WIK-Consult • Report

Report for Spark New Zealand and Vodafone New Zealand

Submission

In response to the Commerce Commission's "Draft pricing review determination for Chorus' unbundled bitstream access service"

and

"Draft pricing review determination for Chorus' unbundled copper local loop service"

including the cost model and its reference documents

Non-Confidential version

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Contents

Executive Summary

1. WIK-Consult has been appointed by Spark and Vodafone New Zealand to provide independent expert analysis of the Commission's TSLRIC cost modelling of UCLL and UBA.

2. The Commission starts with the correct conceptual framework that the hypothetical efficient operator (HEO) would operate a newly built network using latest technology to provide the relevant regulated services. This implies an HEO unconstrained by legacy network and historic network technology decisions of the regulated firm. However, the actual modelling and implementation presented by the Commission on 2 December 2014 deviates from these principles in many respects. Much reference is made to Chorus actual network design, dimensioning rules, legacy structures and technology decisions. Although the Commission conceptually did not feel constrained by all the "realities of the real world", in practice, it made significantly more than usual concessions to these influences. On the other hand, the Commission generously applied a fully fledged Optimized Replacement Cost (ORC) valuation approach to assets without considering differences to real world behaviour of operators. The Commission fails to meet its own standards and principles for an efficient operator and does not arrive at efficient costs. The calculated costs include irrelevant costs, exclude achievable cost savings and rely on inflated input parameter values. The current model does not support the determination of prices based on the relevant TSLRIC.

3. While the Commission accepts the principle of asset re-use as a viable approach it rejects it on the basis of regulatory predictability and the recognition of the opportunity costs of depreciated assets. We disagree with the Commission's view. Neither regulatory predictability nor the consideration of opportunity costs lead to the inevitability of a general ORC asset valuation approach. This approach effectively generates economic rents for Chorus and burdens end-users. The only rationale for the Commission's approach would be to incentivise a forced migration to the fibre networks. We doubt that the Commission has a legal mandate for such a policy.

4. We understand that the Commission has reservations about following a dual asset valuation methodology to provide for re-use of assets for methodological reasons. There are other and perhaps more pragmatic ways to take care of re-use of assets than a dual asset valuation approach. The Commission could still keep its ORC approach for all assets but apply a general deduction factor for the re-use of assets reflecting the difference between brownfield and greenfield costs of deploying a new infrastructure. We recommend that the Commission applies such an investment saving factor in the range of 20% of the investment value.

5. The Commission’s asset valuation approach will inflate wholesale prices which are the major cost component of broadband at the retail level in New Zealand. Given the intense retail broadband competition, wholesale price changes are likely to be passed through to the retail end-users. Broadband users in New Zealand would have to pay higher prices for internet access than they would have to pay today. The retail price implications will not only cause (traditional) static welfare losses. Due to the negative impacts on the path of broadband penetration in New Zealand further negative externality effects will occur as well as negative impacts on the dynamic efficiency of the New Zealand economy.

6. In our previous submission we had already expressed our significant concerns about the Commission’s dual MEA approach, mainly based on the supposed inefficiencies and inconsistencies of such an approach. Thus, as expected, the problem of double-recovery of costs is unresolved, costs are inefficiently inflated, the lowest cost choice technology is distorted and not in line with an efficient cost determination. The dual MEA approach has proven to become a cul-de-sac. The Commission should take the decision, to give this approach up.

7. During our analysis and assessment of TERA’s cost model we developed from step to step a rather critical view of the model. We identified more than 100 faults and deficiencies in the model. Some of them are very serious and not just the reflection of the choice between various viable options. These detailed findings underline our main conclusion that the cost model in its current form cannot inform the Commission on UBA and UCLL TSLRIC pricing. Major re-modelling efforts and major changes of the population of the model with input parameter data is needed before the model can inform the Commission’s decision appropriately.

8. The Commission and TERA claim to have built a true bottom-up model. The actual model developed does not, however, meet this standard in all respects. In many areas of network design the model is more guided by just including elements and structures of Chorus’ existing copper network without developing an efficient network design and an efficient dimensioning of network elements.

9. Our reservations of using the cost model in its current form first of all relate to some formal inconsistencies and technical computational problems. More important are major conceptual deficiencies caused either by decisions of the Commission, the implementation approach chosen or by implementations which are not coherent with decisions of the Commission. These methodological deficiencies relate to the cost efficient technology choice, the coverage of FWA, the modelling approach of FWA, and some allocation rules and principles. We also have strong reservations regarding the efficiency concept(s) of the modelling. Major efficiency potentials are not exhausted or not even modelled. Effectively the model does not represent the network and the cost of an efficient operator. Furthermore, many engineering dimensioning rules implemented in the model are not state of

the art, best practice or simply not what an efficient operator would do. A major deficiency results from the basic algorithms to determine trench length which is the major cost driver in the access network. The algorithm used tries to minimize cable length. What should have been done to achieve the lowest cost is the minimization of trench length instead.

10. We have expressed significant concerns as to the appropriateness of TERA's modelling approach. Many engineering and dimensioning rules are not state of the art and/or not efficient. Many cost parameter choices are overly conservative or cautious resulting in inflated and inefficient costs. Conversely, we have also identified some faults and deficiencies which, if corrected, would increase the calculated UCLL and UBA cost. Correcting for the major parts of the faults and deficiencies and populating the model with more appropriate input parameters would, however, significantly decrease the overall cost.

11. We have conducted a global model sensitivity to demonstrate the combined effect of a variety of parameter changes we regard as necessary, and where we corrected for some of the most important deficiencies of the model. Many others could not be corrected because this would require major re-modelling work which we could not conduct. Making these necessary corrections and parameter changes would lead to a UCLL cost which is 41% below the level calculated by TERA. If all of the deficiencies identified by us were corrected for, we would expect the UCLL TSLRIC cost to be in a range of $14 and $16 in New Zealand, which means 43% to 50% below the level calculated by TERA.

12. Most of the necessary corrections regarding UBA have been included in the same global sensitivity. This leads to a reduction of the calculated incremental UBA cost by 23%. If all necessary corrections and parameter changes are included in the model we would expect the UBA TSLRIC cost to be in a range between $7 and $8 in New Zealand. On this basis the relevant TSLRIC for UBA would be between 21% and 31% below the level calculated by TERA.

13. It is not surprising to us that the relevant range of the UCLL TSLRIC cost on the basis of proper modelling is close to the monthly rental benchmark which the Commission has developed under the raw benchmark approach in 2012. In its 2012 benchmark-based decision the Commission rejected the raw benchmark approach because it did not adequately apply the comparable countries requirement and would have resulted in downwards bias of results. The main driver of UCLL costs is the trench length per connection. The Commission considered at the time, that the geography of New Zealand and the distribution of population (and fixed line users) were reasonable indications of a longer average trench length in New Zealand compared to most of the countries included in the Commission's benchmark at that time. In its modelling approach the Commission made the most important assumption of excluding the capital cost of connections

outside the TSO area for the UCLL cost calculation, which we support as a pragmatic approximation. Excluding the 6.4% connections of the non-TSO areas also meant excluding those loops with an over-proportional loop length. Altogether 47.5% of the total road network length is attributed to these 6.4% connections. Excluding these most lengthy loops mostly adjusts for any geographical and cost differences to the benchmark countries. As a consequence, the calculated costs in this specification are mostly comparable (without further adjustments) to European TSLRIC benchmarks.

14. We have undertaken a high-level review and assessment of the UCLL and UBA cost models which Analysys Mason has developed on behalf of Chorus. Our analysis led us to the conclusion that Chorus' models are not suitable to inform the Commission's TSLRIC-based UBA and UCLL pricing FPP determinations.

15. Chorus' model results are structurally unsound and from the level of unit costs they are generating, highly implausible. This is due to conceptual flaws and the use of cost inflating input parameters. There is furthermore a high risk of double-recovery of costs. The UCLL model is modelling both copper and fibre access, is artificially separating them, but includes major cross-subsidies for the fibre network from copper network users. The calculated costs do not represent prudently and efficiently the relevant TSLRIC costs.

0 Introduction and acknowledgements

0.1 Introduction

16. WIK-Consult has been appointed by Spark New Zealand ("Spark") and Vodafone New Zealand ("Vodafone") to support both companies in the course of the cost modelling and FPP process of the Commission. Nevertheless, this submission is brought to the attention of the Commission as an independent expert report.

17. This submission deals with both the Commission's draft pricing determinations regarding UCLL and UBA and the cost model provided by its consultant TERA. This submission is primarily focussed on the cost modelling and on those aspects of TSLRIC which the Commission did not address in previous consultations or did address in a different way.

18. In Section 7 of this submission we will also submit on, and assess, the UBA and UCLL models submitted by Chorus. This is done in a rather short and not intensive way because our analysis shows that the Chorus' models are not suited to properly reflect the TSLRIC of UCLL and UBA and the standards which the Commission has formulated for a proper cost model.

19. In conducting our analysis we had access to the confidential version of the model and the model documentation. We took opportunity to address some questions on the modelling approach and the use of certain parameters of the model. We acknowledge the answers provided by the Commission. Selectively, we checked some of the information provided by the Commission in the data room.

20. There is a confidential and a non-confidential version of this submission.

0.2 Citations

21. To make citation a bit easier we use a few abbreviations. We refer to the Commission's draft determinations in the following way:

    a) **Commission, UCLL** stands for: Commerce Commission, Draft pricing review determination for Chorus' unbundled copper local loop service, Draft determination, 2 December 2014.

    b) **Commission, UBA** stands for: Commerce Commission, Draft pricing review determination for Chorus' unbundled bitstream access service, Draft determination, 2 December 2014.

22. The TERA consultant documents related to the cost model are cited in the following way:

    a) **TERA, Model Reference Paper** stands for: TERA Consultants, TSLRIC price review determination for the Unbundled Copper Local Loop and Unbundled Bitstream Access services, Model Reference Paper, November 2014.

    b) **TERA, Model Documentation** stands for: TERA Consultants, TSLRIC price review determination for the Unbundled Copper Local Loop and Unbundled Bitstream Access services, Model documentation, November 2014.

    c) **TERA, Model Specification** stands for: TERA Consultants, TSLRIC price review determination for the Unbundled Copper Local Loop and Unbundled Bitstream Access services, Model Specification, Public Version November 2014.

23. We refer to our own submissions or cross-submissions from previous consultations of the FPP process in the following way:

    a) **WIK-Consult: Submission of 5 August 2014** stands for: WIK-Consult, Submission in response to the Commerce Commission’s “Consultation paper outlining our proposed view on regulatory framework and modelling approach for UBA and UCLL services (9 July 2014)”, 5 August 2014.

    b) **WIK-Consult: Cross-Submission of 20 August 2014** stands for: WIK-Consult, Cross-Submission in response to submissions to the Commerce Commission’s “Consultation paper outlining our proposed view on regulatory framework and modelling approach for UBA and UCLL services (6 August 2014)”, 20 August 2014.

    c) **WIK-Consult: Submission of 8 October 2014** stands for: WIK-Consult, Submission in response to the Commerce Commission’s Consultation on setting prices for service transaction charges for UBA and UCLL services (25 September 2014), 8 October 2014.

    d) **WIK-Consult: Cross-Submission of 15 October 2014** stands for: WIK-Consult, Cross-Submission in response to the Commerce Commission’s Consultation on setting prices for service transaction charges for UBA and UCLL services (25 September 2014), 15 October 2014.

24. All other documents which we cite are fully documented wherever we refer to them.

25. If we reference within the text to a “para. #” it means a paragraph in this submission.

0.3 Structure of this submission

26. In Section 1 we make comments on some of the general principles on which the TSLRIC price decision of the Commission is based upon. This will not be conducted comprehensively but selectively and focussed on those principles where we either disagree with the Commission’s approach or where we want to make the Commission aware of certain problems and inconsistencies of its approach.

27. Section 2 deals with pricing aspects of UBA. Furthermore, general aspects of the Commission’s modelling of UBA including the implementation in the TERA model are addressed.

28. Correspondingly, pricing and principal modelling issues regarding UCLL are addressed in Section 3.

29. In Section 4 we provide an overall critique of the cost model. The individual subsections address and provide an overall analysis and assessment of the various modules and building blocks of the model. Here we also provide our reservations in relation to the (input) data generation process and the deficiencies regarding the transparency and accuracy of the model input parameters.

30. Section 5 presents our detailed findings of our model analysis. We identified more than 100 faults and deficiencies in the model. Some of them are very serious and not just the reflection of the choice between various viable options. These detailed findings underline our main conclusion that the cost model in its current form cannot inform the Commission on UBA and UCLL TSLRIC pricing. Major re-modelling efforts and major changes in the population of the model with input parameter data is needed before the model can be used to inform the Commission’s decision appropriately.

31. Despite the model deficiencies we have conducted a variety of partial sensitivities with the model to identify the impact of several design element and parameter choices on the model outcome. These are presented in a comprehensive form in Section 6. More importantly we present here two global sensitivities which show that totally different outcomes on UCLL and UBA costs occur if more realistic network design assumptions and more realistic parameters are taken. These global sensitivities still represent only a subset of our model critique issues because many of the faults and deficiencies can only be corrected if major re-modelling work is conducted. This was beyond our scope and also not possible because major parts of the model were not accessible to us. On the basis of the results of

these global sensitivities we provide an overall assessment of the model results and bring them into dimension of international benchmarks.

32. Section 7 provides a short analysis of the model which Chorus has provided and introduced into the process. The analysis supports our argument that Chorus' models are not suitable to inform the Commission's TSLRIC-based UBA and UCLL pricing FPP determinations.

1 General principles of the Commission for determining TSLRIC prices

1.1 The TSLRIC approach of the Commission

1.1.1 General aspects

33. The Commission starts with the appropriate and state of the art conceptual framework that the HEO would operate a newly built network providing the relevant regulated services.[1] This implies that the HEO is not constrained by the legacy network and technology decisions of the regulated firm in the past. This holds for network technology, network design and dimensioning assets as well as for optimizing the cost structure.

34. We fully support this conceptual starting point of the Commission. In the actual modelling and implementation we do, however, observe a large number of deviations from these principles. A lot of reference is made to Chorus actual network design, dimensioning rules, legacy structures and technology decisions. Although the Commission may not have conceptually felt constrained by the "realities of the real world", in practice it made more than usual concessions to these influences. On the other hand the Commission generously applied a fully fledged Optimized Replacement Cost (ORC) valuation approach to all assets without considering differences to real world behaviour of operators in practice. Some of these deviations are acceptable. Others have the clear implication that the modelled network is not efficient, does not represent the standard an HEO would choose today and finally results in unjustified and inflated costs. This leads us to the conclusion that the Commission does not meet its own standards and principles for an efficient operator and for arriving at efficient costs. The calculated costs include irrelevant costs, exclude achievable cost savings and rely on inflated input parameter values. The current model development status and the population of the model with input data does not support the determination of prices based on the relevant TSLRIC.

1.1.2 Re-use of assets not considered

1.1.2.1 General use of ORC not justified

35. The Commission has taken a draft decision to use optimised replacement cost as its asset valuation methodology for all relevant assets which are part of the asset

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[1] See Commission, UBA, para 119 and Commission, UCLL, para.. 149.

base following from the bottom-up modelling. The ORC approach is being applied to all types of assets be they replicable or not, be they re-usable or not. Even fully depreciated assets which are still in use are valued as if they were brand new. The Commission intends to apply the ORC approach independent of whether it represents the behaviour of a rational profit-maximising firm in the market, the behaviour of operators operating in the New Zealand market today and independent of whether that would be in line with a rational investor's perspective.

36. While the reasonable investor expectations were the basis for the Commission's preliminary view to value all assets at ORC, it is now the principle of regulatory predictability which seems to guide the Commission to the inevitability of its asset valuation approach.[2] Furthermore, the Commission assumes a supposed failure of alternative methodologies to recognise the opportunity costs of fully depreciated assets that are still in use.

37. We disagree with the Commission's view. Neither regulatory predictability nor the consideration of opportunity costs lead to the inevitability of a general ORC asset valuation approach. The Commission's approach is not in line with current regulatory developments, it is not representative of operators' behaviour and it is not coherent with investor expectations. Furthermore, the Commission's approach has implications and consequences which are not in line with the long term interests of users in New Zealand.

38. Regulatory price determination in New Zealand is at the crossroads. For the first time the Commission will determine regulated wholesale prices on the basis of a TSLRIC cost modelling approach. That is a break with the regulatory tradition in New Zealand to determine regulated prices on the basis of international benchmarks. It is important to note that this change in the regulatory pricing approach results from a request of (nearly) all stakeholders operating in the New Zealand market. Stakeholders have initiated this change and they are aware (in any case they have to take into consideration) that the outcome of the modelling cannot be predicted in detail and the potential spread of the modelling outcome can be large. The Commission has made clear throughout the modelling process that it has a variety of options in its modelling approach and is not constrained by the Act in its choice. Furthermore, the choice of input parameters has a significant impact on the modelling outcomes. If a modelling exercise is conducted for the first time the criterion of "regulatory predictability" is relatively meaningless with regard to the outcomes of the model. Therefore this criterion does not provide any meaningful guidance to make the choice between various valuation approaches which are at the disposal of the Commission.

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[2] See Commission, UCLL, para. 621.

39. The Commission argues that any asset valuation methodology should consider opportunity cost.[3] We agree in principle, but do not agree with the Commission's conclusion that all assets have to be valued at their ORC. There needs to be a clear understanding of what opportunity costs in this context mean. The proper answer can be and has to be developed from the decision behaviour of a rational operator. A profit-maximising operator would re-use existing assets for the deployment of a new network as long as the opportunity cost of using existing assets are lower than the greenfield investment cost at an ORC level. It may be difficult for a regulator or a modeller to make this opportunity cost approach operational. In para. 59 we propose, however, a pragmatic approach of introducing the re-use of assets which solves that problem.

1.1.2.2 Commission's approach is not in line with current regulatory developments

40. More and more regulators around the world are reflecting on their application of LRIC/TSLRIC pricing so far. They respond to the situation of decreasing demand for copper access and the migration towards NGA and adapt their previous regulated price regime. The MEA approach in a similar or in a modified or different form as applied by the Commission is one conceptual answer to this challenge. The other major conceptual answer contains the valuation of copper network assets differently than under a general ORC approach. Those changes have happened in Australia[4], in some European countries already and will happen in all member states of the European Union soon after following the implementation of the costing Recommendation of the European Commission (up to the end of 2016) which we described in detail in our submission of 5 August 2014.

41. What the Commission calls the “orthodox” view and implementation of TSLRIC for ULL pricing more and more is becoming an out-dated approach that cannot be viewed as orthodox any more. From these developments we are rather sceptical whether the predictability of the regulatory framework in New Zealand as the Commission highlights will be supported by a costing and pricing approach which becomes less and less common in international regulatory practice. We doubt that that is the case.

42. We have highlighted the major elements of the European Commission's costing Recommendation in detail in our previous submission and the Commission is referring to it in detail. We only want to highlight one more aspect which seems to be ignored so far. The European Commission clearly recommends to the European NRAs not to model the access network on a greenfield basis where all relevant network elements should be newly invested. Instead the European Commission

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[3] See Commission, UCLL, para. 630ff.

[4] See ACCC, Inquiry to make final access determinations for the declared fixed line services, Final report, July 2011.

clearly recommends a brownfield costing approach which makes use of existing assets as far as possible to save resources and costs. According to the EU Commission's Recommendation NRAs "*should include any existing civil engineering assets that are capable of hosting an NGA network. Therefore, when building the BU LRIC+ model, NRAs should not assume the construction of an entirely new civil infrastructure network for deploying an NGA network*".[5]

1.1.2.3 The actual value of Chorus' assets

43. TERA provided information on Chorus' fixed asset register (FAR).[6] This table informs about the (historic) gross book value (GBV) and the closing net book value (NBV) of the fixed assets as of 30 June 2013. The relation of both numbers informs on the value of the assets which have already been depreciated.

44. The historic value of Chorus' fixed assets represents a value of $ [...] CNZRI billion (without adjustments). The net book value of the assets amounts to $ [...] billion as of 30 June 2013. This means [...] CNZRI % of the historic asset base of Chorus is already depreciated.

45. Unfortunately, the FAR does not reveal in detail whether the asset classes represent assets for the copper access network, the core network or Chorus UFB fibre networks. Nevertheless, the FAR reveals that a variety of assets or even asset classes are fully depreciated (remaining net book value below 5% of GBV) or significantly depreciated (net book value below 20%) but still in use. Such asset categories include [...] CNZRI. For those assets Chorus will receive an economic compensation twice if the ORC approach is generally applied. Users already in the past have fully compensated and paid for the economic value of these assets and the Commission is requesting that today's and tomorrow's users will have to pay for the use of these fully depreciated assets once more. This double-recovery of costs over time is not related to some tiny and unimportant asset classes. It is related to the most relevant parts of the existing asset base.

46. Compared to an NBV of $ [...] CNZRI billion of Chorus fixed assets (June 2013) the UCLL and UBA prices are calculated on an ORC based asset value of $ [...] CNZRI billion for the access network and $ [...] CNZRI billion for the UBA service. This in sum is a factor of more than [...] CNZRI compared to the actual value of the assets in use if one takes into consideration that Chorus provides a variety of additional services on the basis of its actual asset base which represents [...]

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[5] See European Commission Recommendation of 11.9.2013 on Consistent non-discrimination obligations and costing methodologies to promote competition and enhanced the broadband investment environment, C(2013) 5761 Final, rec. 32.

[6] See sheet "Q6 19 6 a Asset lifes" of the UBA input model "CI_ComCom-UBA Inputs v1.0.xlsx".

CNZRI % of its revenues.[7] These numbers indicate that Chorus will generate supranormal profits under the asset valuation approach of the Commission compared to the actual book value of the assets which are actually used to produce the regulated services. The assets actually used represent about [...] CNZRI (or even less) of the value the Commission is attributing for the purpose of calculating the regulated UCLL and UBA prices.

1.1.2.4 Implications of the Commission's approach

47. The asset valuation approach of the Commission has implications on the level of wholesale and retail prices, on the adoption of broadband services in New Zealand, on the profits of Chorus and on the competition between the copper network and the fibre network platform.

48. The Commission’s asset valuation approach will inflate the level of wholesale prices which are the major cost component in providing broadband access at the retail level in New Zealand. Given the intensive competition at the retail level it can be expected that price changes at the wholesale level will be passed through to the retail level. Broadband users in New Zealand would have to pay higher prices for internet access than they would have to pay today. The retail price implications will not only cause (traditional) static welfare losses. Due to the negative impacts on the path of broadband penetration in New Zealand further negative externality effects will occur as well as negative impacts on the dynamic efficiency of the New Zealand economy.

49. Chorus will receive under the asset valuation approach of the Commission economic rewards for an asset base which is higher by a factor of [...] CNZRI compared to Chorus’ book value of the relevant assets and which even the management of Chorus and the shareholders of Chorus did not regard as necessary to build the new fibre network. This valuation of assets will generate significant windfall profits to Chorus.

50. The existing copper network will still be in use for several years. Furthermore, there will be areas in New Zealand where there are currently and in the foreseeable future no plans to build a fibre network. In those areas the copper network will probably still have quite a long future. This development will imply that the amount of assets which are or will become fully depreciated will steadily increase. This also implies that the windfall profits which flow to Chorus from the ORC valuation approach will steadily increase if the Commission keeps its general ORC valua-

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[7] For the ORC based asset value of the access network in 2015 see Excel map “CI_ComCom - UBA model v5.1.xlsb”, Sheet “Import from the ACCESS model”, cell I2178. For the ORC based asset value of the UBA service see Excel map “CI_ComCom - UBA model v5.1.xlsb”, Sheet “Outputs” cell I18. For the revenues allocated to UCLL and UBA services see Excel map “CI_ComCom-OPEX model v1.10.xlsm”, Sheet “Alloc key”, cell K121.

tion approach for all assets. The issue of unjustified over-recovery of investment cost and the double-recovery of cost will increase in the next few years.

1.1.2.5 Commission's approach not in line with operators' behaviour

51. When the Commission sets the framework for technology choice, coverage, and network configuration it is rightly guided by referring to what the rationally acting profit-maximising HEO would do. In the context of re-use of assets, however, the Commission ignores this important point of reference and is not guided by the actual business behaviour of operators.

52. If a rationally acting operator would have access to resources which could be used or re-used to deploy a new network it would make use of such assets and resources instead of investing or re-investing in those assets if that would result in lower costs. This, of course, should be viewed in a long-term perspective. Saving investment cost at the expense of increasing operating expenses for instance has to generate a combined positive cost saving in NPV terms before that would save costs in the long-term. Otherwise, the firm would not maximise profits. Therefore not considering the re-use of assets is not compatible with a rational behavioural reference point for the HEO.

53. It may be important to shed some light on what the re-use of assets may actually mean in a real operational environment. Operators facing a certain lifetime of an asset may decide to extend that lifetime (significantly) instead of replacing that asset by a new one. The useful lifetime may be extended by conducting some improvements into the quality of the asset with some low incremental investment. Therefore, re-use of assets is consistent with replacement and new investment. Re-use only means that there are relevant options of deployment which lead to lower cost than investing on a greenfield basis. Both aspects are highly relevant in the context of ducts and trenches but not limited to these assets. There are not too many examples around the world where ducts and trenches are fully replaced when it comes to deploying a new network. Re-use of duct and trenches is the rule and not the exemption. Re-use also means to use spare capacity (e.g. for ducts, trenches, fibre pairs and buildings) due to overcapacity or indivisibilities.

54. During the structural separation process and in the following communications to investors Chorus has provided a lot of information about the nature and degree of asset re-use in building its fibre networks and its corresponding deployment policy. In the scheme booklet, the document that sets out the structural separation proposal, Chorus formulated its management's policy regarding re-use of assets:

> *“It is Management's intention to leverage and build upon the existing investment in fibre-to-the-node (FTTN) to deliver the UFB Network by utilis-*

> *ing, to the extent possible, the existing assets and capabilities within the business based on the deployment of over 27,600 kilometres of fibre to date. However, the deployment of the UFB Network is a significant undertaking. Management estimates that to build the UFB Network within the 24 UFB candidate areas awarded to New Chorus will require the deployment of approximately a further 17,000 kilometres of new fibre lines and it will also require additional deployment of fibre from the UFB Network to connect a Premise.“*[8]

Chorus management believed it could achieve around 40% of UFB deployment utilising existing trenching:

> *“Deployment of the communal infrastructure will be achieved utilising several deployment methods. Wherever economically viable existing trenching will be used, otherwise new trenching or aerial deployment methods will be used.* ***Current Management estimates assume that approximately 40% of the deployment will utilise existing trenching, approximately 35% will utilise new trenching and approximately 25% of the deployment will be achieved utilising aerial deployment.*** *However, until the deployment of the UFB Network is fully underway the exact deployment method mix will not be known and could change significantly and will vary on a year to year basis throughout the deployment.*[9] [our emphasis]

Chorus also intends to use a significant degree of copper connection lead-in for the UFB network:

> *“Wherever economically viable the existing copper connection ‘lead in’ duct or pole infrastructure will be utilised to connect Premises and end-users to the UFB Network. Management estimates that it will be able to utilise approximately one third of the existing ducts and one third of the existing aerial pole infrastructure to Premises to connect to the UFB Network. Where existing ‘lead ins’ cannot be utilised, the most cost effective method of connection is expected to be utilised.”*[10]

55. These intentions of Chorus’ management were subsequently reiterated in a presentation to investors in May 2012.[11] In a transcript of that event Chorus’ management states:

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[8] Scheme booklet, page 97, https://www.chorus.co.nz/investor-information#investor-information/annual-reports/annual-reports?&_suid=1422491254375033558946746595525.

[9] Scheme booklet, page 98, https://www.chorus.co.nz/investor-information#investor-information/annual-reports/annual-reports?&_suid=1422491254375033558946746595525.

[10] Scheme booklet, page 98, https://www.chorus.co.nz/investor-information#investor-information/annual-reports/annual-reports?&_suid=1422491254375033558946746595525.

[11] See May 2012 investor day, https://www.chorus.co.nz/investor-information/presentations/2012, https://www.chorus.co.nz/file/48846/investor-day-other-presenters.pdf.

> “*We'll be reusing as much of the existing network as we can for the UFB deployment and identifying opportunities to work with councils and utilities to reduce deployment costs is something that we're really focused on. This can involve trench sharing or linking with footpath programs to avoid reinstatement costs. [...]*
>
> *With 60% to 70% of deployment costs relating to civil work, it's critical to leverage as much of our existing duct network as possible.* ***Half of our existing network is already ducted and we expect to be able to use much of that as we deploy and only 60% of the network will need to be new duct.*** *We're also able to employ a consistent approach across UFB and RBI through the use of many of the same materials on both jobs. For example, we're able to use the same cabinet modified to house active equipment and similar microduct where appropriate for RBI.*
>
> ***In addition to using a lot of the existing duct network, we'll also be able to use much of the fibre deployed for Fibre to the Node to connect the new UFB cabinets back to the central office -- about 50% of the time.” [...]***[12] [our emphasis]

This statement shows that Chorus’ re-use of assets also has an external dimension. We refer to this aspect as sharing of network assets with councils and utilities in Section 5.11.1. External sharing is not yet reflected in the model although it seems to be a reality in New Zealand as we expected. This statement also shows that asset re-use is a reality in the context of UBA.

56. The relevance of asset re-use is furthermore underlined by Chorus’ policy even to determine network architecture depending on the availability of re-usable assets as the following statement highlights:

> “*As we deploy the network down the street, to be able to connect individual houses to the cabinets, we take a flexible approach there too, so can utilise any existing network that may already be there. Our standard approach is to deploy microduct for air blown fibre. This is deployed either into an existing duct, where there is room, or directly into the ground. Microduct enables the actual fibre to be deployed on demand deferring the investment until closer to revenue generation. However, where there is existing duct but no room for microduct, we can use the traditional fixed fibre and utilise a different network architecture. Also, depending on which option is more cost*

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[12] Transcript from May 2012 investor day, page 11, https://www.chorus.co.nz/file/48848/cnu_nz-transcript-2012-05-22t22_00.pdf.

> *effective overall, we will take the duct down either one side of the street or both."*[13]

Upon respective questions Chorus' management confirmed that the amount of duct re-use originally anticipated and planned has been materialized in the effective roll-out.

57. In its annual report for 2014 Chorus has underlined the importance of re-use and external sharing as it has even rescheduled work to maximise sharing opportunities:

> "*Chorus estimates the total cost to build the UFB communal network by the end of 2019 is $1.7–$1.9 billion. The cost of the deployment of UFB communal network for the year was $338 million. About $4 million was spent on 'UFB synergy' work where elements of communal network build were brought forward to align with work being undertaken by other network or infrastructure owners."*[14]

58. In these extensive statements Chorus consistently states a degree of 35% to 50% of asset re-use in building its fibre network. This (internal) re-use is even augmented with external sharing of trenching infrastructure. This is a significant degree of asset re-use which is even higher than we could observe in some European countries. This degree of asset re-use implies a capital expenditure saving of 20% to 30% relative to the greenfield deployment which is assumed in the cost model.

59. The Commission has reservations about following a dual asset valuation methodology to provide for re-use of assets and to value assets differently for methodological reasons. There are other and perhaps more pragmatic ways to take care of re-use of assets than a dual asset valuation approach. The Commission could still keep its ORC approach for all assets but apply a general deduction factor for the re-use of assets reflecting the difference between brownfield and greenfield costs of deploying a new infrastructure. This general deduction factor can be applied either at the level of costs or at the level of investment costs. It can also be applied to all assets or only to asset classes where re-use is most plausible and probable to occur. According to our experience such a brownfield/greenfield investment saving factor in the access network is in the range of 20% of the investment value. On the basis of the investment value of the access network, calculated by TERA, asset re-use would generate investment savings in the order of $ [...] CNZRI billion.

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[13] Transcript from May 2012 investor day, page 11, https://www.chorus.co.nz/file/48848/cnu_nz-transcript-2012-05-22t22_00.pdf.

[14] Chorus, 2014 Annual report, page 33, https://www.chorus.co.nz/investor-information/annual-reports/annual-reports.

1.1.2.6 Commission's approach not in line with investors' expectations

60. Although the Commission will no longer use the concept of "*reasonable investor expectations*" as an independent criterion in its Section 18 considerations**[15]**, this criterion nevertheless has relevance when it comes to assess what operators actually do to meet the expectations of their shareholders and investors. As we already pointed out in our submission from 5 August 2014**[16]** investors expect that operators make best use of their existing network assets when deploying a new network (or expanding the capacity of their existing network). Investors expect the use of assets which have lower opportunity costs than new investment at current replacement costs. They would not accept that the management of the firm would not make use of available cost savings in conducting major new network investments. We have described the various forms which "re-use of assets" can actually take in para 53. Its general nature from an investor's perspective is that the deployment of a new network at so-called brownfield costs leads to lower network deployment cost (in NPV terms) than the deployment at greenfield cost where all relevant network assets have to be fully newly invested. A firm which sets up a new network which can re-use (parts) of its existing asset base and could produce at brownfield cost but chooses not to would not maximise profits. This would not be coherent with the expectations and interests of investors.

61. A major argument of the Commission to keep a general and uniform application of an ORC based asset valuation methodology seems to be "*predictability*".**[17]** **[18]** Predictability from the investor's perspective would require that the management of the regulated firm actually deploys at the lowest achievable costs (in a long-term view), which includes re-use of assets if that lowers cost. If the regulator allows for greenfield deployment cost investors would not oppose, would even ask for it in the lobbying process, but would view it as a windfall profit to them following from regulatory allowances which generate supra-normal profits. The Commission should assume that its HEO meets the rational expectations of its shareholders, not more and not less.

1.1.2.7 Commission's approach not in line with its own modelling approach

62. Several basic criteria and assumptions of the Commission's own modelling approach only make sense if the Commission assumes a re-use of assets. This includes the use of existing ODF locations in the FTTH network and of the existing sites of the FWA.

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[15] See Commission UBA, para. 153 and Commission, UCLL, para. 183.

[16] See WIK-Consult: Submission of 5 August 2014, para. 15.

[17] See Commission, UCLL, para. 300.1.

[18] Without further analysis also Ingo Vogelsang, Current academic thinking about how best to implement TSLRIC in pricing telecommunications network services and the implications for pricing UCLL in New Zealand, November 25, 2014, para. 85f.

63. We will show in Sections 5.6.1 - 5.6.4 that an HEO building a greenfield fibre network would not (necessarily) deploy its fibre network based on the number and locations of the legacy copper network assets. The HEO could achieve a more efficient outcome if it chose a different network architecture with probably less ODF locations than assumed in the TERA model. The Commission's scorched node approach does not allow for achieving these cost savings.

64. On the other hand, building the fibre network along the lines of the existing network nodes of the copper network makes a lot of sense for the legacy network operator. It enables him to make best use of the existing node locations (and buildings), the existing ducts and trenches and (potentially) existing fibre cables. That is exactly what Chorus does and it is a similar architectural deployment approach chosen by other incumbents which are also rolling-out fibre networks.[19]

65. By ignoring the impact of the re-use of assets in the deployment of the fibre network the Commission is distorting efficiency requirements twofold and is violating the long-term interest of end-users. Firstly, end-users are burdened by the Commission's approach with fibre costs which are too high because they do not represent the efficient greenfield deployment architecture. Secondly, the Commission models a fibre architecture which is in line with and only makes sense in the context of asset re-use without letting end-users participate in these benefits. This approach effectively generates economic rents for Chorus and burdens end-users twofold without any benefits to them and without any justification.

66. Finally we note that, in the context of the exclusion of certain capital cost for UBA the Commission made assumptions implicitly relying on the re-use on existing assets.[20] This reflects an arbitrarily use of valuation principles which is not consistent throughout the modelling.

1.2 A uniform MEA network for ULL and UBA

67. The model uses a FTTH Point-to-Point fibre topology as modern equivalent (MEA) asset for the UCLL price determination. This is the most future-proof Next Generation Access (NGA) network architecture existing. It allows for nearly unlimited bandwidth per end-customer, providable on individual demand. The access network infrastructure thus allows for Terabits/s per customer, far beyond todays' demand. But taking into account the age of the old copper infrastructure and the high cost share the civil engineering infrastructure in telecommunication networks has, and considering the fast broadband demand growth it makes sense to set FTTH as the MEA. For sparse populated areas FTTH is replaced by Fixed Wireless Access (FWA) in order to limit the cost per home connected. We are con-

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[19] See for example the deployment strategies of Swisscom and KPN in Europe.

[20] See Section 2.7.

vinced that a hypothetical efficient operator, planning today in a greenfield deployment would deploy such a network. This would also hold for additional bandwidth providing bitstream services. The modelling approach of the Commission does not follow this logic of having just one future-proof infrastructure for all access services.

68. In contrast to the above considerations the Commission's model uses a FTTN based MEA for determining the efficient bitstream (UBA) cost. This the Commission justifies by legal arguments, but it results in severe inconsistencies and cost inefficiencies.

69. While in the FTTH architecture there is an individual fibre between the end-customer equipment and the local exchange without any intermediate cabinet, in the FTTN architecture there is an intermediate cabinet at a scorched node location, which hosts a DSLAM which is connected by a single fibre strand to the next (first) data switch. The end-customers are connected to the DSLAM by the existing copper pairs, only allowing limited bandwidth compared to the future-proof FTTH network. The cabinet location has been taken as given, without any efficiency improving approach. Thus, the optimization approaches already are quite different between both access network architectures, and thus the cost base too.

70. Due to the use of copper in the access network the bandwidth supported by FTTN compared to FTTH is very poor and in no case really future-proof, because it does not allow for more than 100 Mbps downstream and allows asymmetric transmission only. This generates a real major performance delta to FTTH.

71. The model operates in a manner that the network architecture (FTTH or FTTN) with the lowest cost will be the one determining the UCLL price. The Commission argues for this approach with the implementation of a performance delta between fibre and copper when copper is cheaper. Thus, in fact the FTTN copper network is chosen when the FTTH fibre access network is more expensive than the FTTN network. In this case the factual MEA for UCLL and UBA are the same (FTTN).

72. While the FTTH MEA is amended by FWA, the FTTN copper network is not. This leads to significant additional cost for the copper network, since it has to serve the sparsely populated areas with expensive copper access lines. This means and implies that both architectures are not designed on an architectural level which allows to compare the cost of both network technologies appropriately.

