevant to copper services relevant to UBA and relevant to other services (in 2013) are input in this column. This is allocated to services in the model on the basis of an EPMU
  — UBA customer services costs per line per annum is input in this column
  — Non-UBA customer services costs per line per annum is input in this column
  — UBA marketing and sales costs per line per annum is input in this column
  — Non-UBA marketing and sales costs per line per annum is input in this column
  — UBA Network operations cost per line per annum is input in this column
  — Non-UBA Network operations cost per line per annum is input in this column
- Accommodation cost in terms of floorspace is inserted in column BB. The cost, expressed in NZD per sqm per year, accounts for common space and the level of utilisation.
- Power consumption costs are input in columns BF:BJ. This includes the annual consumption and the cost of electricity.
  — The cost of electricity is based on Chorus actual 2013 consumption and expenditure. The cost per kWh accounts for the cost of accommodating power plant. We apply an uplift of 23% (based on 1/(90%*90%)) to account for a 10% reduction in the usable energy supplied due to DC power plant losses and the reduction in usable energy due to other site operational requirements such as lighting, cable losses etc.
  — Total electricity consumption is based on bottom-up estimates
  — We assume that assets that consume electricity require cooling. We apply a 40% uplift to electricity consumption requirements to account for the power required for cooling.
- Regulatory levies are represented as an asset in the model with a direct opex charge. This is based on the amount of levy charged to chorus in FY2013 and is recovered as an equi-proportional mark-up (EPMU) across all services

Whilst not an opex cost, the IT capex costs are also calculated in the opex model as the source data is common."

The Chorus UBA Model user guide describes in section 3.2.5 how the above Operating costs inputs are used in the UBA model:

"opex in each year is then calculated (number of active assets in each year and unit operating expenditures by asset calculated in a bottom-up way in the *UnitOpex* sheet)."

4.2 Why is maintenance 'non UBA' category included?

The cost is included due to the inclusion in the UBA model of non-UBA services that share some assets with UBA services. The 'Network operations - non UBA' opex cost is directly allocated to non-UBA services as seen from the routing factors table in sheet 'RF'. It has an indirect influence on UBA costs as the 'Network operations - non UBA' cost contribute to the incremental costs on which the EPMU mark-up is applied.

In the Chorus UBA model, asset 384 'Network operations - non UBA' is calculated in the sheet 'AssetIn' based on the total amount of 'Network operations - non UBA' opex divided by the number of non-UBA lines (i.e. 'HSNS lite over copper', 'HSNS lite over fibre', 'HSNS premium' and 'Bandwidth fibre access service').

The value of the total amount of 'Network operations - non UBA' opex has been calculated by Analysys Mason based on Chorus regulatory accounts as explained in sections 4.3, 4.5 and 4.6 of this document. Essentially 'Network operations - non UBA' correspond to the share of network operations costs allocated to non-UBA services.

4.3 What is the source for costs inputs for the costs per line costs and the total figures that are hardcoded?

The Chorus UBA Model user guide describes in section 3.2.4 how the Operating costs (opex) cost inputs have been calculated:

"The opex analysis combines top-down and bottom-up data.

The operating costs of Chorus can conceptually be separated into four main categories:

- *Network opex* which is the costs of operating the network e.g. the non-capitalised cost of cost centres such as Field Services or Network Engineering and can be further divided into
  - Network labour costs
  - Customer services costs (including network provisioning)
  - Network maintenance
  - Network IT
  - Network accommodation

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- • Network electricity
- • Network other
- *Marketing and sales opex* which is the costs associated with the management of Chorus wholesale products e.g. the non-capitalised cost of cost centres such as Market and Product Development or Product Management and Capability
- *Business support opex* which is the costs associated with business overhead and non-network common costs e.g. the non-capitalised cost of cost centres such as Corporate Property or Human Resources[22]
- *Regulatory levies* which are the costs associated with payments to the Government for the TDL and Commerce Commission fees[22].

We used information from several sources[23] to calculate the total annual opex for each of the above opex categories. Those total opex by categories are then allocated to each service type (e.g. copper, UBA etc.)"

This explains that the main source of operating costs is the Chorus general ledger.

4.4 Have any efficiency adjustments been made in the opex calculation? Which costs have not been included in Chorus model? Is there any cost that has been considered as not relevant to the costing of the regulated products?

No efficiency adjustments have been made in the opex calculation.

Costs not relevant to the costing of the regulated products have been excluded at the allocation stage (as explained in section 4.6 of this document). So, for example, costs recovered from third parties have been excluded, costs directly attributable to other services such as UFB have been excluded, and costs recovered from transactions have been excluded from the calculation of the monthly recurring cost.

