TSLRIC price review determination for the Unbundled Copper Local Loop and Unbundled Bitstream Access services

Analysis of Chorus cost model

Commerce Commission

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Summary

0 Executive summary

In December 2014, Chorus published its own bottom-up cost model in the context of the Commerce Commission FPP draft determination. The Commerce Commission (the Commission) has asked TERA Consultants to review this model. While reviewing the model, in January TERA Consultants asked several questions to Chorus in order to clarify different modelling aspects. These questions have all been answered by Chorus and its consultants and have showed that the model was containing at least 4 errors. These errors have been corrected by Chorus, however the updated model has not been shared with the Commission.

0.1 Similar approach to model OPEX and the core network but different approach for the access network

The review of the model developed by Chorus shows that the approach followed by Chorus for modelling OPEX and the core network is quite similar to the one followed by the Commission:

- OPEX modelled by Chorus are based on Chorus accounts. It is thus a top-down approach. However, Chorus does not apply any efficiency adjustment; and
- The core network cost model is a bottom-up model which targets to handle the demand on each node. A difference between both approaches is that Chorus uses a geotyping approach whereas the Commission models each node and is therefore more precise.

The approach to model the access network is however quite different between Chorus and the Commission. The starting point of Chorus approach is the inventory of their network, i.e. the network asset count deployed since the first day the network has been rolled-out until today. Chorus then applies several adjustments:

- the inventory is twisted in order to increase the share of aerial deployment to 20%; and
- the inventory is lightened to reflect some optimization.

The approach followed by the Commission is based on a bottom-up approach constrained by the modified scorched node principles. The starting points are therefore:

- the existing nodes and their coverage areas; and
- the location of all the dwellings.

The Commission then dimensions section by section the network inventory.

0.2 Despite a similar methodology being followed, OPEX results are different between both models

The OPEX derived by the Commission are lower than the OPEX derived by Chorus:

- [ ]**CNZCI** lower for UCLL; and
- [ ]**CNZCI** lower for UBA.

One of the main reasons which explains this difference is that Chorus does not apply any efficiency adjustment on the OPEX whereas the Commission applies two types of adjustment:

- the number of faults has been adjusted to reflect that the Commission is modelling a new network. Thus the part of the OPEX that are sensitive to the number of network faults have been decreased;
- the OPEX of the fibre access network has been decreased to reflect the cost savings generated by a fibre access network as compared to a copper access network.

It is not possible to further analyse the difference between the results and especially to reconcile the results of both models as Chorus did not provide its calculations at the time this report was written.

0.3 Consistent access network inventories however a higher cost of UCLL

The inventories derived by Chorus and the Commission are quite different. However these differences are well understood:

- the Commission has excluded the non-TSO areas whereas Chorus has included them. This scope difference leads Chorus to overestimate (as compared with the Commission) the network inventory;
- Chorus has not modelled precisely the different assets that composed the lead-ins which leads to underestimate the network inventory (less trenches, ducts and cables modelled).

Once the Commission model is modified to take into account these differences, the inventories of both models are overall consistent.

Chorus derives a network annuity that is 274% higher. Besides the scope difference between both models described above, the two reasons that explain this difference are:

- Chorus network asset unit costs are more expensive; and
- Chorus depreciation factors are higher due to a higher WACC, shorter asset lives and lower price trends.

0.4 Comparable core network inventories however a higher cost of UBA

The inventories derived by Chorus and the Commission are consistent for UBA. The main difference is the number of DSLAMs located in cabinets as the Commission has removed from the inventory the 900 DSLAMs that have been funded by the RBI program and Chorus did not take this funding into account.

Chorus however derives a cost of UBA 51% higher than the Commission. This difference is due to the fact that:

- Chorus includes in the cost of UBA the feeder between active cabinets and their parent exchanges whereas the Commission includes it in the UCLL;
- Chorus includes also some marketing costs that have been excluded from the Commission model; and
- Chorus uses a higher WACC and more expensive assets.

1 Introduction

1.1 Background

In December 2014, Chorus published its own bottom-up cost model in the context of the Commerce Commission FPP draft determination. The Commerce Commission (the Commission) has asked TERA Consultants to review this model. TERA Consultants has thus reviewed the following files:

- "Chorus UBA TSLRIC model 1 December 2014 ADDITIONAL PROTECTION.xlsx" which contains the core network cost model and derives the cost of the UBA service; and
- "Chorus UCLL TSLRIC model 1 December 2014 ADDITIONAL PROTECTION.xlsb" which contains the access network cost model and derives the cost of the different access services especially the cost of the UCLL service.

TERA Consultants has focused the review of the model on assessing whether the inputs (unit costs, asset lives, price trends, engineering rules, etc.) and the outputs (network inventory, total investment, annuity, yearly cost, etc.) are consistent with the figures in the model developed by the Commission. TERA Consultants has not assessed whether the methodological principles used by Chorus are in line with the decisions that have been made by the Commission. However, as these decisions impact the outputs of the Commission model, TERA Consultants has tried to assess these effects.

In order to fully understand the models developed by Chorus, TERA Consultants has sent a list of questions on January 16, 2015. These questions have been answered by Chorus on January 30, 2015. These questions have all been answered by Chorus and its consultants and have showed that the model was containing at least 4 errors. These errors have been corrected by Chorus, however the updated model has not been shared with the Commission.

1.2 Structure of this document

This document analyses the model developed by Chorus and then compares its key figures with the outputs of the model developed by the Commission. This document has the following structure:

- **Section 2** – Review of OPEX calculations from Chorus;
- **Section 3** – Review of Chorus UCLL model; and
- **Section 4** – Review of Chorus UBA model.

2 Review of OPEX calculations from Chorus

This section details the key figures of Chorus OPEX calculations that can be compared to the Commission OPEX model. The main topics addressed are the following:

- Results overview;
- Chorus OPEX inputs;
- Chorus modelling principles;
- Recommendations.

2.1 Results overview

The OPEX calculations provided by Chorus are derived from a number of hardcoded cost inputs. The data processing from Chorus General Ledger to the OPEX sections inputs has been performed offline and has not been provided.

As a consequence, the scope of cost categories within Chorus OPEX section is not 100% understood and outputs comparisons are only manageable at an aggregated level (the cost category per cost category analysis is not relevant as scope differences are likely).

For year 2014, the Commission OPEX model outputs are lower than Chorus section outputs for both UCLL and UBA:

- UCLL: [ ]**CNZCI**(129mNZD vs. [ ]**CNZCI**);
- UBA: [ ]**CNZCI** (76mNZD vs. [ ]**CNZCI**).

Figure 1 - Comparison of Chorus and The Commission OPEX calculations outputs for 2014

[**]**

CNZCI

Source: TERA Consultants

On the UCLL side, this difference is fully explained by the efficiency adjustment (based on the LFI) that makes UCLL OPEX decrease by [ ]**CNZCI** as there are no efficiency adjustments in Chorus model.

On the UBA side, the difference could come from a number of assumptions:

- The scope of costs considered;
- The allocation between UCLL / UBA / other services;
- Chorus has used 2013 accounts whereas the Commission has used 2014 accounts as a starting point.

In the absence of detailed calculations, it is not possible to further investigate this gap.

2.2 Chorus OPEX inputs

Chorus and its consultants explain that the Chorus general ledger has been used as the starting point for OPEX calculations.