73. The different MEA networks are characterized by different nodes where the respective networks are terminated. The FTTH MEA network is terminated in the 790 local exchange locations, the FTTN copper UBA MEA network is terminated at the 92 FDS locations, thus at a higher aggregation level (see para. 302).

74. If FTTH is less expensive than the FTTN copper network, the FTTH network is chosen for the UCLL price determination and the FTTN network topology is chosen for the UBA cost determination, combined with the FTTH UCLL prices. Thus, the MEA for both services are not the same, despite the fact that a HEO would actually produce them on the same network. Because the FTTH architecture does not include intermediate cabinets an artificial SLU backhaul is used, derived from the FTTN topology. This completes the inconsistency of the Commission's approach even more, resulting in double-counting of cost for the feeder network segment between cabinet and local exchange (for more details see Section 4.2.4). We once again recommend using the same FTTH MEA for both services, allowing for a copper price performance delta adaption in determining the copper UCLL price (compared to the fibre UCLL price). Both should be based on the same topology and take correct cost shares between copper and fibre lines in the feeder network segment into account (see Section 2.2). Only this approach avoids inconsistencies and leads to efficient costs.

1.3 Asymmetric risk

75. The Commission starts with an axiom saying that asymmetric risks exist within the telecommunications sector which are not reflected in the asset beta of the WACC formula. The Commission has considered asymmetric risks to be relevant for the HEO and has included ex ante allowances for specific categories of asymmetric risk.[21]

76. The Commission is considering the following forms of asymmetric risk:[22]

- Catastrophic risk;
- Asset stranding due to technological change;
- Asset stranding due to competitive developments; and
- Asset stranding due to re-optimisation.

For some of these categories the Commission accepts ex ante allowances; for others it does not.

77. Allowances for catastrophic risk are recognised by the Commission as a relevant cost.[23] We agree with the Commission's view that the HEO would prudently insure against catastrophic risk. Therefore, it is appropriate to consider appropriate insurance cost to cover for catastrophic events as relevant costs. We also agree

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[21] See Commission, UCLL, Attachment F and Commission, UBA, Attachment D.
[22] See Commission, UCLL, para. 701.
[23] See Commission, UCLL, para. 703ff.

with the Commission's view to include costs for seismic bracing and backup generators as part of the relevant cost base of the HEO.

78. The Commission also has decided in favour of an ex ante allowance for asset stranding due to technological change.[24] The preferred option of the Commission for an ex ante compensation for the asymmetric risk of asset stranding is to extend and to adopt asset lives that reflect that risk. De facto the Commission used (with a few exemptions) Chorus' asset lives which incorporate in the Commission's view the risk of assets becoming obsolete due to technological change.[25] In Section 5.8.7 we will show that a variety of these asset lives are lower than relevant international benchmarks. By accepting them the Commission effectively recognizes allowances for an asymmetric risk. All telecommunications network operators face the same or at least a similar risk of technological change. We do not agree with the Commission's assessment that technological change (including the risk of asset stranding) represents an asymmetric risk for telecommunications operators. Technological change is anticipated by the market and represents a systematic risk in telecommunications. It is properly reflected and measured in the asset beta of the WACC formula. That is the common understanding of NRAs. We are surprised that the Commission intends to deviate from this common understanding of regulatory authorities in the telecommunications sector. De facto the Commission's approach would lead to a double-recovery of the same risk.

79. We agree with the Commission that asset stranding due to competition and due to re-optimisation is not eligible for additional ex ante allowances for asymmetric risk. Re-optimization usually is induced by technological change and represents no additional risk component.

80. We fully agree with the Commission's view that ex ante allowances for asset stranding due to future regulatory decisions are not appropriate. By generally applying an ORC asset valuation approach the Commission allows for an asset base for calculating TSLRIC which exceeds the actual valuation of Chorus assets by a factor of [...] CNZRI. Chorus' asset base for the access network represents a historic investment cost value of $ [...] CNZRI billion[26], the actual book value of the access network only amounts to $ [...] CNZRI billion.[27] This compares to a replacement value of the modelled FTTH/FWA network plus the core network relevant for UBA at the amount of $ [...] CNZRI billion.[28] These relations imply for

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[24] See Commission, UCLL, para. 711.ff.

[25] See Commission, UCLL, para. 720.

[26] See TERA, sheet "Q6 19 6 a Asset lifes" of the UBA input model "CI_ComCom-UBA Inputs v1.0.xlsx", cell C92. This value overestimates the relevant historic investment value because it includes Chorus' fibre UFB investment and investments for other services than ULL and UBA.

[27] See TERA, sheet "Q6 19 6 a Asset lifes" of the UBA input model "CI_ComCom-UBA Inputs v1.0.xlsx", cell E92.

[28] See TERA, Excel map "CI_ComCom - UBA model v5.1.xlsb", Sheet "Import from the ACCESS model", cell I2178 plus Excel map "CI_ComCom - UBA model v5.1.xlsb", Sheet "Outputs" cell I18.

Chorus not a regulatory risk but in contrast a regulatory generosity which we do not fully agree with.[29]

1.4 Exclusion of certain capital costs

81. We recognize that the Commission takes note of the fact that the HEO will not incur all of the capital cost of building the network itself.[30] Chorus in the past and network operators today receive capital (or other cost) contributions from the Government, from the TSO funding regime and from users directly to build the network nationwide including coverage in remote and rural areas which represent low density and high cost characteristics.

82. These various forms of contributions do not only have relevance for the past. As the Commission rightly assumes, the HEO as a profit-maximising entity will in the real world not build a nationwide network including all high cost areas/customers without capital contributions from other sources. Not considering those capital contributions would lead to a double-recovery of cost.

83. We support the pragmatic assumption of the Commission that the HEO would not deploy its network beyond the TSO coverage area. We also support the pragmatic assumption of the Commission that the HEO deploying a nationwide network will still have to cover the operating expenses of running the network also for the non-TSO connections but not the capital cost of deploying the network also in the non-TSO areas.

84. Despite this general recognition of capital cost contributions from other sources we have to state several weaknesses and imperfections in the Commission's approach of dealing with capital contributions. In Section 5.3.1 we will show that the Commission and in particular the modelling approach ignored major capital cost contributions by users regarding the lead-in segment of the network. In Sections 2.7 and 3.5 we will furthermore show that the Commission did not properly include all relevant capital cost contributions which are relevant for deploying the HEO network.

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[29] See our analysis of the non-consideration of the re-use of assets in Section 1.1.2.

[30] See Commission, UCLL, Attachment J and Commission, UBA, Attachment H.

2 UBA specific aspects

2.1 TSLRIC for UBA

85. The Commission’s cost model generates a uniform TSLRIC figure for the additional cost of the UBA increment independent of the type of the UBA service. The regulated bitstream services consist of a basic variant (“BUBA”), which is by far the mostly demanded bitstream access service, and a set of enhanced bitstream services (“EUBA”) which differ according to the bandwidth of the real-time channel of the services. Furthermore, the EUBA service variants offer a real time class of service in addition to the best efforts BUBA service.[31] The cost model of the Commission does not provide cost differentials between Basic UBA and the various EUBA variants. This outcome follows mainly from the assumption, that bandwidth is not a cost driver for UBA. Further service feature differentials which might cause cost differences are also not modelled. We have criticized the appropriateness of ignoring bandwidth as a cost driver in para. 270.

86. The Commission, however, did not follow its own cost modelling results and its TSLRIC pricing principles in determining the bitstream access prices. Instead, the Commission used a gradient approach to determine the price differentials between BUBA and EUBA variants. While the gradient approach ensures that the average revenue from the relevant products equals the average TSLRIC costs (if nothing changes), it does not reflect the structure of costs. The intention of the gradient approach is that prices reflect customers’ relative willingness to pay for the different service variants. The Commission used the gradient in place from the 1 December 2014 price differentials which are determined in the UBA IPP and which are based on an international benchmarking approach.[32] Applying the gradient led to a price differential between the BUBA service and the EUBA 180 service of 36%. Because the Commission did not identify cost differentials between services it is de facto not applying a TSLRIC based pricing approach but a value based pricing approach.

87. One may argue that this pricing approach despite not being in line with TSLRIC pricing principles may not lead to relevant market distortions because the resulting level of prices is (just) cost-covering. Currently, there is only a negligible demand for the real-time channelized EUBA services and nearly all bitstream access demand is related to BUBA/EUBA 0. This also means that there are only minor deviations of a TSLRIC price for BUBA/EUBA 0 from the price determined by the gradient approach of the Commission.

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[31] See Commission, UBA, para. 335.

[32] See Commission, UBA, para. 361.

88. If, however, within the regulatory period demand is shifting towards EUBA services major distortive effects may occur. A shift of demand from BUBA/EUBA 0 to other EUBA variants will have three distortive implications: Firstly, Chorus will become overcompensated compared to cost-based pricing. Secondly, wholesale access and broadband retail becomes more expensive without any increase in the relevant costs. Thirdly, the BUBA/EUBA 0 service becomes relatively more expensive compared to the other EUBA services without any change.

89. We recommend the Commission follows one of the following two options: The Commission could either give up its gradient pricing approach totally and follow a TSLRIC based pricing approach. Or the Commission should commit to change its gradient pricing approach within the regulatory period, if relevant shifts of demand occur. If the Commission expects relevant changes to occur in the demand pattern, it should follow the latter approach.

90. The cost of providing the UBA service vary geographically. The costs in more densely populated urban areas are lower than those in less densely populated rural areas. These differences follow mainly from the scalability and the utilization of FDS and DSLAMs. Most of the DSLAMs, especially those in non-urban areas, are poorly loaded compared to their port capacity. Thus, the cost per port increase due to a lower scale of operation (see Sections 5.4.1 - 5.4.3 for more details). In consequence this is also true for the FDS. Those FDS in non-urban areas support DSLAMs with less customers and thus their cost per customer increase. The largest DSLAMs are installed in local exchange locations with relatively short access lines, mainly in urban areas. These DSLAMs scale well, and the FDS in consequence also. One can also reasonably assume that the trench cost per customer for the SLU backhaul between DSLAM locations and FDS locations will be significantly larger in non-urban areas. The Commission is required to set a geographically averaged price for UBA. But we are also advised that one of the conditions associated with the service is that the Commission may apply a competition test to it. From our experience competitive services are most likely to become available in the lowest cost areas, and it is important that access seekers have information on these cost differentials to inform efficient build or buy decisions. Therefore, we recommend to the Commission to derive urban and non-urban UBA TSLRIC values from the model and develop a geographically averaged price on this basis. The model should be capable of deriving such results.

91. The Commission intends setting a constant TSLRIC price in nominal terms over the regulatory period. Therefore the Commission needs to determine the nominal price for each year and then sets it equivalent in present value terms to the tax-adjusted tilted annuity over the regulatory period. The main reason for the Commission taking this approach seems to be price stability over the regulatory period. Price stability is not a value in itself. There are also intertemporal competitive effects which have to be taken into consideration to determine the appropriate price

path. Assume that costs increase over time. Then access seekers which shift their service demand from UBA to fibre products and/or other unregulated wholesale products would be facing higher UBA expenditures under a constant UBA price compared to a TSLRIC price which reflects the cost path in each year. This may distort competition and the efficient choice of access seekers among various wholesale products. Furthermore, a constant price over a five year period can be more disruptive to the market at the beginning and the end of the regulatory period if there is a steady cost trend. Therefore we recommend the Commission considers its preliminary decision of a constant UBA price over five years and to determine a price path which is in line with the cost path developed by its own cost model.

2.2 MEA for UBA

92. The modern equivalent asset for a UBA product should be oriented at what a hypothetical efficient operator would deploy today if he would build up a new network from scratch (greenfield approach). We are convinced that the HEO would never invest in a newly constructed copper network, even if the copper lines only have to be deployed in the last network segments close to the customers' premises. Fibre has significantly superior transmission characteristics with regard to bandwidth and transmission quality. Such investment decisions which take into consideration copper access lines are only taken in a path-dependent manner, when copper lines already exist and a combined fibre/copper solution allows the operator to reduce immediate investment requirements to meet the actual bandwidth demand and compete faster with existing cable-TV network operators (operating on DOCSIS 3.0). A nationwide fibre roll-out is more time consuming than just a roll-out of a fibre feeder network. An HEO not having access to existing copper access lines thus in any case would roll-out fibre to the home.

93. One might debate, whether a FTTH point-to-point (PTP) or a point-to-multipoint (PTMP) topology is more appropriate. A PTMP topology with splitters in the field (somewhere between the local exchange and the customer premises) requires electronic equipment to control and manage the single fibre access at the local exchange. This equipment (e.g. GPON) will limit the bandwidth of the access lines. It also only allows UBA services to be offered at local exchange sites. A PTP topology is not limited in bandwidth to that extent[33] and thus more future-proof. It also allows unbundling. The cost of both topologies do not differ significantly[34]. A network operator being required to offer ULL and UBA services will of-

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[33] State of the art technology allows for more than 10 Tbps over a fibre strand and there still is a wide range of improvement.

[34] See Hoernig, S.; Ilic, D.; Neumann, K.-H.; Peitz, M.: Plückebaum, T.; Vogelsang, I. Architectures and competitive models in fibre networks, Bad Honnef, Dezember 2010, http://www.wik.org/uploads/media/Vodafone_Report_Final_WIKConsult_2011-01-10.pdf and Hoernig,

fer both services on the same access network topology, since it makes no sense from an efficiency and cost optimisation point of view to implement two topologies, particularly because the GPON technology may be also deployed on a PTP fibre topology.[35] Thus from our point of view the appropriate MEA for the UBA service in New Zealand should be FTTH on a PTP fibre topology in particular when that also is the relevant MEA for providing UCLL. In countries with settlement structures like New Zealand it will be amended by FWA in sparsely populated areas. This would be the most efficient approach for an operator which provides both the UBA and the UCLL (and other access) services (see also Section 1.2).

2.3 Network optimisation

94. The UBA network is a part of the overall NGN and NGA network an HEO (offering all services Chorus offers, regulated and unregulated) would be operating, and one has to assume that this will be designed and operated in the most efficient manner. This requires that all services being transported over such a network have to be taken into account. Only taking all services into account guarantees that the HEO network operates at the same level of scale Chorus (and the HEO) could achieve.

95. Designing an efficient NGN network requires developing an efficient network hierarchy with network nodes of sufficient capacity and with an efficient connecting trench network. This should incorporate best practice or even legally and regulatorily defined network resilience obligations, typically expressed by physical ring network topologies. Since even for the core network the network infrastructure costs represent the largest share of the total cost, a cost efficient dimensioning is important. This would also have an impact on the trench lengths and routes for the trenches used in the UBA model. We cannot observe any such network optimization in the model description or in the model itself. Although it is argued for the UBA network trenches to be optimized efficiently[36] this only can be performed according to geospatial conditions without taking NGN network hierarchy considerations into account (see Section 4.2.1). We know from many cost modelling exercises that network efficiency – even in its infrastructure topology – strongly depends on network traffic, but for example the Tail Extension Service (TES) of Chorus has not been taken into account in the modelling (Model Specification, Section 7.1). TERA instead just takes the node locations and the existing connections as they are reported by Chorus, and just optimizes neighbouring node connections in

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S.; Jay, S.; Neumann, K.-H.; Peitz, M.; Plückebaum, T.; Vogelsang, I.
The impact of different fibre access network technologies on cost, competition and welfare, Telecommunications Policy 36 (2012), pp 96 - 112, http://ssrn.com/abstract-1985747.

[35] See WIK-Consult, Submission of 5 August 2014, para. 25ff.

[36] TERA's Model Documentation, Section 4.2 states "*that the path followed by the core links are not Chorus' actual paths as these paths have been optimized*".

a shortest path manner along streets. The only “traffic” included in the FDS is the traffic from the bitstream ports, aggregated by the DSLAMs. This is conceptually inappropriate and not efficient. It neglects for example the Ethernet leased line traffic completely.

96. It is neither set by definition nor obvious or conclusively argued that the UBA FDS node locations are the optimal locations or that the number of FDS nodes is most efficient. Even if we would agree that the existing 92 handover points should also be supported in future, it is still not clear that the number of FDS network nodes – which concentrate the traffic of all DSLAMs directly - is most efficient, or if additional concentrating Ethernet switches would help to reduce the underlying network infrastructure cost. We observe modern network architectures where all DSLAM backhaul connections are concentrated in DWDM ring topologies, passing through all local exchange locations and terminating the backhaul lines at the first data switches of the core network, thus reducing infrastructure cost. These rings allow an operator to double-assign the traffic of each local exchange to two not collocated higher level network nodes and thus maintain or even improve the network resilience against line failures. Non of these aspects have been considered or introduced into the UBA network architecture of the model. Thus even an indication of network optimization is missing. Instead, the existing historic network topology of Chorus has been accepted and reproduced, including the existing DWDM and submarine cable sections and their cost.

2.4 Network dimensioning

97. As already described above the network traffic and the quality of service of each particular service has to be taken into account for an efficient network dimensioning. It is quite obvious that a dimensioning of the network nodes just according to the number of customers will not be efficient. While a DSLAM with approximately 760 customer ports backhauled by an 1 Gbps link – similar to those used in the model - can support a peak average capacity of approximately 1.4 Mbps per port (or customer) and thus provide sufficient capacity for today’s demand and demand in the near future (approximately 300 Kbps), this will change with the increasing demand of the future.

98. But already with today’s demand one can show, that under certain circumstances an FDS would limit the average peak capacity to 140 Kbps only, significantly below capacity demand (for details see Section 5.4.3). This demonstrates in a simple manner that the approach of modelling the FDS size only according to the ports and not also according to the average peak capacity per end-customer traffic is misleading. It results in an under-dimensioned network, not being able to support the actual customer demand. Thus, the cost might be underestimated by the model design in this respect.

99. The UBA model has to be efficiently dimensioned according to traffic demand and quality of service of all services and not just by the number of customers. That is what operators do and what a proper modelling approach should replicate.

2.5 Asset lifetimes

100. The Commission and TERA took asset lives of Chorus as the appropriate starting point.[37] Only where (major) deviations from international benchmarks were observed, were corrections made. Effectively we could only identify a few deviations from the Chorus' numbers. As we will show in Section 5.8.7 a variety of asset lives is too short as to benchmark observations.

101. We have general reservations against the Commission's procedural approach. If the Commission is of the opinion that asset lives should primarily be based on New Zealand typical and representative economic practice of operators, it should have conducted a national benchmark (see Section 4.2.9.1). Several operators in the New Zealand market use the same or a similar equipment, face the same or similar costs in certain network assets. It is good practice in such a case to rely on the real world experience of a variety of stakeholders in the market and not only on that of the regulated firm.

2.6 Price trends

102. We do not provide a comprehensive analysis of price trends assumed in the model. Instead we will focus on a few selected items.

103. Beca has forecasted the price escalation for trenching by 3% per annum[38]. It is based on the New Zealand Capital Goods Price Index up to June 2014. The method of mixing the different asset types and the methodology for extrapolation remain uncertain. We doubt this value to be appropriate since according to our experience trenching experiences major efficiency improvements over time and will continue to do so. Also new technologies (like micro-trenching) will be applied more and more. This is especially reflected in the index for pipelines, which significantly decreased in the recent past (2012 – 2014)[39]. Thus, the price trend for trenching should reflect these efficiency improvements over time. We therefore recommend a price trend of 1% instead of 3%.

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[37] See Commission, UCLL, para. 735.

[38] Beca report of 25 November 2014, p. 8.

[39] Table 3, CGPI in the Beca report (see above) reports for pipelines an average decrease of 6.35% p.a.

2.7 Exclusion of certain capital costs

104. The Commission recognizes that Chorus and Vodafone have received Governmental payments as capital contributions to extend the broadband capability of their networks to remote and rural areas. Both companies received capital contributions to build infrastructure in these areas.[40]

105. Instead of taking the full amount of the RBI subsidy that Chorus received into account, the Commission only considered and removed the capital cost related to the number of DSLAMs and active cabinets deployed by Chorus under the RBI initiative. These additional active cabinets and DSLAMs are regarded as incremental with regard to the RBI initiative. This approach of the Commission falls short in two aspects: Firstly, it ignores subsidies for other incremental infrastructure network elements and secondly, it ignores subsidies received by Vodafone which are also relevant in the HEO context.

106. The Commission only allows for capital contributions for active cabinets and DSLAMs to be excluded in RBI areas but not for network assets of the feeder segment. This is inconsistent under the ORC costing approach of the Commission. As the fibre cable between the cabinet and the FDS is a network segment incremental to UBA it should also be part of the capital cost exclusion due to RBI subsidies.

107. As Network Strategies has pointed out in its submission there is no direct subsidy for DSLAMs paid through the RBI. The total subsidy of Chorus under its RBI contract amounts to $ 236 million from 2011 to 2016.[41] TERA has calculated the implicit capital contribution to UBA to an amount between $ 13.7 million in 2019 and $ 15.8 million in 2015.[42] This is only a fraction of the total amount of subsidy which Chorus receives under its RBI contract.

108. The Commission argues that the feeders should remain in the relevant capital and cost base due to the assumption that there would have already been passive cabinets at those locations before the RBI.[43] First, the availability of passive cabinets is only an assumption, reflecting an understanding of locations which might not hold in reality. More importantly, the Commission’s argument would only hold, if the Commission considered the re-use of assets as a relevant concept to be applied. Although we generally still favour the approach of re-using assets[44] we have to request that the Commission remains consistent and coherent in its ap-

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[40] See Commission, UBA, para. 641.

[41] See Network Strategies, Commerce Commission Draft Determination for UCLL and UBA, A review of key issues. Report for Spark New Zealand and Vodafone New Zealand, February 2015, Section 3.1.

[42] See Network Strategies, Commerce Commission Draft Determination for UCLL and UBA, A review of key issues. Report for Spark New Zealand and Vodafone New Zealand, February 2015, Section 3.1.

[43] See Commission, UBA, para. 646.

[44] See Section 1.1.2 of this submission.

proach. It cannot follow a pick and choose approach regarding the re-use of assets. Further, the RPI subsidy is paid for fibre to schools and FWA cell sites. Therefore, at a minimum and following the Commission's logic, if the Commission chooses not to exclude the RPI capital cost than it should at least recognize the trench sharing necessary to get the fibre to the schools.

109. Not only Chorus but also Vodafone has received capital contributions to improve broadband availability in RBI areas. Vodafone also is under the obligation to provide a bitstream access service in its RBI footprint area. It is important to note in this context that Vodafone's RBI service does overlap to some degree with Chorus' (xDSL) capable copper network. There are, however, a number of customers who would receive very poor quality xDSL services who can now receive high quality wireless RBI services and actually prefer to use it. Therefore, Vodafone's contribution to provide UBA in certain RBI areas has to be taken into consideration (at least to a certain degree) for the HEO. This also implies that the relevant capital contributions have to be deducted from the capital base of the HEO.

3 UCLL specific aspects

3.1 TSLRIC for UCLL

110. The Commission intends to set a constant TSLRIC price in nominal terms over the regulatory period. In the context of UBA (see para. 91) we argued in favour of a periodic pricing according to the TSLRIC value of UCLL in each year of the regulatory period. These arguments also hold in the context of UCLL. Efficient intertemporal migration decisions of access seekers to UFB require that access seekers are facing the relevant cost in each particular year and not on the average of a five year period.

3.2 MEA for UCLL

111. The infrastructure an hypothetical efficient operator would deploy for a point-to-point copper access network should be future-proof for a long period of time. As the copper network has now been in use in some countries for more than 100 years a new modern equivalent asset (MEA) should also at least be capable of supporting the end-customer demand as long as possible, but at least as long as the typical long term depreciation period for telecommunications infrastructure last today. The only infrastructure we see supporting this is FTTH, and because of its flexibility as a PTP topology, like the copper network before. This once again enables physical unbundling of the bottleneck access infrastructure except in those areas where FWA is the most appropriate UCLL MEA. We therefore fully support the Commission's draft decision in favour of FTTH PTP as UCLL MEA, subject to the proviso that it will be replaced by FWA in the most expensive remote areas due to significant cost savings.

112. The fact that many operators deploy FTTH point-to-multipoint topologies instead is not necessarily driven by pure efficiency considerations, but also by the interest and incentive of re-monopolizing the access market by only offering UBA or bitstream services instead of unbundled physical infrastructure and so benefitting from the higher value chain. From a company perspective these additional aspects may be weighted against the need and risk of reinvesting in GPON like technology sooner as expected. From a social welfare point of view the PTP topology offers more advantages due to its openness for higher and more flexible bandwidth per end-customer and its independency from transmission system suppliers.

3.3 Network optimisation

113. The MEA network is assumed to be deployed as a new network and according to state of the art methodologies. Nevertheless state of the art modelling methodology allows for taking the major network nodes of an access network to be unchanged. This is called a scorched node approach. Typically the local exchange locations are such scorched nodes, since it is (was) the purpose of the access network to concentrate all access lines in these locations, which also are the border locations of the aggregation and core network. These locations have been determined in the past driven by the length restrictions copper pairs have for transmitting analogue telephone signals. Improving the transmission method by digitisation allowed for transmitting higher and higher bandwidth and improved signal quality. This is now at its end. Higher bandwidth is now achieved by making the copper part of the access lines shorter and shorter and by moving the traffic concentrating electronics closer and closer to the end-customers, first choosing the cabinets (for FTTC with ADSL or VDSL DSLAMs) and then using distribution points in front of the buildings for the next DSLAM generation of G.fast (also called FTTS or FTTdp). The fibre is growing closer and closer to the customer premises, in the end forming an FTTH network[45]. A HEO would in any case not take care of existing local exchange access areas but would efficiently optimize their boundaries according to cost. The need to organize these areas according to hierarchical telephone numbers has fallen away with upgrading the mechanical, relay based telephone switches by the first more flexible digital switches some 40 years ago. The TERA model does not take this cost reducing aspect into account.

114. In this regard we consider the modelling approach of the Commission as unnecessarily conservative. Even if the Commission had constrained its modeller to use the existing number of nodes and their existing locations, there would still be room for efficiency improvements by endogenously allocating access lines to exchanges. The Commission has followed this approach for the cabinet areas due to a lack of data provision by Chorus. There is no acceptable reason why the Commission has wasted the efficiency potential to extend this approach also to the MDF area boundaries.

115. The routing of each access fibre line is performed according to a shortest path algorithm without considering any intermediate cabinets. Thus for the fibre network the modelling philosophy allows for neglecting the cabinets as scorched nodes, but for the copper access network model the cabinets are also taken as scorched nodes, while their access areas are optimized in the model endoge-

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[45] Fibre does not suffer from the copper length restrictions regarding bandwidth. This is also recognized by the UBA model, which locates the first data switch in only 92 locations. Thus one can argue in consequence, that these FDS locations may be the only concentration points for a fibre access network. In consequence the fibre routing should be optimized to these few star points instead of using the local exchange locations as scorched nodes.

nously (due to the lack of data). Since the copper network cost may be taken into account in the performance adjustment process when these costs are below the fibre cost, this difference in approaches seems to be contradicting or at least incoherent. In order to prevent this inconsistency we propose to optimize the copper cabinet locations and their respective access areas also in the model endogenously.

116. Routing all access lines according to shortest paths between the customer premises and the local exchange location may not result in a most cost efficient access network, since the trenching cost have also to be taken into account. The algorithms considering this important side condition typically are called augmented shortest path algorithms. The model description just refers to a shortest path algorithm without detailing the approach, and the lack of transparency in the geodata processing does not allow us to analyse the approach TERA has implemented. Thus we expect the model to significantly overestimate the efficiently required trench length and thus to overestimate the cost also significantly. (See Section 5.9 for the different characteristics of a shortest path and an augmented shortest path algorithm; for a further detailed analysis of fibre and duct sizes and their effects on trenching cost we refer to Sections 5.6.1 - 5.6.4 of this submission.)

3.4 Network deployment

117. The HEO would deploy its MEA network to the most efficient degree of cost efficiency. This includes sharing trenches with other network operators, with utilities' infrastructure and with the infrastructure public transport organisations or public authorities may operate. While the Commission in its draft determination accepts the concept of sharing, it is in the model only applied to overhead infrastructure and sharing with local utilities. It is neither accepted and implemented for underground infrastructure nor for sharing with other organisations than utilities. We propose going beyond the point implemented so far to become more realistic and efficient.

118. The model considers five soil classes for determining the trenching cost in rural areas, based on an aggregated form of the most detailed and advanced geo-information available in New Zealand. We appreciate and support that approach. Unfortunately this information is only available for rural areas. For urban areas a simple sixth class "urban" is considered. We know from our experience that there is also a wide spread of trenching cost in urban areas, depending on surfaces and underground conditions, street crossings and other traffic infrastructures etc. Thus more accurate cost determination would be achievable considering more detailed information also here.

119. According to our understanding of the Beca report[46] the soil classes have been determined within polygons. The trenching cost of a street segment then has been allocated according to the polygon in which the street segment is located. Nevertheless, typically and according to the model description the trenches are assumed to be constructed beside the roads. Thus, soil and surface conditions may be different beside the road than in the rest of the polygon, which is not considered in the model. Therefore we assume a systematic cost overestimation of the trenching cost – at least in the rural areas (see Section 5.8.6 for a more detailed analysis of this aspect).

120. Network deployment state of the art engineering rules and dimensioning methodologies should be considered also in modelling the cost of the access network in order to estimate the cost of an efficient network. There are a number of detailed observations we made which tend to overestimate the access cost. We detail them in Section 5.

3.5 Exclusion of certain capital costs

121. To calculate the cost for UCLL the Commission excluded the capital cost of deploying the network also in areas outside the TSO boundaries.[47] The Commission regards this approach as a proxy of the relevant reality.[48] The Commission assumes that the capital cost to connect those 6.4% address points are provided by other sources. Neither the Commission nor TERA do provide any analysis on the sources of these capital contributions, be it the Government, the TSO funding mechanism or the users themselves.

122. Instead of conducting a quantitative approach to test the appropriateness of its proxy approach, the Commission describes certain capital contributions which Chorus has received. The Commission cites Chorus' subdivision reticulation policy[49] which can lead to compensations which even exceed the relevant cost. The Commission should, however, have conducted an analysis of the extent to which the Governmental capital contributions for UFB and for the RBI also would reduce the capital requirements of the HEO. In particular the RBI contributions aim at extending the broadband capability of the network to more remote and high cost areas. Without this Governmental contribution no profit-maximising operator would provide service in those areas. The Commission should therefore also deduct those capital contributions from the relevant cost base of the UCLL network.

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[46] Beca: FPP Corridor Cost Analysis of Trenching and Ducting Rates in NZ – Final Issue Nov 14, Appendix 1, p. 3 and p.6f.

[47] See Commission, UCLL, Attachment J.

[48] See Commission, UCLL, para. 820.

[49] See Commission, UCLL, para. 816ff.

123. Chorus' subdivision policy[50] underlines that users pay significant contributions to be connected to the fibre network. These have to be taken into account in a forward looking perspective. According to this recent document the standard charge per premise for any fibre subdivision development in Chorus contracted UFB areas amount to $ 900. The standard charge within non Chorus contracted UFB areas amounts to $1,600 per unit/dwelling if certain conditions are met. Further, Chorus' policy for high cost subdivisions is to fully recover its incremental CAPEX cost plus a margin.

124. The analysis of Network Strategies shows that not only the RBI contributions of the Government, but also at least some part of the UFB contributions have to be considered as capital contributions which lower the relevant cost of the HEO.[51] Network Strategies estimates a potential subsidy for the HEO of $ 813 million, a number which is close to the subsidy per premise past ($ 1118) which Chorus receives under the UFB programme.[52]

125. There is a consistency problem between the TSO boundary approach of the Commission and the modelling of FWA as part of the MEA approach. The model does not exclude the possibility that some of the FWA connections in the model are outside the TSO boundaries. If and insofar that this is the case, there is a certain degree of double-recovery of costs for which the HEO would have got an external capital contribution as part of the relevant cost base. In fact, as Network Strategies has shown in its submission[53], a mapping of the TSO areas with the FWA connections in the model reveals that 7,011 buildings/7,111 dwellings which are connected via FWA fall outside the TSO area.[54]

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[50] See Chorus Standard Subdivision Policy, 23 April 2014.

[51] See Network Strategies, Commerce Commission Draft Determination for UCLL and UBA, A review of key issues. Report for Spark New Zealand and Vodafone New Zealand, February 2015, Section 3.1.

[52] See Network Strategies, Commerce Commission Draft Determination for UCLL and UBA, A review of key issues. Report for Spark New Zealand and Vodafone New Zealand, February 2015, Section 3.3.

[53] See Network Strategies, Commerce Commission Draft Determination for UCLL and UBA, A review of key issues. Report for Spark New Zealand and Vodafone New Zealand, February 2015, Section 2.1.

[54] See Network Strategies, Modelling Fixed Wireless Access, UCLL and UBA Final Pricing Principle, Report for Vodafone and Spark, February 2015, Section 2.2.8.

4 Model critique

4.1 General deficiencies

4.1.1 Model not bottom-up in all respects

126. The Commission and TERA claim to have built a true bottom-up model. The actual model developed does not, however, meet this standard in all respect. In many areas of network design the model is more guided by just including elements and structures of Chorus' existing copper network without developing an efficient network design and an efficient dimensioning of network elements.

127. The following examples demonstrate that the model is not guided by the efficiency approach of bottom-up modelling:

    (1) The FWA network is actually not modelled but it is based on existing mobile sites and their coverage areas (see Section 4.2.6).

    (2) Microwave and submarine links are not optimized (see Sections 5.6.10 and 5.6.11), but the actual links in Chorus' network are included.

    (3) DWDM links are included in the core network links, but they are not optimized and even an appropriate dimensioning is not modelled. Simply the historic cost of Chorus are applied on the existing links (see Section 4.2.7).

    (4) The local access areas of the local exchanges are not optimized. In case of copper modelling the cabinet locations are also not optimized (see Sections 4.2.3 and 4.2.5).

    (5) Any existing SDH links in Chorus' network will are disregarded and replaced by Ethernet links, but a further optimization of the links and the core network topology is not processed.

128. The most relevant parts of the OPEX are not modelled bottom-up but are based on Chorus actual OPEX calculated from the accounts (see Section 4.2.2.1).

4.1.2 Model incomplete and lacks explanation

129. The model does not make the geospatial modelling transparent. The description for the access line length optimization is missing. The set of input parameters in the interface between the geospatial model and the MS Access module of the Access module is incomplete (Section 4.2.1).

4.2 Model elements

4.2.1 Geospatial modelling

130. The geospatial modelling process including the application of the shortest path algorithm is not part of the modules made available by the Commission. Some documentation is provided by TERA, but this does not even give a complete overview of the relevant parts. The most detailed information is restricted to the input data files for the MS Access model as part of TERA's access model, and even this description is not complete.[55] Thus one can state that the description of the geospatial modelling is insufficient and incomplete.

131. The shortest path algorithms for the copper and fibre topology optimization are not specified in detail, neither in the Model Reference Paper, nor in the Model Specification nor the Model Documentation. The Model Documentation, Section 4.3.1 simply states "*In the fibre networks, the dwellings are connected: … From the FAT directly to the MDF through a distribution cable following the shortest path from the FAT to the MDF.*" This leads us to the conclusion, that the trenches considered in the model are not efficient (see Section 5.9). An application of looking for the shortest line length from each individual access point (address points), combined in CCT/FAT, to the next local exchange (simple shortest path) typically does not result in the most efficient trench construction which follows an augmented shortest tree. Such trench cost optimisation should also include FWA and core network trenches in the access network areas. Figure 31 of the Model Specification provides an illustrative example of inefficient trench design due to the simple path optimization for the FWA connection, independent from the rest of the access network trenches (see also Section 5.9).

132. The Model Documentation, (Section 4.2) names three input tables detailing the paths with all sections traversed. The tables' detailed descriptions in the Model Documentation Sections 4.2.1.3 – 4.2.1.8 do not allow to identify path descriptions as a sequence of sections. These descriptions are not complete.

133. For example, Table 28 "Source Sections" in the Model Documentation should include a TX-ID field for identifying the FWA use (see Model Documentation, Section 4.3.2.2 FWA coverage), but it is not included. Thus also this table description is incomplete.

134. If one intends to reproduce the geospatial modelling, since it includes crucial information about the trench length, which is the most important cost driver of the

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[55] See Model Specification, Section 3 (geospatial) and Model Documentation, Section 4.2 (inputs to the MS Access file of the Access model part), describing the outputs of the geospatial modelling as inputs for the MS Access module. There is no describing section of the geospatial modeling in the Model Documentation at all.

access network, this cannot lead to comparable results because of the lack of description how the paths are calculated. Nevertheless, the results of such independant computation then could not be processed in the model provided by TERA due to the insufficient table description with the lack of relevant input parameters listed and described above. One could not feed the model with the appropriate input files because the description of the input files in the Model Documentation is incomplete (see para. 133 above).

135. The Model Documentation, Section 4.2 states "*that the path followed by the core links are not Chorus' actual paths as these paths have been optimized*". It remains completely uncertain according to which conditions these paths have been optimized. We assume that this did not occur according to the conditions we described in Section 2.3, because a NGN node hierarchy optimization and subsequent trench optimization would be required first and is not conducted at all. Furthermore, we cannot understand how this core trench optimization can be matched with Chorus' DWDM, microwave and submarine cable information and then lead to correct results.

136. The geospatial modelling is uncertain and cannot be checked by us (and others) during the consultation process because it is not made available to interested parties. Its output files, which build the input files for the MS Access module of the access model, are incompletely described, so that one cannot substitute the geospatial modelling by alternative approaches in order to challenge it, since such results would be incomplete also. The application of the shortest path approach leads to a significant cost overestimation for the trenches due to the lack of an augmented shortest path approach which minimizes trenching cost (for details we refer to Section 5.9 of this Submission).

4.2.2 Modelling OPEX

4.2.2.1 Overall approach flawed

137. TERA's OPEX model basically relies on an approach which takes the OPEX from Chorus accounts with some efficiency adjustments.[56] In addition, the expenses for electricity and buildings are calculated bottom-up. TERA argues that using top-down data for calculating OPEX represents best practise.[57] We do not agree.

138. We agree with TERA that the approach chosen is better than just relying on the accounts of Chorus without efficiency adjustments, because some inefficiencies and irrelevant costs can be and seem to be excluded. Nevertheless, the approach

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[56] See TERA, Model Reference Paper, p. 41ff.

[57] See TERA, Model Specification, p. 9.

chosen remains flawed in principle and in particular in the case of Chorus. Furthermore, major adjustments conducted by TERA are highly subjective and fail any test of adequacy and appropriateness.