4.5 The link between the inputs used to derive opex in Chorus model and the regulatory accounts of Chorus is not straightforward. How are these inputs related to the regulatory accounts? Could you explain the steps used to derive the inputs of Chorus model from the regulatory accounts?

The process used is described below

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[22]   This is represented as a UBA component and non-UBA component in terms of assets. As both are allocated to services through an equi-proportional mark-up both the UBA and non-UBA component have an impact on the calculated cost of UBA.

[23]   Primarily the Chorus General Ledger

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Step 1: Mapping all GL codes to one of 59 expense categories:

[RI:

]

Step 2: Defining a list of allocation drivers:

That step is described in section 4.6 below

Step 3: Assigning a customised allocation driver to each of the 59 expense categories:

That step is described in section 4.6 below

Step 4: Calculating the Inputs of Chorus model:

The inputs of the Chorus model are calculated as the sum of the share of the different expense categories allocated in Step 3 to UCLL, UBA and other services.

More precisely:

- **[RI:**

]

4.6 From the accounts, how have costs been allocated between UCLL, UBA, other services? (e.g. IT costs, business overheads…). Could the metrics used for the allocation of these costs be provided?

A list of allocation drivers have been created and are shown below:

[CI: *Figure 4.1: List of allocation drivers [Source: Analysys Mason, 2015]*]

Allocation driver	Copper	UBA	Other in UBA model	Other services	Fibre	Billable Provisioning	Billable third party	Overhead	RBI	square meters	kwh

Each of the 59 expense categories (except IT and Corporate expense categories) is assigned to an allocation driver selected from the ones listed in Figure 4.1, as shown below.

[CI: *Figure 4.2: Mapping between expense categories and allocation drivers [Source: Analysys Mason, 2015]*

IT costs are allocated in a different way

IT costs are split between 'Product & Customer IT', 'Business Support IT' and 'Network IT' based on an analysis of the IT systems and their use provided by Chorus.

For 'Network IT', a group of miscellaneous systems supporting different types of services including legacy services, the approach taken here is to select the systems that are relevant for UBA and include them in the Opex costs of UBA assets. There are no 'network IT' systems specific to UCLL.

'Business Support IT' are included in the 'business support' mark-up described in the following section.

'Customers IT' are treated as a separate IT mark-up - the split between UCLL, UBA and other services is made based on revenue[24] so that the mark-up is allocated in a equi-proportional way to all services.

Please note that a share of that mark-up is allocated to non-regulated services and to transactional costs.

A similar approach is applied for IT capex.

Corporate costs are allocated in a different way

All other corporate costs (including Regulatory levies, direct costs by the legal, HR, Board and Executive and CFO teams, indirect costs for usage of the property infrastructure for corporate purposes, the costs of Business Support IT and the annualised cost of the business support assets) are treated as a separate business support mark-up - the split between UCLL, UBA and other services is made based on revenue[25] so that the mark-up is allocated in a equi-proportional way to all services.

Please note that a share of that mark-up is allocated to non-regulated services and to transactional costs.

4.7 Why have the working capital allowance costs been included and what is the source of these costs?

Including working capital allowance costs is a common practice in the regulatory models built by Analysys Mason. It aims to recognize the fact that the modelled operator requires a working capital to be able to operate.

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[24]   Note: total revenue by service group (UCLL, UBA, other in UBA, etc) is used as a proxy for total costs by service group because the combined UCLL and UBA models do not model all Chorus services which means we do not have costs for all services. Within the UCLL and UBA models, EPMU is used to allocate IT opex, IT capex and business support to the different services modelled in each of those models.

[25]   Note: total revenue by service group (UCLL, UBA, other in UBA, etc) is used as a proxy for total costs by service group because the combined UCLL and UBA models do not model all Chorus services which means we do not have costs for all services. Within the UCLL and UBA models, EPMU is used to allocate IT opex, IT capex and business support to the different services modelled in each of those models.

The value used corresponds to a **[RI:]** worth of operating costs as working capital **[RI:
                        ]**. This means that the modelled operator needs **[RI:]** of its annual opex
in working capital.

The working capital is necessary to operate and should therefore form part of the capital base on
which a return is earned (i.e. via the WACC). This return on capital is treated as an operating cost.

4.8   What is the source of price trends?

Different parts of the opex calculations use different price trends:

- Direct opex inputs (i.e. the cost inputs calculated as explained in sections 4.3, 4.5 and 4.6 of this
  document) use a 0% real cost trend as the default cost trend

- Accommodation opex costs (i.e. floorspace) use a 1% real cost trend as an Analysys Mason
  assumption for the cost trends of real estate in New Zealand

- Power and air conditioning opex costs (i.e. kWh) use a 1% real cost trend as an Analysys Mason
  assumption for the cost trends of power in New Zealand