The calculations on the raw general ledger data has been performed offline. As a consequence, only the metrics and hardcoded cost inputs used can be analysed. Key findings are summarised in the 2 tables hereafter:

Table 1 – Details on UCLL OPEX calculations performed by Chorus (2014 figures)

Opex cost category	NZD (2014)	%	Comments on the approach
Route	[ ] CNZCI	[ ]CNZCI	
Building	[ ] CNZCI	[ ] CNZCI	[ ]CNZCI sqm x [ ]CNZCI NZD per sqm per year (scope is not 100% clear) 8% allowance for working capital
Line testing	[ ] CNZCI	[ ] CNZCI	
Access cable pressurisation	[ ] CNZCI	[ ] CNZCI	
Wireless	[ ] CNZCI	[ ] CNZCI	- [ ]**CNZCI** NZD "Wireless direct feed link" = [ ]**CNZCI** links x [ ]**CNZCI** NZD per link per year - [ ]**CNZCI** mNZD "Wireless feeder link model 5 - up to [ ]**CNZCI** mbps = [ ]**lCNZCI** inks x [ ]**CNZCI** NZD per link per year 8% allowance for working capital
Fibre feeder	[ ] CNZCI	[ ] CNZCI	
Maintenance costs	[ ] CNZCI	[ ] CNZCI	- [ ]**CNZCI** mNZD "SLU network operations per line" = [ ]CNZCI SLU lines x [ ]**CNZCI** NZ$ per line per year - [ ]**CNZCI** mNZD "UCLL network operations per line" = [ ]**CNZCI** UCLL lines x [ ]**CNZCI** NZ$ per line per year 8% allowance for working capital
Wholesale costs	[ ] CNZCI	[ ] CNZCI	[ ]**CNZCI** lines (ie [ ]**CNZCI** SLU lines + [ ]**CNZCI** UCLL lines) x UCLL market sales [ ]**CNZCI** NZ$ per line per year 8% allowance for working capital No source for the value [ ]**CNZCI** has been provided.
Provisioning costs	[ ] CNZCI	[ ] CNZCI	[ ]**CNZCI** lines (ie [ ]**CNZCI** SLU lines + [ ]**CNZCI** UCLL lines) x UCLL customer services [ ]**CNZCI** NZ$ per line per year 8% allowance for working capital
Product and customer IT	[ ] CNZCI	[ ] CNZCI	Hardcoded fixed cost + 8% allowance for working capital
Business overhead	[ ] CNZCI	[ ] CNZCI	Hardcoded fixed cost + 8% allowance for working capital
Regulatory levies	[ ] CNZCI	[ ] CNZCI	Hardcoded fixed cost + 8% allowance for working capital
TOTAL	**[ ]** CNZCI	**[ ]** CNZCI	

Source: TERA Consultants analysis of Chorus model

Table 2 - Details on UBA OPEX calculations performed by Chorus (2014 figures)

Opex cost category	NZD (2014)	%	Comments on the approach
ISAM cards and chassis	[ ] CNZCI	[ ] CNZCI	asset count x Opex per asset
Aggregation switch cards and chassis	[ ] CNZCI	[ ] CNZCI	
OFDF	[ ] CNZCI	[ ] CNZCI	
Other network costs	[ ] CNZCI	[ ] CNZCI	Product & customer IT + Element management system (EMS) + service management system (SMS) --> All hardcoded in "Assetin"
Feeder passive assets	[ ] CNZCI	[ ] CNZCI	
Provisioning	[ ] CNZCI	[ ] CNZCI	
Maintenance	[ ] CNZCI	[ ] CNZCI	[ ]**CNZCI** UBA lines x [ ]**CNZCI** $ network operations UBA [ ]**CNZCI** non UBA lines x [ ]**CNZCI** $ network operations non UBA
Wholesale and commercial	[ ] CNZCI	[ ] CNZCI	
Regulatory levies	[ ] CNZCI	[ ] CNZCI	Hardcoded in "Assetin"
Business overhead	[ ] CNZCI	[ ] CNZCI	Hardcoded in "Assetin"
TOTAL	**[ ] CNZCI**	**[ ] CNZCI**	

Source: TERA Consultants analysis of Chorus model

As detailed in the two tables above, an 8% working capital allowance assumption has been set in the Chorus model. The reasoning behind this assumption has been detailed by its consultants in its answer to TERA Consultants questions:

> *"It aims to recognize the fact that the modelled operator requires a working capital to be able to operate.*
>
> *The value used corresponds to [ ]**CNZCI** worth of operating costs as working capital [ ]**CNZCI**. This means that the modelled operator needs [ ]**CNZCI** 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."*[1]

In the Commission model, no working capital allowance has been modelled has telecommunications operators generally do not have to pay their supplier upfront but rather several weeks after the work has been done (e.g. service companies performing repair activities).

2.3 Chorus modelling principles

Although no detailed calculations have been provided, the principles within the Chorus model have been presented.

These are close to the ones the Commission has tried to implement in its OPEX model.

Chorus model follows a 4-step approach starting from Chorus General Ledger:

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

All the cost codes within the general ledger are mapped to one of the 59 expense categories hereafter:

[1] AM Response to TERA's Questions 30 January 2015.pdf

Figure 2 - 59 expense categories within the Chorus model

Area	Cost categories
Sales & Marketing (4)	[ ]CNZCI
Customer Services (9)	[ ]CNZCI
Network Operations (39)	[ ]CNZCI
IT opex (4)	[ ]CNZCI
Corporate (3)	[ ]CNZCI

Source: AM Response to TERA's Questions 30 January 2015.pdf

It is to be noted that the OPEX inputs data provided during the data collection process was not structured following these 59 categories.

2.3.2 Step 2: Defining a list of allocation drivers

A set of allocation drivers has then been defined:

Figure 3 – List of cost drivers within the Chorus model

[ ]**CNZCI**

Source: AM Response to TERA's Questions 30 January 2015.pdf

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

For each of the 59 expense categories (except IT and Corporate expense categories), the most relevant cost driver is identified.

This aims at allocating the OPEX to UCLL, UBA and other services.

Figure 4 – List of cost drivers within the Chorus model

[ ]**CNZCI**

Source: AM Response to TERA's Questions 30 January 2015.pdf

IT costs and corporate 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 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.*

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 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."[2]

It is to be noted that the approach implemented in Chorus model for IT costs and corporate costs is in line with the one the Commission and TERA Consultants have intended to implement in their model despite limited guidance from Chorus.

2.3.4 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.

[2] AM Response to TERA's Questions 30 January 2015.pdf

3 Review of Chorus UCLL model

3.1 Scope and technology used

3.1.1 Technology

The network modelled by Chorus is a copper network. It also includes fibre cables between active cabinets and their parent exchange ("fibre feeder" in Chorus model, "SLU backhaul" in the Commission model). The prices derived by the model are based on this copper network.

In the Commission model, the price of the different regulated prices is based either on a copper network or on a mix between fibre and fixed wireless access (FWA). The Commission models therefore two access networks: a copper network and a fibre and FWA network. The prices are derived based on the least expensive network which is the draft model published by the Commission the fibre and FWA network.

As Chorus has modelled solely a copper network, all the comparisons that are described in this document are based on the copper network modelled by the Commission and not the fibre and FWA network although the latter network is the one used to derive the prices.

3.1.2 Coverage and scope

In Chorus model, the coverage is restrained to actual existing premises covered by copper. This, in particular, means that customers covered by FWA are excluded.

In the Commission model, the coverage of the modelled network includes all the dwellings. In particular, it includes dwellings covered by FWA. There is however an option allowing to restrain the network coverage to TSO areas. In the draft determination, the prices are based on a network restrained to the TSO areas.

The Commission states in its model reference paper that *"Chorus would not have extended its network outside the TSO-area unless it received capital contributions when doing so.*[3]*"*

In the Commission model, narrowing the nationwide network only to TSO-areas leads to a 25% decrease in annuity and investment, decreasing annuity from 610mNZD to 460mNZD.

In the Chorus model, it would lead to a 365mNZD drop in annuity.

Unless explicitly specified, the figures quoted in the following sections are based on the network coverage restrained to the TSO areas.

[3] MRP, criterion 17.

3.1.3 Services

The Commission provides as an output an aggregate price for the full local loop (subloop and backhaul): the UCLL.

Chorus distinguishes three services according to the technology used (active or passive cabinet, direct distribution from MDF):

- SLU: sub-loop unbundling: copper from active cabinet to premise;
- NC-UCLL: non-cabinetized UCLL: copper from MDF to premise through passive cabinet (feeder + distribution), including direct distribution from MDF; and
- UCLFS: unbundled copper low frequency service.

The three services modelled by Chorus are comparable to the single UCLL service priced by the Commission.

3.1.4 Lead-in

3.1.4.1 Scope of lead-in

External termination points (ETP) and building distribution frames (BDF) are included in Chorus model although the Commission definition of UCLL states the service stops just before the ETP.