139. The basic conceptual flaw from using top-down OPEX data from the accounts of the regulated firm in a bottom-up modelling context follows from the fact that the asset structure generated from the bottom-up model is usually significantly different to the actual network being operated. Differences occur with regard to the age structure of the assets, the volume of the assets in the various asset categories and the type of assets. “Older” networks usually need (much) higher OPEX than a network which is built according to optimized replacement costs. An optimized efficient network usually needs less asset volumes of a particular type. A MEA network usually consists of modern assets which are not only cheaper but also cause less operational expenditures than their predecessors. Efficient and relevant OPEX, however, depend on these aspects of the relevant assets. We recognize that TERA has tried to adjust Chorus top-down accounting figures to reflect relevant costs for a replacement cost modelling approach. TERA scaled down the actual maintenance cost by an efficiency factor reflecting a lower level of fault (LFI) in a newly build network compared to Chorus’ old network. This factor was derived from a single-sourced benchmark approach. Although we agree with the general efficiency adjustment direction conducted we have to state that the approach applied by TERA is rather subjective and the single source nature of the benchmark is highly questionable.

140. Relying on top-down accounting information on OPEX is in particular questionable in the case of Chorus. The OPEX accounting numbers of Chorus may have some relevance for the copper access network but they provide no information on the MEA network which informs the costs of the UCLL in the FPP. Chorus OPEX accounts provide neither relevant information for FTTH nor for FWA. TERA’s approach of deriving the relevant OPEX for the nationwide FTTH/FWA network by dividing the level of OPEX per line in the copper network by a factor of two[58] is extremely rough and questionable. Although we agree with the general direction and the overall amount of the adjustment, the approach remains highly subjective and unsubstantiated.

141. Any approach of relying on top-down OPEX accounts has to check for double-counting of costs, has to sort out irrelevant costs and has to apply proper allocation keys to come closer to the efficient level of the relevant OPEX. Double-counting can occur in a variety of cost items. Double-counting for instance occurs when certain planning, installation or maintenance activities are booked as OPEX at the first stage and activated at a later stage as CAPEX. Double-counting occurs when OPEX accounts are not differentiated to services. This is of particular rele-

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[58] See TERA, Model Documentation, p. 132f.

vance in the Chorus case and relating to transaction services which look similar to network maintenance. We could not identify any systematic approach in TERA's cost analysis approach to take care and to manage this problem adequately.[59]

142. Irrelevant cost for the relevant MEA network have to be excluded. This is a complex exercise which usually takes several rounds of iteration. The risk of having irrelevant costs in the cost base is relatively high in the case of Chorus due to the installation and deployment of new fibre networks in parallel to the existing copper network. Upon a respective question[60] the Commission has stated that OPEX related to the UFB networks are excluded from the relevant cost base. But neither the Commission nor TERA have provided any information or evidence how they have solved this problem and which approach they have conducted. Therefore, the Commission and TERA have provided no comfort that they have excluded irrelevant costs of Chorus' accounts from the relevant cost base.

143. Without claiming to provide a comprehensive analysis we want to provide some examples of irrelevant costs which are part of the OPEX/common cost cost base:

a) In the excel map "CI_ComCom-OPEX model v1.10.xlsm", "Sheet Other Costs" we find the cost position "oversea travels" (see cell I150), which has been fully taken into the cost base (see cell L150). With a high probability costs for overseas travel have nothing to do with the regulated products in the FPP process, because these are offered in New Zealand. Following the links to the sheet "Costs summary", it can be observed, that these costs have been considered with a share of 78% as part of the relevant non-network costs, which are allocated to UCLL and UBA.

b) In the excel map "CI_ComCom-OPEX model v1.10.xlsm", "Sheet Other Costs" we find several cost positions dealing with advertising costs (see cells I125-127); some of them were even capitalised (see cell I134). All these positions have been fully included in the cost base (see corresponding cells in column L). With a high probability costs for advertising have nothing to do with the regulated products in the FPP process. They might be more related to the unregulated competitive products of Chorus. Regulated products need no advertisement for increasing demand, because Chorus has a dominant position in these markets anyhow. Following the links to the sheet "Costs summary", it can be observed, that these costs have been considered with a share of 78% as part of the non-network costs, which are allocated to UCLL and UBA.

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[59] See Section 5.3.3 for more details.

[60] See http://www.comcom.govt.nz/dmsdocument/12808, sheet "questions" in the excel-map, column B, question ID 20 and answer column G.

144. Generally most of the cost positions are chosen as relevant with a simple and digital “Yes“ or “No” decision. We can neither observe reasons and explanations for such a digital consideration nor can we find explanations, how far these positions have been examined for efficiency. It looks rather obvious that efficiency tests have not been conducted.

145. Given all the imperfections, conceptual flaws and inappropriate applications of the top-down approach with efficiency adjustments as applied by TERA we clearly do not share TERA’s view that the most appropriate and best approach to determine efficient OPEX has been chosen. We see clear reasons why using instead a mark-up approach on CAPEX will be superior. This approach would have been more precise and less subjective than the approach taken by the Commission and TERA. Thus, we definitively do not share TERA’s opposite view.[61] We recommend the Commission reviews its current approach and substitutes it by a mark-up approach on CAPEX whereby the mark-ups can be derived from an international best practice benchmark. If the Commission follows this recommendation it could be much more confident of achieving a structure and level of OPEX which fits and is coherent with its MEA network choice. The current approach represents more a second and probable even third best approximation.

4.2.2.2 Critical elements in detail

4.2.2.2.1 Overhead on Chorus maintenance contracts not justified

146. Chorus is not conducting (all) network maintenance activities on its own. All or some of these activities are out-sourced to service companies. Although TERA’s wording is imprecise[62] our understanding from TERA’s Model Documentation is that some overhead allowances on top of the contractors’ fees are imposed to represent Chorus costs of dealing with contractors.

147. This compensation of overheads might imply a double- or over-recovery of the same service element costs. The service companies’ fees already include allowances for overheads. Costing for additional overheads on Chorus’ side entail the risk that outsourcing of maintenance may not be a cost efficient solution because of the double-recovery of costs. Before checking the efficiency of outsourced processes it has to be checked whether it is efficient to outsource processes at all.

148. There is furthermore an allocation issue and requirement to avoid double-recovery. In the context of the Commission’s transaction charges consultation paper Chorus revealed that there is no one-to-one relationship between third party charges and transaction charges (we assume this also holds for outsourced

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[61] See TERA, Model Reference Paper, p. 43.

[62] See TERA, Model Documentation, p. 25.

maintenance activities). Therefore there is a need to allocate these service costs to the relevant processes. We could not identify whether TERA has conducted these checks and allocations. There is in particular the incentive on Chorus' side to allocate more cost to regulated than to unregulated network services as would be justified from a TSLRIC perspective. We could not identify that TERA is aware of that problem and avoided it by proper checks.

4.2.2.2.2 Inflating labour related OPEX over time by the LCI ignores efficiency improvements

149. The OPEX model is based on Chorus' 2013/14 accounts. In order to forecast the OPEX for 2015 and the subsequent years of the regulatory period the Commission used a cost escalation approach for labour related OPEX.[63] The Commission decided to inflate the labour related OPEX of the base year by using only the LCI rather than a disaggregated index approach because the labour costs dominate that part of the OPEX.

150. We regard it as plausible to rely on the LCI without further disaggregating the index. We are, however, not convinced that it should be impossible to achieve efficiency and productivity gains in New Zealand over a five year period. Telecommunications operators steadily realize productivity gains in their operations. These productivity improvements are to a relevant degree embedded in the capital asset structure, but they are also related to the use of labour in the production process. Operators and RSPs usually also run specific labour efficiency improvement programs to reduce labour costs. Process related costs are therefore also subject to efficiency improvements. It is for this reason that other regulators required significant efficiency improvements for transaction services which are mainly driven by operating expenses.[64] For these reasons it is appropriate to assume that the HEO also materializes OPEX related efficiency gains. Therefore, it is appropriate to inflate labour related OPEX by the LCI index but at the same time, the LCI index should be corrected by an efficiency adjustment factor with reflects productivity gains over time. Efficiency and productivity improvements should not be lower than 5%. Significant productivity improvements have been achieved in the recent years and are being achieved by telecom operators by modernizing the workforce management systems in combination with smart phones which immediately allows to adapt service routes by traveling salesman algorithms to changing service demand over the working day. We have observed these efficiency improvements in several European countries and assume they are also valid in New Zealand and should be taken into consideration by the Commission.

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[63] See Commission, UCLL, para. 776f.

[64] See WIK-Consult, Submission of 8 October 2014.

151. For example, the British regulatory authority, Ofcom, estimates forward looking costs for monthly rental fees and transaction fees with a top-down approach by extrapolating costs of BT's regulatory accounts. Ofcom applies an efficiency factor to the cash expenditure in this model (OPEX and CAPEX). For the latest assessment, a base case net efficiency rate of 5% per year was applied to both, OPEX and CAPEX.[65] As this estimation is primarily based on the incumbent's (BT Openreach) data of the past and of BT's own forecast, the efficiency rate of 5% per year represents in our view the lower limit of possible efficiency gains.[66]

152. We can provide another example from the Danish cost model. The Danish regulatory authority uses an annual productivity gain factor to reduce OPEX.[67] This factor is fixed at 2% per year.[68]

4.2.2.2.3 Constant non-labour related OPEX over time do not sufficiently take potential efficiency improvements into account

153. For non-labour related OPEX the Commission assumes that efficiencies offset general inflation and that this part of the OPEX should be treated as nominally constant over the regulatory period.[69] TERA is reasoning this assumption by the fact that these OPEX are difficult to forecast as to their heterogeneity.

154. Because the general inflation rate in New Zealand floats below 5% p.a. nominally constant costs represent an efficiency increase of less than 5%. This is not sufficient as we already pointed out in the context of labour related OPEX (s. para. 150).

4.2.3 Modelling the copper network

4.2.3.1 Overestimation of costs due to inappropriate engineering approaches

155. The copper access network is modelled per local exchange within the existing access area boundaries, also using the existing cabinets as scorched nodes. The access areas of the cabinets are derived in the model endogenously, because this data has not been provided by Chorus. Thus at least regarding the cabinet access

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[65] http://stakeholders.ofcom.org.uk/binaries/telecoms/ga/fixed-access-market-reviews-2014/statement-june-2014/volume2.pdf, page 128.

[66] http://stakeholders.ofcom.org.uk/binaries/consultations/llu-wlr-cc-13/annexes/annexes.pdf, pages 33 to 39 and http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/statement/WBA-draft-statement.pdf, pages 254, 255.

[67] Modification and development of the LRAIC model for fixed networks 2012-2014 in Denmark, Specification document, page 100.

[68] See https://erhvervsstyrelsen.dk/gaeldende-prisafgoerelse-2015, Excel Map 2012-55-DB-DBA-Fixed LRAIC-Access Cost Model - v4.07 DBA - Public.xlsb, Sheet "Dashboard", cell I47.

[69] See Commission, UCLL, para. 778.

areas an optimization approach has been taken. From our point of view (see also Section 3.3) the local exchange access areas and, for the copper network, also the locations of the cabinets would have to be optimized, since a HEO, if deploying new copper networks at all, would do this in a most efficient manner, since this has impact to the largest cost driver which is the trenching cost. Such optimizations are missing. TERA's model therefore overestimates the cost of the copper network.

156. The Model Specification in Section 4.2 states that "*When the street cabinet contains active equipment, then the link between the MDF and the street cabinet is a fibre cable used to provide the SLU backhaul. … In such a case there is no feeder in the local access network.*"[70] According to our information this does not reflect the real installation of copper access lines in New Zealand, which supports UCLL and at least UCLF in those "cabinetized" areas also. Thus, we are wondering how the existing UCLL/UCLF demand is reflected in the copper model.

157. Section 4.2 of the Model Specification also deals with the non-recurring connection fees contributing to the cost of the lead-in, and to other lead-in contributions, which have to be excluded from the recurring cost of the copper (and fibre) access lines (see Section 5.3.1 of this Submission). The Model Documentation in Section 4.3.4.4 describes, that each dwelling has its own lead-in cable. This is not efficient taking multi-dwelling buildings into account. So this leads to a cost overestimation.

158. Section 4.3.4.2 of the Model Documentation describes the access network deployment on one (major) or both sides (major and minor) of the street. The decision is taken comparing the cost to cross the road per each building or deploying the infrastructure on the minor side also. According to our experience it would be more efficient to share the crossing trench between two neighbouring buildings instead of crossing the street per building. This has a significant impact on the relevant cost.

159. Further cost overestimation results from the fact that the *"size of the trench is uniform along the trench"* (Model Documentation, Section 4.3.5.5.1), where *"trenches – and ducts – are as long as the longest cable of the section"* (Model Documentation, Section 4.3.5.5.2). Furthermore, "*the lead-in share of the trench size is the same on major and minor sides*", implies another cost overestimation, since the number of buildings on each side is not equal, already recognized by the modellers by the definition of a major side of the street.

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[70] See also TERA, Model Documentation, Section 4.3.3.4.2.

4.2.3.2 Ignoring FWA in the context of the copper network

160. The Commission has now accepted and taken as a principle starting point that the HEO is a substitute for Chorus. In the Commission's word: "*The hypothetical network is a replacement for Chorus' existing network. Our hypothetical efficient operator is a substitute for Chorus; ...*"[71] This principle not only holds for modelling the FTTH network as the relevant MEA. It should also hold when the Commission is modelling the copper network as a counterfactual to check and test whether a copper or a fibre network generates the lower access costs. Also the copper network should be deployed efficiently.

161. Conceptually, the Commission is modelling a copper access network not as an alternative MEA. It calculates the cost of copper access to adjust the cost of the FTTH/FWA MEA if the copper access network was less costly than the FTTH/FWA network to reflect the different capabilities of the network.[72] De facto this approach implies taking the copper network cost as the relevant cost in the case where they prove to be lower. However, in this case the copper cost are nevertheless too high due to the missing efficiency gains provided by FWA.

162. If the HEO constructed a new copper network it would also make use of the cost saving potential of deploying FWA in the low density/high cost areas. The considerations to make use of FWA are the same as in the case of deploying a fibre network. The cost comparison between a copper and a fibre network should be conducted with the same assumptions on the share and locations of FWA.

4.2.4 Coexistence of copper and fibre in the feeder (SLU backhaul and UCLF)

163. The MEA for the unbundled copper access network is, as many other telecommunication regulators also decided, an FTTH (+FWA) network. The cost for the UCLL service will be determined from the cost for an FTTH network (plus FWA in remote RBI areas) or from the cost of the copper access network, if this turns out to be lower than the fibre network. Thus already for determining the cost base for UCLL both networks have to be modelled.

164. In the following paragraphs we will show that in TERA's model the UCLL cost (price for the unbundled copper loop) includes the cost of the DSLAM fibre backhaul, a network element not required for providing the UCLL, but for the UBA service. Taking into account that the MEA for UCLL is FTTH instead of copper, this does not become an intuitive or even acceptable approach. The UCLL price of the fibre MEA is higher than it might be if it is only based on the copper infrastructure elements. As a second result we will show indications that the (pure) copper cost

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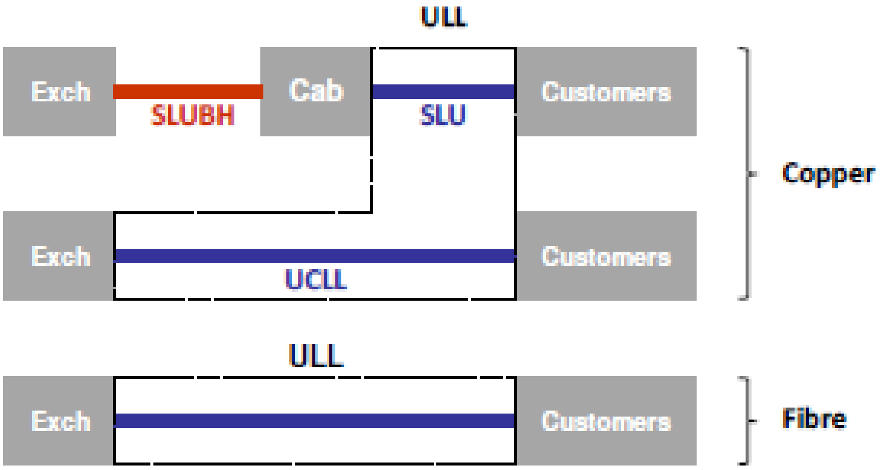
[71] See Commission, UCLL, para. 159.

[72] See Commission, UCLL, para. 287.

might be lower than the fibre cost and thus a copper price adjusted UCLL price has to be determined instead of a FTTH price to inform the UCLL price determination.

165. In principle the copper modelling is required also since the MEA for the UBA service is determined by the Commission to be the copper network, which aggregates the point-to-point copper lines on their path to the local exchanges (also called Main Distribution Frames: MDFs) in intermediate street cabinets. Typically DSLAMs at the local exchanges concentrate the access lines and forward the customer traffic to the FDS (First Data Switch), where it is handed over to the UBA wholesale customers. In case that the access line is too long for transmitting sufficient bandwidth the DSLAM may be located in the street cabinets, thus shortening the copper loop length and allowing for higher bandwidth. Since the DSLAM is connected to the FDS by high bandwidth Ethernet interfaces of 1 Gbps and above the transmission connection between these two active network systems is a fibre strand, because a copper pair cannot support these high bandwidths.

Figure 4-1: Modelled access networks in principle



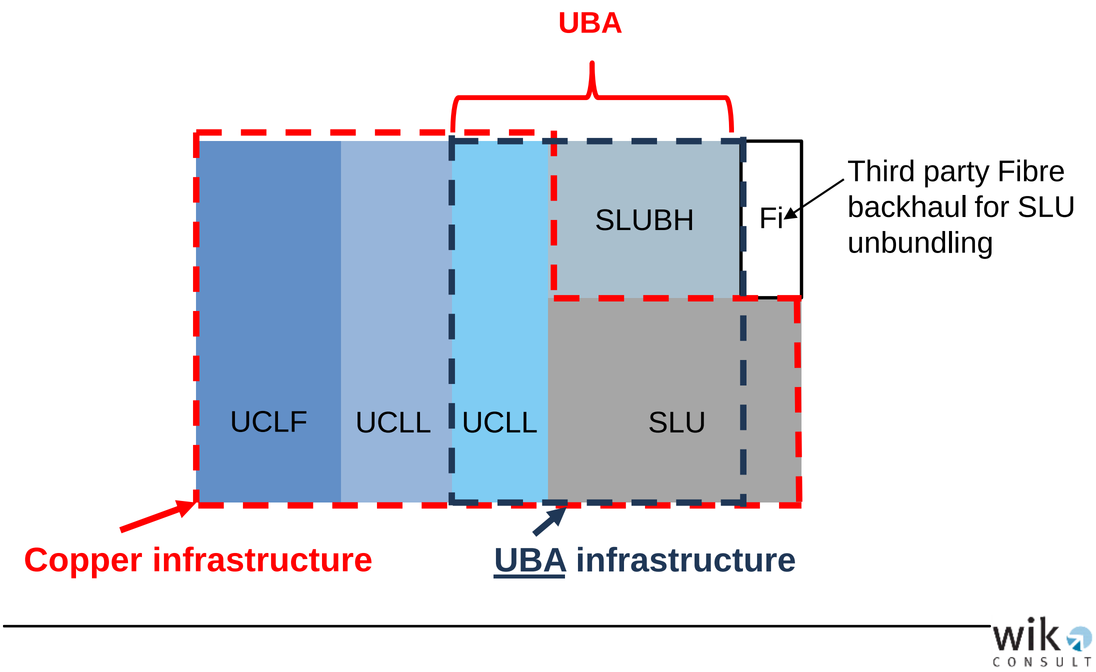
Source: TERA, Model Documentation, Figure 40

166. In Figure 4-1 the Exch (local exchange) and Cab (street cabinet) are the locations where DSLAMs can be located for providing the UBA service. Between the exchanges and the 92 FDS locations on a higher aggregation level for each of the DSLAMs in the cabinet or exchange a fibre strand is required for connecting FDS and DSLAM. These fibres are part of the core network.

167. Besides Chorus other network operators can also produce their own bitstream services by making use of the unbundled copper lines at the local exchanges and

the street cabinets, collocating their own DSLAMs at these locations instead of using the Chorus' ones, thus being able to design their end-customer products independent from the incumbent and his quality.

Figure 4-2: Services in a copper access network



Source: WIK

168. Figure 4-2 provides an overview over the different services which can be used in a copper access network. With the unbundled copper loop the UCLF service allows to transmit telephone signals over the copper line. These signals typically only use the lower frequency band. The UCLL service allows to use the lower and the higher frequency band of the copper loops, thus in addition enables DSL transmission. It may happen that the lower frequency band for voice is not used but only the DSL transmission, where the data may include Voice over IP (VoIP) transmission. These services can be requested by any telecommunication operator for simply producing telephone services and/ or their own broadband access. For those areas where the DSLAMs are not located in intermediate cabinets the UCLL service is also used by Chorus for connecting the customers to their UBA DSLAMs in the exchange locations. In areas where the DSLAMs are located in the street cabinets Chorus uses (its own) SLU service connecting the end-customers. The DSLAMs in the cabinets use the SLUBH service for being connected to the local exchange (and from there to the FDS). The SLU service may, at least in theory, also be used by other operators, using their own fibres for backhauling or renting the SLUBH also. Thus it may happen that the SLUBH fibres are installed in parallel to the UCLL or UCLF copper pairs in their feeder network

segment (or main cable) between cabinet and exchange. The SLUBH fibres are an add on, being installed later than the original copper network, and are dedicated for connecting the (UBA) DSLAMs. They are not part of the copper access network, although they share some feeder trenches with it. Also they are not required for providing the UCLL service.

169. The Commission's draft determination and in consequence the model description (6.5.1.1. – The UBA Service) postulates two axioms:

- "$P_{UCLL} = P_{SLU} + P_{SLUBH}$ *: Each full line should have the same price.*
- $C_{Network} = C_{ULL} + C_{SLUBH}$ *: The total cost of the network (cost of connecting all customers) is the total cost of the copper network (UCLL + SLU = ULL) plus the total cost of the SLU backhaul.*"

170. The second equation adds cost to the cost of the access network which are not part of the copper network, but an add on. This becomes more clear with the transformation into:

- $C_{Network} = C_{UCLL} + C_{SLU} + C_{SLUBH}$

With

- $P_{UCLL} = C_{Network} / \#_{ULL} = (C_{ULL} + C_{SLUBH}) / \#_{ULL}$ ($\#_{ULL}$: Number of ULL)

171. It becomes obvious from this deduction and derivation that the UCLL cost (price for the unbundled copper loop) includes the cost of the DSLAM fibre backhaul, an element not required for providing the UCLL service, but needed for the UBA service. This is not an intuitive approach when taking into account that the MEA for UCLL is FTTH instead of copper. The UCLL price of the fibre MEA is higher than it might be if it is only based on the copper infrastructure elements.

172. Since the price for UCLL is not only paid by the UBA customers but also by at least a significant demand of UCLF (UCLF price is set equal to the UCLL price), these customers cross-subsidize the UBA service especially in its bandwidth increasing component (DSLAM at cabinet), from which just these customers do not benefit from. This also holds in case of other UCLL customers using an unbundled loop instead of the UBA service of Chorus. Avoiding double-recovery has been the goal of the Model Specification, Section 8.9.2.2: "*It is therefore important to ensure that no cost is recovered twice and that all cost are recovered.*" This goal has not been met. Also the Commission's draft determination on UCLL, paragraph 872, admits that "*there is a potential for double recovery in modelling a FTTN MEA for UBA and a FTTH MEA for UCLL*" because of the feeder trenches. We believe such over recovery or at least cross-subsidy not to be justified, caused by

a wrong axiom, which neglects cost causation and which finally follows from the inconsistencies of using a dual MEA approach.

173. Having decided for an FTTH + FWA MEA the Commission decided for a copper – fibre performance delta adjustment (fibre allows for much higher bandwidth and transmission quality than copper) by taking the cost for the cheaper network. This will be the cost for the fibre + FWA network if this is cheaper than the copper network, or the cost for the copper network, if this turns out to be cheaper than the fibre + FWA network. One could state, a performance delta adjustment for the UCLL price is coming into account, if the copper network is cheaper than the FTTH + FWA network. The cost comparison is based on the yearly total cost, including annual CAPEX, OPEX and non-network cost. While the comparison is performed twice, for each MDF area individually and for the cost of a nationwide network of either FTTH + FWA or copper, the latter option based on nationwide networks has been decisive.

174. In fact the model compares the copper network cost (without any cost for SLU fibre backhaul) with the FTTH + FWA cost, reduced by the cost for the SLU backhaul.[73] This is hard to understand because there is no cabinet, no comparable network topology nor any SLU backhaul in the FTTH + FWA architecture. The cost for the SLU backhaul are not determined in the fibre, but in the copper model part. Thus it results in a theoretical value, used only for the decision which cost to take into account. There is no physical equivalent against which the copper network has been compared with.

- $C_{Fi2015} - C_{SLUBH} \leq C_{ULL}$? If yes: cost base is fibre, if no: cost base is copper

175. For the computation of the UCLL cost in both cases the annual cost of the SLU backhaul is considered in addition to the values compared. In case of the FTTH + FWA based price determination the reduction to the theoretical value is reversed, in case of a copper based price determination the cost of the SLU backhaul are considered in addition to the copper total cost. This looks strange and without any precedence

176. The cost of the UCLL calculated on the basis of fibre are the annual cost of the fibre network (CAPEX, OPEX and non-network cost) divided by the total demand for access lines. There are no SLU backhaul cost included, since this fibre network topology does not include cabinets. Nevertheless, the UCLL price can be subdivided into a SLU and a SLU fibre backhaul share (following the equation UCLL = SLU + SLUBH), resulting in theoretic values without physical equivalent. On the basis of the copper lines the cost are calculated by adding the fibre SLU backhaul cost – with the cross-subsidization effect already described above. Thus in case that the UCLL cost are determined on the base of FTTH + FWA there is

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[73] See also Commission, UCLL, para. 348.

no SLU backhaul cross-subsidy from UCLL. In the case of copper there is the cross-subsidy. Thus in both cases the cross-subsidy should be avoided. Those demanding a UCLL connection do not need the SLU fibre backhaul. Its cost shall be allocated to the UBA users, as it is intended in the Model Specification, Section 8.9.1. The cost base for determining the performance delta therefore should be the pure copper access network cost for the full UCLL lines (C_{UCLL}, $P_{UCLL} = C_{UCLL}/\#_{UCLL}$). The full UCLL lines share the cables and trenches of the distribution and lead-in network segments with the SLU lines terminating at the cabinets and the trenches with the SLU fibre backhaul in the feeder network segment, and the cost have to be allocated accordingly ($C_{Network} = C_{UCLL} + C_{SLU} + C_{SLUBH}$). In a coherent interpretation of the results it is not the fibre (+FWA) network which provides the lower access cost solution but the copper network. This thesis will become even more true when we compare fibre + FWA with copper + FWA.[74]

4.2.5 Modelling the FTTH network

4.2.5.1 Similar model deficiencies as for modelling the copper network

177. Modelling the FTTH network has one major difference to the copper network model approach. There is no scorched node cabinet between the customer end-points and the local exchange location anymore. In the model’s terminology there only is a distribution and no feeder segment. But the local access areas are the same. Therefore our reservations regarding the copper network access areas also hold here (see Section 4.2.3, para. 155). The access area should be newly delineated according to efficiency criteria.

178. It also holds that as for copper lead-ins the fibre lead-ins for multi-dwelling buildings should be combined in one cable to save costs (see para. 157).

179. Also with fibre cables the street should be crossed once per two neighbouring buildings on the opposite side instead of each opposite building, as the model proposes (see para. 158).

180. Cost overestimation as already described in para. 159 for the copper network trench size shall be avoided for the fibre access network also.

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[74] In another (not so coherent comparison) one would have to compare a FTTH point-to-point topology with a copper point-to-point topology (using street cabinets), which both allow for the full physical connection between all end-customers and the local exchange. We would expect this copper access network to have lower cost than the fibre access network, because only some copper feeder pairs would have to be added in the anyhow existing copper feeder cables (e.g. required for the UCLF service) instead of the fibre SLUBH. (Disadvantage of this approach is that as a result the UCLL customers pay for additional feeder copper pairs which are neither required nor used, but introduced for theoretical consistency.) Nevertheless, also in this interpretation of the results it is not the fibre (+FWA) network which provides the lower access cost solution but the copper network. This thesis will become even more true when we compare fibre + FWA with copper + FWA.

4.2.5.2 Cost adjustment has to be conducted per exchange

181. The MEA concept of the Commission effectively makes the technology choice to determine the cost of UCLL dependent on the model outcome. The cost of the cheaper technology will inform the relevant cost calculation. The model calculates access costs at the MDF level. According to the model outcome copper access generates lower cost in some MDF areas and fibre access (including FWA) in other MDF areas.[75]

182. The Commission has decided to make the decision on the selection of the lowest cost technology on the basis of a nationwide uniform deployment of either copper access or fibre access (including FWA)[76]. This choice does not lead to the lowest cost configuration of providing the access services. According to a model simulation conducted by TERA a technology choice MDF by MDF would lead to a cost reduction for UCLL by 4.8% compared to the base case of a fibre (including FWA) MEA approach.[77]

183. The Commission does not provide any argument why a technology choice at the national level best fits with its definition of TSLRIC or the long-term interests of users. The Commission itself relies on a technology mix between fibre access and FWA. This decision is based on the search for a cost efficient outcome. A mix of technologies (fibre and FWA) leads to a lower cost outcome than just considering one technology. This technology choice of the Commission is not even conducted on a MDF by MDF level but on the much more decentralized level of a line by line choice. If a cost model takes all relevant cost into consideration there is no reason to assume that a technology choice at the national level has operational or other indirect advantages. The decision of the Commission in favour of a technology choice at a nationwide level therefore is not consistent with its MEA approach and its TSLRIC principles.

184. Furthermore, it is no relevant counter-argument that operators may choose a uniform technology or that the Government prefers a nationwide fibre network. TSLRIC is basically a valuation exercise. A feasible network deployment has to be assessed by relevant asset values. It does not matter that the “real” network technology mix of operators in the market at a certain moment in time differs from the efficient network of the hypothetical operator.

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[75] See CI_ComCom - UBA model v5.1.xlsb, Sheet “OPEX and ACCESS”, lines 72 – 791 or 806 -1525.

[76] See TERA, Model Reference Paper, p. 10.

[77] See TERA, Model Specification, p. 80.

4.2.6 Modelling the FWA network

185. The Commission has chosen a FWA footprint in the access network which is not compatible with its own TSLRIC principles. The FWA footprint is determined by exogenous principles and considerations and not on the basis of a cost optimization approach. As a consequence, the Commission's approach leads to a footprint of FWA which is too low and the cost saving benefits of FWA for UCLL are not fully exploited. An optimized FWA coverage approach would result in lower ULL cost.

186. The modelling approach chosen by TERA within the artificially set RBI boundary of the Commission itself is not efficient and does not represent the approach which an HEO would choose. Correcting certain mistakes in the modelling approach and making it more efficient would lead to a larger coverage of FWA within the RBI boundaries, would connect more customers with FWA, would lower the cost of FWA (per line) and would lower the overall UCLL cost.

187. Furthermore, TERA has chosen parameter values for FWA which we regard as inappropriate or inflated. Applying more appropriate values would reduce FWA and UCLL costs furthermore.

4.2.6.1 Deficiencies in the actual modelling approach

188. TERA has selected a rather simplistic FWA modelling approach. This is a pragmatic and resource saving way forward but it is missing the proof to generate a cost efficient outcome. There are neglected efficiency improvements by optimizing numbers and locations of base stations and the number of sectors per site. In any case it is not acceptable that TERA uses (native) LTE equipment (and the capacity constraints of that equipment) which is not state of the art LTE advanced technology.

189. TERA used the location and coverage of Vodafone's sites to model its FWA network. TERA provides, however, no evidence that the number and location of those sites are the result of coverage optimization with regard to FWA. [...]

CNZRI. For that purpose TERA would have had to apply its own radio propagation model. It is most plausible that using additional sites to generate compact coverage areas within the RBI boundaries for FWA would be more efficient than the selection of individual connections to be served by FWA driven by throughput capacity constraints which are just chosen by the modeller and not by the opportunities which would be available for an HEO which intends to build an efficient network.

190. TERA assumes a standard configuration of one base station per site equipped with three sectors. The site is operated stand-alone just for providing FWA services. A uniform investment value for planning, site cost, electrical power provision and base station equipment is assumed.

191. The number of customers covered by a base station is obtained by dividing the FWA base station peak throughput at busy hour by the customers' peak throughput at busy hour.[78] This approach as such is correct. TERA, however, assumes that each sector of a base station has a capacity of 16.67 Mbps which allows to serve just 67 customers. TERA states "*the technology used by the FWA network should be based on the most advanced technology ...*"[79]. That is actually not the case in the model. The Commission on the other hand is referring only to LTE and not to LTE advanced in the FWA context.[80] LTE advanced, however, provides base stations with a capacity of 150 Mbps and 300 Mbps.[81] On the basis of the same usage patterns this capacity enables the operator to serve significantly more customers per base station than assumed in the model. If in contrast to the Model Reference Paper only the lower performant LTE (instead of LTE advanced) should be considered as relevant technology for FWA the peak capacity used for sector dimensioning should be at least at around 35 Mbps and thus at least double the capacity as used in the TERA model.[82]

192. Whether this larger capacity can be used depends on the location of customers within the coverage area. To test this potential outcome we conducted a model run with the TERA model with a sector capacity of 150 Mbps instead of 16.67 Mbps. This sensitivity led to a cost reduction of 11% for UCLL. This proves that a larger number of expensive FTTH connections in the FWA coverage areas of the model and within the RBI boundaries could be substituted by less expensive FWA connections if a more appropriate and available capacity approach of LTE systems would have been chosen. The overall efficiency and the cost level of the access network could be significantly improved just by using state of the art LTE advanced technology.

193. There seems to be a basic misunderstanding of the Commission on FWA capacity.[83] Given the capacity assumptions of TERA it is not a FWA tower which can serve 67 customers in the coverage area but one sector of the antenna. TERA, however, is assuming a standard configuration of three sectors per site. Therefore

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[78] See TERA, Model Specification, p. 49.

[79] See TERA, Model Reference Paper, p. 12.

[80] See Commission, UCLL, para. 602ff.

[81] We refer to the following sources: H. Holma, A. Toskala, "LTE for UMTS: Evolution to LTE Advanced – Second Edition", Wiley, 2011, M. Sauter, "From GSM to LTE An introduction to mobile networks and mobile broadband", Wiley, 2011, Motorola White Paper, „Realistic LTE Performance From Peak Rate to Subscriber Experience", 2009, F. Khan, "LTE for 4G Mobile Broadband Air Interface Technologies and Performance", Cambridge University Press, 2009.

[82] See: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=4555.

[83] See Commission, UCLL, para. 294.1.

the assumed capacity constraints support to serve 3 x 67 customers per site. This capacity potential can even be further enhanced by using more than three sectors per site which corresponds to state of the art mobile deployment.

194. By not increasing the capacity of FWA sites properly the Commission failed to meet its own standard for FWA deployment: "*For the FWA coverage areas we have ensured that 100% of customers within each FWA coverage area can be connected to the network ...*"**[84]** As we have shown on the basis of the sensitivity results we represented in para. 191 TERA's model implementation actually did not ensure 100% of customers were covered. This could have been achieved by properly dimensioning FWA.

4.2.6.2 Scope of FWA footprint not cost-optimized

195. In its choice of the MEA technology the Commission is guided by selecting the technology which leads to the lower cost of access. The Commission has defined the decision criterion to choose a FTTH/FWA hybrid technology if that is the lower cost access technology compared to a copper access technology.**[85]** This consideration is guided by the Commission's understanding and requirements of TSLRIC.

196. The same decision logic should be applied in determining the scope and footprint of FWA compared to FTTH (or copper access). The model should enable the Commission to take this choice in order to optimize costs and this would be consistent with TSLRIC. This is not the approach the Commission has followed. Instead, the Commission fixed the footprint of FWA by an external setting at the edges of the network *"... FWA should be confined to the current and projected RBI FWA footprint*".**[86]** The Commission regards expanding the FWA boundary outside the RBI FWA footprint to be inconsistent with its consideration of unbundling and the observed network roll-out in New Zealand.**[87]**

197. Consistency with the observed network roll-out in New Zealand is not necessarily an appropriate criterion in a TSLRIC context. This holds in particular even before we note that the RBI area is defined by the Government and not by a business decision of operators or the HEO. The decision to apply FWA in the RBI area is also driven by the Governmental subsidies which flow into this deployment. This aspect is totally ignored by the Commission.

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[84] See Commission, UCLL, para. 595.
[85] See Commission, UCLL, para. 287.
[86] See Commission, UCLL, para. 524.
[87] See Commission, UCLL, para. 555.

198. The Commission is aware that it has chosen a conservative approach regarding the extent of FWA in the modelled network[88] meaning that access costs could be lower by applying an optimization approach to deploy FWA. This is clearly supported by the modelling approach which has been conducted by Network Strategies and its results.[89]

4.2.6.3 Sharing of FWA sites with mobile service sites not considered

199. TERA assumes that the FWA sites are exclusively built and used for the sole purpose of FWA. That is not what an HEO would do. Radio towers usually are capable of hosting several base stations. The site investments usually represent several times the amount of the base station investment. The HEO would therefore internally share the site with other mobile services and as many sites as possible with mobile operators. Sharing can take both directions: Either the HEO rents site capacity from mobile operators or the HEO sells site capacity to mobile operators. The economic impacts are the same. Site cost are cut by a factor of close to two (or even three, if three operators share a site).

200. The model ignores the cost savings of sharing sites with other operators. Sharing of sites is happening in New Zealand. The HEO is in a different position. It is assumed to make use of available efficiencies because it is unconstrained by decisions in the past and potential strategic disadvantages to share. The Commission should therefore assume a relevant degree of site sharing of FWA sites. In the model the opposite is happening. TERA assumes (inflated) site costs which reflect the capability (and the additional cost) of hosting four operators on a site but assumes that the site is only used by one (the FWA) operator.[90]

4.2.6.4 Spectrum cost too high

201. The FWA spectrum cost in the model are based on the price at the most recent New Zealand spectrum auction. 9 (2 x 5 MHz) lots were available at that auction. 8 of them were sold in the first round for $ 22 million per lot. To calculate the FWA spectrum cost, this cost per lot has been multiplied by a factor of 4 to reflect the fact that 2 x 20 MHz are used in the model for providing the FWA services.[91]

202. A spectrum cost of 88 million just used for FWA in a limited area is inflated to what an HEO would be prepared to pay for that spectrum. The reference price on which the spectrum cost in the model is based upon, relies on the mobile broadband use of the spectrum on a nationwide basis. The revenue potential of using the spec-

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[88] See Commission, UCLL, para. 555.