The Commission includes neither ETP nor BDF in its model.

3.1.4.2 Modelling of lead-in assets

Apart from ETP, BDF and distribution points (DP), Chorus does not model lead-in passive assets and uses instead a fixed price for each lead-in. There are two "lead-in" assets included in Chorus model:

- the first represents the costs of new lead-in installation; and
- the second represents the costs of incremental lead-in installation.

Both "assets" include the costs of supply and installation of passive assets, excluding ETP, BDF and DP.

However, Chorus answer to the Commission question regarding lead-in (§2.1) is not consistent with Chorus model. Indeed, in Chorus model, the unit cost of ETP is null, as it is "*assumed to be included in lead-in*[4]", whereas Chorus states in its answer to the Commission questions:

"The ETP, DP and building frames themselves (at MDUs) are not included in the lead-in asset and are modelled separately[5]*."*

---

[4] Sheet "AssetIn", cell R74

[5] Chorus answers to the Commission questions, §2.1, page 3

The Commission models distribution points as well as passive lead-in assets, in a bottom up manner.

Aggregate costs of lead-in are compared in the section 3.5.3 infra.

3.2 Comparison of high level results

Chorus calculates the price of three services, while the Commission calculates the price of one single UCLL service.

The prices assessed by Chorus are 2.5 times as high as the price assessed by the Commission.

Table 3 – Comparison of UCLL prices

Unit price (NZ$/month)	**Chorus**	**The Commission – Based on fibre and FWA**	**The Commission – Based on copper**
NC-UCLL	74.10	28.22	30.19
SLU	81.43		
UCLFS	84.87		

Source: TERA Consultants

The spread between the price derived by the Commission and the price derived by Chorus stems from 3 main drivers:

- the Commission models the network with a narrower scope than Chorus (i.e. excluding ex-TSO areas);
- the Commission uses lower depreciation rates than Chorus to derive annuity from investment (using different price trends and cost of capital); and
- the Commission uses lower unit costs than Chorus.

Other things being equal, the inventory of assets estimated through a bottom-up approach by the Commission is consistent with the top-down inventory used by Chorus as it will be detailed in §3.3.1.

3.3 Comparison of inventory

The starting point of Chorus model is Chorus own network inventory. Chorus uses its own network inventory on which it performs several adjustments:

- the share of aerial deployment has been increased to 20%;
- the network sharing has been set to approximately 2.5% of civil engineering infrastructures; and
- the length of routes is discounted to reflect route optimization.

The inventory derived by the Commission is based on a bottom-up approach which uses the location of all existing dwellings and the engineering rules provided by Chorus.

3.3.1 Comparison of inventories with retreated scopes

As Chorus has modelled solely a copper network, all the comparisons that are described in this document are based on the copper network modelled by the Commission and not the fibre and FWA network although the latter network is the one used to derive the prices.

However, the Commission and Chorus do not use the same regional scope. Plus, the Commission and Chorus can use divergent definitions for some assets, or different engineering rules.

In this subsection, the inventory modelled by the Commission has been retreated in order to reflect the assumptions made by Chorus and the asset split. This reprocessing allows a better comparison between the two models.

The following changes have been made to the Commission inventory:

- The network coverage includes non-TSO areas;
- the final drop assets (infrastructures and cables) are excluded;
- the ducts allocated to distribution are excluded, in order to reflect Chorus assumption to bury directly distribution cables;
- the share of aerial network has been set to 20%;
- the number of poles have been increased to reflect divergences in inter-poles average distance; and
- the sub-ducts are excluded from duct inventory.

Following those adjustments, the inventory modelled by the Commission is overall in line with Chorus inventory.

Table 4 - Comparison of access network inventories (with adjustments)

Asset	Unit	Inventory		Comparison
		Chorus	Commission (copper)	
Copper joints	#	[ ]CNZCI	227,481	[ ]CNZCI
Distribution points	#	[ ]CNZCI	411,421	[ ]CNZCI
Lead-in	#	[ ]CNZCI	1,911,066	[ ]CNZCI
Poles	#	[ ]CNZCI	453,458	[ ]CNZCI
Manholes	#	[ ]CNZCI	855,539	[ ]CNZCI
Trenches	km	[ ]CNZCI	60,885	[ ]CNZCI
Copper cables	km	[ ]CNZCI	95,079	[ ]CNZCI
UG	km	[ ]CNZCI	76,941	[ ]CNZCI
OH	km	[ ]CNZCI	18,138	[ ]CNZCI
Ducts	km	[ ]CNZCI	22,421	[ ]CNZCI
SLUBH fibre	km	[ ]CNZCI	52,898	[ ]CNZCI

Source: TERA Consultants

This comparison between both inventories shows that they are overall consistent (several categories have less than 10-15% difference) even if some differences are observed for some categories. These differences are described below.

3.3.1.1 Copper joints

In Chorus model, the average distance between joints is [ ]**CNZCI**, whereas in the Commission model the average distance between joints is 418 meters.

The Commission assumes joints can be replaced by existing distribution points for distribution cables. When considering distribution points as joints, the average distance between joints in the Commission model drops to 149 meters.

In the Commission model, the number of joints is determined by the length of cable drums as well as by engineering constraints such as installing joints at each intersection.

3.3.1.2 Distribution points

The number of distribution points modelled by the Commission is lower than the number of distribution points derived from NetMap.

3.3.1.3 Lead-in

In Chorus model, the number of lead-in installations is lower than in the Commission model.

The Commission assumes lead-ins are installed for all dwellings, as the optimised network is obliged to serve all locations.

Chorus applies an “optimization” factor to the number of lead-ins to be installed. In its answer to the Commission questions, Chorus concedes than lead-in must be installed to all locations:

"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[6]*."*

3.3.1.4 Poles

The number of poles modelled by the Commission is in line with the number of poles derived from NetMap.

The number of poles in Chorus model is obtained by the ratio of aerial routes over [ ]**CNZCI** meters[7].

It shall be noted than the number of poles presented in the above table has been adjusted to reflect the inter-poles distance assumed by Chorus.

In the Commission model, the average distance between poles is 61 meters[8], whereas Chorus assumes poles are separated from each other by [ ]**CNZCI** meters.

3.3.1.5 Manholes[9]

There are much lesser manholes in Chorus model. The average distance between manholes in Chorus model is about [ ] **CNZCI** km, i.e. [ ]**CNZCI** times higher than the nominal maximum distance between manholes provided by Chorus to the Commission in the data collection phase[10].

Plus, the number of joints is inconsistent with the number of manholes: there are many less joints than manholes, while underground joints must be located in manholes.

TERA Consultants believes that this part of the model developed by Chorus is erroneous.

3.3.1.6 Trenches

Trenches are shorter in the Commission model.

However, as allocation key differ from the Commission model to Chorus model, a greater share of trenches and ducts is allocated to the lead-ins in the Commission model than in Chorus model.

As total trenches (final drop + distribution + feeder + backhaul) are [ ]**CNZCI** km long, using similar allocation keys would lead to halve the length of trenches, in line with Chorus NetMap inventory.

3.3.1.7 Copper cables

The length of copper cables modelled by the Commission is in line with the length of cables derived from NetMap.

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[6] Chorus answers to the Commission questions, §2.5

[7] Chorus answers to the Commission questions, §2.3

[8] Assuming a nationwide scope and a 20% share of aerial network.

[9] Manholes means here any type of chambers (Manholes, handholes, pitholes, etc)

[10] Chorus data collection, item 6.14.1.e (iv)

In the

Table 4 - Comparison of access network inventories (with adjustments), the breakdown of Chorus cables into overhead and underground cables is obtained applying the share of aerial network onto total cables.

The length of feeder cables is in the same order of magnitude in both models ([ ]**CNZCI** km in the model developed by the Commission, [ ]**CNZCI** km in Chorus model).

3.3.1.8 Ducts

The length of ducts is shorter in the Commission model.

For the same reason aforementioned, a greater share of ducts is allocated to the lead-ins in the Commission model. Using similar allocation keys would lead to a duct length closer to the duct length derived from NetMap inventory.

Overall, there are much more ducts in the Commission model since distribution cables are directly ducted in the Commission model whereas they are directly buried in the ground in the modelled developed by Chorus.

3.3.1.9 Backhaul fibre

Fibre feeder (SLU backhaul in the Commission model) is shorter in the Chorus model in 2015.

However, in the long run, the length of backhaul in the Commission model is in line with NetMap assets.

Indeed, as Chorus models a progressive deployment of backhaul fibre, the backhaul is actually incomplete in 2015. In the long run, i.e. starting from 2019, the length of backhaul amounts to [ ]**CNZCI** km.

The length of backhaul modelled by the Commission ([ ]**CNZCI**) is then close to Chorus inventory.

Figure 5 – Feeder deployment in Chorus model

[ ]**CNZCI**

Source: Analysys Mason

3.3.1.10 Other assets

Chorus inventory includes assets (buildings, line testing, access cable pressurisation, tie cable, wireless, maintenance, wholesale costs, provisioning costs, IT, regulatory levies) that are not taken into account explicitly in the model developed by the Commission.

Nevertheless, most of the assets aforementioned (installation costs, maintenance costs, wholesale costs, provisioning costs, business overhead and regulatory levies) are not actually taken into account in investment and annuity, but are added overhead as common costs and operational expenditures.

When comparing investment and annuity between both models, those assets are then not taken into account.

On the contrary, Chorus does not model fibre joints, while the Commission does.

The difference in the number of cabinets stems from an inadequate adjustment performed in Chorus model[11].

3.3.2 Comparison of effective inventories

In this section, Chorus inventory is compared with the Commission effective inventory, i.e. the inventory from which investment and annuity are derived. This inventory represents a copper network covering TSO-areas, with a 36% share of aerial network.

The adjustments listed in the previous section are not applied onto Commission inventory in the following table.

As a consequence, significant differences appear between the Commission and Chorus inventories.

Table 5 – Comparison of access network inventories (without adjustments)

Asset	Unit	Inventory		Comparison
		Chorus	Commission (copper)	
Copper joints	#	[ ]**CNZCI**	233,502	**[ ]CNZCI**
ETP	#	[ ]**CNZCI**	-	
Distribution points	#	[ ]**CNZCI**	350,979	[ ]**CNZCI**
Lead-in	#	[ ]**CNZCI**	-	
Poles	#	[ ]**CNZCI**	388,688	[ ]**CNZCI**
Manholes	#	[ ]**CNZCI**	534,350	**[ ]CNZCI**
Trenches	km	[ ]**CNZCI**	60,416	[ ]**CNZCI**
Copper cables[12]	km	[ ]**CNZCI**	154,925	[ ]**CNZCI**
Ducts	km	[ ]**CNZCI**	130,351	[ ]**CNZCI**
Cabinets	#	[ ]**CNZCI**	10,471	[ ]**CNZCI**
SLUBH fibre	km	[ ]**CNZCI**	52,898	[ ]**CNZCI**

Source: TERA Consultants

3.3.3 On-top adjustments to Chorus inventory

3.3.3.1 Optimization of route length

Routes (aerial routes and underground routes), ducts, manholes as well as cables and joints are discounted in order to optimize route lengths in Chorus model. A discount of 35% is applied to cables and joints, and 15% to underground infrastructures. (A 10%"additional efficiency adjustment" is applied to nominal "optimized asset counts multipliers").

[11] Chorus answer to the Commission questions, §2.9

[12] In this table, there is large increase for copper cables and ducts as compared to the table 13 because now the lead-ins are fully modelled and each asset that composed this lead-in are included in the network inventory.

3.3.3.2 Treatment of aerial deployment

The access network cost model adjusts the length and number of aerial assets. It applies a multiplier to Chorus existing assets stemming from NetMap.

To do so, an [ ]**CNZCI** multiplier is applied to aerial routes (i.e. installation of aerial cables on poles) while a [ ]**CNZCI** multiplier is applied to underground routes (i.e. trenching and ducting).

After combination with the route optimizer, it is equivalent to multiplying aerial routes by [ ]**CNZCI** and underground routes by [ ]**CNZCI**.

In the end, it leads to a 20% share of aerial network[13] in the Chorus model, as compared to 36% in the Commission model.

In the model developed by the Commission, using a 20% share of aerial network would lead to 3.9% increase in annuity.

Conversely, the annuity derived by Chorus would decrease by around 4%[14] if the share of % aerial network was set to 36%.However, it appears only [ ]**CNZCI** of distribution points are aerial in the Chorus model, while around 50% of distribution points are aerial in the Commission model, where it is assumed 49% of lead-in is aerial.

Indeed, the aerial multiplier is inconstantly applied onto aerial assets: aerial and underground distribution points are not impacted by the aerial multiplier.

3.3.3.3 Use of network sharing

In the Chorus model, an average 2.48% discount is applied onto infrastructures to reflect network sharing, in the same order of magnitude than in the Commission model.

All routes, ducts, and most of manholes are discounted with a 2.5% factor. On the contrary, no discount is applied to pits (small manholes) and SLUBH manholes. Those two types of manholes account for [ ]**CNZCI** % of total manholes[15].

In comparison, a 2.17% average discount is applied to infrastructures in the Commission model[16]. This stems from a 50% discount to aerial infrastructures and no discount to underground infrastructures.

---

[13] 20% is obtained by the ratio of aerial distribution and copper feeder routes divided by total distribution and copper feeder routes, in the full network deployment.

[14] As aerial adjustment is performed offline (§2.7 of Chorus answer), the Commission is not able to perform the same adjustment in Chorus model.

[15] Weights following 2015 investment for gross replacement cost.

[16] 2015 investment.

3.4 Cost allocation to other services

In Chorus model, infrastructure costs are allocated between services according to the number of customers, whereas the Commission allocation key is based on cables' surface.

The number of customers is not the dimensioning driver of civil engineering. The allocation key used by Chorus is therefore not in line with a capacity based cost allocation approach.

In the Commission model, it is assumed ducts are not shared between access cables and core cables. As a consequence, when a trench is shared between access and core, at maximum 50% of the trench cost is allocated to core.

In the same way, as cable surface is not linear with the number of copper pairs, a greater share of underground infrastructures is allocated to final drops in the Commission model. Consequently, distribution and feeder assets might actually be greater in Chorus model than in the Commission model.

3.5 Comparison of unit cost inputs

3.5.1 Overall comparison

Almost all assets are more expensive in Chorus model than in the Commission model.

Comparisons are detailed in the following table:

Table 6 - Comparison of asset unit costs

Item	**Difference** (%) **or factor** (x) between Chorus model and the Commission model	**Comment**
Copper cable	2 pairs : [ ]**CNZCI** 4-100 pairs : [ ]**CNZCI** 200-2000 pairs: ~ [ ]**CNZCI**	Chorus inventory includes more types of cables than the Commission inventory.
Fibre cable	12F-48F: [ ]**CNZCI** 96F-144F: [ ]**CNZCI** 216F: **CNZCI** 312F: [ ]**CNZCI**	Unit costs for fibre are relatively insensitive to F-count due to high labour costs, as Chorus assumes fibre cables are blown.
Copper joint	Distr.: [**CNZCI** Feeder [ ]**CNZCI**	
Fibre joint	[ ]**CNZCI**	
Copper DP	[ ]**CNZCI**	
Duct	110mm: equivalent. 32mm and 50mm:[ ]**CNZCI**	
Trench	Distr:[ ]**CNZCI** Feeder: [ ]**CNZCI**	Distribution trenches are more expensive in Chorus model while it assumes distribution cables are directly buried without any duct.
Pole	[ ]**CNZCI**	[ ]**CNZCI** meters.
Manhole	[ ]**CNZCI**	Large set of manholes, from [ ]**CNZCI** kNZD to [ ]**CNZCI** kNZD (the Commission unit cost is in average [ ]**CNZCI** kNZD).
Street cabinet	Active: [ ]**CNZCI** Passive: [ ]**CNZCI**	The scope of the asset "cabinet" is unclear in Chorus model, as other cost items might be added along. The comparison is performed with only assets tagged "cabinet"
MDF and ODF ODF	Cost item are broken down into many sub-items in Chorus model. One MDF may possibly contain more than one unit of each item. Plus, no tag gathers all the items related to MDF. Sub-items include: MDF, OFDF (both cheap), line testing, cable pressurization, other costs, tie cable.	