[89] See Network Strategies, Modelling Fixed Wireless Access, UCLL and UBA Final Pricing Principle, Report for Vodafone and Spark, February 2015.

[90] See Section 5.8.10.

[91] See answer of the Commission to the TERA model, Annex 1, no. 8, 12/23/2014.

trum for the purpose which it was auctioned for in the respective auction represents more than $ 100 million annually, while the annual revenue potential of the FWA use represents a revenue potential of less than $ 10 million p.a. It is realistic to assume that an HEO would only be prepared to pay a fraction (if at all) of what the Commission/TERA is assuming as frequency cost for the FWA spectrum.

203. The Commission does not specify the way in which the HEO could get access to the spectrum: It could be in an auction, leased it from another operator, or getting it allocated by the Government to ensure broadband access in more remote areas.[92] The last is a fair assumption. No efficient operator, however, would pay a "*price that operator's actually paid in the real world*" in a totally different environment and for a totally different purpose.

204. Also from a public policy point of view it would look inconsistent or even strange if the HEO would have to pay a spectrum fee. FWA will be (primarily or even exclusively) deployed in areas of the country where it will not be profitable to provide communications services at the prevailing (uniform) end-user prices. In these areas subsidies would be needed anyhow to provide the service. Why should the Government on the one hand side provide subsidies in the TSO/FWA areas and at the same time increase the cost of the operator by requesting frequency fees. This would result in a zero sum subsidy game at a higher level. For these reasons the appropriate conclusion for the Commission would be to assume that the HEO would not have to pay for its spectrum.

4.2.7 Modelling the core network

205. The core network in the model's understanding includes the network from the DSLAMs in the cabinets and/ or local exchange locations to the first data switch (FDS), which is located in 92 node locations. There are 5,496 active cabinets and 790 exchange locations hosting DSLAMs, and in 92 of the local exchange locations a FDS is collocated (see Model Specification, Section 7). The fibres are routed from the DSLAMs via the appropriate local exchange towards the next FDS, using intermediate microwave links, submarine cables and DWDM links as they are installed in the Chorus network. Since "*the path followed by the core links are not Chorus' actual paths as these paths have been optimized*" in the geospatial modelling (see Section 4.2.1), we observe an inconsistency which we cannot check due to the intransparency of the geospatial modelling.

206. The active equipment selected for the model is not appropriate for the New Zealand network, nor is it state of the art. It may not even be sufficient to support already todays customer demand of approximately 300 Kbps average throughput in the busy hour under certain circumstances and will perform even worse with in-

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[92] See Commission, UCLL, para. 606.

creasing demand in the next five years of the regulatory period.[93] Both, DSLAMs and FDS, are dimensioned on the basis of the number of ports fitting into the chassis (called subracks in the model), not taking customer traffic demand into account. Thus, the model does not allow for dimensioning sufficient capacity. It furthermore does not consider traffic demand for additional, unregulated services using the same network, like Ethernet leased lines or TES (Model Specification, Section 7.1), VDSL customers or UFB customers. As a result the model does not allow for all relevant cost decreases caused by scale effects and results in cost overestimation for the UBA service. For details we refer to Section 5.4.3 of this submission.

207. The number of fibres in the DSLAM to local exchange connections are overestimated, thus cost sharing is not defined properly. The estimation of one leased line per cabinet using a fibre is not argued for nor is any benchmark for deriving such figure explained (Model Specification, Sections 3.8 and 8.7.2.2). The sharing factor for the DSLAM - FDS fibres in the local exchange - FDS paths appear to be underestimated, but anyhow not dimensioned properly due to the lack of an efficient DWDM modelling in this core network part. For details see Sections 5.4 and 5.14.4 of this submission.

4.2.8 Modelling/optimizing the entire core for trench optimization

208. In order to design an efficient national NGN network all traffic passing across this network has to be taken into account. In case of New Zealand this shall be the regulated UBA service, the UBA backhaul service and any unregulated service being provided over the NGN network of Chorus. Besides UBA this should include the TES (Tail Extension Service) service, VDSL services, other data services and any Ethernet leased lines, but also any UFB service (using the same network platforms).

209. According to the sources and sinks of the traffic and the amount of traffic in its regional distribution an efficient network hierarchy can be determined, allocating additional higher level network functions to existing network node locations. Additional network core nodes are installed there taking over these functions. These nodes shall be connected by higher level core node rings or network meshes. The lower level network nodes – in case of New Zealand this might at a first glance be the 92 FDS locations - will be allocated and connected to the higher network level nodes according to efficiency criteria. Also the allocation of each DSLAM to a FDS shall be determined by efficiency criteria. The efficient implementation of such a

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[93] Moores law of doubling the traffic every 1.5 years would result in 600 Kbps after 1.5 years, 1.200 Kbps after 3 years and 2.500 Kbps after 4.5 years. Even when this rule will not hold for the average peak capacity per end-customer a significant increase can be expected. This increase also will depend on the capabilities of the copper access network. One can expect that high usage end-customers will migrate to the UFB fibre network, where available and affordable.

network requires network rings and trenches which are not necessarily the same as today. In any case the optimal trenches are the result of such a network modelling approach, thus cannot be determined by a geospatial modelling before network hierarchy and topology are determined. Thus the trench optimization being addressed in the geospatial modelling description (Model Documentation, Section 4.2) can only be performed efficiently if the network hierarchy is already determined, otherwise it results in sub-efficient solutions.

210. As already stated in Section 2.3 there is no proof that the 92 FDS locations are the most efficient ones for the NGN access switch locations. It is also unclear whether their number is efficient. Assuming that the 92 node locations shall be taken as scorched nodes it is still unclear, whether the trenches between the FDS and the local exchange locations are efficient in order to connect the DSLAMs to the FDS. They are only then to be used if the local exchange locations are also set as scorched intermediate nodes for the DSLAM – FDS connections. While in the FTTH case a FTP – FDS access network topology optimization may compete with the local exchange intermediate node, it is the cabinet – FDS topology in case of copper. Nevertheless, the Commission has at least implicitly decided for the local exchanges as intermediate scorched nodes in its draft determination without improving their efficiency to the extent demonstrated here.

4.2.9 Input parameter generation

4.2.9.1 Data generation process in New Zealand not sufficiently related to parameter requirements of the model

211. Models which calculate costs in order to determine prices for regulated products have to be populated with data such as equipment prices, network parameters, demand numbers etc. Getting appropriate data for cost models is as important as the model mechanic itself in order to calculate efficient costs. Taking that into account an adequate procedure for collecting appropriate input data is to describe the model and its input parameters properly, so that the stakeholders can generate the data fitting to the model.

212. Common and adequate regulatory practice is to finish and describe model and input parameters first, publish and consult it with stakeholders and after that starting the data request. Thus the stakeholders are prepared for qualified responses. For example in Germany the national regulatory agency (NRA), BNetzA has taken this approach for nearly two decades. For all of the different cost models model descriptions and questionnaires are available[94]. The questionnaires are distribut-

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[94] See for example http://www.bundesnetzagentur.de/cln_1421/DE/Sachgebiete/Telekommunikation/Unternehmen_Instit

ed to all relevant stakeholders at the beginning of the price approval procedure in order to ensure the use of updated data in structures fitting to the cost models. Before this step the model reference document was published or updated and modified by a public consultation process, if required. So the stakeholders know exactly in advance which data are requested.

213. The Commission obviously has chosen another procedure for the present FPP process. First, the Commission started Section 98 data requests in February 2014, later the Commission released a model reference document for consultation in December 2014[95], together with the model. In a proper process the Commission should have built the model first and then issued the data request in a targeted way according to the model input parameter requirements. Furthermore, stakeholders should have had access to a model reference document so that they could develop a clear understanding of the data request including a clear definition of the relevant input parameters.

214. The unusual procedure of the Commission has several shortcomings:

a) Section 98 data request questionnaires address questions in a very general and unspecified way, because the model and its data input requirements had not been finished at the time of distribution of the questionnaires. This led to the effect, that the delivered data do not necessarily fit well to the input requirements of the cost model. For example, question 6.13.12 c of the questionnaire sent to Vodafone on 17th of April 2014 asks for unit costs of the core assets: The questionnaire provides a differentiation between cards, subracks and racks while the model distinguishes four different asset classes: ports, cards, subracks and racks. Moreover, the questionnaire does not reflect that asset classes can differ between suppliers or even within one supplier following different commercial approaches. This has the effect, that the questionnaires do not necessarily reflect the suppliers' reality and the answering parties deliver different inputs not fitting to the model. This probably led here (and in other cases) to the effect, that the Chorus supplier systems have been chosen as the basis for the TERA model and the supplier's price system was transferred to the model without change. A discussion how different suppliers' systems can

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utionen/Marktregulierung/massstaebe_methoden/kostenmodelle/anschlussnetz/anschlussnetz-node.html, http://www.bundesnetzagentur.de/cln_1421/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Marktregulierung/massstaebe_methoden/kostenmodelle/branchenprozessmodell/branchenprozessmodell-node.html, http://www.bundesnetzagentur.de/cln_1421/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Marktregulierung/massstaebe_methoden/kostenmodelle/breitbandnetz2x/breitbandnetz2x-node.html.

[95] See http://www.comcom.govt.nz/regulated-industries/telecommunications/regulated-services/standard- if Spark is not producingquest terms-determinations/unbundled-copper-local-loop-and-unbundled-bitstream-access-services-final-pricing-principle/.

be used to parameterize the model, so that all relevant parties can deliver reasonable input, was obviously not processed.

b) The general and unspecified way of the data request caused a significantly and inadequately increased data generation effort for the participating parties.

c) Moreover, the Commission's procedure makes the FPP process in general questionable. The discussion about the cost model is still ongoing. If this results in changes of the model, further data requests may be started.

215. Another aspect affecting the quality of data negatively is the selection and the limitation of parties addressed for input data contribution. Common and adequate regulatory practice is to invite all stakeholders of the regulatory process and other competent experts to attend. This allows to get a quite complete picture about available data. It enables to identify efficiencies appropriately. For example in Germany the national regulatory agency, BNetzA, sends a mandatory data request questionnaire to all participants of the regulatory process and other experts, for example to equipment suppliers also. Other European regulators, for instance those of Austria, Luxembourg and Spain act in the same way.

216. In the current New Zealand FPP process this cannot be observed. Not all stakeholders have been involved in the Section 98 process. A justification for this limitation cannot be recognized by us. Even when some operators are currently not deploying fixed access networks, they are producing backhauling and backbone networks, partly with the same equipment used in access networks. Furthermore, equipment suppliers have not been asked. The reduction of addressees rises weight and influence of the incumbent's data. This leads to distorted costs used for modelling, not reflecting the available market knowledge in New Zealand at all. In TERA's CI input Excel map we could observe, that more than 90% of the data used in the current input tools are originated from the incumbent Chorus. Moreover, our samples from the data room show, that most of this input data has been taken from Chorus without checking and proving their appropriateness and without transparent efficiency adjustments. Valid justifications for that procedure are in most cases not explained neither in the documentation nor in the CI input Excel map.

217. Comparing the different Section 98 questionnaires addressed by the Commission we observe substantial differences in the questions asked. Common and adequate regulatory practice is to distribute a unique questionnaire for cost model data request to all stakeholders and experts participating in the regulatory process. For example the German and Austrian NRAs send the same mandatory data request to all participants, including the hint, if data is not available to an addressee it has not to be provided. This results in utmost transparency already at the begin-

ning of the process. As already addressed in para. 215 a procedure as applied in New Zealand results in an incomplete market overview.

218. In the current FPP process we observed for example, that Chorus and Vodafone received different questionnaires. For instance Chorus was asked for asset lifetimes of equipment but Vodafone was not asked. A justification for this difference is not recognizable. Vodafone is a very experienced telecommunications provider and even in the case some data would not be available, it would have made sense to ask.

219. In any case these different questionnaires led to a reduced data quality. Moreover, it is a doubtful process treating even the competitors of the incumbent in a different manner, with less opportunities to take part in the Section 98 data request and thus in the full FPP process.

220. The consequence of the inappropriate data gathering process is, that the current inputs of the cost model do not meet the quality requirements of the price determination processes. Instead, it leads to additional administration efforts and costs without generating cost efficient model input data.

4.2.9.2 Data sources not always documented

221. An adequate regulatory practice is to document the sources of the data properly. Otherwise it is not possible for stakeholders or independent third parties to evaluate the data used regarding their appropriateness. After having taken several samples from the TERA tools we conclude, that the documentation is incomplete.

222. This can be demonstrated by the following example: In the excel map CI_ComCom - Inputs - v7.3.xlsx, on the sheet “1. Common parameters” the values for the two input parameters “IncurredLeadinUrban” and “IncurredLeadinrRural” are presented, but their data source is not revealed (the corresponding cells K48/49 are empty). There is a link to the input calculation sheet “Cu2.”, but also here the sources are not presented precisely (the linked cell L170 is empty and the content of the other linked cell (L169) just provides the information “Geomarketing data” without any further information).

223. Also: In the excel map “CI_ComCom - Inputs - v7.3.xlsx”, Sheet “4. Costs”, two input parameters concerning poles (“regulatory consent”, “network deployment compliance”) are provided as one-off cost without further explanations (lines 14 and 15). Asking TERA for further clarification (“What does this investment represent in the NZ context? What are its cost drivers?”) we got the answer: “*These costs are costs that were submitted by Chorus during the MEA discussion. Please refer to their August 2014 submission. The cost driver is the roll-out of poles.*” Neither Chorus’ submission nor the unspecified cost driver statement of the Commis-

sion/TERA allows an evaluation of these input parameters. Chorus' submission and its Incite study describe these positions in a general way providing no information how these costs were calculated. Furthermore, the model treats these costs as fixed cost only, not related to a cost driver. This is not consistent with the answer of the Commission/TERA. One could, for example, have expected a relationship between the degree of overhead cabling and these compliance costs. Due to the incomplete explanation the input data used cannot be assessed properly. Thus, it is not possible to evaluate, whether further cost efficiency potentials have been considered appropriately.

4.2.9.3 Benchmark and other sources not revealed

224. In the case that Chorus' data were not available (for example see TERA, Model Specification, CI version, final version for release.pdf, pages 16, 59, 61, 63) several benchmarks are used by TERA for checking inputs provided by Chorus or for generating input data. The TERA documents do not provide more detailed information. This information is superficial and not appropriate to enable assessing the benchmark sources and the process. The concrete benchmarks used are not revealed or made available. One typical example is the Macro-Parameter specifying the leased line cost share in the access network (Model Specification, Section 3.8; see also Section 5.14.4), which is neither explained nor applied.

225. Also the model tool does not provide more precise information on data sources. We want to demonstrate this with the following two examples:

    a) In the excel map CI_ComCom - Inputs - v7.3.xlsx on the sheet "2.1. Copper inventory" the unspecified data source "benchmark" is mentioned for the input parameter "ActiveSC" (see cell I76) and also the linked input calculation sheet "Unit costs calculation". In the same excel file no further information on the benchmark (see cell K353) is presented.

    b) In the excel map CI_ComCom - Inputs - v7.3.xlsx the sheet "4. Costs" provides the unspecified source "TERA expertise" regarding the input parameter "subduct" (see cell L20). Also the linked input calculation sheet "Unit costs calculation" in the same excel file provides no further information on the TERA expertise (see cell O37).

226. In consequence, these unspecified data sources cannot be evaluated or qualified. Thus, further cost efficiency potentials cannot be evaluated appropriately.

4.2.9.4 Definitional structure of certain inputs unclear in the model

227. A condition for an adequate input for cost models is a precise description, what the input parameter includes. In several samples from the TERA tools we found input parameters which are not described precisely, for example: The excel map CI_ComCom - Inputs - v7.3.xlsx the Sheet “4. Costs” shows an input parameter described as “MW site” (see cell I43). Further information about the content of this parameter cannot be found on this sheet. Following the linked cell on sheet “Unit costs calculation”, cell H433, this sheet also gives no further hints about the content of this parameter. Analyzing this sheet we assume the cost of microwave links are summed up here, but no further information is provided. It remains unclear, whether this position contains active and/or passive equipment (e.g. building costs of the site) and how the costs of each link was calculated. Also in the accompanying TERA documents we could not find additional information, which clarifies this parameter. The Model Reference Paper just provides the hint that “*The model should include Chorus’ existing microwaves links*” (page 30), but in the model itself we could not find a link to the data room with Chorus’ information provided the Section 98 request.

228. Once again it cannot be evaluated, if further cost efficiency potentials have been considered appropriately. Moreover, it cannot be evaluated, whether there is double-counting of costs. For example, the MW site costs can include property costs and the OPEX model also seems to include rental costs for microwave sites (see TERA, Model Documentation, CI version, final version for release.pdf, page 31 and CI_ComCom-OPEX model v1.10.xlsm, sheet “Parameters”, I13).

4.2.9.5 Input parameters are not sufficiently differentiated between copper and fibre assets

229. As a consequence of the FTTH MEA approach, the cost model calculates access network costs on the basis of copper and fibre networks. Not only the copper and fibre cables themselves have different costs, also other related costs like ducts, maintenance etc. may differ as a result of the different technical characteristics of copper and fibre cables. After having taken samples we come to the conclusion, that the model does not differentiate properly costs between copper and fibre cables. For example: In the excel map CI_ComCom - Inputs - v7.3.xlsx,” the sheet “4. Costs” contains input data for ducts with 50 and 110 mm diameter and subducts with 32 mm diameter (cells I18 to I20). These duct diameters are appropriate for copper cables. Fibre cables, however, are thinner than copper cables. Consequently, the ducts currently used in the cost model are overdimensioned for calculating the costs of the access network (see also Section 5.4.4). This has not only the effect, that the duct costs themselves are overestimated for fibre access, but also trenching costs, which represent a more significant cost volume. Trench-

es can be dimensioned smaller due to smaller duct requirements and more efficient costs can be calculated for fibre access than currently implemented in the cost model. For example the model of the Danish regulator provides smaller ducts for fibre (see Section 5.8.3).

4.2.9.6 Input parameters are not sufficiently differentiated between feeder, distribution and drop segment

230. The cost model calculates costs for different levels of the access network (drop, distribution and feeder segments). Hereby the different sizes of network elements have to be regarded. Analyzing the model on a sample basis shows, that this approach was not processed consequently. For example: In the excel map CI_ComCom - Inputs - v7.3.xlsx", the sheet "4. Costs" contains input data for manholes (see cell I23). The Model Documentation describes different manhole sizes in order to achieve cost efficiency: "*A chamber is either a manhole, a handhole or a pithole. It is an underground box where joints are installed and can be easily accessed.*" (TERA, Model Specification, CI version final version for release.pdf, page 43). Following the cell link we find on sheet "Unit costs calculation" cell J46, pointing to the other preparing calculations on this sheet. Looking in detail we find, that four different sizes of manholes are considered (see cells H47 to H50), which obviously does not fit to the description in the TERA, Model Specification above (4 instead of 3). The distribution of the four manholes sizes, also input parameters to the model (see cells I47 to 50), are not calculated endogenously by the model itself (as it should be) in order to achieve cost efficiency. Instead, following the sources for these sheets we are led to the data room and to the Section 98 request responses by Chorus (20140605_Confidential_Q 6.14.1 I (ii-iv) Manhole costs v1.1). Obviously, the cost input structure of Chorus was used for calculating averaged input values. Furthermore, it seems that Chorus practices a decentralized purchase of material ("NP 01-11") with probably more than one supplier (Chorus states, that costs "can be assumed as average"). That means, that there are more model weaknesses than the unsubstantiated distribution described above, which was not calculated by the model itself and can also not found in the data room. Additionally, we cannot find a justification for the decentralized purchase approach of material with different input prices, to be cost efficient. Quite the contrary can be assumed. The simple averaging of different supplier prices in the model ignores best practice prices and the potential of scale effects of buying material from just one or at least less suppliers. Instead, the lowest price would have to be taken as the most efficient one.

4.2.9.7 Adaption of original data to cost model input parameter data mostly uncertain due to missing descriptions

231. In order to evaluate the appropriateness of input data a complete description of the transformation process from the data of the Section 98 request or data of other sources into input data for use in the model is needed. This transformation process in most cases is not described nor transparent. For example: In the excel map CI_ComCom - Inputs - v7.3.xlsx on the sheet “4. Costs” the parameter “Manhole” suffers from significant methodological weaknesses as we described in Section 4.2.9.6. Moreover the generation of this input parameter is not transparent end-to-end. We found two excel files (20140605_Confidential_Q 6.14.1 I (ii-iv) Manhole costs v1.1)) in the data room, but their content is not congruent with the data used in the sheet “Unit costs calculation” in the excel file CI_ComCom - Inputs - v7.3.xlsx. We have identified cost deviations in both directions, which we could not explain and which we assume to be caused by the lack of transparency in the benchmarking process.

4.2.9.8 Input parameters are overestimated due to calculation errors

232. While checking the input parameter calculations we found significant calculation errors. For example, the calculation of active equipment uses wrong currency rates for transforming supplier prices to NZD: The Excel Map “CI_ComCom-UBA Inputs v1.0.xlsx”, sheet “Equipment per year” provides the calculation of input. The cell AB 49 also contains installations costs[96]. Installation costs are provided in the currency NZD[97] but asset costs are provided in the currency EURO.[98] The sum of this positions is multiplied with the exchange rate €/NZD in spite of including an addend in NZD[99]. This leads to wrongly increased costs because a part of this sum, the installation cost, already is expressed in NZD, but is multiplied with the exchange rate of 1.57 in addition.

4.3 Choice of lowest cost technology

233. According to the UBA model[100] the FTTH/FWA access network represents a CAPEX value of $ [...] CNZRI million p.a.[101] The copper access network on the other hand represents a CAPEX value of $ [...] CNZRI million.[102] In terms of total annual cost (as the sum of annualized CAPEX, OPEX and non-network related

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[96] “=SUMME('Q 6.17.12 (a) - ISAMs'!E11;'Q 6.17.12 (a) - ISAMs'!E12;'Q 6.17.12 (a) - ISAMs'!E14)+'Q 6.17.12 (d) Install Costs'!D10”

[97] See sheet “Q 6.17.12 (d) Install Costs”, cells D4 and D10.

[98] See sheet “Q 6.17.12 (a) - ISAMs”, cells E11, E12 and E14.

[99] See sheet “Equipment per year”, cell M49. (=Z49*AB49+AD49*AF49).

[100] See Excel map CI_ComCom - UBA model v5.1.xlsb, sheet “OPEX and ACCESS”.

[101] See Cell, L801.

[102] See Cell, Q801.

cost) the 2015 cost of the FTTH network amounts to $ [...] CNZRI million[103] and the cost of the copper network to $ [...] CNZRI million.[104] Thus, the 2015 total cost of the FTTH network exceed the corresponding cost of the copper network by 14.2%. On the basis of these model based calculations it looks like that the copper access network technology generates lower costs than the fibre access technology.[105]

234. The Commission did, however, not make its lowest cost technology choice based on these cost considerations mentioned in para. 233. Instead it deducted from the cost base of the fibre access network the SLU backhaul cost calculated by the model. The resulting number is lower than the copper access costs which is not corrected for the feeder segment of the network. On this basis the Commission came to the conclusion that the fibre network represents the lower costs.

235. There is no obvious reason for us why the decision on the lowest cost technology is based on two different network configurations of the underlying network technologies. As a consequence, the UBA model generates a result according to which the copper access network represents the lower cost and not the fibre network (see also Section 4.2.4).

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[103] See Cell, K801.

[104] See Cell, P801.

[105] For more details of our analysis see Section 4.2.4.

5 Why can the Commission's cost models in their current form not inform the Commission on UBA/UCLL TSLRIC pricing?

5.1 Overall inconsistencies

5.1.1 Inconsistencies between the cost model tools and the Model Documentation

236. The tool and the Model Documentation contain inconsistencies. A clear example is represented by the costs for handover points. The Model Documentation of TERA provides the information, that the assets for handover points have to be excluded: “*Chorus’ core network restricted to the part located between the DSLAM and the first data switch, the handover point being excluded from the UBA service as this part of the handover connection, which is paid separately.”*[106] We agree with this exclusion in order to avoid an inappropriate double-counting of costs. We could not, however, find this exclusion (completely) in the model.[107]

5.1.2 Discrepancies between the various models

237. TERA’s cost model actually consists of three cost models (as they call them). We would prefer to call these elements “modules” of one model because only the interaction of all three modules generates meaningful results to inform the FPP price determination.[108]

238. The Microsoft Access module derives the “inventory” of all passive network elements. This module generates as an output the inventory of the local access network which is transposed into costs in the form of annualized CAPEX in the Microsoft Excel modules. The OPEX model derives the OPEX, the indirect CAPEX (as part of the non-network costs), the common cost and the costs of transaction charges. We did not see any further reference in the Model Documentation papers or the model itself on the separation of costs related to and caused by transaction services and the costing (and/or pricing) of transaction services. The core

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[106] See TERA, Model Reference Paper, p 24.

[107] In the excel map “CI_ComCom - UBA model v5.1.xlsb” the sheet “Allocation keys” obviously has the function to calculate allocation keys, for example the allocation key for “Interconnection” in line 66. The cell N66 calculates the allocation factor. Following the links of this cell to the cells N57 and N55 it can be observed, that costs for REN ports are allocated to interconnection services. This seems wrong because costs for RSP ports have not been excluded from the calculation as they should. Cost for RSP ports also represent handover costs which are paid separately by the interconnection partners and may not remain in the cost basis for ULL and UBA services. This inappropriate allocation is confirmed by following further cell links to the sheet “Network dimensioning”, cells K130 and 131: By checking the cells K 122, 123, 130 and 131 we see that the costs for RSP handover are still included in the cost base for ULL and UBA services.

[108] See TERA, Model Documentation, p. 8f.

module derives the inventory and the cost of all active assets and allocates the common costs to the different services and determines the final total costs or prices of the regulated services.

239. The definition and the separation of these modules entail a variety of implausible elements. We found that OPEX and non-network cost values in the OPEX and core network modules are different as the following tables show. We could not explain or find the reasons for these discrepancies.

Table 5-1: UCLL OPEX and non-network cost shares in the OPEX and the core (UBA) model

- Results for „UCLL Opex-Model“ obtained by dividing Opex per line figures from Opex model by total cost per line from UBA model
- Results for „UCLL UBA-Model“ obtained by dividing Opex figures from UBA model by total cost from UBA model

	2015	**2016**	**2017**	**2018**	**2019**
UCLL Opex-Model	**22.81%**	**22.49%**	**22.17%**	**21.86%**	**21.55%**
Opex	13.72%	13.47%	13.22%	12.97%	12.73%
non-network cost	9.08%	9.02%	8.95%	8.89%	8.82%
UCLL UBA-Model	**23.55%**	**23.17%**	**22.80%**	**22.43%**	**22.07%**
Opex	12.99%	12.79%	12.60%	12.41%	12.22%
non-network cost	10.56%	10.38%	10.20%	10.02%	9.85%
UCLL Difference	**-0.74%**	**-0.69%**	**-0.63%**	**-0.58%**	**-0.53%**
Opex	0.74%	0.68%	0.62%	0.56%	0.50%
non-network cost	-1.48%	-1.36%	-1.25%	-1.14%	-1.03%

Source: WIK model analysis

Table 5-2: UBA OPEX and non-network cost shares in the OPEX and the core (UBA) model

- Results for „UBA Opex-Model“ obtained by dividing Opex per line figures from Opex model by total cost per line from UBA model
- Results for „UBA UBA-Model“ obtained by dividing Opex figures from UBA model by total cost from UBA model

	2015	**2016**	**2017**	**2018**	**2019**
UBA from Opex-Model	**56.59%**	**56.97%**	**57.31%**	**57.63%**	**57.92%**
Opex	34.05%	34.12%	34.17%	34.20%	34.21%
non-network cost	22.54%	22.85%	23.14%	23.43%	23.71%
UBA from UBA-Model	**56.71%**	**57.04%**	**57.35%**	**57.63%**	**57.87%**
Opex	34.12%	34.17%	34.19%	34.20%	34.18%
non-network cost	22.59%	22.88%	23.16%	23.43%	23.69%
UBA Difference	**-0.12%**	**-0.08%**	**-0.03%**	**0.01%**	**0.04%**
Opex	-0.07%	-0.05%	-0.02%	0.00%	0.03%
non-network cost	-0.05%	-0.03%	-0.01%	0.00%	0.02%

Source: WIK model analysis

240. The three modules interact on a one-way basis. The access and the OPEX modules of the model are independent modules. The core module on the other hand relies on the results of the other two modules. There is, however, an interaction between the core and the OPEX module in a backward relation which can generate inconsistent results. Some allocation keys in the OPEX module are imported from the core module and thus form a circular relationship. These are then fixed and cannot be changed for sensitivity analysis or when major parameters are being changed.

241. Another discrepancy between the OPEX model and the UBA model relates to the number of lines used. Table 5-3 shows that the numbers used in the two models differ to some extent.

Table 5-3: Difference in number of lines between the OPEX and the UBA model

Line type	**Opex Model**	**UBA Model**
UCLL	1,759,251	1,758,153
UBA (xDSL)	1,100,000	1,136,355

5.2 Implausible and inconsistent model results

5.2.1 Increase/decrease of FDS capacity increases/decreases UBA cost

242. For analysing the model correctness we varied i.a. the number of slots per FDS.[109] In varying the number of slots in the FDS having originally 7 slots by doubling them to 14 and reducing them to 3 (- 57% capacity) and leaving all other parameters unchanged we found an unexpected result. Doubling the capacity increases the UBA cost instead of reducing it, as we would have expected, and reducing the capacity by 57% decreases the UBA cost instead of decreasing it.

	Base Case	+ 100%	- 57%
UBA [NZD per month]	10.17	10.18	10.16
Variation [%]		+ 0.06	- 0.06

Source: WIK-Consult calculation with the TERA model

243. Analysing deeper we found in the case of a decreased FDS (7) capacity an investment decrease of -5.72% for the FDS total investment and even more astonishing a -25.54% investment decrease in racks, and consequently also a decrease of -4.72% in site investment. While the site cost decrease due to a rack decrease seems consequent, the significant rack decrease caused by a switch capacity decrease is not plausible. With lower switch capacity more switches would be required and thus more racks for hosting them and not less. Stepping deeper into the model and analysing the figures of area CH we found the number of FDS (7) decreasing from 1 (base case) to -3 (-57% case). A negative number of switches is not a realistic model result, thus we conclude the switch calculation in the model is not operating correctly.

5.2.2 Copper investment and cost react on fibre price and lifetime changes

244. In varying the fibre cable prices up by 100% and down by 50% in the MS Excel access module we found that the copper investment and copper cost also reacted significantly. This also happened when varying the fibre joint cost to the same extent. The copper investment and cost did react also in a comparable manner (Figure 5-1 (investment) and Figure 5-2 (cost)). This does not seem to be reasonable. Vice versa: when varying the copper cable prices and joints to the same extent the fibre investment and cost do not react. We regard this second behavior of

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[109] Ceteris paribus.

the model as reasonable and would have also expected it in varying the fibre prices.

Figure 5-1: Price variation + 100%, reaction of copper and fibre investment in the MS Excel access module, individual variation of different assets, result in ARC elasticity in %

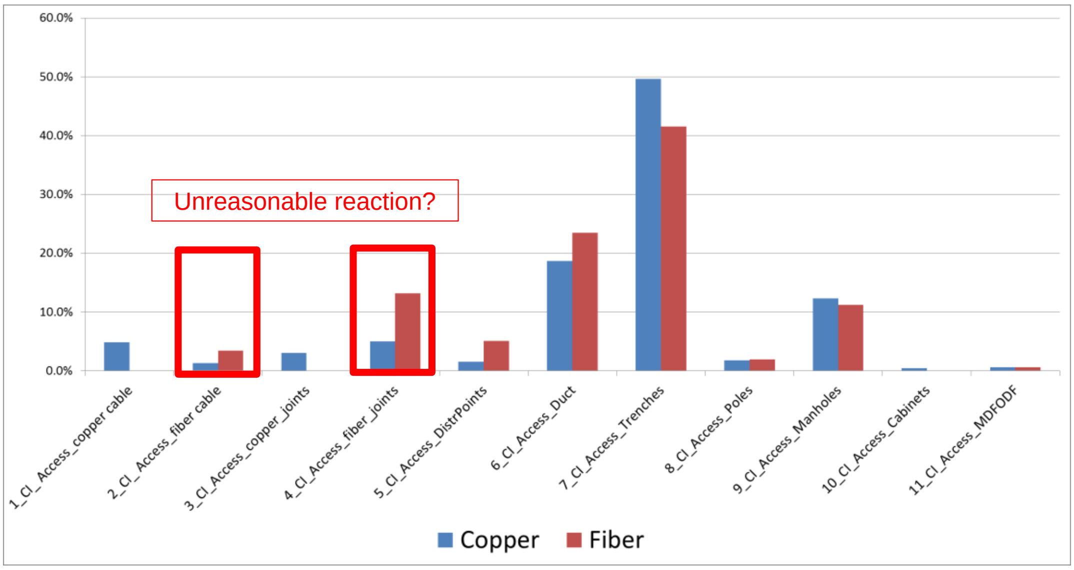


Figure 5-2: Price variation + 100%, reaction of copper and fibre cost (CAPEX) in the MS Excel access module, individual variation of different assets, result in ARC elasticity in %

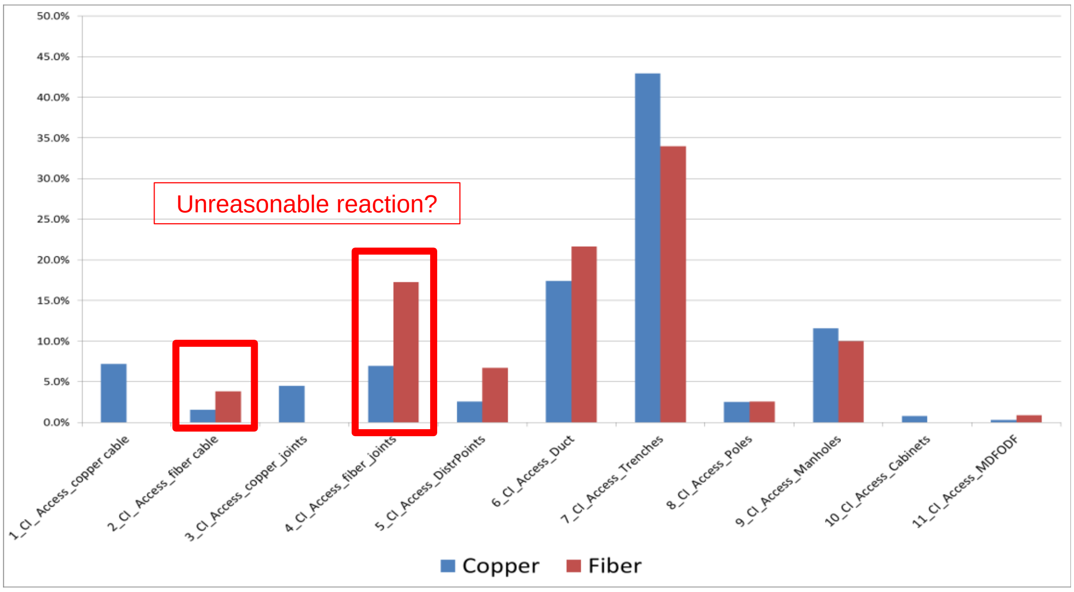
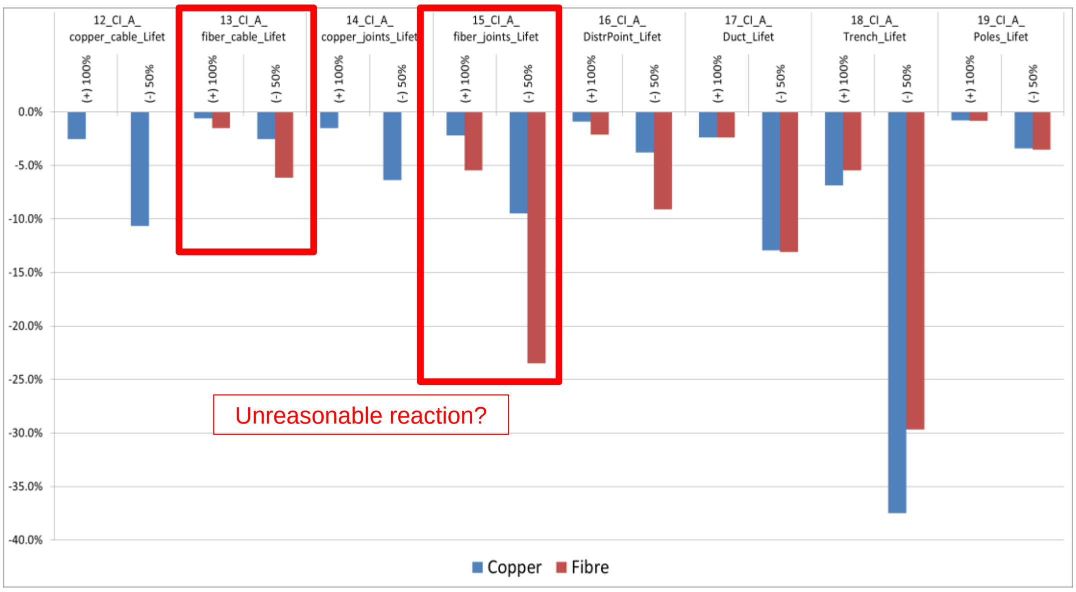


Figure 5-3: Asset lifetime variation + 100%/ - 50%, reaction of copper and fibre cost (CAPEX) in the MS Excel access module, individual variation of different assets, result in ARC elasticity in %



245. Varying the asset life time for fibre cables or fibre joints by +100 or -50% shows the same reactions on copper and fibre cost (Figure 5-3) as already described above when varying their prices. Once again varying the copper cable and copper joint lifetimes in the same size do not induce any fibre cost changes at all. We have expected the latter behaviour of the model. The first reaction, however, looks strange and cannot be explained by us. We believe that the model does not operate properly in this regard.