Source: TERA Consultants

3.5.2 Unit costs of routes

3.5.2.1 Underground routes

Chorus provides two sets of costs for trenching:

- distribution underground routes; and
- feeder underground routes.

Distribution underground routes do not include ducting (i.e. installation of duct in trench), as distribution cables are directly buried.

Feeder underground routes include ducting and trenching.

Distribution underground routes cost in average [ ]**CNZCI** NZD per meter in Chorus model, i.e. [ ]**CNZCI** % more expensive than trenching unit costs used in the Commission model and derived from BECA analysis.

Chorus input costs for distribution trenches are more than [ ]**CNZCI** times more expensive than the Commission input costs[17] ([ ]**CNZCI** NZD per meter vs. [ ]**CNZCI** NZD per meter).

Feeder underground routes are twice as expensive in Chorus model.

3.5.2.2 Aerial routes

Regarding aerial routes, Chorus assumes the average distance between poles in [ ]**CNZCI** meters.

This assumption is inconsistent with the data Chorus provided in section 6.14.1.e (v) of the data request, where it is stated that:

Table 7 - Inter-poles distances provided by Chorus during the data collection phase

Distance between poles	Nominal distance	Average distance
In rural areas	[ ]**CNZCI** m	[ ]**CNZCI** m
In urban areas	[ ]**CNZCI** m	[ ]**CNZCI** m

Source: Chorus

In order to assess aerial route unit costs, Chorus assumes the average distance between poles is [ ]**CNZCI** meters. However, as rural areas weight more than urban areas in the nationwide network, average distance between two poles around shall be closer to 60 m[18] than to [ ]**CNZCI** m.

[17] Commission unit costs for trenches provide from BECA.

[18] Assuming [ ]**CNZCI** and [ ]**CNZCI** are rural and urban averages. It shall be noted that the Commission uses a nominal distance in its bottom up approach to assess the number of poles. It leads to a 61 meters average distance (see section 3.3.1.4).

The annual cost derived by Chorus would decrease by 2.5% if the average distance between two consecutive poles was set to 60m.

3.5.3 Unit costs of lead-in

Chorus provides for package prices for lead-in installation. Those packages include supply and install of passive assets[19], with a separate modelling for ETP and distribution point.

The lead-in in the Commission model starts at the DP and ends at the EPT. It includes the following assets:

- cables;
- ducts;
- trenches; and
- dedicated poles.

The average investment cost for lead-in is [ ]**CNZCI** NZD in Chorus model ([ ]**CNZCI** mNZD investment for [ ]**CNZCI** billion final drops). This is consistent with the average investment of 828 NZD per lead-in derived in the model developed by the Commission.

However, average annuity is much higher in Chorus model (see section 3.7 of this paper).

3.6 Investment

For most assets, investment in 2015 appears significantly higher in Chorus model than in the model developed by the Commission.

The spread in investment is driven mostly by:

- higher unit costs in Chorus model; and
- larger scope in Chorus model (ex-TSO areas are included).

[19] Chorus answers to the Commission questions, §2.1

Table 8 – Comparison of access network investments

Asset	Chorus	Commission (copper)	Comparison
Copper joints	[ ] CNZCI	312	**[ ] CNZCI**
ETP	[ ] CNZCI	-	
Distribution points	*[ ] CNZCI*	159	**[ ] CNZCI**
Lead-in	*[ ] CNZCI*	-	
Aerial route	[ ] CNZCI	183	**[ ] CNZCI**
Manholes	[ ] CNZCI	1,014	[ ] CNZCI
Underground route	[ ] CNZCI	4,039	[ ] CNZCI
Copper cables	[ ] CNZCI	499	**[ ] CNZCI**
Ducts	[ ] CNZCI	1,101	[ ] CNZCI
Cabinets	[ ] CNZCI	44	**[ ] CNZCI**
MDF	[ ] CNZCI	42	[ ] CNZCI
Other costs (line testing, access cable pressurization, wireless, IT)	[ ] CNZCI		
SLUBH fibre (cable + joints)	[ ] CNZCI	56+268	[ ] CNZCI
Total	**[ ] CNZCI**	**7,714**	[ ] CNZCI

Source: TERA Consultants

The spread between the investment in poles between the two models stems from the reuse factor used by the Commission.

Indeed, the number of poles is in the same order of magnitude in both models (see section 3.3.2). Poles are [ ]**CNZCI** times more expensive in Chorus model and a 50% discount is applied onto poles inventory in the Commission model, in order to reflect the sharing of poles between Chorus and utilities companies.

In the end, Chorus investment for poles is [ ]**CNZCI** times higher than the investment modelled by the Commission.

The investment for SLU backhaul is lower in Chorus model since the backhaul is [ ]**CNZCI** shorter in Chorus than in the Commission model in 2015 (see section 3.3.1.9).

3.7 Depreciation factor (GRC/Annuity)

When computing monthly unit prices for UCLL services, Chorus considers a permanent asset replacement from 1962, i.e. replaces assets on an on-going basis.

Chorus also provides for outputs based on Gross Replacement Costs (GRC), i.e. based on a network being entirely built each year.

The Commission also models GRC, and derives monthly unit prices from GRC.

The investment computed by Chorus is compared to the investment derived in the Commission model (excluding core and FWA network levels, but including backhaul).

Chorus GRC annuity[20] is then compared to annuity modelled by the Commission[21].

For every asset, the depreciation factor, i.e. the ratio of annuity over investment, is higher in Chorus model.

This leads to a higher annuity.

The spread in depreciation factor stems from various drivers which are described in the following sections.

3.7.1 Higher WACC

Chorus uses a 9.62% real pre-tax WACC, which corresponds to 11.25% in nominal terms[22].

The Commission uses a different approach to implement WACC. WACC is determined as:

- 6.47% nominal post-tax WACC, according to the Commission draft paper "Cost of capital for the UCLL and UBA pricing reviews[23]";
- it then applies the standard tax rate (28%);
- for each asset a tax shield is taken into account, lowering the standard tax rate to an average around 17%[24];
- the average nominal pre-tax rate used by the Commission is therefore 7.80%

The difference between 11.25% and 7.80% leads to large differences in depreciation rates, then in annuities.

Using a 7.80% nominal pre-tax WACC in Chorus model would decrease annuity by about 400mNZD, from 1,721mNZD to 1329mNZD.

[20] Before adding opex and common costs.

[21] Before adding opex and common costs.

[22] "Output" sheet, lines 56 to 64.

[23] http://www.the Commission.govt.nz/dmsdocument/12774

[24] If a uniform tax rate is applied, then the relevant tax rate is 17% to obtain the same annuity.

3.7.2 Shorter asset lives

Most asset lives are consistent between both models.

However, infrastructure assets have significantly shorter asset lives than in the Commission model.

Table 9 – Infrastructure asset lives

Asset	Commission	Chorus
Trench ("UG route" in Chorus)		
In distribution	50	20
In feeder	50	50
Poles ("aerial route" in Chorus)	[ ]**CNZCI**	14

Source: TERA Consultants

Using 50 years for distribution underground routes and [ ]**CNZCI** years for aerial routes would lead to decrease Chorus annuity by 6.5%.

3.7.2.1 Aerial routes

Regarding "aerial routes", Chorus answers in §2.12[25] that aerial routes' asset life is derived from overhead cable asset life[26]. At the same time, in §2.2, Chorus states that aerial routes include:

- [
-
-]**CNZCI**

Plus, according to Chorus data collection[27], asset life for poles is [ ]**CNZCI** years in Chorus asset life register.

As aerial route replacement is driven only by pole replacement, aerial route asset lives shall be inferred from pole asset life, i.e. [ ]**CNZCI** years.

3.7.2.2 Underground routes

Since distribution cables are directly buried, Chorus assumes that distribution trenches are reinstated when cables are replaced, in a consistent approach.

However, it appears unit costs for trenches are inconsistent with such assumptions (see section 3.5).

[25] Analysys Mason, *Report for Chorus to provide to the Commerce Commission – Response to TERA questions regarding the Chorus UCLL and UBA models*.

[26] Chorus data collection, extract from asset life register, item Q 6.19.6.a, row 84.

[27] Chorus data collection, extract from asset life register, item Q 6.19.6.a, row 88.

3.7.3 Much lower price trends

Chorus price trends are significantly lower than the price trends assessed by the Commission.

Chorus uses real price trends rather than nominal price trends (consistently with using real WACC): price trends provided by Chorus are spreads from CPI.

Conversely, the price trends used by the Commission include CPI.

After taking the CPI into account, Chorus uses lower price trends than the Commission.

The following table summarizes the difference between the price trends used by Chorus and the price trends used by the Commission.

Table 10 – Comparison of real price trends

Asset type	Chorus		Commission
	Material	Labour	Material + labour
Copper joint	-1%	-0.60%	0.98%
Distribution points	-1%		0.94%
Aerial route	1.50%		0.88%
Manhole	1.50%		1.03%
Underground route	1.50%		1.49%
Copper cable	0%		1.33%
Ducts	0.50%		1.49%
MDF/ODF	Composite (c. -4%)		0.12%
Fibre cable	-3.80%		0.98%

Source: TERA Consultants

Chorus price trends are broken down into:

- Labour price trends: -0.6% for all assets; and
- Material price trends: from 1.5% to -7.5%

while the Commission provide one single price trend for each asset.

The compound price inflation used by Chorus is the result of labour price trend applied onto labour costs and material price trend applied onto material costs. In the end, the aggregate material and labour price trend is between the material and the labour price trend.

3.7.3.1 Labour price trends

Chorus assesses labour price trend as -0.6% in real terms, i.e. assuming wages grow slower than CPI.

According to the New Zealand national statistical office, labour cost index had grown by more than 3% per year between 2007 and 2009, then by more than 2.1% since 2010 in nominal terms[28], in line with inflation (CPI).

In Chorus model, the annuity would decrease by 2.64% if labour price trend was 0%.

Assuming wages follow real GDP growth in the long run (2.6% average real growth rate since 2000[29]) in real terms, it would lead to a 14% decrease in Chorus annuity.

Some assets are mostly composed of labour, such as underground routes and manholes. Thus, for those assets, price trends are higher in the Commission model than in Chorus model.

3.7.3.2 Supply price trends

Chorus uses lower price trends for MDF and ODF assets, down to -7.5% spread with CPI.

In comparison, the Commission uses stable material prices for those assets.

Regarding copper and fibre cables, Chorus uses lower price trends than the Commission.

As infrastructure assets are mostly made of labour, comparison of material price trends appear less relevant.

3.7.4 Synthesis

For all assets, the depreciation factors computed by Chorus are significantly higher than the depreciation factors computed in the model of the Commission.

The total depreciation factor, computed as 12.4%, in Chorus model is twice as high as in the Commission model.

In the following table, the depreciation factor is the ratio annuity on investment.

In the Chorus model, annuity and investment are extracted from the spreadsheet “MTAD”. In the Commission model, annuity and investment are extracted respectively from the spreadsheets “Annual cost” and “Investment”. The amounts considered in the Commission model correspond to the Access network + SLU backhaul.

[28] New Zealand national statistical office: http://www.stats.govt.nz/browse_for_stats/economic_indicators/prices_indexes/LabourCostIndexSalaryandWageRates_HOTPMar14qtr/Commentary.aspx#annual

[29] Reserve bank of New Zealand: http://www.rbnz.govt.nz/statistics/key_graphs/real_gdp/

Table 11 – Comparison of depreciation factors

Asset type	Depreciation factor		Comparison
	Chorus	Commission	
Copper joints	11.8%	8.8%	1.34
Distribution points	11.5%	9.9%	1.17
Poles	13.8%	9.0%	**1.53**
Manholes	9.3%	5.6%	**1.66**
Trenches	11.6%	5.2%	**2.24**
Copper cables	12.1%	8.8%	1.38
Ducts	9.9%	5.2%	**1.92**
Cabinets	17.0%	11.1%	**1.53**
MDF	11.1%	8.8%	1.27
Fibre/SLUBH	10.8%	8.0%	1.34
Total	**12.4%**	**6.0%**	**2.08**

Source: TERA Consultants

Some assets are taken into account in Chorus model but not explicitly in the Commission model. Those assets are not presented in the above table. Some of those assets have short assets lives (e.g. line testing, IT costs, cable pressurisation), then have a very high depreciation rate.

However, the “total” raw of the above table takes into account the whole annuity and investment.

As investment is twice as high in Chorus model, and as the depreciation factor is twice as high in Chorus model, the annuity modelled by Chorus annuity is about 4 times as high as the annuity modelled by the Commission.

3.8 Number of customers

The number of customers is equivalent in both models, around [ ]**CNZCI** million customers. Thus, the differences in unit price between Chorus model and the Commission model stem from differences in total annuity.

Table 12 - Total copper connections (thousands)

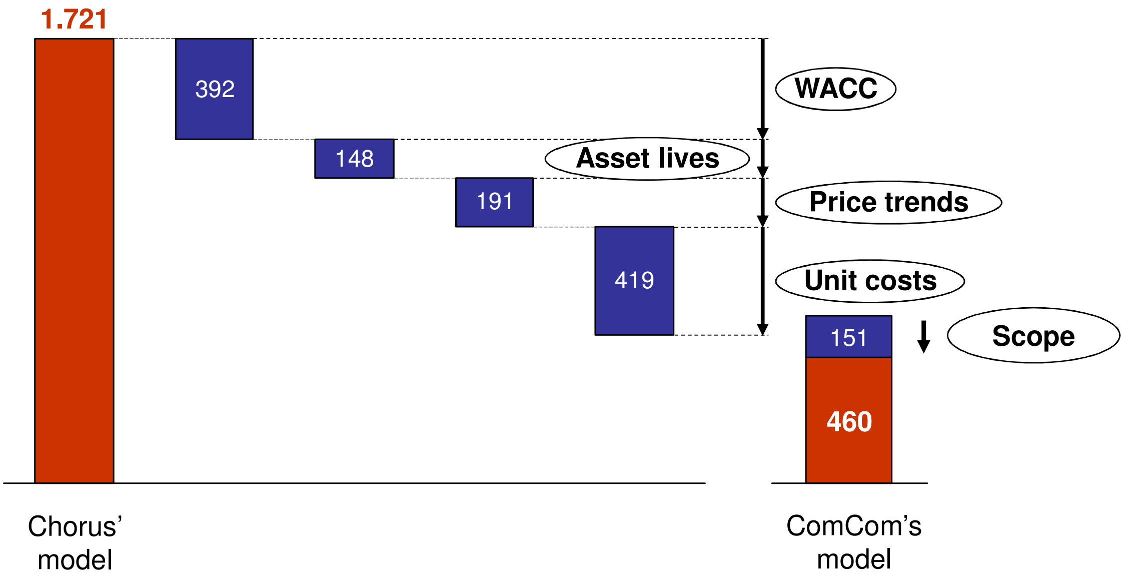
TERA	Chorus
1,714	[ ]**CNZCI**

Source: TERA Consultants

3.9 Reconciliation

The following figures shows a bridge between the annuity derived in Chorus model and the annuity derived in the Commission model:

Figure 6 - Annuity reconciliation



Source: TERA Consultants

In order to figure the drivers of spreads in access annuity between both models, the Commission input assumptions have been progressively applied onto Chorus model:

- In 2015 the total access annuity amounts to 1,721mNZD in Chorus model;
- The annuity decreases by 392mNZD down to 1,329mNZD when applying the weighted average cost of capital determined by the Commission;
- The annuity decreases by 148mNZD down to 1,181mNZD when applying in addition the asset lives used by the Commission for poles and distribution underground routes;
- The annuity decreases by 191mNZD down to 990mNZD when applying in addition the Commission price trends; and
- The annuity decreases by 419mNZD down to 571mNZD when using in addition the Commission unit costs[30].