5.3 Insufficient exclusion of double-recovery of costs

246. Any regulatory TSLRIC costing approach has to take care that the same costs are not recovered twice (or even three or four times). Otherwise, the regulated entity becomes overcompensated, access seekers (and retail customers) as a consequence would pay too high a price for the relevant service. Double-recovery of costs is not compatible with TSLRIC pricing. It is for this reason that Clause 4B of Schedule 1 of the Act also sets a ban on double-recovery of cost.

247. Double-recovery of cost can have many reasons and sources. It can be based on a blurred definition of services, of costs and cost categories. It can follow from certain cost allocation rules applied. It can also relate to the approach of how the relevant cost are identified. Some methods of determining costs are more vulnerable to double-recovery than others.

248. We have identified areas where double-recovery of costs explicitly occurs (Section 5.3.1). Furthermore, we have identified areas where the existence of double-recovery is highly probable because the Commission and/or TERA has not taken care of the problem at all or not with sufficient care. Generally, the Commission has relied on cost calculation methods with a high risk of double-recovery to occur although there had been alternatives which would have been more advisable for other reasons but also for the reason to minimize the risk of double-recovery.

5.3.1 Not considering lead-in compensations

249. TERA's "base case scenario" which informs the Commission's draft FPP price determination based on the UCLL cost calculation includes all cost of the lead-in segment of the access network. For major parts of this network segment Chorus, however, receives capital expenditure contributions from users. Some segments even have been directly contributed and covered by the users themselves. The HEO therefore does not have to cover and bear the cost of major parts of the lead-in segment of the access network. Having the full lead-in cost included in the cost base of the access network and as part of the monthly rental would lead to a double-recovery of costs. Under the current cost calculation practise of the Commission Chorus would be compensated for costs which are supposed to be covered by the users themselves and directly.

250. The lead-in is defined as the network segment between the (last) distribution point (which is either the CCT in the copper network or the FAT in the fibre network) and the equipment outside the building, to which the customer premises are linked and which is called the external termination point (ETP) of the access line. The lead-in consists of two sub-segments:

- The vertical sub-segment which is the segment (or length) from the building to the road.
- The horizontal sub-segment (or length) which is the segment at the road from the property boundary to the CCT/FAT.

In case of aerial deployment the lead-in length per dwelling is determined as the hypotenuse of the triangle formed by the vertical length and the horizontal length.[110] The lead-in represents a major part of the cost of the access network. In case of the copper access network the CAPEX share of the lead-in amounts to 17.1% and in case of the fibre network 26.3% of total CAPEX.[111]

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[110] See TERA, Model Documentation, p. 71.
[111] WIK-Consult calculation based on the TERA model.

251. There are three different forms in which users contribute to the cost of deploying the lead-in segment:

    (1) Users have to provide an open trench on their estate.

    (2) Users have to contribute to the cost of installing a standard lead-in at an amount of $ 195.

    (3) Users have to contribute to the cost of installing a non-standard lead-in at an amount of $ 195 for the first 100 m plus time and materials for any additional distance.

252. According to Chorus' general terms and conditions for lead-ins the "*Copper Service Lead-In is installed into an existing open trench*" and "*the customer is required to provide an open trench from the ETP through to the Network Access Point (eg. pillar outside)*".[112] Different to the TERA model Chorus is defining the lead-in from a Network Access Point which is different to the location of the distribution point in the model. According to Chorus' definition the lead-in ends at the property boundary of the customer and therefore only represents the vertical sub-segment as defined in para. 250. As a conclusion customers have to provide the open trench (or the poles) to deploy the cable within their property boundaries. These costs are not covered by Chorus but by the user directly. These terms and conditions should also represent the environment in which the HEO deploys its network.

253. Chorus charges the customer[113] a one-off connection fee of $ 195 for standard copper service lead-in installations for installations under 100 m. As part of that installation service Chorus installs a 20 mm pipe into an existing open trench (or one which has to be provided by the customer) and provides an underground service lead-in and/or four span of overhead service lead between the Network Access Point and the ETP.[114] Economically this installation charge covers (fully or partially) the cost of the pipe (in case of underground installation), the copper cable of the vertical lead-in, and the respective installation. The connection fee of $ 195 represents an average cost because parts of the relevant cost are driven by the length of the vertical lead-in. Depending on the actual cost of providing the vertical lead-in the connection fees are covering these costs fully or partially. In any case the connection fees are a direct contribution of the users to deploy the lead-in connections and reduce the CAPEX of Chorus to deploy the access network.

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[112] See Chorus: Copper Service Lead-In, printed from http://customer.chorus.co.nz/copperserviceleadin on December 05 2014.

[113] This charge is billed to RSPs.

[114] See Chorus: Copper Service Lead-In, printed from http://customer.chorus.co.nz/copperserviceleadin on December 05 2014.

254. For non-standard lead-ins (where the vertical lead-in length is above 100 m) a different cost compensation regime is applied. In this case the user is charged $ 195 for the first 100 m plus time and materials for any additional distance. This pricing regime means that all vertical lead-in costs above 100 m are fully covered for Chorus and will be fully contributed by the users. The first 100 m are covered insofar as the lump sum connection fee is cost covering.

255. TERA's model contains the option to exclude connection fee revenues from the relevant cost base. Furthermore, it includes the option to exclude the cost of the non-standard lead-ins. The model does not foresee any option to exclude trenching cost related to the vertical lead-in although this network segment is directly contributed by the user and can therefore not be part of the cost base. Although TERA's model foresees the options to exclude the connection revenues and the cost for non-standard lead-ins, these options are not activated for the actual cost calculation. "By default, all lead-ins are included in the model."[115] This means that all the lead-in contributions by users mentioned in para. 251 are included in the cost base which is being used to calculate the UCLL cost/price. This approach of the Commission represents a significant double-recovery of the cost of the lead-in segment, because the cost are either covered directly by the user or paid for by connection fees. To avoid double-recovery all the three cost elements in para. 251 should be excluded from the UCLL model cost calculation.

5.3.2 OPEX cost calculations bear a high risk of double-recovery

256. OPEX are basically derived from Chorus' accounts. This approach bears a relevant risk of double-recovery. Installation costs which have to be capitalized at first hand appear as OPEX. OPEX are usually not separated in the accounts according to services. The allocations needed are usually not sufficiently related to cost causation.

5.3.3 Network OPEX and OPEX for transaction services not always separated

257. The total cost of an RSP for using the UCLL and/or the UBA service consist of recurring monthly UCLL and UBA charges and of one-off transaction charges. Transaction charges arise from events like connections, transfers, interference investigations or cease of service. The cost of providing transaction services are predominantly operating expenses and only to a minor degree related to capital expenditure.

258. The Commission has not yet finalized and not yet published its costing approach towards transaction services. In its most recent process and issues paper the

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[115] TERA, Model Specification, p. 36.

Commission announced to publish its draft decision on non-recurring charges end of May 2015.[116] We assume that this draft decision will include the costing approach of the Commission.

259. The costing approach for transaction services has to clearly separate the cost of providing the transaction services from the costs and in particular the OPEX of the recurring UCLL and UBA services. For the recurring UCLL and UBA charges this means that the relevant cost base of these services should not include costs which arise in providing the transaction services. Otherwise there would be a double-recovery of the same costs.

260. According to our knowledge from other cases transaction services are often provided by the same cost centres of an operator and major parts of the cost of transaction charges can only be determined by cost allocation rules. From the description of the reference files for OPEX in TERA's Model Documentation[117] it is not transparent to us whether Chorus' detailed accounts are separated between regulated (and unregulated) recurring and non-recurring services. There are, however, indications that that is not the case. E.g. one of the OPEX model reference files include "provisioning costs".[118] Without knowing details of that file, provisioning costs seem to be more related to transaction services than to network OPEX. Consequently they should be excluded from the relevant cost base. It is not transparent to us whether this actually happened in the model.

261. This should be explained in more detail. Due to the rather rough description of this module and the TERA documents, it cannot be reconstructed in how far transactions costs have been eliminated. Our understanding is, that the sheet "Alloc key" of the OPEX model is the central sheet to calculate all allocation keys (see cell B2: "*This sheet is used to calculate all allocation keys used in the model.*"). This sheet also suffers from rough descriptions and missing explanations. So only a rough check is possible. It looks like allocation keys have been calculated on a product basis (for example UCLL, UBA, others) and on a network element basis (for example MDF, DSLAM & First level of EAS, Remaining EAS & Others Equipt, DSLAM & Active Equipt, Passive Equipt, Feeder, D-Side/Lead-in). We could, however, not identify an allocation key which explicitly refers to recurring and non-recurring cost/charges.

262. We also checked the sheet with central results which are exported to the core model. Here we just found a description for the indirect CAPEX related to regulated services. This does not exclude the possibility that costs in relation to transac-

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[116] See Commerce Commission, Process and issues update paper for UCLL and UBA pricing review determinations, Consultation paper, 19 December 2014, para. 10.

[117] See TERA, Model Documentation, p. 18ff.

[118] See Table 1 of the Model Documentation, p. 19.

tion services are included because at least major parts of these services are also regulated.

263. The OPEX model uses a variety of rather broad cost categories like “IT network expenses”, “core network technicians”, or “filed services”. These costs can be related to recurring and to non-recurring services. There is, however, no indication at all in the OPEX model that parts of such joint costs have been allocated to transaction services.

264. Not even referring to the potential problem by TERA or the Commission that some of the OPEX costs allocated to network services may be costs caused by transaction services nor providing any allocation approach clearly supports the indication that the OPEX costs calculated by TERA include costs which would have to be allocated to transaction services.

5.3.4 Not considering re-use of assets also has an element of double-recovery

265. If an operator uses certain assets beyond their economic lifetimes, it receives economic compensation for an asset which is already fully depreciated if the ORC asset valuation approach is generally applied. The relevant asset earns revenues twice at least as long as it is finally used. In cost terms over-recovery of costs occurs, the user pays for costs it has already paid for in the past. The same holds if an asset which is already depreciated is re-used for a different purpose. This holds for example if a particular trench built for a copper access network is now used for a fibre network.

266. We have shown in Section 1.1.2.3 that major parts of Chorus’ asset base of the copper network is already fully or mostly depreciated.

5.4 Engineering dimensioning rules are not state of the art

5.4.1 Size of cabinet and DSLAMs not appropriately dimensioned

267. The street cabinet assumed in the model can host 2 subracks with a maximum of 384 ports each, and for each of the subracks 1 fibre operated at 1 Gbps is considered. There are approximately 1.2 million customers using the UBA service (Model Specification, Section 7.2). With approximately 6,300 DSLAM node locations there is an average of 190 active UBA customers per DSLAM. Since there are 790 DSLAM exchange locations serving significantly more than the average number of UBA customers per DSLAMs one can assume that the utmost proportion of the cabinets support less or equal 192 UBA customers. We estimate, based on support by operator experts, that 85% of the DSLAMs serve less or

equal 192 UBA customers, and approximately another 11% serve less or equal 384 UBA customers. Thus less than 5% of the DSLAMs serve more customers, but one can assume all those to be hosted in local exchanges. This analysis allows the following conclusions:

- The DSLAMs for service in cabinets are significantly overdimensioned in the model, half the size of one subrack would be absolutely sufficient in 85% of the cases!
- There is no need for a two subrack cabinet!
- There is no need for a second backhaul fibre!

268. An appropriate sizing of DSLAMs would therefore start with a small DSLAM version of 24 or 48 ports. Such systems are available as so called stackable pizzaboxes, so that one can scale these boxes by stacking them each on top of those being installed before using the same backhaul connection. This represents efficient dimensioning, significantly saves cost and allows for a high degree of flexibility.

5.4.2 Size of FDS and racks not appropriately dimensioned

269. The dimensioning algorithm for the FDS and its racks has a failure resulting in an unjustifiable negative number of switches and decreasing rack demand, when reducing the port capacity per switch. This is already described in detail in Section 5.2.1. Furthermore, the FDS have to be designed by also taking the user traffic into account (see Section 5.4.3).

5.4.3 Dimensioning according to customers and/or traffic

270. It remains important to observe the DSLAM backhaul capacity of 1 Gbps. While at the cabinet level each end-customer may be served by 2.6 Mbps average peak capacity[119], at the local exchange sites a full DSLAM can only support 1.3 Mbps. This still is sufficient even when SHDSL cards are introduced, which typically approximately require 2 Mbps, but also have half the port density of the ADSL cards. Nevertheless, with increasing traffic demand over time, and the relevant time is the regulatory period, thus the next 5 years, there is not so much bandwidth left. Thus, a pure port oriented DSLAM dimensioning approach may be sufficient for small cabinet locations, poor copper access line performance (up to VDSL, depending on sub-loop length) and todays’ customer traffic. But with increasing customer bandwidth demand and new technology options (e.g. VDSL vectoring,

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[119] 1 Gbps/384 Ports = 2.6 Mbps.

G.fast) this may have to change to a dimensioning that also takes the traffic demand into account (see also Section 4.2.7, para. 205).

271. Considering the FDS capacity the situation already today becomes quite different. The FDS could become a bottleneck. In the combination of large DSLAMs being connected to each possible port of a FDS, except 2 slots for 10 G ports connecting to the upstream network and one handover port, there are only approximately 140 Kbps per end-customer left[120], thus significantly less (~50%) than already consumed today. This makes clear that the switches in any case already today have to be dimensioned not only on the base of ports, but on traffic too. Otherwise, the model could configure port combinations resulting in a capacity significantly too low for todays' and anyhow for the increasing customer demand in the future.

272. The switches parameterized for the model are obviously old fashioned or outdated equipment. Operators use more performant switches and higher port densities in the market than used in the model. Thus updating to more performant equipment would typically reduce the cost. Furthermore, as already stated for the DSLAMs, we recommend to use a wider spread of FDS sizes in order to better adapt to the local traffic demand, as we can also observe in network implementations.

273. The Commission is justifying its approach of not allocating backhaul costs on the basis of bitstream service traffic for the reason that this would lead to distortionary effects between services.[121] We do not subscribe to this argument. If the allocation of costs according to its real cost drivers would lead to distortions then something would be fundamentally wrong with the modelling approach.

5.4.4 Ducts for fibre and copper cables not to be dimensioned the same

274. While copper cables are assumed to be directly filled into a duct, and assuming a duct inefficiency factor of 40%[122], fibre cables are filled into an individual subduct. The subduct has an external diameter of 32 mm. Only one subduct size is considered in the model. It remains unclear from the Model Documentation whether the duct inefficiency factor is also applied for the dimensioning with subducts.[123] In any case this duct dimensioning rule results in a significantly higher duct and thus trench demand for fibre cables compared to copper cables. If the principal design decision to use subducts for fibre cables should be kept – TERA has not really ar-

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[120] 768 ports per DSLAM, connected to 1 Gbps ports of the FDS, 20 1G ports per card, 12 slots per switch, two of them used for backhauling and hand over.
Number of end-customers per switch: 768 x 20 x 10 = 153,600.
Switch capacity per end-customer: 2 x 10 Gbps / 153,600 = 130 Kbps.

[121] See Commission, UBA, para. 242.

[122] TERA, Model Documentation, Table 38, Sections 4.3.4.5 and 4.3.5.5.4.

[123] Question 41 is answered by: yes, the inefficiency factor is applied. We calculate 37% instead of 40%.

gued for – the subduct size will have to be reviewed and differentiated to achieve a more appropriate and efficient fibre cost estimation.

275. The Model Documentation in Section 4.3.4.5 states that lead-in ducts of 50 mm size are used and can be shared among the dwellings of a building, where each dwelling is served by an individual cable. It is also stated: “*Plus, in the fibre network, each fibre cable is protected within a dedicated subduct*.” Two subducts (for fibre) will not fit into a 50 mm duct. Nevertheless, Table 38 of the Model Documentation states, that a 32 mm subduct is intended to be deployed in a 110 mm duct, which shall be better suitable. Thus, in contrary to the Model Documentation one has to conclude that in case of fibre a 110 mm duct is applied for the lead-in.

276. Also for all other network segments where fibre cables are deployed a subduct is used, increasing the space demand in the trenches. Thus, we assume that the fibre network infrastructure is conceptionally relatively more expensive regarding trench size and cost than the copper network.

277. Using one subduct size for all fibre cables does not appear to be appropriate and efficient. The subduct defined and generally used in the model is oversized for most of the fibre cables. This leads to a waste of resources and unnecessarily increases cost. According to Table 42 (Model Documentation) the 144 fibre cable has a diameter of 10.8 mm[124]. Assuming an internal subduct diameter of 28 mm[125] there is a lot of inefficiency left, which is not required for fibre cables. Using state of the art gliding fluids for fibre cable installation a 4 mm spare size in the diameter should be more than sufficient, so that a 24 mm diameter fibre cable could be installed in the subduct with 32 mm diameter. None of the cables has this size. The largest cable specified in Table 42 with 312 fibres has a diameter of 16.2 mm. Hence the subduct used should be specified in a smaller diameter version (e.g. 21 mm internal/ 25 mm external diameter, and at least one additional smaller subduct (e.g. 12 mm internal, 14 mm external diameter (1 mm thick wall)) should be defined in the model also in order to host the mostly used small cable types up to 48 fibres. Table 5-4 may illustrate appropriate subduct sizes, compared to the ones used in the model:

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[124] N.B.: there is no reason for the incoherent fibre cables diameters in Table 42 of the Model Documentation; we assume that TERA relies on outdated historic data.

[125] 32mm – 2x2mm (wall) = 28mm.

Table 5-4: Fibre cable diameter and appropriate subduct sizes compared with the TERA model approach

Fibre cable diameter [mm]	Subduct size required [1 mm wall, outer diameter in mm]	Subduct size in the model [outer diameter in mm]
5	11	32
8	14	32
11	17	32
16	22	32
24[126]	30	32

278. The subduct size in the model is significantly oversized compared to the space requirements of the major part of the fibre cables. Duct costs could be lower if they were chosen more appropriately. More importantly, a significant amount of trenches could be smaller than calculated in TERA's model to host the relevant amount of fibre cables. Trenching cost increase with trenching size. Therefore significant savings could be realized if subducts and ducts were structured and dimensioned efficiently. We cannot identify any reason why TERA has chosen such inefficient subduct sizes for fibre in the model.

279. A rough estimate assumes doubling the number of cables per large duct by using a smaller subduct instead of the oversized duct of the model. Looking into the trench cost table in Appendix 2 of the Beca report of 25 November 2014 one observes that the trench cost savings by reducing the number of large ducts required from 2 to 1 are between 30% and 70% and from 4 to 2 between 50% and 80%. The trench cost reduction depends on the trench size and the number of ducts inside and on the soil classes (five rural and one urban).

5.4.5 Use of adjusted larger fibre cables appropriate and more efficient

280. Using one lead-in cable per dwelling (Model Documentation, Section 4.3.4.4) is not efficient from our point of view in the case of multi-dwelling (MD) buildings. Each of the cables would include one copper pair or one fibre strand, and a second fibre strand as spare. Constructing separate cables instead of using one combined cable increases the effort to install them, and increases space demand in the ducts or pole capacity in case of overhead deployment. In the case of fibre cables each of the cables deployed underground would be protected by an individual subduct of 32 mm diameter. While trenching cost already in the copper case will become larger than required, this in any case is even more true for fibre

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[126] Not used in the model.

lead-ins hosted in individual subducts, resulting in a significant cost overestimation for lead-in cost of MD-buildings.

281. Even for a combined cable accessing MD-buildings, in case of underground deployment a smaller subduct would be more efficient (see Section 5.4.4).

282. The copper and fibre cables in the distribution and feeder segment of the access network are dimensioned according to the number of dwellings, either in single or multi-dwelling buildings, and their copper pairs or fibre strands respectively per dwelling. In addition, a mark-up for spare capacity is taken into account. When this "*local demand exceeds the largest cable available (2000 pairs in copper underground, 50 pairs in copper overhead, 312F in fibre, overhead and underground), the local demand is addressed with multiples of the largest cable*"[127]. Fibre cables are introduced in subducts, before they fit into a duct. The cable dimensioning itself looks reasonable, while for fibre cable deployment the subduct diameter is oversized (see Section 5.4.4), especially because most distribution and feeder cables are significantly smaller than the maximum size (see Section 5.4.1 for cabinet sizes). Cable dimensioning in the model is inefficient, not state of the art and thus cost are overestimated.

283. There is also an efficiency and dimensioning problem regarding the SLU backhaul: In the copper access network the active cabinets are served by a 12 fibre cable connecting it to the next local exchange location. This cable is located at the feeder network segment, but is part of the core network (for the UBA service). There are two fibres per cabinet considered, but in the utmost cases only one fibre is required (see Section 5.4.1). Thus, using a 12 F cable is completely overdimensioned, even when it carries (1) additional fibre for the leased line service in addition (Model Specification, Section 8.7.2.2). It can even occur in the model, that several 12 F cables are installed in parallel, each connecting one DSLAM as SLU backhaul (Model Documentation, Section 4.3.5.2.2). This is inefficient and not state of the art. The fibres should share the same cable, which can be dimensioned according to the rules described for the local demand above. This would also reduce the significant cost inefficiency, that every DSLAM – local exchange fibre cable would use its individual (oversized) subduct.

284. Fibre cables connect the FWA base stations to the next local exchange. We assume, that a single fibre or at least fibre pair would be required for the connection (the model description does not detail this). But for any of these connections an individual 24 F fibre cable is used. Thus, also here it may occur that some street sections host several 24 F fibre cables in parallel, also using their individual subducts each (Model Documentation, Section 4.3.3.4.1). Also this deployment is highly inefficient and should be replaced by smaller cables and by a joint usage of

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[127] TERA, Model Documentation, Section 4.3.5.2.1.

a single FWA cable in the parallel segments, dimensioned as above. State of the art of access network cabling also is to combine all feeder cables of a street segment (i.e. SLU backhaul and FWA) into one upstream feeder cable (also called Main Cable) directed to the next local exchange location and dimensioned as described above instead of using many parallel cables. This has two effects: it saves cable cost, but more importantly it saves trenching cost due to the high number of parallel subducts otherwise.

285. FWA cables towards the local exchange (and core cables like SLU backhaul (feeder)) are generally constructed underground, even if the access network in the street segment is constructed in an overhead manner (Model Specification, Section 6.3.4). Using the same trench infrastructure is state of the art even in case of overhead deployment and saves significant cost. This should also be implemented in the model.

286. This might be different in street segments being passed by typical core network cables. In the model terminology these are cables connecting the local exchanges to the FDS (Core Exchange) and FDS underneath each other (Core EAS) or with higher level core network nodes of the REN or core NGN network. It is state of the art that such network connections are installed underground wherever possible due to the high degree of sensitivity of the data transported and for network resilience reasons. Nevertheless, also these connections are assumed in the model to be realized by individual 24 F fibre cables in individual subducts, occurring to be parallel in some street segments, thus requiring significant larger trenches than in the case, where these cables are combined to aggregated larger fibre cables. Hence this aggregations should be considered in the model also in order to improve cost efficiency according to state of the art efficient deployment.

287. The maximum fibre cable size parameterized in the model has 312F fibres. Larger cable sizes are available in the market, thus should also be considered in the model in order to reduce fibre cable cost. So far the model overestimates fibre cable costs.

288. A summarizing overview of cable and duct efficiency improvement options is presented in Section 5.6.5 below.

5.4.6 Pole dimensioning parameters should be different for copper and fibre network

289. Fibre cables have a significantly lower weight per meter compared to copper cables of the same size due to smaller strand diameter and less material weight. In addition, the isolation is significantly thinner and less heavy. No drilling of fibre pairs is required compared to a copper cable. In addition the model assumes a

one fibre per connection approach, compared to the paired copper strands in any electric copper network.

290. Less heavy cables allow for a larger pole distance in case of fibre, compared to an copper overhead cabling approach, thus reducing the fibre trench cost of overhead cabling compared to a copper overhead approach. This should also be considered in the model by taking different pole distances for the copper and the fibre network into account in case of overhead cabling.

5.5 Insufficient Model Documentation and model transparency

5.5.1 Geospatial part of the model not accessible

291. The geospatial part of the model is not published and its operation mode is uncertain due to the lack of an adequate model description. This especially affects the most cost sensitive aspects of the shortest path computation (see also Section 4.2.1).

5.5.1.1 Results cannot be tested

292. Since the algorithms applied are not accessible one cannot test them by simple examples in order to verify the correctness of their computation. Due to the lack of information which methodology of the shortest path has been applied and due to the incomplete description of the geospatial results one even cannot rebuild the missing program in order to check the results.

5.5.1.2 Model consistency cannot be tested

293. One cannot test the geospatial computation for consistency to determine whether it forms a coherent whole with the rest of the model, e.g. regarding the areas to be covered by FWA, when a new, more LTE advance like technology is introduced affecting the FWA coverage areas.

5.5.1.3 No possibility to change demand in a meaningful way

294. The model designs the access network to pass and connect all address points. Where several addresses are identified to be at the same location a multi-dwelling building or a building combining several business units or a combination of residential and business use is assumed. It remains unclear if all address points are connected to the access network by lead-ins or if the demand is distributed

among the address points in a manner that not all of the address points are connected to the access network.

295. Furthermore, it remains unclear how the leased line demand and the additional data service demand is distributed among the address points or how it is considered otherwise. We assume that it is neglected in the geospatial modelling at all due to the lack of data.

296. Anyhow, due to the lack of transparency of the geospatial modelling and demand allocation it is not possible to change the demand allocation to address points in another way than fixed in the model. E.g. the effect of a growing demand over time cannot be calculated.

5.5.2 Beca's approach to determine trenching costs cannot be verified

297. Beca’s report, “FPP Corridor Cost Analysis of Trenching and Ducting, Rates in NZ - Final Issue Nov14” contains just a more general description of its approach than a detailed description of the calculation. In so far a detailed evaluation of the calculation is not possible. However, it can be observed, that parts of the input prices of the calculation are overestimated (see Section 5.8.5).

298. In the Beca report the average traffic management costs were estimated on a sample basis with $ 5.26 per metre. Due to the national character we asked [...] CNZRI for its experience with this costs. [...] CNZRI suppliers answer resulted in costs in a range between $ [...] CNZRI per metre in rural areas and $ [...] CNZRI per metre in urban areas. This demonstrates, that the efficient average costs are significantly lower than the cost value taken by Beca, which are thus overestimated.

5.6 Insufficient cost and engineering efficiencies taken into consideration

5.6.1 Efficiency and cost improvements of changing MDF/ODF boundaries not considered

299. Beside the few corrections of MDF boundaries described in the Model Specification, Section 3, there is no correction of MDF access areas according to efficiency criteria considered in the model which would allow to correct inefficiencies grown up over time in the historic development path of the network. This will increase cost for all access networks computed and is, according to our understanding, contradicting the LRIC approach of modelling. Optimizing MDF access areas is full in line with a scorched node approach which takes the location of the nodes as given. It is not convincing to follow such an approach for cabinet areas (due to the

lack of data) as TERA did and not following it for the MDF boundaries. See also Section 5.3.

5.6.2 Efficiency and cost improvements by modifying number of ODF/MDF not considered

300. We already pointed out in Section 3.3 of this document that a fibre access network architecture is not subject to the same line length restrictions as a copper network. This is to some extent already reflected in the model design for the UBA network, where the first data switches (FDS) are located in only 92 of the 790 local exchange locations, forming the first higher level of network nodes compared to the simple (passive) access line concentrating function of all 790 local exchanges. Going a step further towards next generation access (NGA) will end in an FTTH architecture, but now already ending at only 92 local exchange node locations. The transmission electronics are then distributed between customer premises (dwellings) and the FDS. In this case a new access area delineation for each of the FDS locations and the address points should be conducted and a new routing of fibre access lines in order to determine a new most efficient access network. Therefore, we recommend that the Commission rethinks the approach regarding new fibre access network boundaries and the fibre line routing approach to realize more obvious network efficiencies.

301. The 92 FDS locations in the modelling approach are chosen as scorched nodes. It is, however, not guaranteed that these locations are the most efficient new “local exchange” locations or that their number is most efficient (see also Section 4.2.8). This in theory has to be checked by a scorched earth approach. A scorched earth approach would result in a significant change of the approach chosen so far. It would not allow for a copper line performance adjustment, Thus, it may be inappropriate for todays’ application. In future a scorched node approach shall be taken into account, addressing pure fibre networks.

302. Modelling the UCLL FTTH network all fibre lines calculated terminate at the local exchange locations. It is not stated in any document where to aggregate traffic in this case in order to forward it to the higher network levels. One could assume that either the fibre lines are terminated at Ethernet swítches (FDS) in the 790 local exchanges (classical FTTH) or routed via the local exchange – FDS trenches to the 92 FDS locations. The first case contradicts to some extent to the UBA FTTN MEA approach, since the FDS locations are different. The second case requires the fibre access network to be optimized towards the 92 FDS locations. This once again demonstrates that the two MEA approaches cannot be harmonized from a single HEO’s point of view (see Section 1.2 also).

5.6.3 Efficiency and cost improvements of modifying number and location of street cabinets not considered

303. For modelling the copper access network the TERA model uses the cabinet locations as scorched nodes, thus assuming that these locations would not be replaced by a HEO deploying a new most efficient FTTC[128] access network for UBA. In order to achieve highest bandwidth performance the cabinet locations should be optimized observing restrictions regarding maximum SLU length. The cabinet should be located in the middle of its access area or at its edge, closest to the local exchange, depending on which approach results in lower trenching cost (according to our experience the latter one is more cost efficient). In any case a HEO would optimize the number of cabinets and its locations in order to meet its bandwidth expectations at lowest cost. Thus, a modelling approach which relies on the number and locations of the cabinets of the legacy network overestimates the cost of an efficient network.

5.6.4 Efficiency and cost improvements of modifying core links not considered

304. In Section 4.2.8 we already argued for an entire core network optimization including all traffic and all network nodes. Beside the DSLAMs and the FDS all other NGN nodes shall be considered, since a HEO will optimize its network according to all traffic and benefit from the highest scale achievable. This means that the optimization affects the network hierarchy and the most efficient connections between the nodes of each hierarchy level and between neighboring levels. So the connecting ring respectively mesh networks get its most efficient topology depending on network hierarchy optimization, resulting out of network element cost and traffic considerations. The efficient core network connection topology is a result of an iterative process until the most efficient network topology has been found. It cannot be simply performed by a geospatial computation, because the network hierarchy and the node size depend on traffic and cost optimization over all network levels.

5.6.5 Efficiency and cost improvements of passing a street section by feeder, FWA and core links

305. On a street section there are in any case distribution and lead-in cables in its horizontal part combined in a trench. In addition in case of a copper network there often are feeder cables included, either fibre from the cabinet to the local exchange for DSLAM/ SLU backhauling or copper for establishing the UCLL connections to the exchange. The sections may also be passed by FWA fibre access lines con-

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[128] FTTC: Fibre to the Curb or Cabinet, sometimes also called FTTN, with “N” for Node. But the expression “node” is quite unspecific and is also often used for the local exchange.

necting the FWA base station with the local exchange and they may be passed by core network cables from the local exchange to the FDS location or between the FDS locations and higher network level nodes of the NGN. All these cables share the same trenches at the major side of a street segment[129], except in the case that there is overhead deployment for the access network. In case of overhead deployment the core network and the FWA cables are deployed underground. While it is state of the art deploying core network links underground due to network resilience reasons, this from our point of view is not required for FWA and SLU backhaul fibres, which belong to the feeder network segment as the model does. For reasons of cost efficiency we propose to deploy these cables in overhead deployment when the access network in this street segment is also deployed overhead, thus avoiding to dig trenches just for these cables.

306. The fibre cables for SLU backhaul, for FWA access and core segments above the local exchange in the model are standardized in fixed sizes and are routed individually cable by cable between their endpoints. The standardized cable size is 12 fibres for SLU backhaul and 24 fibres for each of the other cables. The number of fibres is significantly overestimated for SLU backhaul and FWA access and should be downsized accordingly. A SLU backhaul connection typically consists of one fibre (per cabinet) and a FWA backhaul requires 1-2 fibres.

307. Furthermore, it may occur that several fibre cables of the same kind (SLU backhaul, FWA, core, …) use the same street segment in parallel. Both is not state of the art and results in overestimating cost. Thus SLU backhaul cable segments should be combined into one cable and should also be combined with FWA cable segments, since all fibres are part of the feeder network segment of the access network and are directed to the same local exchange location. This would be the more efficient engineering approach.

308. Also the other individual core network cable segments (each including 24 fibres) shall be combined into one cable according to the core network ring or mesh connections they belong to, as this is state of the art of core network operation under network resilience conditions.

309. Combining the individual cables in one larger cable has several cost advantages: It saves

- Cable cost,
- Cost for spare and unused fibres,
- Cable routing and operation cost,
- Cost for joints (see Section 5.6.6),

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[129] The side of the street with more buildings.

- Cost for chambers (see Section 5.6.6),
- Cost for subducts,
- Cost for ducts and trenches.

310. Especially the last two points have a significant cost impact, because trenching costs are the most significant cost driver in access networks. (See also Sections 5.4.4 for ducts and 5.4.5 for cables).

5.6.6 Efficiency and cost of joints, CCT, FAT, pits, manholes and chambers

311. Joints[130] are used to branch or connect cables, and they are calculated in the model per cable (see Model Documentation, Section 4.3.5.4.1.1). There is no joint in a lead-in cable, since it starts at a CCT/ FAT and terminates at a ETP.

312. The number of joints is determined by the cable length and the drum length of the cable. There is one joint at the rear of each street segment, if the cable still has a continuation in the respective rear street segment. Intermediate cable network nodes may replace joints.

313. Hence in the distribution segments joints may be replaced by CCT/FAT, cabinets or MDF/ODF. In the feeder segment they maybe replaced by cabinets or ODFs. On the minor side of a street there only is a distribution cable, where joints can be replaced by CCT/FAT.

314. The joint demand for "*FWA and core cables is determined in a similar manner as for the distribution network level*" (Model Documentation, Section 4.3.5.4.3). We wonder if the joint demand here cannot be better compared to the feeder network segment, because CCT/FAT should not play a role here.

315. Thus, the number of cables has a high impact on the number and cost of joints also (see Sections 5.6.5 and 5.4.5 above). Thus joint cost optimization follows cable optimization. If the number of cables is higher than required then the number of joints respectively their cost is overstated significantly. That is our finding with TERA's model.

316. Chambers are either manholes, handholes or pitholes. They are underground boxes of decreasing size hosting CCT/FAT or joints. Their dimensioning rules remain unclear in the model since the Model Specification and the Model Documentation (Section 4.3.4.5, respectively Section 4.3.5.6) are unspecific. It only is described that their number depends on the maximum pulling distance of the fibre cables and the number and size of the connectors they shall host.

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[130] See TERA, Model Specification, Section 4.3.3.

317. In an underground deployment each CCT/FAT and joint requires a manhole. The Model Documentation states "*that all equipment for each cable are collocated*" (Model Documentation, Section 4.3.5.6). We interpret this as collocation is taking place at the same locations for all connecting equipment of all cables as state of the art efficient network deployment will do. We could not verify whether the model implementation will do so. The model description remains unclear in this regard. It also remains unclear how the chambers of different sizes are dimensioned, so how many cables, joints and CCT/FAT a manhole, handhole or pit may host. Typically also the number of ducts play a role in chamber dimensioning. This cannot be recognized in the model at all. Nevertheless, following this assumption we can state, that the cost for chambers strongly depend on the number of connectors (joints, CCT/ FAT), which once again depends on the number of cables. Thus cable optimization also here has an important role and a larger cost reduction and efficiency improvement opportunity has been identified which is neglected in the model implementation.

5.6.7 Efficiency of modern trenching technologies

318. Modern trenching technologies include micro-trenching, a deployment technique cutting a slot into the surface of the ground and digging a shallow trench for deploying a duct shortly below the surface. This method allows for fast and cheap trenching and is used in many European countries as one option reducing the deployment cost of broadband roll-out. This technology has not been considered by the Beca report and its trenching cost determination at all (see Section 5.8.6). This is surprising insofar as Chorus itself states that it uses micro-trenching technologies already in its UFB fibre roll-out (see Section 1.1.2.5).

5.6.8 Efficiency and cost of building access lines (lead-in)

319. Each dwelling has its own individual lead-in cable in the model. Thus, multi-dwelling buildings are accessed by many cables. No operator would do that but would combine cables. In overhead deployment there are already savings if the lead-in cable is a combined cable, thus only requiring one single cable deployment cost, cheaper poles etc. In an underground deployment a combined copper cable saves duct space und thus reduces trenching cost. A combined fibre cable saves many subducts and in consequence even more duct space and by this reduces trenching cost significantly (see also Section 5.4.4). Thus, we strongly recommend to the Commission to eliminate this cable inefficiency in the model and to combine the lead-in cables for multi-dwelling buildings into one single cable and to adapt the subduct sizes for fibre cables.

5.6.9 No efficiency consideration conducted for non-network cost

320. The non-network or common or overhead costs in the model are derived from Chorus' accounts. We could not identify that comprehensive checks for efficiency of these cost items have being conducted by the Commission or TERA. Instead, we made the following observations:

- The data room does not reveal all data provided by Chorus. For example the answers relating to non-network cost, Q 6.19.4, were not available.
- Insofar as data were provided, we observed, that Chorus account data were transferred to the green input sheets of the Excel map without any adjustments. On these green input sheets we could not observe any evaluations which lead to adjustments on these sheets. For example the sheet "3.a IT" of the Excel map "CI_ComCom-OPEX model v1.10.xlsm" contains the same values as the corresponding file in the data room.
- The before mentioned data were then transferred unadjusted to the blue allocation sheets. We understand, that these sheets (just) have the function to allocate the costs to different products, network elements etc. by different allocation keys. This corresponds to our observation, that these blue allocation sheets do not entail checks for efficiency. For example, the sheet "IT allocation" of the excel map "CI_ComCom-OPEX model v1.10.xlsm" just makes a check for relevance, but this is just a "Yes/No" decision, meaning that, if relevance has been stated, the costs are fully included in the relevant cost base (see columns J and L). After that procedure the costs are allocated to the products UCLL, UBA and other products. Also at this level no corrections for inefficiencies have been conducted. The various allocation keys themselves can also not be checked for appropriateness, because they are not explained, described in detail or justified. Only a rough description is available. There are no further explanations, how these allocation keys have been quantified and how these allocation keys have been linked to the cost accounts of Chorus.[131] Just the results of the underlying considerations are provided in the tool. Then the allocated costs are transferred to the sheet "cost summary". Here the column J provides for some cost categories an efficiency adjustment option. It is, however, not transparent how this efficiency adjustment option has been materialized.