After those adjustments, Chorus access annuity is in line with the Commission extended-scope annuity (610mNZD).

However, following model reference paper criteria, the Commission does not model network outside of TSO areas, as deployment in ex-TSO is uneconomic. As a consequence of this difference in scope, the Commission access annuity is 460mNZD.

Thus, unit costs and components of the depreciation factor explain most of difference between the two models.

[30] The Commission unit costs are not implemented for assets which are analyzed in section 3.5 of this paper.

4 Review of Chorus UBA model

This section details the key figures of Chorus UBA model that can be compared to the Commission UBA model calculating the UBA increment. The main topics addressed are the following:

- high level results and distribution of costs (see §4.1);
- inventory (see §4.2);
- price inputs (see §4.3);
- depreciation factors (see §4.4);
- trenches cost allocation (see §4.5);
- number of customers (see §4.6); and
- the cumulated effect of Chorus assumptions (see §4.8).

4.1 Comparison of high level results and distribution of costs

Chorus model outputs a UBA increment cost of 16.17 NZD, whereas the Commission calculates an increment of 10.65 NZD. This represents a 52% difference between the two models.

Table 13 - Key figures (in mNZD)

Category of cost	Chorus	The Commission
Total network investment	[ ]**CNZCI**	526.9
Annual VDSL CAPEX	[ ]**CNZCI**	69.7
Total network OPEX	[ ]**CNZCI**	80.8
Annual UBA Costs	[ ]**CNZCI**	123.8

Source: TERA Consultants

The comparison between the two model costs shows a significant difference between the total investments calculated. However the total investment calculated by Chorus corresponds to a wider network:

- Chorus model considers the entirety of a core network whereas the scope of the Commission model is reduced to the UBA service, and therefore does not take into account the regional and national inter-exchanges link capabilities of the network. Chorus model includes some investments for other equipment as well as some core trenches that are not used by the UBA service, but that are recovered by some other services. The Commission model includes only xDSL customers (including some UBA customers and some VDSL customers) and exclusively the equipment required to provide this service.
- The model developed by Chorus includes the fibre feeders between the active cabinets and their parent exchange in the UBA increment, whereas the Commission includes these feeders in the UCLL.

However it is possible to compare the annual costs. The following table provides a comparison of the cost distribution:

Table 14 - Distribution of total annual costs

Asset	Chorus (a)	Chorus relevant scope (b)[31]	The Commission (c)
DSLAM at cabinet	[ ]CNZCI	[ ]CNZCI	[ ]CNZCI
DSLAM at exchange	[ ]CNZCI	[ ]CNZCI	[ ]CNZCI
Total DSLAMs	[ ]CNZCI	[ ]CNZCI	[ ]CNZCI
Switch + OFDF	[ ]CNZCI	[ ]CNZCI	[ ]CNZCI
Mgt system	[ ]CNZCI	[ ]CNZCI	
Inter-exchange	[ ]CNZCI	[ ]CNZCI	[ ]CNZCI
Maintenance	[ ]CNZCI	[ ]CNZCI	
Total	**81%**	**100%**	**100%**
Feeder	[ ]CNZCI	UCLL	
Marketing & other customer costs	[ ]CNZCI	Not included	

Source: TERA Consultants

The primary analysis (columns (a) versus (c)) shows that the scope chosen by Chorus and the Commission is slightly different. Indeed, Chorus adds:

- marketing and customer costs that should not be part of the regulated wholesale services, these costs are therefore excluded; and
- some feeder costs. Chorus considers these costs as part of the UCLL costs, and therefore should also be excluded from the analysis.

The comparison shows a significant difference between Chorus and the Commission models cost distributions: the asset “DSLAMs at cabinet” drives more costs in Chorus model. This is due to the RBI contribution-related investments that are not included in the Commission scenario.

Chorus model also allocates less costs of the fibre network to the UBA service. This is explained by the allocation key: Chorus models more core services than the Commission and then allocates the trenches and cables costs based on the traffic. This reduces the share of fibre costs allocated to the UBA service as compared to the Commission allocation rules. This is further detailed in the section 4.5 below.

Chorus model includes some additional management systems and maintenance costs. These costs are included in the Commission OPEX model, and distributed over the different costs categories based on CAPEX. They are therefore not shown as a specific cost category in the Commission Model.

[31] The share of the annual cost borne by each asset has been reassessed by removing the feeder and the marketing and other customer costs in order to have the same scope than the Commission model.

Table 15 - UBA annual costs

Asset	Chorus	The Commission
DSLAM at cabinet	[ ]CNZCI	[ ]CNZCI
DSLAM at exchange	[ ]CNZCI	[ ]CNZCI
Switch + OFDF	[ ]CNZCI	[ ]CNZCI
Mgt system	[ ]CNZCI	
Inter-exchange	[ ]CNZCI	[ ]CNZCI
Maintenance	[ ]CNZCI	
Total UBA scope	**[ ]CNZCI**	**[ ]CNZCI**
Feeder	[ ]CNZCI	
Marketing & other customer costs	[ ]CNZCI	

Source: TERA Consultants

The total costs allocated adjusted to the UBA scope are then comparable. Chorus model calculates [ ]**CNZCI** more costs ([ ]**CNZCI** versus [ ]**CNZCI** mNZD). If the RBI funding is excluded from the Commission model, the annual cost raises to [ ]**CNZCI** mNZD. The remaining difference in costs is mainly due to difference between the DSLAM at Cabinet unit costs.

4.2 Comparison of network inventories

Both models use a bottom-up approach, however whereas the Commission takes a “per-node” dimensioning approach, Chorus uses geotyping, and therefore aggregates all sites to make them fall into 5 geotypes. Both models use similar assets allowing comparing the inventories required to provide the UBA service.

Table 16 - Key volumes

Asset	Unit	Chorus	The Commission
DSLAMs at cabinet	#	[ ]CNZCI	4,590
DSLAMs at exchange	#	[ ]CNZCI	892
Switches	#	[ ]CNZCI	101
xDSL customers	#	[ ]CNZCI	1,136,355
Feeder cables	km	[ ]CNZCI	50,095
Feeder trenches	km	[ ]CNZCI	23,295
Inter-exchange cables	km	[ ]CNZCI	46,144
Inter-exchange trenches	km	[ ]CNZCI	14,535

Source: TERA Consultants

4.2.1 DSLAMs at cabinet

Chorus model includes [ ]**CNZCI** cabinets in addition to the number of cabinets derived in the Commission model. This difference is explained by the exclusion from the inventory in the Commission model of the 900 cabinets that have been funded by the RBI program.

4.2.2 DSLAMs at exchange

The difference in terms of DSLAMs at exchange (+5%) is explained by several factors:

- Chorus model is based on a geotyping approach which leads to an approximated inventory for a few set of sites that may fall out of the geotype for certain years; and
- Chorus takes into account 5% of un-used ports, therefore all DSLAMs take into account 5% additional capacity.

4.2.3 Switches

The number of switches is mainly driven by the number of cards required to aggregate all DSLAMs collected on the site, and if some other services are provided, the number of connections required to connect the related equipment to the network.

The number of switches is therefore directly impacted by the number of DSLAMs at exchanges, and by additional services that share these switches, whereas the Commission model uses FDS dedicated to the xDSL services. As Chorus models more DSLAMs and additional services, the number of switches required increase.

4.2.4 Length of trenches

The following table compares the length of cables and trenches between the Commission and Chorus model (before and after the correction made by Chorus following the questions sent by the Commission):

Table 17 - Cables and trenches lengths

Asset	Unit	Commission model	Chorus model	Chorus model after correction
FWA cables	Km	4,857		
FWA trenches	Km	1,239		
Feeder cables	Km	52,898	[ ]CNZCI	[ ]CNZCI
Feeder trenches	Km	10,176	[ ]CNZCI	[ ]CNZCI
Core cables	Km	28,695	[ ]CNZCI	[ ]CNZCI
Core trenches	Km	4,078	[ ]CNZCI	[ ]CNZCI
Feeder + Core trenches	Km	14,254	[ ]CNZCI	[ ]CNZCI

Source: TERA Consultants

Chorus model was showing inconsistent lengths of core cable as compared to core trenches as there were more trenches than cables. However the model has been adjusted and a new split has been provided. Nonetheless the new model has not been provided.