321. This approach generally is vulnerable to a variety of misidentifications, overestimation of costs and other distortive effects. This approach has to exclude irrelevant cost from the relevant cost base. Those have to be identified in the accounts

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[131] See TERA, Model Documentation, p. 31f.

and excluded. Common or overhead costs are those which cannot be attributed and allocated to individual services. If there is a cost driver relationship for certain cost categories they have to be directly allocated to services and not via an EPMU based allocation rule. To avoid such distortions each cost category has to be checked whether it can be totally or partially be attributed to individual services before such costs are treated as common cost. Also non-network costs have to be checked whether they have to be capitalized according to some standard rules.

322. We have identified a variety of examples where these necessary tests have not been conducted properly and transparently. These examples do not make the claim of being complete. This is simply not doable from an external perspective. As we know from examples we have conducted in other countries, it requires usually three to five rounds of interaction with the regulated firm to make the necessary checks. We did not have this possibility. From the Model Documentation and the Commission's determination documents it is not clear to us whether TERA or the Commission has conducted such an identification process with Chorus. Even if best effort is undertaken such a cost assessment process will provide certainty whether the appropriate cost have been identified only at the 80% to 90% level.

323. To give an example: From the OPEX model we understand, that common or overhead costs are classified via the allocation key "non-network". For example on the sheet "Pay cost allocation" of the model we find several accounts which have been classified as common costs (see column L). An explanation for this classification is not given on this sheet. The column N provides commentaries but in the case of classification "non-network", the commentary is (just again) "non-network (cost)" or a blank cell. The reasons for this classification remain unclear. Also the column BA "description" does not clarify the classification process but gives rise to further implausibility. For example, cell BA14 provides the information "All staff in the Sales & Marketing cost centre". Generally product and sales managers are responsible for certain products and can be allocated to these products and therefore do not represent common cost. Another example provides cell BA27: "*All staff in the CIO cost centre which contains staff who deliver and support IT solutions to plan and manage our network.*" Such IT solutions support network functions and represent network related costs. Generally IT staff is responsible for certain network elements and therefore does not represent common costs.

324. The largest bias of the top-down approach as applied by TERA and the Commission results from the fact that the costs identified represent Chorus' actual costs and not (necessarily) the overhead cost of an efficient operator. Excluding certain cost items from Chorus' accounts represents a rather imperfect approach to achieve the efficient cost level. Therefore we have a clear preference to use a mark-up approach on attributable service cost and recommend the Commission to do the same. The appropriate mark-up can be generated either on the basis of a

national benchmark in New Zealand or an international benchmark from mark-ups used in other cost models

325. In any case given the deficiencies and problems of the top-down approach of the Commission, the Commission should have conducted a simple top-down benchmark approach to test the appropriateness of the common cost mark-up resulting from its own approach. The Commission's model generates the cost structure for UCLL and UBA as documented in Table 5-5.

Table 5-5: Cost structure of UBA and UCLL models

	2015	2016	2017	2018	2019
UBA from UBA-Model					
OPEX	34.12%	34.17%	34.19%	34.20%	34.18%
CAPEX	43.29%	42.96%	42.65%	42.37%	42.13%
non-network cost	22.59%	22.88%	23.16%	23.43%	23.69%
UCLL UBA-Model					
OPEX	12.99%	12.79%	12.60%	12.41%	12.22%
CAPEX	76.45%	76.83%	77.20%	77.57%	77.93%
non-network cost	10.56%	10.38%	10.20%	10.02%	9.85%

Results for “UBA/UCLL OPEX-Model” obtained by dividing OPEX per line figures from OPEX by total cost per line from UBA model

Results for “UBA/UCLL UBA-Model” obtained by dividing OPEX figures from UBA model by total cost from UBA model.

Source: WIK-Consult calculations based on TERA's cost model

326. The cost share of non-network cost amounts to slightly more than 10% for UCLL and more than 23% for UBA. The corresponding mark-ups on total attributable cost (sum of CAPEX and OPEX) amount to 11.1% for UCLL and 29.9% for UBA. We have already pointed out in Section 5.12.2 that this allocation is not in line with applying an EPMU allocation rule. Both mark-ups are beyond any acceptable level of an efficient cost structure. NRAs apply mark-ups for non-network costs which usually do not exceed 10%. For example, the German regulator BNetzA calculated a common costs mark-up of 4.9% on direct cost of local loop unbundling.[132] This mark-up was calculated with an activity-based cost model. In Denmark a 3%

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[132] See BNetzA decision BK 4-07-001, page 38, 4.3.1.7.

mark-up for non-network costs on direct costs of local loop unbundling and bitstream is used.[133] [134]

5.6.10 No efficiency test conducted for submarine links

327. The model includes Chorus' existing submarine links connecting islands to the main land as part of the core network.[135] Submarine links are relative expensive network elements.

328. TERA did not conduct an efficiency analysis regarding these links. Some of the links may no longer be needed in an optimal configuration of the core network. Furthermore, TERA should have analysed whether some of the existing submarine links may be more efficiently substituted by more cost efficient advanced microwave links or by high performance hermetically coated Erbium doped fibre submarine cables. TERA correctly argues that submarine cables should only be used where microwave links cannot be used, but actually they did not make this test.

329. We would have expected that the submarine links have to be dimensioned and equipped at least according to the SLU backhaul demand towards the FDS. But neither such description nor any model implementation can be found.

5.6.11 No efficiency test conducted for microwave links

330. TERA argues that microwave links could be used on remote sites with no easy access.[136] We share this view.

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133 See excel map 2012-55- B-DBA-Fixed LRAIC-Core Cost Model - v7.2 - Public_mark_up.xlsb, sheet "Non network mark-up", cell O117.

134 Even in Denmark, where the mark-up on direct costs of LLU are overestimated due to an extremely expanded non-network cost understanding (10.8%) (see excel map 2012-55-DB-DBA-Fixed LRAIC-Core Cost Model - v7.2 - Public_mark_up.xlsb, sheet "Non network mark-up", cell H111 * cell O111) the mark-up on direct costs of bitstream products is significantly lower than in New Zealand:
Layer 1:For the component MSAN the mark-up is fixed with 10,8% (see excel map 2012-55-DB-DBA-Fixed LRAIC-Core Cost Model - v7.2 - Public_mark_up.xlsb, sheet "Non network mark-up", cell H111 * cell O111
Layer 2: For the component MSAN the mark-up is fixed with 10.8% (See excel map 2012-55-DB-DBA-Fixed LRAIC-Core Cost Model - v7.2 - Public_mark_up.xlsb, sheet "Non network mark-up", cell L111 * cell O111) and 33.7% for the transport from MSAN to the POI 1 (See excel map 2012-55-DB-DBA-Fixed LRAIC-Core Cost Model - v7.2 - Public_mark_up.xlsb, sheet "Non network mark-up", cell H111 * cell O111), weighted mark up = 17.6%
Layer 3: For the component MSAN the mark-up is fixed with 10.8% (See excel map 2012-55-DB-DBA-Fixed LRAIC-Core Cost Model - v7.2 - Public_mark_up.xlsb, sheet "Non network mark-up", cell H111 * cell O111) and 33.7% for the transport from MSAN to the POI 2 (See excel map 2012-55-DB-DBA-Fixed LRAIC-Core Cost Model - v7.2 - Public_mark_up.xlsb, sheet "Non network mark-up",cell L111 * cell O111), weighted mark up = 22.1 %.

135 See TERA, Model Specification, p. 32 and Model Reference Paper, p. 30.

136 See TERA, Model Reference Paper, p. 30.

331. The model took into account the existing microwave links in Chorus' actual network. This means that the use of microwave technology was not modelled bottom-up. There may be cable links which could be more efficiently be substituted by microwave links. There might also be microwave links which might be better substituted by cable links. High bandwidth microwave links become more expensive by an exponential curve. Thus, increasing traffic demand may generate a new break even switching point for fibre links substituting microwave links. This has not been tested by TERA.

332. We would have expected that the microwave links have to be dimensioned and equipped at least according to the SLU backhaul demand towards the FDS. But neither such description nor any model implementation can be found.

5.6.12 No utilisation rates considered for DSLAMs and FDS

333. Typically a DSLAM or switch cannot be fully loaded with ports, but requires some spare ports to be taken into account. Thus, not all ports of a port card will be used for end-customer connections and traffic. There are several reasons for this dimensioning requirements:

- There has to be spare for new customers or new connections in order to react on demand bulks so that new ports cannot be provided and installed just in time.
- Single ports on a board may have a fault which can only be repaired by a board exchange. Since such exchange will affect all connections of the board the exchange will be planned in a coordinated manner with the customer's affected when several ports have faults.
- In case of direct customer connections (on DSLAMs) customers may cease their contracts (change to competitor, move or die, upgrade to higher service, …) and thus release the port, which may be held open for a while in order to connect the next customer at the same location.

Such not optimal but efficient filling of port cards may be reflected in cost modelling by a utilisation factor which will be different for the aggregation switches and the customer DSLAMs. Typical values are 85% – 90 % for the switches, respectively 70% – 80% for DSLAMs.

5.6.13 No spare capacity in feeder segment of the copper network

334. We refer to our analysis in Section 5.12.4.

5.6.14 No spare capacity in fibre access cables

335. Concerning copper cables input parameters for spare capacity are used (see Section 5.12.4). The analogue input sheet “3.2 Fibre parameters” in the excel map “CI_ComCom - Inputs - v7.3.xlsx” does not provide such input parameters for fibre cables. A justification for this inconsistency cannot be found in the documentation and in the tools. From our point of view this spare capacity is missing.

5.6.15 No requirements on network resilience considered

336. A carrier class network typically has carrier class equipment with high MTBF[137] or availability values. Nevertheless, carrier class design also includes network redundancy and system redundancy in case of at least single node failures. This gets growing relevance due to the growing importance of telecommunications for citizens and enterprises and the whole economy, whose critical business processes rely more and more on telecommunications. The TERA model does not consider any of the state of the art means for offering appropriate network resilience and its model description does not even argue for or against such characteristics.

337. Typical features of resilience might be the following ones: The DSLAMs might be double-homed at two FDS at different locations, they might be connected in a ring topology instead of a star, the FDS could be double-homed as well and embedded in ring topologies, the FDS could be mirrored by a second FDS in a load sharing or hot-stand-by manner, just to mention some standard options. Since there are only 92 active network aggregation node locations left at least single node location failures (e.g. a fire in the location) should be protected by double-homing the DSLAMs as standard state of the art methodology, because in the case of such node failure a larger area and a major number of end-customers compared to a local exchange failure of the past would be disconnected from service for several days.

5.7 Technical computation problems

5.7.1 Manual transfer of input and intermediate data needed

338. Several modules are used for calculating costs. These modules are not systematically linked to each other. This has the consequence, that data have to be shifted manually from one module to the other. This bears the significant risk, that data will not be transferred adequately, for example:

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[137] Mean Time Between Failures.

a. Output of the Excel-map “CI_ComCom-OPEX model v1.10.xlsm”, sheet “EXPORT”

[...

[redacted]

] CNZRI

b. Input to the Excel-map “CI_ComCom - UBA model v5.1.xlsb”, sheet “Import from the OPEX model”

[...

[redacted]

] CNZRI

The comparison of the two tables above shows higher OPEX values in the module, which calculates the prices (b.) than computed in the OPEX module (a.).

5.7.2 Memory space of the model

339. The model operates at the edge of the MS Access memory space capacity (2 GByte), which requires permanent resets of the model (memory space repair) before starting new computations. We doubt whether such model design can guarantee correct computations at any time and are wondering, whether some restrictions and shortcuts of the model may be caused by this limitation.

5.8 Inflated cost due to the use of inappropriate input parameters

5.8.1 Equipment choice should have been supplier neutral

340. The equipment used in the model is to the utmost extent based on information provided by Chorus. This covers DSLAMs, FDS Ethernet switches, duct and cable cost etc. These data are typically historic data, describing equipment being bought some eight years ago. Neither system performance nor system components have been actualized to state of the art systems Therefore the model is not using relevant prices.

341. State of the art modelling exercises typically request the same information regarding the network components from all relevant suppliers/ operators in the market, thus revealing an overview of implemented and market proven equipment in a wider choice of performance and bought at different price levels. From these responses one can then develop typical equipment types of different sizes on average to progressive performance classes and at prices being close to current market reality. This equipment in its sizes and performance classes may not exist in the market, but is close to all existing offers, though in its model implementation is hypothetical and supplier neutral (see also Section 4.2.9.1). The major advantage of this approach compared to using Chorus' historic systems and their prices and performance characteristics is that it comes closer to the state of the art MEA equipment a HEO would use. Thus this approach better meets the regulatory reference point than just relying on Chorus' actual vendor prices.

342. Another more operational additional advantage is that such procedure also allows to publish the equipment parameters without violating any operators business secrets. It also allows to close gaps where Chorus would not have answered by using national market data instead of international benchmarks.

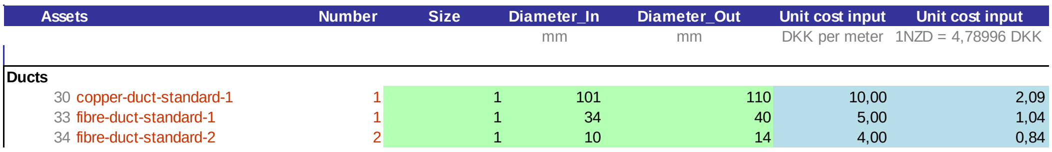
5.8.2 List prices do not reflect volume discounts for dominant providers

343. Many equipment prices and other cost parameters in the model are based on list prices which Chorus has provided to the Commission. See for example sheets "Q 6.17.1 - 3 (2)", "Q 6.17.12 (a) – ISAMs", "Q 6.17.1 – 3", "Q 6.17.12 (d) Install Costs" and "20140919 B3_C_Q 6 ESS7 pricing" of the Excel-Map "CI_ComCom-UBA Inputs v1.0.xlsx and price lists of the data room: 20140605_Confidential_Q 6.14.1 (f) General Cable CTL Fibre Cables Catalogue. 20140605_Confidential_Q 6.14.1 (f) General Cable MTO Fibre Cable Catalogue, 20140605_Confidential_Q 6.14.1 (f) Prysmian CTL FO Cables, 20140605_Confidential_Q 6.14.1 (f) Prysmian CTL FO Cables.

344. List prices of vendors do not represent the relevant purchase prices of equipment and other services to deploy a new network. List prices are usually only relevant – if at all – when equipment is purchased for an incremental expansion of network coverage and capacity or for replacement investments. When large scale network deployments are at stake operators are usually able to negotiate significant discounts on list prices. According to our experience such discounts are in a 20% to 40% range. TERA is taking up this point in criterion 56 where they argue: "*Prices used in the TSLRIC models should reflect those that an efficient operator with the bargaining power of an operator with significant market power would face.*"[138] We fully share this view but we do not see it reflected in the actual derivation of parameters used in the model. Using list prices of equipment is not compatible with this criterion. The HEO which the Commission is modelling should be in a position to negotiate and use such large discounts. Therefore whenever the Commission/TERA is relying on list prices it should apply a volume discount of 30% which is the midpoint of the relevant range of such discounts.

5.8.3 Equipment prices in detail

345. The equipment prices have a direct effect on the asset costs. We agree with the Commission's view that the unit costs of active assets in the core network are quite uniform across jurisdictions as there is an international market for these assets.[139] TERA, however, used a variety of equipment and other input parameter prices which are not in line with international best practice. In the following paragraphs we will refer to some rather obvious examples: In the excel map "CI_ComCom - Inputs - v7.3.xlsx, the sheet "4. Costs" contains input data for ducts with 50 and 110 mm diameter and subducts with 32 mm diameter (see cells I18 to I20). The input prices we find there significantly exceed the experiences we made in preparing cost models for other regulatory authorities. For example in the Danish cost model we find the following comparable ducts and its input prices.[140]



Assets	Number	Size	Diameter_In	Diameter_Out	Unit cost input	Unit cost input
			mm	mm	DKK per meter	1NZD = 4,78996 DKK
Ducts						
30 copper-duct-standard-1	1	1	101	110	10,00	2,09
33 fibre-duct-standard-1	1	1	34	40	5,00	1,04
34 fibre-duct-standard-2	2	1	10	14	4,00	0,84

The input prices used in Denmark are up to seven times lower than the input prices used in New Zealand[141]:

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[138] TERA, Model Reference Paper, p. 41.

[139] See Commission, UBA, para. 304.

[140] See https://erhvervsstyrelsen.dk/gaeldende-prisafgoerelse-2015, Excel Map 2012-55-DB-DBA-Fixed LRAIC-Access Cost Model - v4.07 DBA - Public.xlsb, Sheet Assets, lines 104, 107, 108.

[141] See excel-Map, CI_ComCom - Inputs - v7.3.xlsx, Sheet 4. Costs, lines 18, 19.

[...

[redacted]

] CNZRI

346. Moreover this input data are mostly based on Beca experience and are significantly higher than [...] CNZRI

[...

[redacted]

] CNZRI

[...] CNZRI for example:

a. Comparable to the 50 mm diameter duct:

[...

[redacted]

] CNZRI

⇨ $ [...] CNZRI per metre in comparison to $ [...] CNZRI per metre used by TERA

b. Comparable to the 32 mm diameter subduct:

[...

[redacted]

] CNZRI

⇨ $ [...] CNZRI per metre in comparison to $ [...] CNZRI per metre used by TERA

Moreover the calculation of the TERA input model data is not transparent or not justified. On the linked sheet "Unit costs calculation", the values of the Beca models, which can't be checked due to the fact, that they aren't published, are continued to be used in further calculations (lines 35 -43):

c. Costs of ducts with 50 and 110 mm given by Beca are increased by further 20% (cells K35, K36). A justification for this procedure is not given on the sheet. Furthermore it is possible that Beca delivered prices for 6m long ducts because input costs are divided by 6 (cells K 38 and K41). Having again a look at [...] CNZRI another significant cost exaggeration can be observed:

[...

[redacted]

] CNZRI

⇨ $ [...] CNZRI per metre to $ [...] CNZRI per metre in comparison to $ [...] CNZRI per metre used by TERA

d. Costs of subducts with 32 mm given by Beca are calculated with TERA expertise (cells K37, O37):

With the "Forecast function" of excel the price of the 32 mm subduct is calculated by a simple linear trend function (x value= diameter) from the costs of ducts with 50 and 110 mm. This is not justified, because the requirement of the quality of subducts is less in comparison to ducts as subducts are running through ducts and are protected by them. The consequence is, that subducts are significantly less expensive than ducts assuming a comparable diameter. We are wondering about that rough cost overestimation and not appropriate estimation process because input data for subducts have been requested and delivered in the Section 98 procedures.

5.8.4 Investment payment inappropriate

347. TERA assumes a construction time (time to build) of the network of six months.[142] We believe that is a reasonable assumption. We, however, do not agree with TERA's assumption that the building time should also reflect the time between the moment the investment is paid and the network is generating revenues. This assumption is too conservative.

348. Large telecom operators and those with significant market power in particular are able to negotiate vendor contracts which harmonize investment payment and revenue generation. Operators usually do not pay earlier than a system is ready for operation or negotiate "pay as you grow" arrangements. The Commission should assume the HEO to be in such a position. It follows that the annuity formula should not include a prefinancing period of six months but should assume that investment payment occurs when revenue generation starts.

5.8.5 Cable surplus too high

349. Technical reasons require a surplus on cable length, which increases the cable costs. The surplus input parameters are shown in the Excel-file CI_ComCom - Inputs - v7.3.xlsx, Sheet "2.2. Copper parameters", cells H10 to H19 with value 3m and on Sheet "3.2 Fibre parameters", cells H21 to H28 with value 3m up to 15 m. These lengths exceed significantly the experience we made in preparing cost models for other regulatory authorities or WIK team members made when working for operators in their professional past.

Moreover it is stated unspecified on the sheets, that this input data mostly bases on benchmarks. Their values are significantly higher than data [...] CNZRI

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[142] See TERA, Model Reference Paper, p. 44.

[...

[redacted]

] CNZRI

[...] CNZRI shorter surplus of 1 or 2 m for overhead and underground copper lines:

[...

[redacted]

] CNZRI

350. Furthermore we wonder why, in relation to surplus lengths > 3m of fibre cables (see sheet “3.2 Fibre parameters”, cells H23 to H26), TERA did not use its benchmark despite the fact that it does that for the majority of the surplus parameter. Instead of that, TERA actually uses unadjusted Chorus input data (20140605_Confidential_Q 6.14.1 (e) (ix) Terminations-MH-Copper-Fibre).

5.8.6 Beca's trenching costs exceed relevant benchmarks significantly or are too high

351. Analysing the Beca report for trenching and ducting rates in New Zealand we understand, that fees for Statutory Planning and Consenting of local authorities for the deployment of trenches in the communities are considered in the trenching cost presented in the Tables of Appendix 2. Also the cost for planning and managing the traffic along the streets during the construction phase are included. Thus, there should not be a comparable cost in the model in other positions in order to avoid double-counting. The status of the positions "Regulatory consent" and "Network deployment compliance" remain uncertain and are not transparent to us (see Section 4.2.9.2). It can not be excluded that they imply double-counting because there are separate cost positions on consent and compliance in the model.

352. Beca describes the generation of the price corridor Table in Annex 2 of its report being based on assumptions and conditions which provide a significant saving potential of the figures listed:

- The relevant works are of large scale, but the contractors being asked by Beca represent mid-sized or small firms, having 20 or less workers (Beca report, p. 9). From our point of view and observation in other countries large scale constructors would work at lower prices than these local constructors.

- For longer term contracts on regular ongoing work with Chorus Beca provides an example of pricing "*as much as 20% lower than their normal tender pricing*" (Beca report, p.9), which has not been taken into account within Beca's pricing model. This would be more relevant for the ORC of a new network and would generate another potential for reducing costs.

- Beca's price request was for "indicative, cover all rates" prices due to the fact, that the willingness to respond was anyhow low without concrete orders to expect, and why should the contractors inform the market about their real competitive prices, reducing the achievable price level as a result (Beca report, p. 11). This was not challenged by Beca and is another reason for a significant downsize potential of costs.

- We understand that the cost for thrust pits and entry/exit trenches are included in the per meter rates of Annex 2. Thrust pits could later also been used to deploy chambers, thus give an additional cost saving option which is not reflected in the model.

- The data set and methodology chosen does not consider road cuttings or embankments which cut result in cheaper construction than the soil classes of the polygons the road are passing (Beca report, Appendix 1, p. 6 and 7).

353. We therefore assume that the basic data collected by Beca represent a saving potential for the trenching cost in Annex 2 of the Beca report between 30-45% as reasonably applicable in the cost model. A proper interpretation of Beca's raw cost data would require to use such a lower level of trenching cost in the model.

354. Furthermore, Beca is not considering modern, state of the art micro-trenching deployment methods as already used by operators in Europe and for example legally enabled in the German telecommunication law, which would result in another trench cost reduction potential of an estimated additional amount of 10% – 20%. This is essential insofar as Chorus seems to be using micro-trenching in its fibre UFB deployment.[143]

5.8.7 Asset lifetimes too short

355. The asset lifetime input data are listed in the excel file CI_ComCom - Inputs - v7.3.xlsx, sheet "Asset lifes", column J and in the excel file CI_ComCom-UBA Inputs v1.0.xlsx, sheet "Input – Assets", column P". The descriptions on these sheets mostly give no links to further sheets and leave the source unknown. Despite this, we finally found one of the rare links and link concatenation leading to the sheet, which contains the asset lifetime input data provided by Chorus in response to the Section 98 request: CI_ComCom-UBA Inputs v1.0.xlsx, sheet "Q6 19 6 a Asset lifes", column F. Comparing this sheet with the sheets mentioned above we conclude that most of the asset lifetime data used base on the data provided by Chorus, which have not been amended in the TERA model. However, due to the lack of information on these sheets it is unclear if at all and how the input data in the TERA model was qualified. Exemptions are the asset lifetimes of MDF and SDF. Here the sheet "Asset lifes" states a benchmark as a source. But again this information is unspecified and the content as well as the quality of the benchmark remain unclear (cells K 107 – K 114). Some more hints are provided in the document TERA, Model Specification, CI version final version for release.pdf, pages 63/64: It confirms our assumption that in most cases Chorus information has been taken without any adjustments:

> "*TERA have used the following list of asset lives. [Asset lives provided by the Chorus data collection have been used as a starting point. When the asset lives provided seem out of line with what has been observed in other jurisdictions or were not provided, benchmarks have been used. The asset*

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[143] See Section 1.1.2.5.

> *lives benchmarked come from decisions (publicly available or not) made by other national regulatory authorities mainly located in Europe.]*"[144]

More information is not provided, so it is impossible to assess the data properly .

356. Beside these significant methodological weaknesses we have reservations regarding some of the lifetime values and regard them as not adequate:

    a. Fibre cable lifetime

    Copper and fibre cable lifetimes have been taken unadjusted from Chorus data (see document TERA, Model Specification, CI version final version for release.pdf, page 63). For both cable types it is 20 years. This identical value for the quite different assets does not reflect, that the technical lifetime of fibre is significantly longer compared to copper due to greater robustness concerning influences of environment, especially concerning humidity and insulation. Moreover the economic lifetime of fibre is longer because fibre is the future proven technology and will substitute copper step by step. For this reason a 20 year lifetime of fibre cables is not adequate. Other NRAs assume fibre cable lifetimes of 30 to 40 years.[145]

    Duct and trench lifetimes are set to 50 years in the cost model. Taking the longer technical and economic lifetime of fibre cables into account, it would be adequate to harmonize the lifetimes of these assets to that extend that fibre cables have half of the duct lifetime. An HEO would almost once replace fibre cables before ducts and trenches are replaced. Therefore also a 25 years lifetime for fibre cables is appropriate.

    b. Pole and other overhead assets lifetimes

    The cost model currently uses different lifetimes for overhead assets equipment. While overhead copper cable and copper cable terminal lifetimes are fixed to 14 years, pole lifetimes are assumed to be 20 years (excel file CI_ComCom - Inputs - v7.3.xlsx, sheet "Asset lifes"). Different lifetimes are not consistent with the operational practice of operators and an efficient deployment. Operators replace overhead assets simultaneously in order to avoid repeating installation costs. Taking our experience into account with preparing cost models for other regulatory authorities, a twenty years lifetime for all pole related assets are appropriate.

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[144] See TERA, Model Specification, p. 63f.

[145] See for instance the Danish cost model, public version, 2014.

c. Street cabinets and underground cable lifetimes

The cost model currently uses different lifetimes for underground assets equipment. While street cabinet lifetime is fixed to 14 years, for copper cables 20 years are set (excel file CI_ComCom - Inputs - v7.3.xlsx, sheet “Asset lifes”). Different lifetimes are not consistent with the practice of operators. Operators replace underground assets simultaneously in order to avoid repeating installation costs. Taking our experience into account with preparing cost models for other regulatory authorities, a twenty years lifetime for all underground related copper assets are appropriate. This also applies for active street cabinets, so far here only the costs of the passive asset parts are considered. For now the same investment values are considered (excel file CI_ComCom - Inputs - v7.3.xlsx, sheet “2.1. Copper inventory”, cells I76 and I77). Accordingly, the lifetime for ODFs, now 20 years, is too short. It should be set equal to the 50 years lifetime for fibre cables.

5.8.8 Costs for manholes too high

357. Beside the methodological weaknesses of the manhole cost calculation which we already described under Sections 4.2.9.6 and 4.2.9.7, additionally the supplier averaged input prices are too high. The model currently uses the following averaged input prices (the excel file CI_ComCom - Inputs - v7.3.xlsx, sheet “Unit costs calculation, lines 45 to 50):

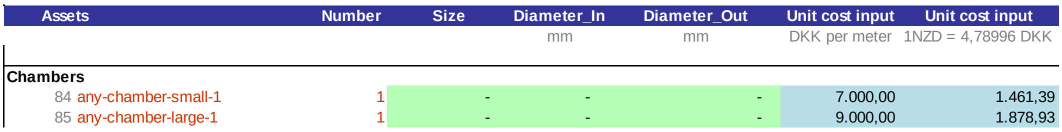
[...

[redacted]

] CNZRI

The investment cost above includes the labor costs for installation. Taking our experience into account with preparing cost models for other regulatory authorities or WIK team members’ experience made when working for operators in their professional past, the costs in sum are too high.

358. For example in the Danish cost model we find the following chambers and its input prices. We reassured that these assets contain installation costs, so that they are comparable to the total prices in the TERA model in New Zealand.[146]



Assets	Number	Size	Diameter_In	Diameter_Out	Unit cost input	Unit cost input
			mm	mm	DKK per meter	1NZD = 4,78996 DKK
Chambers						
84 any-chamber-small-1	1	-	-	-	7.000,00	1.461,39
85 any-chamber-large-1	1	-	-	-	9.000,00	1.878,93

The input prices including installation used in Denmark are significantly lower than manhole prices and the average manhole price including installation in the TERA model in New Zealand.

5.8.9 Pole and overhead cable lifetime should be the same

359. We refer to our analysis and remarks in Section 5.8.7.

5.8.10 FWA site costs too high

360. The model assumes an average FWA site cost of $ [...] CNZRI. Because there are no other investment parameters related to the base station equipment in the model we assume that the “site cost” parameter includes the site investment and the base station investment in a standard configuration with three sectors. A proper modelling approach would treat sites and base stations separately because both network assets have different lifetimes and a different OPEX pattern.

361. Even if we assume that “site costs” include the base station equipment the investment parameter looks rather inflated. An international benchmark of mobile network cost models generates a site cost in the range of $ 150,000 to $ 180,000 and an equipment cost for LTE advanced equipment in the range of $ 35,000 to $ 50,000. While equipment cost should be roughly the same in New Zealand as in Europe, there may be national specificities with regard to site cost. Because the relevant FWA sites are located in remote and rural areas we would expect those costs to be lower in New Zealand than the benchmark figure mentioned above which represent national averages.

362. The relatively high RBI site costs seem to be related to specific requirements of the RBI which are different characteristics which a commercially acting HEO would choose. Masts are required to be taller than an operator would choose. Furthermore, the masts had to be suitable for co-location for four operators. This requirement increases costs significantly. An HEO would only dimension that way if he has a realistic chance to share the site with as many other operators. Here the

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[146] See https://erhvervsstyrelsen.dk/gaeldende-prisafgoerelse-2015, Excel Map 2012-55-DB-DBA-Fixed LRAIC-Access Cost Model - v4.07 DBA - Public.xlsb, Sheet Assets, lines 164, 165.

model is rather inconsistent: The model is based on site costs which include the upgraded cost of sharing the site with four operators without making any sharing assumption and making instead a stand alone usage for FWA.

5.8.11 Costs for active equipment too high

363. The excel file CI_ComCom-UBA Inputs v1.0.xlsx, sheet “Input – Assets” contains the input data for the active equipment. This input data neither reflect the possibilities of modern active equipment nor do the input prices themselves reflect efficiency. In the sheet, column J, the “driver capacity” for the active equipment was fixed to one single value, resulting in a one size fits all approach. This is not cost efficient. Taking various traffic volumes into account, operators use different sizes of active equipment. The reduction of the active equipment to a single configuration in the model has cost increasing effects:

    a. In sites with less traffic than the configuration chosen, costs per unit increase due to larger spare capacities. Would the model allow for smaller capacity, the costs per unit would be decreased. It is state of the art of cost modelling to dimension the system sizes according to traffic demand endogenously.

    b. In sites with higher traffic than the configuration chosen in the model the costs per unit increase because the small systems have to be used several times and scale effects of larger systems do not come into account. If the model offers the option to configure systems with a larger capacity, the costs per unit would decrease.

364. In state of the art telecommunication network cost modelling the equipment used in the model will be collected and derived from a market consultation with all relevant operators in the market which all receive the same set of questions in a structured questionnaire. This enables them to describe their network architecture, redundancy concepts and system sizes and performance including lifetimes, expected price trends and prices. Qualified averages over the systems characteristics and prices result in a set of predefined systems of different size, from small to large, as they are typically available on the supplier market. We sometimes call this equipment generic equipment – since it represents systems being available, but not necessarily being supplier-specific. The data request approach of the Commission did not met this requirement and prerequisite of a proper modelling which is independent of the incumbent’s historic cost and network architecture (see Sections 4.2.9.1 and 5.8.1).

365. The model then endogenously dimensions the adequate equipment according to traffic demand at the specific node location. We use a set of several systems of

different size in our cost models prepared for cost determination in regulatory procedures. The following tables show five different DSLAM sizes for cabinet and local exchange deployment and its cost used for European regulators:

a. Cabinet DSLAM small[147]:

[...

[redacted]

] CNZRI

b.Cabinet DSLAM middle:

[...

[redacted]

] CNZRI

c.Cabinet DSLAM large:

[...

[redacted]

] CNZRI

---

[147] Plug in Unit (PIU) stands for subrack in the NZ context

d.Exchange DSLAM small:

[...

[redacted]

] CNZRI

e. Exchange DSLAM large:

[...

[redacted]

] CNZRI

366. In order to compare the different configurations and prices between the TERA model and data we use for European regulators, we calculated the total costs of DSLAMs depending on the number of incoming ports (lines). The following assumptions have been made: The TERA model does not differentiate between ADSL and VDSL cards (only xDSL cards), while our data do due to its different costs. Moreover the TERA model differentiates between xDSL and SHDSL cards. The distribution of these different card types we have calculated with the data of the TERA documentation and the data in the UBA model. This leads to the following results (own calculation):

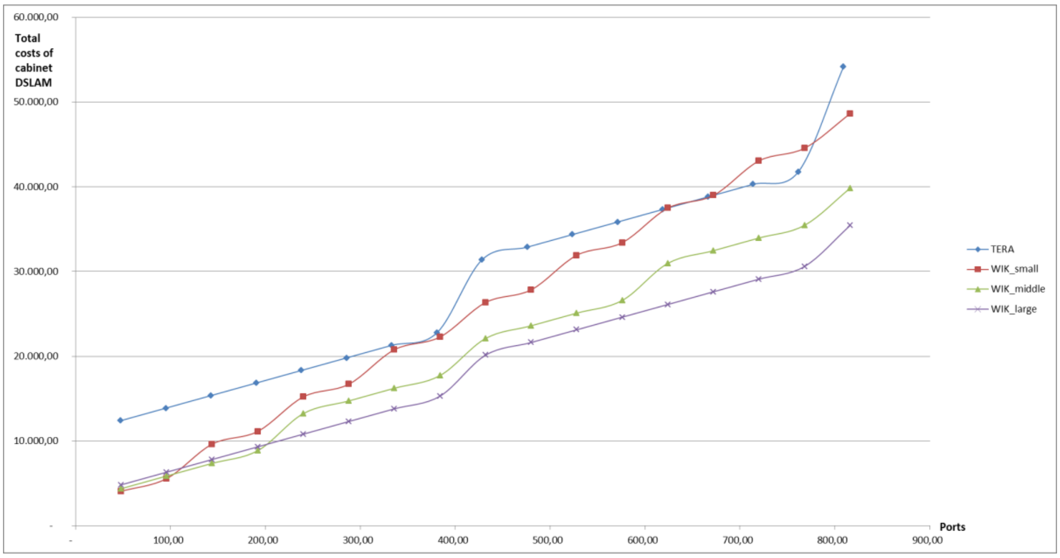
[...

[redacted]

] CNZRI

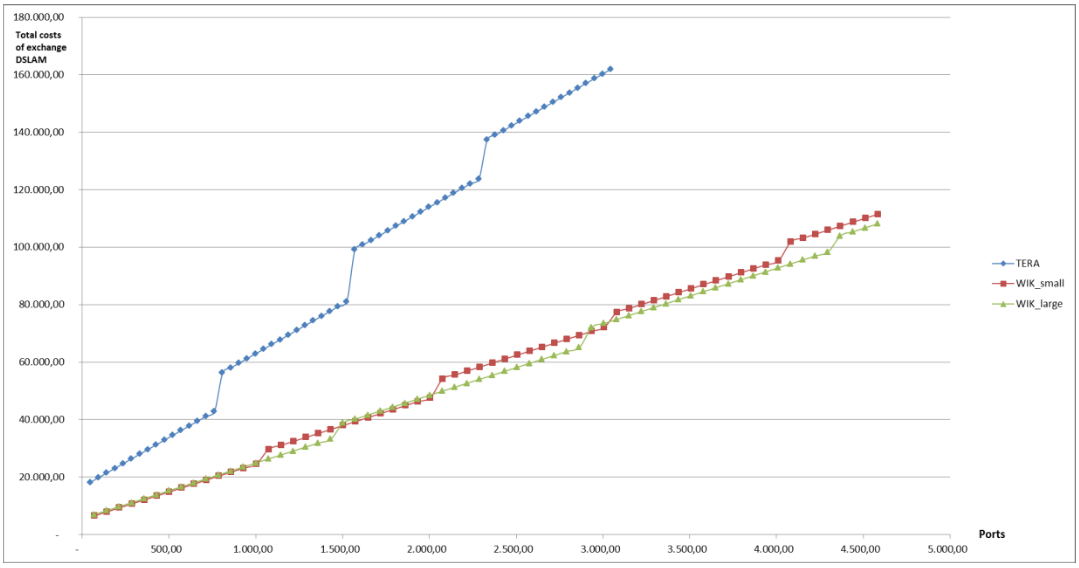
367. Comparing the data we use for European regulators in its generic equipment with the input data of the TERA model demonstrates, that the equipment prices used in the cost model are too high compared to European reference prices:

a. Cabinets



Up to about 600 incoming ports the total investment of all sizes of cabinet DSLAMs of WIK are cheaper than the DSLAM used by TERA. Regarding cabinet DSLAMs of more than 600 ports at minimum the middle sized and the largest cabinet DSLAM of WIK are cheaper than the DSLAM used by TERA. However, for every number of ports there are at minimum always two cabinet DSLAMs of WIK, which are cheaper than the single DSLAM used by TERA. Additionally the use of different cabinet DSLAM sizes allows to find the minimal cost for each cabinet location like an efficient operator would do.

b. Exchanges



For all constellations of input ports the total investment of WIKs' exchange DSLAM's is lower than the DSLAM used by TERA. Additionally the use of different exchange DSLAM sizes of WIK allows to find the minimal cost for each exchange location like an efficient operator would do.