The total length of trenches for Chorus feeder and core network remains lower than the length calculated by the Commission. This may be due to allocation rules (based on traffic in Chorus Model) and some “on-going deployments” effects (Chorus model taking into account a chronology for deployments where the Commission considers a network “as it would be deployed today”).

The total length of cables deployed varies significantly between the Commission model and Chorus model. Chorus figures correspond to the 2013 calculated inventory (fixed in the Chorus UBA increment model).

The difference of inventory is further detailed in the Access section above.

4.3 Comparison of price inputs

Chorus and the Commission use assets which may be different, but that are comparable in terms of engineering rules. The table below shows for comparable assets the unit costs used in both models.

Table 18 - Unit costs (NZD/asset)

Asset	Chorus	The Commission	Difference
DSL card	[ ]**CNZCI**	1,560	[ ]**CNZCI**
DSLAM at cabinet	[ ]**CNZCI**	10,395	[ ]**CNZCI**
DSLAM at exchange	[ ]**CNZCI**	15,756	[ ]**CNZCI**
Switch card	[ ]**CNZCI**	4,976	[ ]**CNZCI**
Switch subrack	[ ]**CNZCI**	23,376	[ ]**CNZCI**

Source: TERA Consultants

The unit costs that have been used by the Commission are based on the data provided by Chorus during the data collection phase. The differences that are observed in the previous table are therefore unexplainable.

4.4 Depreciation factor (GRC/Annuity)

The depreciation factors are a combination of the depreciation formula used, the WACC, price trends and asset useful life values. The value can be calculated by dividing the GRC value (cost of replacing the equipment) by the annuity value (which represents the annualized cost of the equipment).

Table 19 - Depreciation factors

Asset	Chorus	The Commission	Variation	Annual CAPEX
DSLAM	20%	24%	-18%	[ ]**CNZCI**
Switches	31%	31%	0%	[ ]**CNZCI**
Civil engineering	10%	8%	+16%	[ ]**CNZCI**

Source: TERA Consultants

DSLAMs have a higher price trend and longer asset lives in Chorus model which reduce the depreciation factor, whereas civil engineering-related assets (trenches, ducts and cables) have a lower price trend and a shorter asset live which raises the depreciation factor.

However, as civil engineering assets account for [ ]**CNZCI** of the total annual costs whereas the DSLAMs account for only [ ]**CNZCI**, the overall impact leads to a higher annual cost computed by Chorus.

4.5 Trenches cost allocation factors to UBA service

Trenches take a significant part of the UBA service cost. The following table provides an approximate allocation factor of these total costs to the UBA service.

Table 20 - Trenches allocation to UBA

Network level	Chorus	The Commission
Feeder	[ ]**CNZCI**	67%
Inter-exchange	[ ]**CNZCI**	33%

Source: TERA Consultants

The feeder part is not part of the UBA in the Commission model and is therefore included in the UCLL costs. The Commission model outputs are almost not sensitive to the level of the allocation key used for the feeder. The [ ]**CNZCI** points difference between the allocation key used by Chorus and the one used by the Commission have therefore no material impact on the cost of the access products (cf. sensitivities analyses conducted between the soft and hard lockdown).

The cost of the inter-exchange links is allocated based on the traffic of each service using these links in Chorus model, whereas the Commission model bases its allocation on the assumed number of fibres used by the xDSL services over the total number of fibres used in the fibre cable. The allocation key defined by Chorus is therefore not consistent with the capacity based approach as the traffic is not the dimensioning driver of these inter-exchange links.

4.6 Number of customers (Boost, UBA, VDSL)

The Boost service is not detailed in Chorus model, only the traffic generated by the service is detailed. The forecasts regarding the number of customers used by Chorus in order to dimension the DSLAMs are the following:

Table 21 – Chorus forecasted number of customers

Customers	2014	2015	2016	2017	2018	2019
UBA customers	[					
VDSL customers						
SHDSL customers						
Total xDSL customers						
Total DSL customers						]

CNZCI *Source: TERA Consultants*

The number of DSL customers (services using the same DSLAMs) is forecasted to remain almost stable by Chorus over the 2014-2019 period. However the share of VDSL customers increases significantly from [ ]**CNZCI** to almost [ ]**CNZCI** in 2019.

In 2014, the Commission assumes [ ]**CNZCI** xDSL connections (UBA + VDSL), number very close to the [ ]**CNZCI** provided by Chorus. However the Commission includes [ ]**CNZCI** SHDSL lines, whereas Chorus considers only half ([ ]**CNZCI**).

These differences are not explained as the figures used in the Commission model are based on the data provided by Chorus during the data collection phase.

4.7 Other topics

4.7.1 Trench sharing with utilities

Chorus assumes that 5% of core trenches are shared with utilities whereas the Commission includes no sharing with utilities.

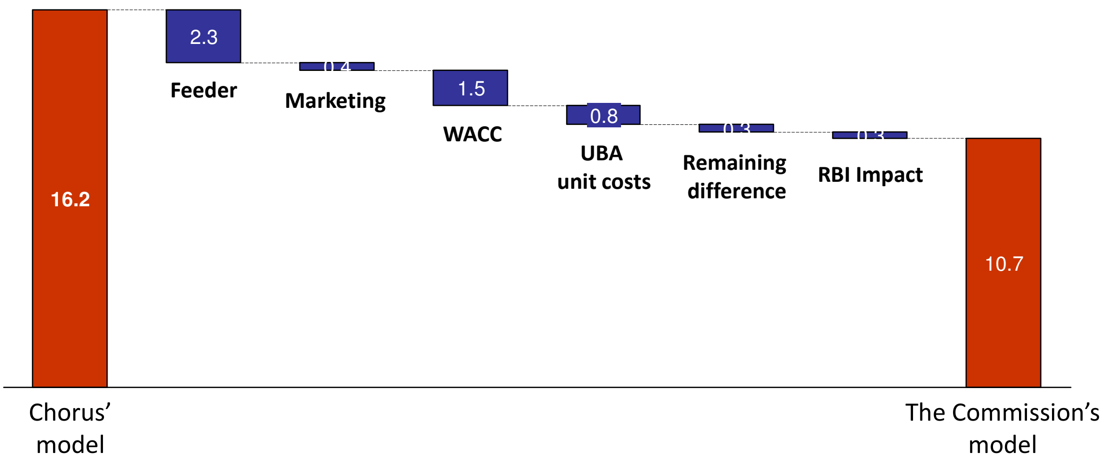
4.7.2 The UBA gradient calculation

In Chorus model, the gradient is applied only to UBA related services. The cost of commercial VDSL2 is excluded. The Commission follows the same approach.

4.8 Reconciliation

Different effects may explain the difference between UBA unit cost outputted by Chorus and the Commission models.

Figure 7 – Bridge between Chorus and the Commission UBA cost



Source: TERA Consultants

The figure above presents the effect of the different factors between the Commission model and Chorus model. Chorus input values have been changed to reflect the Commission inputs.

The figure above does not show the effect of using different price trends and asset lives in both models as:

- their impact taken independently is very limited:

  - Impact of using the Commission asset lives instead of Chorus' decreases UBA price by circa. 1%; and
  - Impact of using the Commission price trends instead of Chorus' increases UBA price by circa. 1%;
- their impact taken together is almost null (they have opposite impact).[32]

The remaining 0.3NZD include the effect of several factors:

- the variation of unit costs regarding trenches and fibre cables;
- the cost of the management system; and
- the impact of cost allocation methods.

This bridge shows that the difference between the output computed by Chorus and the output derived in the Commission model is fully explained by the scope difference (feeder and marketing being included in Chorus model), the WACC, the unit costs and the impact of the RBI program.

[32] NB: the impact have been assessed in a specific order but it should kept in mind that depending on the order of the bridge, the impact can be different