368. Another cost improvement could be achieved by using the stackable DSLAMs described in Section 5.4.1 ("pizza-boxes").

369. The excel file CI_ComCom-UBA Inputs v1.0.xlsx, sheet "Input – Assets" contains not only the input data for DSLAMs but also for the switches (FDS). TERA provides the data, that [...] CNZRI.

This is not appropriate and leads to an overestimation of costs (see para. 372).

370. The specification of the 7450-ESS switch exclusively used by TERA shows[148], that the capacity is significantly larger: A 7450-ESS switch can host up to 5 or 10 IOMs depending on the used subrack 7 or 12. Each IOM can contain up to 10 MDA or 20 MDA depending on the used subrack. A MDA can be represented by a 0 ports SFP 1G or 1 port SFP. So the capacity of a subrack-7 is up to 200 ports SFP 1G or 10 port SFP 10G and a subrack-12 up to 400 ports SFP 1G or 20 ports SFP 10G. This is nearly double the capacity considered by TERA.

371. TERA misunderstood the specification of the ESS-7450 switches. TERA obviously just considered the number of slots, ignoring that two slots are blocked by central

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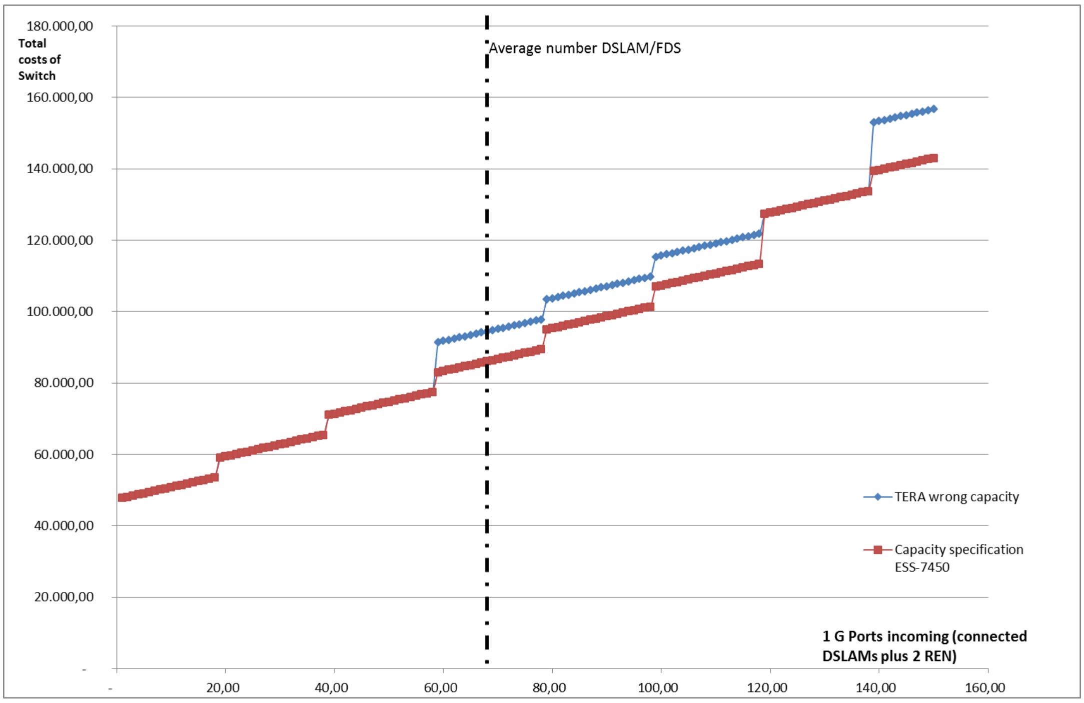
[148] See Annex 2: Specification of switches ESS-7450.

functions but that the remaining 5 or 10 slots provide double the capacity because each slot can host two port cards.

372. We calculated the costs of FDS which depend on the number of DSLAM linked to the FDS. Each DSLAMs can be linked with a 1 GB port which offers enough bandwidth for the customers. The following illustration shows the effect of the inappropriate approach of TERA used:



Due to the nature of the step costs of TERA's supplier model, in a range between 60 and 120 DSLAMs per FDS and more than 140 DSLAM per FDS the FDS costs are significantly overestimated by TERA.

373. Additionally it remains unclear, why TERA chose the 7450-ESS and within the 7450-ESS just one possible card configuration (20*1Gbps and 1*10 Gbps). The 7450-ESS offers capacity of up to 100 Gbps. Even with very optimistic assumptions of future bandwidth the switch is oversized. Assuming on average 600 kbps per xDSL customer in most cases 10 Gbps and 30 Gbps switches are appropriate. Additionally, more card configurations are possible. An appropriate cost model considers different size and configuration options and identifies with an optimization calculation the efficient size and configuration for each FDS. This reduces the costs per unit close to an optimum with the same effects that we already de-

scribed in para. 363. For example for the switch 7450-ESS [...][149] CNZRI

[...

[redacted]

] CNZRI

These new IMM ports offer a higher port density. Thus, more 1 Gbps ports fit into IOMs and subrack slots. This leads to higher scale effects reducing the costs per 1 Gbps port and per line.

374. The calculation of input prices for active equipment in the cost model are processed on the sheet “Equipment per year”. Again we found methodological weaknesses and some of them we already found for other calculations. For example: unadjusted Chorus data was used. Column V links to the data room answers of Chorus in the Section 98 request. Cell V46 takes the cost value for DSLAM-Racks in cabinets in the base year from Chorus answers without adjustments. However, checking samples we once again conclude, that neither the cost tool itself nor the data room (see also linked sheet “Q 6.17.12 (a) - ISAMs “) give indications for cost efficiency check or qualification in detail. Additionally, this sheet reveals that Chorus delivered more differentiated system configurations than used in the model. This might be happened in order to ease modelling and prevent from calculating different configurations depending on the particular traffic demand.

5.8.12 Handover points overcharged

375. Besides the finding that handover points are inappropriately considered in the monthly rentals (see Section 5.1.1), leading to double-compensation, the current monthly rentals for handover points are overcharged. The current monthly rentals for BUBA and EUBA 1GB ports are[150]:

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149 [...] CNZRI

150 See http://www.comcom.govt.nz/regulated-industries/telecommunications/regulated-services/standard-terms-determinations/unbundled-bitstream-access-uba-services/unbundled-bitstream-access-uba/current-version-of-uba-std/, STANDARD TERMS DETERMINATION FOR CHORUS' UNBUNDLED BITSTREAM ACCESS SERVICE, SCHEDULE 2, UBA PRICE LIST PUBLIC VERSION, Updated to incorporate Commerce Commission decisions, amendments, and clarifications through 5 November 2013, page 15.

Service component	Description	Core or Sundry	Charge Invoiced	Price Change Mechanism	Charge
2.9 Access Seeker Handover Connection Monthly Rental Charge – GigE capacity. Basic UBA Service only.	Standard Monthly rental for an Access Seeker Handover Connection– GigE capacity.	S	Monthly in advance.		$2,752.22 Based on an underlying service costs of [ ] **CHORUS COI** plus a mark up of [ ] **CHORUS COI** to cover common costs and maintenance.
2.10 Access Seeker Handover Connection Monthly Rental Charge – GigE capacity. Enhanced UBA Services only.	Standard Monthly rental for an Access Seeker Handover Connection– GigE capacity.	S	Monthly in advance.		$212.30 Based on an underlying service costs of [ ] **CHORUS COI** plus a mark up of [ ] **CHORUS COI** to cover common costs and maintenance.

Neglecting the issue, that the input prices for handover ports may be too high anyhow, the following rough calculation shows, that even in the case, that the input prices of the TERA model would represent prices of an HEO, the current monthly fees of the UBA STD overrides appropriate costs significantly. Assuming that on average a FDS is linked to around 68 DSLAMs and every FDS provides two 1 GB links to the REN, the following calculation can be derived from the TERA input data:

[...] CNZRI

This leads to a total CAPEX of 60,721.10 $ and per 1GB port of 867.44 $. Taking the asset life time of 5 years and a WACC of 8.9 % of the TERA model into account monthly CAPEX costs of around 18 $ result. Comparing this result with the monthly prices of the UBA STD shows, that either an unrealistic and inappropriate OPEX and non-network costs mark-up occurs or the prices cannot be justified at all.

5.8.13 Calculation of power supply and cooling costs are not appropriate

376. The input data for power supply and cooling are listed in the excel file CI_ComCom-UBA Inputs v1.0.xlsx, sheet “Input – Assets”, lines 37 – 54). The sheets “Q 6.15.3 Power” and “Q 6.15.3 Infrastructures”, which are linked with this

input, contain calculations based on it without further explanations. In order to clarify this and other unspecified content we asked TERA[151] and found, that a fix investment of 100,000 NZD for all exchange locations has been applied. Even small cabinet locations are inadequately oversized. The value has been derived from a regression analysis of 4 sample locations which are not proven to be representative. We severely doubt the appropriateness of the approach chosen and assume a significant cost overestimation.

377. Even after asking clarifying questions[152] the accuracy of the power consumption cost calculation remains uncertain due to insufficient answers from TERA and due to the lack of linked data sheets in the cost model tools.

378. For details we refer to Annex 1 of this Submission.

5.8.14 Inadequate use of currency rates

379. In the excel-map “CI_ComCom - Inputs - v7.3.xlsx”, sheet “Unit costs calculation”, the prices of the cells J190, 191, 198, 199 are presented in the original price list of the data room in Australian Dollar (AUD) in contrast to the other prices, which are presented in US Dollar (USD).[153] But all prices are transferred to New Zealand Dollars (NZD) per exchange rate USD/NZD. This increases the prices in NZD after conversion significantly, because the USD is more expensive than the AUD.

5.9 Inappropriate optimization algorithms - Shortest path algorithm does not lead to minimal trenching cost

380. An algorithm which optimizes the fibre (or copper line) routes to the local exchange (LEX) individually node by node as it is described in the TERA Model Documentation (see Section 5.2.1) does typically not generate the most efficient civil engineering cost, because it does not construct a shortest trench length tree. A simple example in Figure 5-4 demonstrates the relation of both approaches. While the red graph is a shortest trench tree, the green graph is the graph resulting from all individual shortest paths of the nodes to the LEX. The incremental length for the nodes 1, 3, 8 and 11 are longer than in the green graph.

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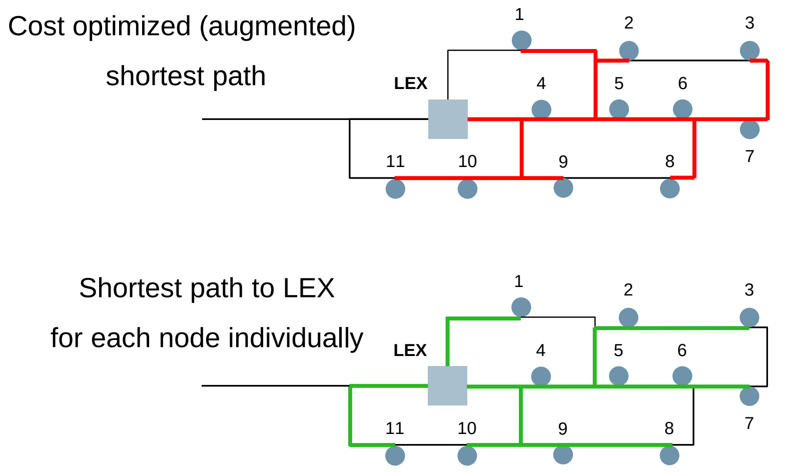
[151] http://www.comcom.govt.nz/dmsdocument/12808, sheet “questions” in the excel-map, column B, question IDs 45, 46 and answers column G.

[152] http://www.comcom.govt.nz/dmsdocument/12808, sheet “questions” in the excel-map, column B, question ID 47 and answers column G.

[153] See 20140605_Confidential_Q 6.14.1 (f) General Cable CTL Fibre Cables Catalogue , 20140605_Confidential_Q 6.14.1 (f) General Cable MTO Fibre Cable Catalogue, 20140605_Confidential_Q 6.14.1 (f) Prysmian CTL FO Cables, 20140605_Confidential_Q 6.14.1 (f) Prysmian CTL FO Cables.

Figure 5-4: Augmented vs. individual node shortest path

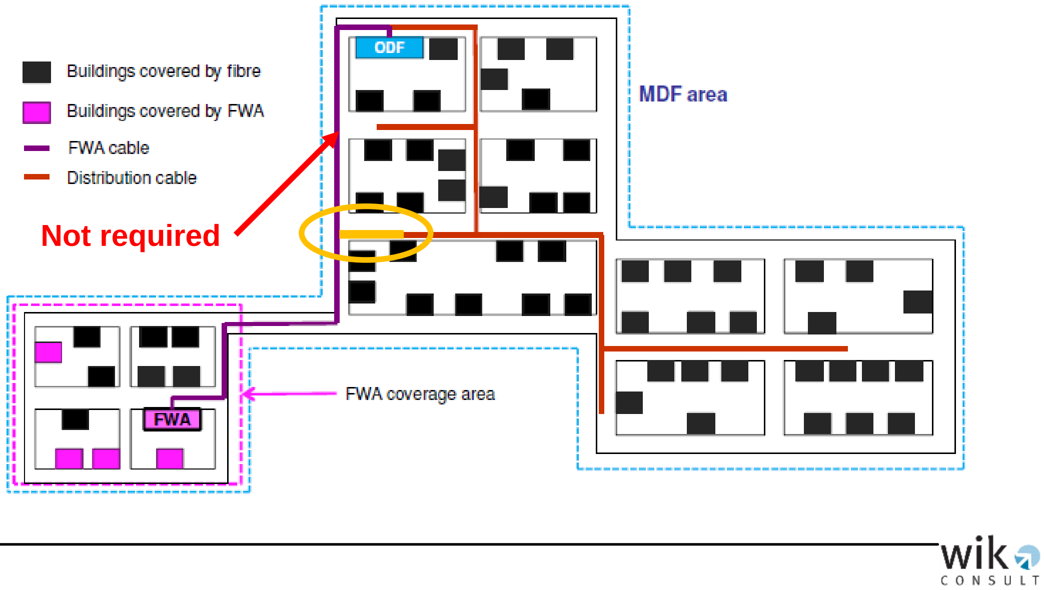


Nodes 1, 3, 8 and 11 have higher additional trench length than above

Source: WIK

381. It is not only important to efficiently optimize the trenching towards all relevant address points but also to coordinate the efficient trenching for the FWA infrastructure and the core network links to the utmost extent. Figure 5-5 provides a negative example of mismatch of FWA and other access trenches. Here the most efficient FWA trenching would result in the short orange additional trench instead of the not required longer trench marked by an arrow.

Figure 5-5: Example of uncoordinated shortest path algorithms, resulting in inefficient trenching



Source: TERA, Model Specification, Figure 31, complemented by WIK

382. The Commission and its consultant TERA admits the inefficiencies caused by the individual length based approach, arguing, that a trench cost optimizing approach "*is generally not used by regulatory authorities in a TSLRIC context*" and that the "*length based optimization is widely used by regulators*" (Model Reference Paper, Sections 2.6.2.2 respectively 2.6.2.3). At least the first assertion is false, since we can identify the fact that the NRAs of Germany, Switzerland, Austria and Spain using trench length optimizing augmented shortest path algorithms. Since such algorithms are inherently standard tools of modern geodata processing systems, it is neither unduly complex nor very difficult to use them also for network deployment. Cost optimization should be more guided by trench length optimization because that is the dominant cost component.

5.10 Inclusion of irrelevant costs

5.10.1 Exclusion of irrelevant cost for non-network cost not transparent

383. After analysing examples from the OPEX model "CI_ComCom-OPEX model v1.10.xlsm" we understand, that the exclusion of relevant costs in most cases is processed in the allocation sheets. For example, the input cost parameter "regulatory levies" (see cell 171) has been taken unadjusted from the sheet "4. Other'!B117", which contains the data of the section 98 responses of Chorus. Here

there are no further information about this cost position. The content of this position remains unclear, although the Commission also asked for " List of GL codes/activities included in each category with a meaningful description of the activity performed and the value of expenditure on each item. This listing should be consistent with the categories used for Chorus' statutory accounts." (see cell A6, sheet "4. Other"). In the data room we could not find the Chorus' answers to the linked question 6.19.4., so further clarifying information was not found (state 15/01/2015). Hence, the content remains unclear. Besides that, these costs have been fully accepted as input parameter (see cell J171 and L171). A further explanation, especially the description of the efficiency check process and its results, was not given here. This and other positions are summed up (sheet "Costs summary", cell I 90) and the sum is weighted with a factor 78% (see cell I200) in order to eliminate cost for non-regulated products. Regarding the position "regulatory levies" as part of the sum, this process itself is contradictory: So far the costs of "regulatory levies" are justified, they all have to be taken into account and would have to be weighted with 100%, if the sense of this allocation factor is to eliminate the costs for non-regulated products. If the sense of this allocation factor is also to eliminate the costs for regulated products, which are not regarded in this FPP process (which remains unclear in the tool), the process nevertheless remains inadequate due to the lack of transparency concerning this cost position. It is possible, that these costs are mostly spent for regulated products which are not regarded in this FPP process. It seems that an overall allocation key has been used here without checking all cost positions. Moreover the example shows, how difficult and extensive it is to check the process of TERA due to imprecise and incomplete documentation.

5.10.2 Exclusion of non-relevant OPEX cost not transparent

384. TERA excluded certain maintenance costs nominated by Chorus for not being relevant for the UBA and UCLL services. One of the reasons for exclusion was that some costs were related to non-relevant services. TERA did, however, not reveal according to which principles and guidelines it has excluded certain nominated costs as irrelevant. Thus, this part of the costing process remains opaque to us and it cannot be assessed with regard to completeness and accuracy.

385. Labour related OPEX cost face the risk of double-recovery when labour costs counted as OPEX are also capitalized e.g. as installation costs. TERA relied on Chorus' files of labour costs for OPEX which had already excluded capitalized labour.[154] TERA, however, did not reveal whether and how it checked for the completeness and accuracy of this exclusion and therefore a potential double-recovery of labour cost (as OPEX and as capitalized labour) remains.

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[154] See TERA, Model Documentation, p. 27.

386. In its cost assessment process for OPEX TERA classified certain OPEX cost as costs related to provisioning.[155] Such costs are in our assessment at a first glance related to transaction services like provisioning (model position "Provisioning customer services") and not to network OPEX. It is not transparent to us whether TERA excluded these costs from network OPEX or not. If they did not they allocated transaction service related cost to network OPEX with the potential of double-recovery.

5.10.3 Cost of non-standard lead-ins (> 100 m) included although fully paid by users

387. We have shown in Section 5.3.1 that it is appropriate to assume that the cost of non-standard lead-ins are fully covered by the users directly. These costs are therefore irrelevant costs for calculating UCLL costs and have to be excluded from the model calculation.

5.11 Exclusion of relevant cost savings

5.11.1 Sharing of duct and trench infrastructure to be considered

388. The Model Specification describes in Section 4.4 that the underground infrastructure is internally shared with the core network. We agree with this step towards internal sharing. The potential of sharing, however, still is implemented incomplete within the modelling process. There is for instance no sharing between the underground FWA and underground SLU backhaul infrastructure and overhead distribution and feeder cables, despite the fact, that these cables can be classified as feeder cables too (from an operating risk point of view). As already pointed out in Section 5.6.5 the FWA and SLU backhaul fibres should use the same overhead trench instead of using separate expensive underground trenches.

389. The model allows for considering external sharing with utilities and in principle with other infrastructure owners, as demonstrated by Table 2 of the Model Specification. While there is an external sharing with other utilities of 50% in the overhead deployed areas there is no external underground sharing considered. The Model Specification simply states that "*No such sharing exists in relation to duct or trench infrastructure*" (Model Specification, Section 4.4.3). That is true for the model. It is, however, neither efficient nor does it represent operators' reality in New Zealand. We continue to hold the strong view that even if such sharing did not exist, an HEO with a forward looking perspective would make use of it. Sharing with other infrastructure owners is:

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[155] See TERA, Model Documentation, p. 28ff.

- State of the art in other jurisdictions,
- A win-win situation for both cooperating operators and of more importance in competitive markets due to the higher pressure of saving cost due to the lack of guaranteed monopoly returns even for the ducts managed inefficiently,
- An option a new HEO would try to exploit.

Thus, we think that the Commission should reconsider the position on external sharing in underground deployment to achieve efficient deployment cost currently not represented in the model.

390. We could not directly include sharing parameters into TERA's model to identify the impact of sharing on the resulting cost calculation. Considering sharing reduces trenching costs. From the experience with our own cost models we know that the relevant range of trenching cost reductions due to proper sharing assumptions are in the range of 5% to 30% of trenching cost. Therefore we run model sensitivities with these cost reductions on trenching. Table 5-6 shows the impact of this cost saving potential on the UCLL and UBA costs. Compared to the Commission's base case proper sharing assumptions can reduce UCLL costs between 1.3% (5% reduction) and 7.9% (30% reduction). The impact on the UBA costs are more limited and are in a range between 0.3% (5% reduction) and 1.6% (30% reduction).

Table 5-6: Impact of trenching cost sharing

Main results	Unit	Base Case	Scenario	Scenario	Scenario	Scenario
			trench price (-5%) change rate in %	trench price (-10%) change rate in %	trench price (-20%) change rate in %	trench price (-30%) change rate in %
UCLL						
National monthly rental	NZD/ month	28.22	-1.3%	-2.6%	-5.3%	-7.9%
Urban monthly rental	NZD/ month	20.63	-1.2%	-2.3%	-4.6%	-7.0%
Non-urban monthly rental	NZD/ month	47.73	-1.5%	-3.0%	-6.0%	-9.0%
UBA		10.17	-0.3%	-0.5%	-1.0%	-1.6%
BUBA monthly charge	NZD/ month	38.39	-1.0%	-2.1%	-4.1%	-6.2%
EUBA 40 monthly charge	NZD/ month	40.56	-1.0%	-2.0%	-4.0%	-6.0%
EUBA 90 monthly charge	NZD/ month	41.10	-1.0%	-2.0%	-3.9%	-5.9%
EUBA 180 monthly charge	NZD/ month	42.06	-1.0%	-1.9%	-3.9%	-5.8%

Source: WIK-Consult calculation based on the TERA model

5.11.2 Sharing of cables in feeder and distribution segment not efficient

391. FWA and SLU backhaul cables belong to the feeder network segment. Both are directed to the next local exchange. Both are (over-) dimensioned in fixed cable sizes of 24 respectively 12 fibres. Thus they should be combined into one fibre feeder cable at each street segment they pass, thus saving cables and the related infrastructure cost (see Section 5.4.5).

5.11.3 Sharing of FWA sites to be considered

392. We have shown in Section 4.2.6.3 that sharing of FWA sites with mobile operators has not been considered, despite being dimensioned for. This inappropriate assumption excludes a highly relevant cost saving.

5.12 Some cost allocation rules arbitrary and not justified

5.12.1 Allocation rules for fibre links not justified

393. The Model Specification, Section 8.7.2.2 explains the capacity based link cost allocation for the links between the cabinet and the local exchange and the links between the local exchange and its next (parent) FDS location.

394. For the link between the cabinet (DSLAM) and the local exchange a fibre use-based approach has been taken, arguing that from 12 fibres in the cable 2 are used for 2 DSLAMs being backhauled to the FDS and 1 is used for a leased line or a dark fibre connection. We doubt this distribution to be correct, because in nearly all cabinets only one DSLAM for concentrating the end-customers is installed. Therefore, only one fibre would be required (see Section 5.4.1). Furthermore, we doubt that only one fibre per cabinet is needed and used for leased line and dark fibre business. In addition we miss a cost share allocated to the FWA fibre cable. We recommend to the Commission to adapt the cost sharing approach in the network segment between the cabinet and the local exchange by reducing the fibre for SLU backhaul to one, increasing the fibres for leased lines to a number based on actual demand and add the fibres required for FWA connections.

395. In the Model Specification, Section 3.8 TERA states that due to the lack of leased line data provided by Chorus "*a macro-parameter has been defined that defines the level of cost that is allocated to the leased lines. This macro parameter indicates the percentage of the length of access network which is shared with the access part of fibre leased lines. The value of the macro-parameter has been set so that the share of cost borne by the leased lines is consistent with what has been observed by TERA in other countries, where operators have provided detailed geospatial information on the access part of leased lines and therefore where it has been able to precisely assess the percentage of the access network which uses the same infrastructure as the access part of fibre leased lines.*" Unfortunately the benchmarked countries and the values derived are not mentioned, so a verification with other benchmark data is not possible. Our expectation would be a significantly higher number (2-3) of leased lines and dark fibre per cabinet location than assumed by TERA (see also Section 5.14.4). Furthermore, the derivation of the share based on fibre use as described in the paragraph above and in the Model Specification, Section 8.7.2.2 directly contradicts the just mentioned macro-parameter and its derivation from benchmarks.

396. The Commission could have checked that (or still can check that) if it had asked Chorus to provide the appropriate leased line data so that TERA would not have had to make arbitrary and in our view doubtful assumptions.

397. This cost allocation between different services may only be applied for the fibre part of the feeder segment, which in some cases also has to include the FWA links. Another share of the trench cost has to be allocated to the copper feeder segments (Commission, UCLL, para. 874). The concrete cost allocation in the model also remains unverified and accordingly its validity is uncertain. We assume a significant cost overestimation for the UBA service.

398. For the local exchange to FDS links another allocation rule has been applied in the model. In the Model Specification, Section 8.7.2.2 TERA simply states that "*the cost allocation of the link … is based on the fact that there are three services (bitstream, voice and leased lines) using this link and the cost should therefore be split between these three services.*" It does not appear to be systematic to apply a fibre use-based approach first, a simple service-based approach then, and a macro-parameter based approach based on precise benchmark data in the description also. A true bottom-up based approach would base the cost allocation on resource consumption, here on the fibre use. One may doubt if a voice service can be simply allocated to a fibre use between local exchange and FDS, since the voice traffic is at least in parts a small bandwidth share in the UBA, and the PSTN voice traffic behind the local exchange is out of scope for the Chorus network. Thus the service allocation chosen (equal parts for voice, bitstream and leased lines) does not hold, because voice just has a minor share in the bitstream part of services and is integrated into the bitstream. Voice therefore cannot carry link cost in addition.

399. Here it becomes obvious that the missing consideration of all services commonly used in the NGN underlying physical infrastructure in the model does not allow to allocate the infrastructure cost of the core network appropriately. Assuming that the leased lines are routed as fibres up to the FDS in a comparable manner to the DSLAM backhauls and assuming 2 fibres per street cabinet for leased lines and dark fibre and one fibre for UBA (DSLAM) we recommend allocating 1/3 of the link cost to UBA and 2/3 to the leased line service.

5.12.2 Non-network cost are allocated on the basis of OPEX and not on total attributable cost

400. The Commission supposes an EPMU approach to allocate corporate overheads[156] which TERA also names "*non-network common costs*".[157] This ap-

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[156] See Commission, UCLL, para. 863.

[157] See TERA, Model Reference Paper, p. 39.

proach is broadly supported and applied by NRAs in their cost modelling exercises.[158] WIK also supports this approach.

401. Under the EPMU approach common cost are allocated in proportion to total attributable costs. Or as TERA rightly words: "*Under the EPMU approach, each service is allocated a share of the common cost in proportion to that service's share of total attributable costs.*"[159] Total attributable cost in a bottom-up modelling context is the sum of (annualized) CAPEX and the OPEX of a particular service.

402. The implementation of non-network common cost allocation in the model, however, follows a quite different approach. Common cost are not allocated according to the total attributable cost of a service, but according to the total OPEX of each service. In TERA's words: "*Once the amount related to non-network costs for UCLL and UBA services is calculated, it is allocated between the two services with an EPMU approach based on the total OPEX of each service*."[160] This allocation approach is in total contradiction to the approach which the Commission suggested in its draft determination and which would be the proper implementation of the EPMU rule.

403. The highly distortive effects become obvious when one compares the impact of TERA's allocation rule on the costing/pricing outcome. TERA's allocation generates an absolute value of non-network common cost for UCLL per line per month of $ [...] CNZRI and of $ [...] CNZRI per UBA line for the year 2015. The distortive effects become even more obvious when one compares the share of non-network common cost in the total cost per line of the UBA and UCLL service respectively. The overhead cost share amounts to [...] CNZRI %[161] of the total cost of UCLL per line in TERA's base case scenario in 2015. For the UBA service the overhead cost share amounts to [...] CNZRI % in 2015.

404. As we have shown in para. 326 the implicit mark-up of overheads looks a bit too high for UCLL. Regarding UBA, however, the mark-up of [...] CNZRI % exceeds relevant international benchmarks by a factor of two to three. Therefore it would be totally unacceptable only to apply the EPMU allocation rule properly. This would just lead to a zero sum re-allocation game of non-network common cost from the UCLL to the UBA service. Besides getting the allocation right the major request to the Commission would be to bring down the level of non-network common cost to an acceptable level according to the efficiency standard of international best practice and then apply the allocation rule in an appropriate way.

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[158] See for instance ERG: Recommendation on how to implement the Commission recommendation C (2005) 3480-2005-

[159] See TERA, Model Reference Paper, p. 39. See also Commission, UBA, para. 702.

[160] See TERA, Model Documentation, p. 46.

[161] WIK-Consult calculation with the TERA model.

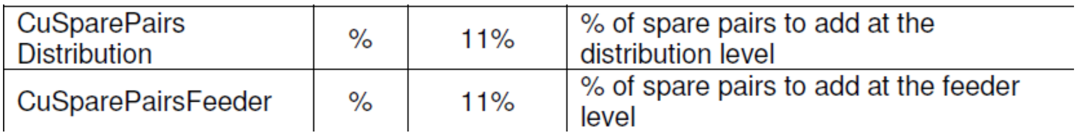
5.12.3 Allocation rules for active cabinets not appropriate

405. The allocation of other maintenance cost to “DSLAM & Active Equipment” and “Passive Equipment” has not been provided by Chorus and now are allocated by TERA on a pro-rata basis on the number of active and passive cabinets in case of passive cabinets (Passive Equipment) and by 100% to active cabinets (DSLAM & Active Equipment).

406. We wonder, why the cost for the passive equipment is not fully allocated to the UCLL cost and by that also recovered by the BUBA service, which includes the UCLL cost. This we would have expected under this approach. If there are reasons against this view we are wondering why there has not been taken the same cost allocation key as for the Chorus maintenance already differentiated into active and passive. Thus, the decision described in the Model Documentation, Section 3.3.11.1.3 appears to be very arbitrary, not consistent and is not really argued for.

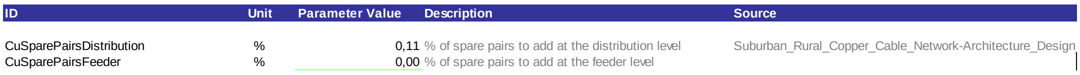
5.12.4 Cable spare in distribution 11% in documentation, but 0% in the model

407. The Model Documentation p. 60 provides the information, which values are used for spare capacities of copper cables:



CuSparePairs Distribution	%	11%	% of spare pairs to add at the distribution level
CuSparePairsFeeder	%	11%	% of spare pairs to add at the feeder level

The excel file “CI_ComCom-UBA Inputs v1.0.xlsx, sheet “2.2. Copper parameters”, reveals a different picture:



ID	Unit	Parameter Value	Description	Source
CuSparePairsDistribution	%	0,11	% of spare pairs to add at the distribution level	Suburban_Rural_Copper_Cable_Network-Architecture_Design
CuSparePairsFeeder	%	0,00	% of spare pairs to add at the feeder level	

This does not only represent an inconsistency between documentation and tool, but it seems, that Chorus provided figures for the distribution part (see above column source), but not for the feeder part. It looks like, that it was planned simply to take the same value for the feeder part. Our own experience shows, that it’s also adequate to foresee a spare capacity for the feeder part. But this value has to be lower than the value in distribution part, because, for example, demand changes in the different distribution cables of one feeder cable often are neutralizing themselves. That is for example the case, if one customer moves from on distribution cable to another in the same feeder cable. The customer needs an additional copper pair in another distribution cable, but uses the same feeder cable.

5.12.5 Allocation of IT costs implausible and unsupported

408. Parts of the IT costs are treated in the model as non-network cost. These costs are allocated directly to services by using an allocation key of [...] CNZRI % for UBA, [...] CNZRI % for UCLL and [...] CNZRI % for other services.[162]

409. These allocation keys are not supported by or justified in the documentation. For us these allocation keys are highly implausible for two reasons: Why should “other services” which generate [...] CNZRI % of Chorus’ revenues not bear a certain part of these costs? Furthermore, which service characteristic would justify that UBA bears four times more IT cost compared to UCLL while it represents only [...] CNZRI %[163] of the UCLL revenues?

410. The Excel map “CI_ComCom-OPEX model v1.10.xlsm”, sheet “Alloc key” includes nine different network IT allocation keys, which are not explained in detail on this sheet. One of them is the IT allocation key mentioned under para. 408, which is presented with not rounded numbers. The source is just stated as “TERA Consultants assumption” (see cell L65) and the allocation key itself is named with “Benchmark” (see cell F65), so that this allocation keys cannot assessed by us due to this unspecified information. Following the links of this allocation factors to the sheet “Costs summary”, these allocation factors do not seem to be used, because they are multiplied with “0” cost values (see cells I 212 to 213 and cell I189). Surprisingly the multiplication factor, the cost value, stands for “IT network costs”, although they should be multiplied with non-network IT costs (See TERA, Model Documentation, Table 26 – Non-network cost allocated to UCLL and UBA). Finally the cell above (I188) contains the “IT non-network costs“. These are summed up with other positions to “Non-network costs except IT costs ” (see cell I183 and I199) without using the allocation key for IT costs shown in the Table 26, TERA, Model Documentation.

5.13 Inappropriate cost allocation

411. TERA identified network OPEX and non-network OPEX on the basis of files provided by Chorus. TERA made, however, some adjustments. Chorus “*... categorization has been reviewed in* order *to take into account all costs*”.[164] TERA did not reveal neither in the Model Documentation nor in the model itself what type of al-

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[162] See TERA, Model Documentation, Table 26.

[163] [...] CNZRI.

[164] See TERA, Model Documentation, p. 17.

location actually was conducted in this context. The sheet "Alloc key" of the Excel map "CI_ComCom-OPEX model v1.10.xlsm" contains the calculation of all allocation keys relating to TERAs statement in cell B2 : "This sheet is used to calculate all allocation keys used in the model." Using the cell detective one can follow the links between cells and so calculations. But there are not comprehensive explanations concerning the check of Chorus input data and the methodology chosen for the calculation of different allocation keys. Moreover it is difficult to match the rough description of the TERA, Model Documentation, pages 23 – 35 with the Excel map "CI_ComCom-OPEX model v1.10.xlsm" because concrete links are missing. In addition allocation keys provided by Chorus are used, for example for tax rates.[165] Explanations and information about the check for appropriateness also are not given in the tool.[166] The information given in the documents and the model are rough and incomplete. Moreover we found obviously wrong cost allocations: In the sheet "IT allocation", lines 172 and 173 provide "Telecom overhead" costs. Overhead costs generally represent common costs which have to be allocated to all products. But here these costs are inappropriately and exclusively allocated to ULL and UBA products via the allocation key "Direct UCLL/UBA".

5.14 Inappropriate consideration of demand

412. In its draft FPP determination for UCLL and UBA the Commission has reconfirmed a variety of principles which it had already proposed in its July consultation paper.[167] Some further specifications and decisions how to deal with the relevant demand have been added in the draft determinations. Among those principles are the following ones: "*A network demand footprint for UCLL that includes all current copper connections prior to UFB migration.*"[168] The HEO "*does not need to compete to gain or retain customers.*"[169] Therefore a fully loaded network is assumed which covers 100% demand. This demand is constant during the regulatory period. The Commission makes the most important statement

> "*The network demand footprint determines the number of connections over which total modelled costs will be spread, and informs where the hypothetical network will be deployed.*"[170]

Furthermore the Commission decided that the HEO would only cover demand within the TSO boundaries (without external capital cost contributions);[171][172] this

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[165] See TERA, Model Documentation, p 43.

[166] See excel map " CI_ComCom-OPEX model v1.10.xlsm", Sheet ""Rent&Taxes allocation", lines 110 - 113.

[167] Commerce Commission, Consultation paper outlining our proposed view on regulatory framework and modelling approach for UBA and UCLL services, 9 July 2014.

[168] See Commission, UCLL, para. 478.

[169] See Commission, UCLL, para. 479.

[170] See Commission, UCLL, para. 481.

[171] See Commission, UCLL, para. 488.

assumption leaves 6.4% of actual connections out of the relevant demand. The Commission also ignored migration and included in its demand concept fibre connections in Chorus' UFB areas and in the LFC areas. In TERA's words: "*... the demand for the copper access network is Chorus' actual copper demand plus the LFC demand and the Chorus UFB demand.*"[173] The same definition holds for fibre access demand.[174]

413. We fully support the principal decisions on the concept of demand taken by the Commission and referred to in para. 412. However, we have to state major differences and deviations between these principles and their implementation in the model. This begins with the fact that the model uses different concepts of demand throughout the modelling. Furthermore, the network is covering more than 100% of demand. On the other hand, the model is missing a certain amount of connections. In any case the basis of connections over which network costs are allocated is too small.

5.14.1 Demand figures differ across the models

414. The fact that demand figures used for various parts of the model differ proves that something is fundamentally wrong with the demand concept formulated by the Commission.

415. The access network is build and dimensioned to service 1,994,654 address points.[175] These address points are related to 1,815,420 locations (or buildings). The majority of them are single dwelling units and the smaller part multi dwellings units which represent several address points. These address points are the basic geospatial starting point to design the access network. Address points therefore represent the network (coverage) demand.

416. For the calculation in the OPEX model [...] CNZRI connections (active lines) are being used.[176] This number has been used here to calculate an IT allocation key. It is also exported to the core model.

417. For allocating total cost to costs per line TERA is using a number of [...] CNZRI connections.[177] This number is generated from the following sources:[178]

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[172] More precisely, the network demand coverage includes all connections beyond the TSO boundaries, but excludes their capital cost from the cost calculation (see Commission, UCLL, para. 489).
[173] See TERA, Model Specification, p. 34.
[174] See TERA, Model Specification, p. 45.
[175] See CI_ComCom - Access network - v7.0.accdb, Table SOURCE_BUILDINGS, Column NB_TOTAL, Data summed up and number of ID_Building.
[176] See CI_ComCom-OPEX model v1.10.xlsm, Sheet Results, cell K17.
[177] See, CI_ComCom - UBA model v5.1.xlsb, Sheet Outputs, cell H87) and "Sheet „ Allocation keys ", cells I14 and I32.
[178] See, CI_ComCom - UBA model v5.1.xlsb, Sheet „Dashboard", cell H19.

Copper connections	[...
Fibre connections	
LFC connections	
Total	]
	CNZRI

418. These differences are not explained by TERA and indicate major inconsistencies in the concept of demand in the modelling approach. The difference between the number of address points and the number of LLU connections may partially be explained by the address points outside the TSO boundaries which do not bear capital costs. Because these address points represent 6.4% of the connections they can only partially explain the difference, if at all.

5.14.2 Network dimensioned for more than 100% demand

419. Building the network to connect all address points means dimensioning according to potential demand and not to actual demand. Although we have some reservations to the number of connections used for cost allocation[179], this number is closer to actual demand for connections than the number of address points. On that basis the network is modelled for 113.5% of (actual) demand and not 100% of demand. Different to the principle set by the Commission the network is not fully loaded but over-dimensioned.

420. TERA had access to the actual connections of the network run by Chorus.[180] This data set would have been the more appropriate starting point for designing and dimensioning the network. TERA is not providing any analysis whether these discrepancies are due to problems of the address data base used and/or are due to in-active lines which are connected or whether the network is deployed in areas were de facto is no network. In any case the resulting network is over-dimensioned.

421. We observe that TERA has used a reduced number of copper connections in the year 2014 (from [...] CNZRI (Chorus forecast) to [...] CNZRI). The reduction is unexplained. This increases copper line cost unjustified.

5.14.3 Access demand of certain services not considered

422. The number of connections used in the model to distribute the network costs to access connections seems to be the sum of access lines used for the UCLL, UBA

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[179] See para. 413.

[180] See answers of Chorus containing number of active lines in 2013 and forecasts of the following years, relating to the question 6.18.2.c in the data-room.

and UCLF services. The relevant demand should, however, not be limited to those services but should include all services which use the access network. This should include but is not limited to leased lines, bounded lines and special data access line services.

423. The Model Specification provides no indication that such services have been considered. Insofar as that is the case, the cost of the access network are spread over a number of connections which is too low.

5.14.4 Consideration of leased line demand inappropriate

424. According to the Model Specification, Section 3.8, the fibre leased lines are modelled from a core part which is shared with other services and an access part made of dedicated fibre cables. The use of dedicated fibre cables per leased line is inefficient. The fibres should be integrated into larger cables. This is even more important when each fibre cable should use its own overdimensioned subduct, thus significantly increasing the cost for it (see Sections 5.4.5 and 5.4.4).

425. Because Chorus did not provide any data regarding the access part of the fibre leased lines a macro-parameter has been defined by TERA indicating the percentage of the length of the access network which is shared with the access part of fibre leased lines (see Model Specification, Section 3.8). It has been set according to TERA’s observation in other countries. The value is not mentioned in the specification nor are the countries named being taken as reference nor is the methodology of setting the benchmark value transparent. Thus, once again an invalid benchmark has been chosen.

426. Despite the definition of the above mentioned leased line macro-parameter the Model Specification in Section 8.7.2.2 states fixed shares being used to distribute the cost between bitstream, leased lines and the voice service. This means, the feeder network segment between the active street cabinet and the local exchange location one fibre has been considered, and two for connecting the DSLAMs. While we have shown in Section 5.4.1 that the DSLAM fibre demand is only one per cabinet, the demand for leased lines (incl. dark fibre and managed services) is completely underestimated according to our experience. We would expect 2 – 3 fibres per cabinet. We admit that this depends on several factors, e.g. the distribution of business customers over the country, the degree of communication demand per business customer and the level of leased line charges. But no adequate leased line demand estimation has been made as far as we can see.

427. For the segment between the local exchange location and the parent FDS there is also no macro-parameter for cost allocation applied, but a fixed ratio of 1/3 for each of the following services: leased lines, bitstream and voice (see Model Spec-

ification, Section 8.7.2.2). In principle the leased line fibre demand could have been here calculated endogenously to the model since the fibre demand on the feeder link has been explicitly counted as 1 fibre per active cabinet. Such an allocation also contradicts the feeder line ratio of 1 fibre for leased line, but 2 for bitstream, because in consequence there should be two times the leased line fibres for the bitstream fibre demand on the Local Exchange-FDS segment also, but instead two equal shares (each 1/3 of the total) have been taken into account.

428. It remains completely unclear how the fibre demand (for leased lines, bitstream and voice) is correlated to the other infrastructure – FTTH fibres or copper backhaul segments for UCLL to the local exchange. They should share the same trenches and their cost which does not seem to be implemented in the model.

429. While for the Local Exchange-FDS segment the voice service carries one third of the cost (see above), there is no voice service bearing cost of the feeder segment between street cabinet and local exchange. This looks both strange and inconsistent, since the voice service has to be transported to the end-customers in any case. If it is assumed that voice is transported within the bitstream, then it will be routed within the bitstream capacity up to the FDS. If it is assumed to be transported over UCLL lines then it will be aggregated at the local exchange locations, thus one or two fibres might be sufficient and the cost share for leased lines should be increased and the voice share reduced appropriately.

430. Summarizing we state that the leased line demand is not considered appropriately. A macro-parameter is not evaluated in a proper state of the art manner, and in contrast to the Model Specification it is not applied, but fixed cost shares are used instead, not being derived endogenously to the model but in an inconsistent and quite artificial manner. Since leased lines typically bear a major cost share of modern, integrated telecommunication networks a proper bottom-up leased line modelling would be required in order to share the infrastructure cost accordingly. There is a strong evidence that the model in its current state and its current parameterization overestimates the cost for the UBA significantly, and may also overestimate the UCLL cost for the same reason.

431. It appears to us that the intransparency of cost allocation of the feeder (cabinet to local exchange) and backhaul (local exchange to FDS) trenches is mainly caused by the dual MEA approach applied (see also Sections 1.2 and 2.2).

5.14.5 Exclusion of terminating segment of international leased lines and other international services is not appropriate

432. According to its Model Reference Paper TERA has excluded or disregarded international parts of the access network. "*The international parts of the access net-*

> *work and of the core networks should be disregarded as they are not included in the scope of services that are priced.*"[181]

433. This approach fails in several dimensions. First of all, any service which uses capacity of the access and/or the core network should be modelled. Otherwise the network segments are not dimensioned such that the full potential of economies of scale and scope which are relevant in the real world is exhausted and the costs of the regulated services are overestimated. This also holds for international services. We do not believe that TERA takes as a starting point that only regulated services have to be regarded to dimension network segments. Furthermore, the terminating segments of international leased lines use the access network, have to be part of the asset dimensioning and should also bear access costs.

5.14.6 Number of copper connections observed by Chorus differ by about 3% from the total in the cost model tool

434. TERA states in the Model Specification[182] that the total number of copper connections observed by Chorus might differ by about 3% from the total provided in the model. This discrepancy is explained and justified by the fact that the figures provided by Chorus come from different sources in Chorus. TERA does not reveal whether considering the Chorus information would lead to a number of connections which is 3% higher or lower than the number used in the model.

435. Inconsistencies of numbers coming from different sources are to a certain degree inevitable. When inconsistencies are identified however, they should be sorted out. TERA does neither reveal whether such an effort has been conducted and what the reason for the inconsistencies actually is. TERA also does not reveal why a number which differs by 3% from Chorus' numbers has been used in the model. The Commission should resolve the inconsistency and provide more transparency on the nature of the justification for the position taken.

5.14.7 Access line demand to increase over time

436. The concept of demand upon which the network dimensioning of the access network and the cost calculation for UCLL is based is consistent with the total access demand provided over the fixed line network independent of the type of access service. This general concept which we fully support raises the question, whether the Commission's assumption of a constant demand over the five year regulatory period is consistent with a relevant demand forecast for New Zealand.

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[181] See TERA, Model Reference Paper, p.8.

[182] See TERA, Model Specification, p. 54.

437. Overall fixed line demand faces two tendencies which impact demand in different directions: The New Zealand population and therefore the number of households which generates additional access line demand grow. On the other hand the number of customers which become mobile-only customers is increasing, but customers often retain their fixed lines for fast broadband. The cable network could not win additional customers over the last few years against the fixed line platform. Whether or not total fixed line demand will be growing depends on the relative development of household demand and substitution to mobile-only users. Although the number of fixed line connections in New Zealand has been stable since the late 1990s, there is reason to assume that the deployment of fibre and the trend to higher bandwidth applications will stimulate demand and will lead to some growth. We refer to the Network Strategies report which shows that fixed line demand in New Zealand should be forecast to grow over the next five years.[183]

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[183] See Network Strategies, Commerce Commission Draft Determination for UCLL and UBA, A review of key issues. Report for Spark New Zealand and Vodafone New Zealand, February 2015, Section 2.3.

6 Model sensitivities and overall assessment of the model results

6.1 Model sensitivities

6.1.1 One reservation on model sensitivities

438. In Sections 4 and 5 of this submission we have argued and provided the necessary evidence that the cost model in its current form cannot be the basis to inform the Commission on its UCLL and UBA pricing decisions. Major changes and adaptions would in our view be needed before the cost model can meet this function and support the Commission's decision accordingly.

439. Our reservations as to the use of the cost model in its current form and status first of all relate to some formal inconsistencies and technical computational problems, which, however, do not look too serious. More important are a number of major conceptual deficiencies which partially relate to decisions of the Commission, others are related to the implementation chosen or to implementations which are not coherent with decisions of the Commission. These methodological deficiencies relate to the cost efficient technology choice, the coverage of FWA, the modelling approach of FWA, and some allocation rules and principles. We have strong reservations regarding the efficiency concept(s) of the modelling. Major efficiency potentials are not exhausted or in some cases not even modelled. Effectively the model does not represent the network and the cost of an efficient operator. Furthermore, many engineering dimensioning rules implemented in the model are not state of the art, best practice or simply not what an efficient operator would do. Bringing dimensioning rules to the level of the relevant state of the art would not in all (but in many) cases generate a decrease in cost. Some of the dimensioning rules which we propose as more appropriate would require more capacity and would therefore increase cost. A major deficiency results from the basic algorithms to determine trench length which is the major cost driver in the access network. The algorithm used tries to minimize cable length. What should have been done to achieve the lowest cost is the minimization of trench length.

440. We also have serious reservations on the costing side of the modelling and the parameterization of the model. The Commission and TERA did not sufficiently take care of the problems relating to the avoidance of double-recovery of costs. The model included a variety of irrelevant costs. In particular the inclusion of all lead-in costs totally ignored the relevant contribution which users provide directly to the capital requirement to deploy the network. Major cost saving opportunities have not been considered or even implemented. The way in which OPEX has been calculated is not convincing to us, rather arbitrary, subjective and finally unsubstantiated.

441. We have great concern about the approach, the way, and the detail of many input parameter values with which the model has been populated. The Commission has not properly relied on the expertise of operators active in the New Zealand market to generate an appropriate data base platform for the model input parameters. Instead, the Commission mostly relied on data provided by Chorus. These data were not sufficiently checked on the basis of a national benchmark in New Zealand and international best practice. As a result, many input parameters in the model are inflated compared to a relevant international best practice benchmark. This holds for many equipment prices in the model, but also for other cost parameters. We have special reservations in the way the trenching costs were derived. These reservations relate on the one hand to the approach which Beca in its corresponding study has conducted and on the other hand on how Beca's raw data have been transposed into model input parameters. As a result, trenching costs in the model look much higher than they should be compared to relevant benchmarks and to proper reference points in New Zealand.

442. We could not test the trench length determination of the model because the geospatial part was not accessible to us. We could not only not analyse this part of the model but also, all interrelationships with other parts of the model could not be tested with regard to consistency. Therefore, we could also not modify demand in the model in a meaningful way and could not run sensitivities with different demand parameters. We regret this implication in particular because we have grave concerns that the concept of demand as defined by the Commission in its draft UCLL determination was not properly and appropriately implemented in the model. This is regrettable insofar as demand and geospatial modelling is the basic starting point of any bottom-up access network modelling.

443. Given these many reservations on our side on the applicability of the cost model in its current form one may doubt whether it is useful at this stage to bring sensitivity results based on the current version of the model to the table and into the discussion. We have decided, nevertheless to present certain sensitivity results with the qualification that the results can only be interpreted structurally and with respect to the overall quantities of effects and implications.

6.1.2 Results of partial sensitivities

444. We have conducted a bulk of ceteris paribus sensitivities where we changed just one parameter or just one configuration or constellation of the model and kept all other parameters or configurations unchanged. Such ceteris paribus sensitivities aim more at identifying the relative importance of certain parameters on the resulting UCLL and UBA costs. Partial sensitivities do not provide a relevant guideline for more cost-based UCLL and UBA prices. Nevertheless partial or ceteris paribus

sensitivities provide useful and important insights into the direction of necessary changes. They also allow for checking the proper operation of the model.

445. In para. 192 we presented the results of an increase of the FWA capacity from 16.6 Mbps to 150 Mbps (as is state of the art LTE advanced technology). This increase of FWA capacity per site reduces UCLL costs by 11%.

446. In Section 5.11.1 we have shown that proper sharing assumptions regarding trenching can reduce UCLL costs by up to 7.9% and UBA costs by up to 1.6%.

447. A technology choice between copper access and FTTH/FWA on a MDF by MDF and not on a nationwide uniform basis leads to a UCLL cost reduction by 4.8%.[184]

6.1.3 Two global sensitivities

448. We have conducted two model sensitivities with which we want to demonstrate the combined effect of a variety of parameter changes we regard as necessary. These changes still reflect only a subset of parameter and model changes which we in total regard as necessary and which we have described in detail in Section 5. Some necessary changes cannot be included in our sensitivity because including them would require re-modelling of (parts of) TERA's model. Table 6-1 summarizes the parameter changes compared to TERA's base case calculation which we included into this first (global) sensitivity.

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[184] See TERA, Model Specification, p. 80.

Table 6-1: Input parameter changes compared to the base case (global sensitivity I)

• MSAccess-Model:	
➢ ActivateLeadinThreshold	from 0 to 1 (connection revenues deducted)
➢ PeakCapacityThroughput FWA	from 16.666 Mbps to 150.000 Mbps
• Excel Access-Model:	
➢ Trench prices	-30%
➢ Duct prices:	-20%
➢ Investment base station:	-25%
➢ Investment frequency:	from 88 Mio. to 44 Mio.
➢ Lead in: Activate Lead in Threshold:	from False to True (exclusion of non-standard lead-ins)
• Excel Core Model:	
➢ Active Equipment prices:	-30%

Source: WIK-Consult

449. Table 6-2 presents the results of the sensitivity and the combined effects on the final prices. These sensitivity results also show that a global sensitivity with the combined and simultaneous effect of all necessary parameter changes is the relevant task because the global effect is different (lower) compared to the sum of the effects of partial sensitivities and parameter changes. The effects of various parameter changes interrelate to each other and influence each other. Only a combined model run is able to represent all these interdependencies. A few relevant (and necessary) parameter changes would lead to a reduction of the UCLL cost/price by more than 25%. These results show that a proper parameterization of the model, considering available efficiency potentials and considering relevant cost savings would generate price levels for UCLL and UBA which are more in line with international benchmarks than the current level of costs/prices presented by the Commission in its draft FPP determinations.

Table 6-2: Effect of parameter changes on base case (global sensitivity I)

Main results	Unit	Base Case	Combination Scenario	
				change rate in %
UCLL				
National monthly rental	NZD/month	28.22	20.15	-28.6%
Urban monthly rental	NZD/month	20.63	15.15	-26.5%
Non-urban monthly rental	NZD/month	47.73	32.99	-30.9%
UBA	NZD/month	10.17	9.52	-6.4%
BUBA monthly charge	NZD/month	38.39	29.67	-22.7%
EUBA 40 monthly charge	NZD/month	40.56	31.70	-21.8%
EUBA 90 monthly charge	NZD/month	41.10	32.20	-21.7%
EUBA 180 monthly charge	NZD/month	42.06	33.10	-21.3%

Source: WIK calculations

450. We have conducted a second global sensitivity analysis. Here we included more parameter and cost changes which we have developed in Section 5. Furthermore, we have changed some parameters of the first global sensitivity such that they come closer to the arguments and assessments we developed in Section 5. All parameter and model changes are represented in Table 6-3.

Table 6-3: Input parameter changes compared to the base case (global sensitivity II)

• MSAccess-Model:	
➢ ActivateLeadinThreshold	from 0 to 1 (connection revenues deducted)
➢ PeakCapacityThroughput	from 16.666 Mbps to 150.000 Mbps
• Excel Access-Model:	
➢ Trench prices	-45%
➢ Duct prices:	-50%
➢ Manhole prices:	-20%
➢ Fibre cable prices	-20%
➢ Investment base station:	-50%
➢ Investment frequency:	from 88 Mio. to 0 Mio.
➢ Lead in: Activate Lead in Threshold:	from False to True (exclusion of non-standard lead-ins)
• Excel Core Model:	
➢ Active Equipment prices:	-30%
➢ Share of civil engineering allocated to xDSL (Cabinet to Exchange):	from 66% to 33% (2/3 to 1/3)
➢ Opex and common cost	
○ OPEX and non-network cost UCLL	-24.25%
○ OPEX and non-network cost UBA:	-26.55%
○ FWA yearly OPEX:	-15%
○ Paycosts (To add to UCLL OPEX) Access Network:	-15%

Source: WIK-Consult

451. A variety of factors influence the trenching costs. It is first of all the trenching costs as calculated by Beca which could be significantly lower if Beca's raw data would consider all relevant factors which influence trenching costs. Furthermore, the over-dimensioning of subducts leads to too large trenches and therefore too high trenching cost. The algorithm used by TERA overestimates trench length which we assumed to increase trenching cost by 5%. We would have preferred to model all these effects specifically which was not possible because it requires major re-modelling work. We represented all these effects in a trenching cost reduction by 45%. This is in our view still conservative because it does not include the re-use of ducts and trenches. FWA site cost of 50% of the parameter value used in the model seems to be more appropriate to us. We intended to reduce OPEX by 15% and common cost by 30% in the model. This was not directly possible in the model. We had to approximate those reductions at some intermediate outputs of the model to come close to the intended reductions of OPEX and common cost. We reduced the allocation of the number of fibres in the link from cabinet to exchange by one, so that this segment of the core network only bears 33% of these link costs (see Section 5.12.1).

452. Table 6-4 shows the results of this sensitivity. Although once again only a subset of model and parameter changes, which we have shown to be needed, are represented in this sensitivity, major impacts on the results of the Commission's base case occur. The monthly rental for UCLL would decrease by 41% to a level of $ 16.64. The effect of our parameter changes on the UBA costs are less intense. The UBA cost would decrease by 23.0% to a level of $ 7.83 per month.

Table 6-4: Effect of parameter changes on base case (global sensitivity II)

Main results	Unit	Base Case	Combination Scenario	
				change rate in %
UCLL				
National monthly rental	NZD/month	28.22	16.64	-41.0%
Urban monthly rental	NZD/month	20.63	12.93	-37.3%
Non-urban monthly rental	NZD/month	47.73	26.17	-45.2%
UBA	NZD/month	10.17	7.83	-23.0%
BUBA monthly charge	NZD/month	38.39	24.47	-36.3%
EUBA 40 monthly charge	NZD/month	40.56	26.14	-25.6%
EUBA 90 monthly charge	NZD/month	41.10	26.55	-35.4%
EUBA 180 monthly charge	NZD/month	42.06	27.29	-35.1%

Source: WIK calculations

6.2 Overall assessment of the model results

453. We have expressed great concerns on the appropriateness of TERA's modelling approach. Many engineering and dimensioning rules are not state of the art and/or not efficient. Many cost parameter choices are not only conservative or cautions. They simply lead to inflated and inefficient costs. We have also identified some faults and deficiencies which, if corrected, would increase the calculated cost for UCLL and UBA. Correcting for the major parts of the faults and deficiencies and populating the model with more appropriate input parameters would, however, (significantly) decrease the relevant cost.

454. In the global sensitivity presented in para. 452 we corrected for some of the most important deficiencies of the model. Many others could not be corrected for because this would require major re-modelling work which we could not conduct. Making these necessary corrections and parameter changes would lead to a UCLL cost which is 41% below the level calculated by TERA. If all of the deficiencies identified by us would be corrected for we would expect the UCLL TSLRIC cost to be in a range of $ 14 and $ 16 in New Zealand, which means 43% to 50% below the level calculated by TERA.

455. Most of the necessary corrections regarding UBA have been included in the global sensitivity II. This leads to a reduction of the calculated UBA cost by 23%. If all necessary corrections and parameter changes would be included in the model we would expect the UBA TSLRIC cost to be in a range between $ 7 and $ 8 in New Zealand. On this basis the relevant TSLRIC for UBA would be between 21% and 31% below the level calculated by TERA.

456. It is not surprising to us that the relevant range of the UCLL TSLRIC cost on the basis of proper modelling as shown in para. 454 is close to the monthly rental benchmark which the Commission has developed under the raw benchmark approach in 2012,[185] as shown in Table 6-5. In its 2012 benchmark-based decision the Commission rejected the raw benchmark approach because it did not adequately apply the comparable countries requirement and would have resulted in downwards bias of results. The main driver of UCLL costs is the trench length per connection. Given the geography of New Zealand and the distribution of population (and fixed line users) there are indications of a longer average trench length in New Zealand compared to most of the countries included in the Commission's benchmark at that time. In its modelling approach the Commission made the most important assumption of excluding the capital cost of connections outside the TSO area for the UCLL cost calculation, which we support as a pragmatic approximation. Excluding the 6.4% connections of the non-TSO areas also meant to exclude those loops with an over-proportional loop length. Altogether 47.5% of the total road network length is attributed to these 6.4% connections.[186] Excluding these most lengthy loops mostly adjusts for the important geographical and cost differences to the benchmark countries. In a model sensitivity TERA has calculated the impact of including the area outside the TSO-derived boundary. Including the capital cost of these 6.4% connections would increase the calculated UCLL cost from $ 28.22 to $ 35.21,[187] which means by 24.8%. As a result, the properly calculated TSLRIC for UCLL are in the relevant range of the Commission's raw benchmark approach in 2012.

Table 6-5: Monthly UCLL rental benchmark set under the raw benchmarking approach of the Commission in 2012

Mean	$ 17.51
Median	$ 17.60
25th percentile	$ 15.95
75th percentile	$ 18.90

Source: Commerce Commission

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[185] See Commerce Commission, Final determination on the benchmarking review for the unbundled copper local loop service, 3 December 2012.

[186] See Commission, UCLL, para. 322, footnote 268 and para. 813.

[187] See TERA, Model Specification, p. 78.

7 Analysis of the UBA and UCLL models submitted by Chorus

7.1 General characteristics and building blocks of the models

7.1.1 Hybrid bottom-up/top-down approach

457. Analysys Mason ("Analysys") has developed UCLL[188] and UBA[189] models of Chorus' networks. In this section we provide a high-level review and assessment of these models regarding their ability to inform the Commission's TSLRIC-based FPP price determination.

458. Analysys provides the following description of its UCLL/SLU model:[190]

> "*The hybrid UCLL model estimates the cost of efficiently building a copper network in New Zealand today to deliver the regulated UCLL, SLU and UCLFS services, using an optimised replacement cost approach and assuming no re-use of assets. The model uses Chorus' actual asset count, with an optimisation adjustment.*"

Correspondingly the UBA modelling approach is described as follows:

> "*The UBA model estimates the cost of delivering the UBA service on Chorus' existing copper network. It estimates the cost of the electronics on a bottom-up basis, but uses Chorus' actual asset counts for civil works.*"

We will show that the model is not estimating the cost of an efficiently engineered copper network and will not derive efficient costs. Instead, it is basically valuing an inefficient network which represents an asset value of $ [...] CNZRI billion at current replacement costs which inflates that value by a factor of [...] CNZRI. The Analysys' general model description is different to the modelling approach actually employed which relies on the re-use of assets of the copper network to build Chorus UFB fibre networks and allocates the costs of this shared use of assets in a unique way.

459. The Chorus model starts with all of Chorus' assets. Thus, beside the copper access cables also the fibre access cables constructed for UFB are taken into account. The cost for the UFB networks is separated in the model by cost allocation factors. The architecture of implementation of this cost allocation is not explained

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188 See Analysys Mason, Report for Chorus to provide to the Commerce Commission, Model user guide for UCLL hybrid bottom-up model, 28 November 2014.

189 See Analysys Mason, Report for Chorus to provide to the Commerce Commission, Model user guide for UBA model, 28 November 2014.

190 Analysys Mason, Presentation, Chorus network modelling, p. 2.

in the accompanying model documentation and thus remains completely opaque and unable to be tested.

460. Analysys seems to model not only a copper access network but a hybrid copper/fibre access network reflecting Chorus actual network environment where Chorus actually builds a fibre network in its UFB areas on top of its existing copper network. Effectively, Analysys models Chorus transition from a copper to a fibre network. This is not the same conceptual starting point as that of the Commission's HEO. Jointly used assets like trenches and ducts are then allocated between copper and UFB. How this allocation is actually conducted remains highly uncertain in the model due to a lack of detail justification. Nevertheless, trenching costs seem to be allocated either on the basis of connections or subscribers.[191] This is not a cost-based but a value-based allocation method which implies a significant cross-subsidization of the fibre network. Under a cost-based and capacity-based allocation rule the fibre network would get that part of the trenching/duct infrastructure cost allocated which is caused by the level of deployment or network coverage of the fibre network, based on the appropriate share of fibre cable duct and/ or trench space consumption. Under a subscriber-based allocation rule the fibre network would get allocated a share of jointly used assets (like trenches and ducts) in proportion to the actual fibre connections compared to copper connections. At a low level of fibre take-up, which is the current reality in New Zealand, the fibre network only gets allocated a fraction of the resources it actually uses as an asset capacity. What Analysys actually does is to burden major parts of Chorus fibre deployment costs to the users of the legacy copper network services. This allocation approach is not in any way consistent with TSLRIC costing principles.

7.1.2 Limited efficiency considerations

461. The model takes Chorus existing asset count as starting point, correcting these by adjustment factors. The goal is obviously to correct the difference between historically grown assets of the existing network towards the asset requirements of a bottom-up efficient network[192]. These adjustment factors differ according to asset groups, deployment forms (aerial, sharing) and also depend on assumptions concerning the degree of optimization (current or highly optimized). The size of the adjustment varies from 5% to 20%. The amount of the adjustment occurs in 5% steps[193], by this representing an arbitrary setting and its reasoning remains completely unclear and unexplained. It is neither argued for nor is it benchmarked towards target values. From our point of view all adjustment values are significantly

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[191] See Analysys Mason, Presentation, Chorus network modelling, 2 December 2014, p. 6.
[192] See Analysys Mason, Presentation Chorus network modelling, 2 December 2014, p. 6.
[193] See Analysys Mason, Presentation Chorus network modelling, 2 December 2014, p. 6.

too low. Instead of the values chosen we would have expected values of several magnitudes higher, as represented in Table 7-1.

Table 7-1: Efficiency adjustment factors

	Adjustment used by Analysys	Minimum adjustment expected
Optimization	10%	50%
Sharing	5%	50%
Aerial	20%	50%

462. Although the identification of network assets is based on Chorus asset counts from the NetMap database, Analysys made some efficiency adjustments on these raw numbers. These adjustments changed the structure of assets and the volume of assets used in the model to calculate costs. The structure of assets e.g. was changed to introduce a higher degree of aerial cabling than currently reflected in Chorus' network.

463. The level of sharing assumed is rather low. 5% of Chorus distribution network is shared with other utilities in the UCLL and 2% in the UBA model. We have already shown that the sharing assumptions of TERA underestimate the cost saving potential of sharing.[194] The assumptions which Analysys made, basically ignore this potential.

464. The way in which these efficiency adjustment factors have been determined and calculated, however, is not transparent. In particular it remains unclear how these adjustments relate to the network architecture and topology and the efficient engineering rules which an HEO would choose, which is unconstraint by the historic network decisions of Chorus. Deducting a certain asset volume from the actual asset count does not transform an inefficient network to an efficient one.

7.1.3 Modelling of OPEX and common cost

465. The determination of OPEX uses the same starting point as the determination of OPEX conducted by TERA in its modelling approach: It basically relies on Chorus actual OPEX without checking the efficiency of the incurred costs. This approach is not even consistent on its own merits. The OPEX as used in the model does not reflect the fact that the structure and volumes of assets are different to Chorus' actual numbers because of the efficiency adjustments which Analysys conducted.

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[194] See Section 5.11.1 of this Submission.

466. Despite adopting the same starting points, TERA made two major adjustments of the starting values for OPEX derived from Chorus accounts: TERA made a first adjustment, recognising that Chorus' actual OPEX reflect the respective maintenance requirements and costs of an "old" network and not the ones of an newly built network, which are lower. Furthermore, TERA adjusted the actual expenditure reflecting the fact, that the OPEX of a fibre network are lower than those of a copper network. Although we have criticized the approach which TERA has applied to make these two adjustments, we nevertheless regard the direction and the extent of these adjustments as necessary. Analysys has not made such adjustments at all. The OPEX used in the model therefore are related to an asset base which is actually not used in the model, represents the maintenance requirements of an "old" network and ignores the maintenance savings of a modern fibre network. As a result the OPEX used in the model are significantly inflated compared to those which an HEO would face which is operating the relevant MEA network.

467. We do not see any explanation in the model user guide provided by Analysys Mason of whether the OPEX which are related to transaction services and not to operating the network are deducted from the relevant cost base. Therefore, there is reason to assume that a lot of irrelevant cost which is not caused by the operation of the UBA and UCLL services is included in the OPEX cost base. This would imply a double-recovery of costs.

468. The Chorus model generates common costs for UCLL which amount to around $ [...] CNZRI million p.a.[195]; the corresponding common cost for UBA amount to around $ [...] CNZRI million p.a.[196] These absolute numbers generate a common cost mark-up on incremental cost of around [...] CNZRI % for UCLL and [...] CNZRI % for UBA. While the common cost mark-up for UCLL is in the relevant range (if one accepts the incremental cost base which we do not), the mark-up for UBA is beyond any relevant range. The significant differences between both mark-ups are not in line with the EPMU allocation of common cost as proposed by the Commission[197] and also supported by Chorus[198].

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[195] Taken from Chorus UCLL model CI sheet TSLRIC rows 3035:3037, topic TSLRIC calculations: 6 Calculation of mark-ups and sheet OPEX, rows 2282:2332, topic OPEX calculations: 5 Category totals.

[196] Taken from Chorus UBA model CI sheet TSLRIC rows 1636:1638, topic TSLRIC calculations: 5 Calculation of mark-ups and sheet OPEX, rows 1236:1272, topic OPEX calculations: 3 Total OPEX by cost categories.

[197] See Commission, UCLL, para. 327.2 and Commission, UBA, para. 292.2.

[198] See Chorus, Submission in response to the Commerce Commission's Consultation paper outlining its proposed view on the regulatory framework and modelling approach for UBA and UCLL services (9 July 2014), pages 7, 15 and 27.

7.2 Chorus' models are not suitable to inform the Commission's TSLRIC-based UBA and UCLLL pricing FPP determinations

7.2.1 No proper MEA consideration

469. The Chorus model does not calculate UCLL costs on the basis of the MEA network which the Commission is regarding as the conceptual framework for calculating the appropriate TSLRIC in New Zealand. Instead, the copper access network still is regarded as the relevant MEA. Nevertheless, the model contains fibre and copper access in a hybrid modelling approach with then artificially and inappropriately separated fibre and copper network elements in order to derive copper access unit costs. Given that Chorus still is operating a copper access network, the modellers might not have had a chance to model a fibre access network once they had made the decision to build a top-down model. Nevertheless, the conceptual mismatch between the modelling principles set by the Commission and Chorus modelling approach is making the exercise more or less useless.

7.2.2 Considering path-dependent asset structures and volumes

470. The basic starting point of Analysys Mason’s top-down modelling approach is the assets which make up the Chorus network today and which are derived from Chorus’ asset data base. The actual network is reflected in the type and volume of assets and network elements, the technology used and in the architecture of the network deployed.

471. A network which represents the historic path of its deployment and growth over several decades looks different compared to a newly deployed network. New construction areas have been developed, new network node functions have been allocated and new technical characteristics require a new efficient network topology design. Another typical example of path dependent inefficiency follows from parallel trenching. If a network growths fast over time often the existing duct capacity – if it exists at all – and existing trench capacity is not sufficient to host additional cables which are needed to meet that demand. In this case parallel trenches have to be deployed. This makes sense from an incremental development path of the network but it does not lead to efficient cost in the framework of a network deployment which dimensions the network on the basis of current demand. This phenomenon is similar to asset re-use. If assets can be re-used even an inefficient network architecture can lead to lower actual costs than an optimized replacement costing approach.

472. A costing approach based on actual asset counts being used in the network often also implies that technologies and assets which no longer represent state of the

art technology are costed (at their current cost). This usually also means that state of the art assets and network equipment are much more productive and efficient (e.g. in terms of capacity or fault rates) or less costly than the equipment actually being used in the network. One can observe in the last decades a permanent cost decrease of electronics for communication systems, measured in capacity of the systems, or a duplication of capacity at the same price every 18 moth approximately. Because old equipment often is traded at low volumes its current prices in addition often are rather high compared to the historic prices. This is another reason for inflated costs following from Chorus modelling approach.

473. While the access network and its trenches in the past have been determined by the copper cable transmission characteristics which in general required a limited copper loop length between end-customer and MDF, this relationship has already changed with the FTTC approach, where the copper pair length should be limited between the cabinet (DSLAM) and the end-customer location. Deploying fibre instead of copper lifts all access line limitations to a large extent, allowing the network builder to concentrate the access network at less ODF locations than the number of MDF locations before. This goes hand in hand in any case with allowing for trench length optimization instead of shortest line length optimization between end-customer locations and the ODF/MDF star point of a point-to-point topology. All these aspects have impact on the appropriate trench length in the access network. Fibre cables allow in any case for the most cost efficient trench length and by this a cost optimizing approach. For these reasons current trench lengths in Chorus network are not a proper representative for efficient trench lengths.

7.2.3 Inappropriate consideration of relevant demand

474. The Chorus' model assumes a constant demand for UCLL over the (intended) regulatory period. Insofar Chorus' and the Commission's models rely on the same assumption. We have criticized the constant demand assumption in the Commission's model before the background of the growing population in New Zealand and the indications of a growing demand.[199] In the same way, Chorus' model also neglects the cost decreasing effect of a growing demand.

475. In contrast to the UCLL model the UBA model assumes a declining demand. This represents a major conceptual difference to the Commission's model which makes the two models unable to be compared without major adjustments, and leads to increased modelled costs.

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[199] See Section 5.14.7.

7.2.4 Ignoring the cost-efficiency contribution of FWA

476. Including the cost saving potential of FWA at the edge of the network is independent of whether a copper or a fibre access network is being modelled. Therefore, Analysys Mason could and should have included FWA in its model, but it has not. A major potential of increasing cost efficiency of the network therefore has been ignored.

7.2.5 Limited efficiency considerations

477. In its top-down modelling approach Analysys Mason corrected the asset structure and volumes it has identified in the Chorus asset data base for efficiency reasons. These efficiency adjustments are not derived from a clear methodology but are based on some ad hoc assumptions. Therefore it remains unclear and unproven what relation the derived network assets actually have compared to those modelled in an efficient HEO network. Making a few efficiency adjustments based on ad hoc assumptions do not transform an inefficient network to an efficient one.

7.2.6 Inflated input parameters values

478. We did not assess and benchmark all input parameters of the Chorus model. Instead, we focussed on a few selected items which have some relevant impact on the level of unit costs. The few examples which we picked indicate a significant cost inflation due to the use of overpriced input parameters.

479. Analysys Mason used vendor price lists to represent equipment prices.[200] In the context of assessing the input parameters of the TERA model we have shown that list prices of vendors do not represent the relevant purchase prices of equipment and other network assets to deploy a new network. List prices are usually only relevant – if at all – when equipment is purchased for an incremental expansion of network coverage and capacity or for replacing individual assets. The general assumption of using list prices of vendors therefore significantly overestimates equipment and other input prices by 20% to 40%.

480. Beside the unit direct CAPEX the chassis for DSLAM and FDS are valued in addition by indirect CAPEX of a significant size, taking values between approximately 0.6 and 5.7 fold of the direct CAPEX value. The indirect CAPEX increase neither depends on the size of direct CAPEX nor on chassis size and it is the same for both FDS chassis sizes despite the fact that they differ in price (see Table 7-2). The port cards of all active systems are not burdened with indirect CAPEX in the

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[200] See Analysys Mason, Report for Chorus to provide to the Commerce Commission, Model user guide for UBA model, 28 November 2014, p. 7f and Analysys Mason, Model user guide for UCLL hybrid bottom-up model, 28 November 2014, p. 7.

Chorus model. Thus neither a rule nor any other description explains such significant cost increase. The amount of indirect investment is unclear and unjustified in its size.

Table 7-2: Indirect CAPEX in DSLAMs and FDS

Network element	Direct CAPEX [NZD]CNZRI	Indirect CAPEX [NZD]CNZRI	Inflation factor
Cabinet DSLAM Chassis 8 cards	[...]	[...]	5.27
Cabinet DSLAM Chassis 16 cards	[...]	[...]	5.71
Exchange DSLAM Chassis 8 cards	[...]	[...]	3.54
Exchange DSLAM Chassis 16 cards	[...]	[...]	2.39
Aggregation Switch Chassis 7 cards	[...]	[...]	0.69
Aggregation Switch Chassis 12 cards	[...]	[...]	0.56

481. The costs of UBA and UCLL in Chorus' model are further inflated by its assumption of the return on capital. Analysys Mason uses a 8.1% nominal post-tax WACC while the Commission uses a WACC of 6.47% for the UCLL and the UBA services[201]. The return on capital is inflated furthermore by the fact that Analysys Mason does not include an adjustment for tax in the annuity formula.

482. Comparing the national average trench prices (Table 7-3 and Table 7-4) one can easily see that the prices in the Analysys model are significantly above those of the TERA model. As shown above, there is evidence that even those in the TERA model are too high already, as shown above. For comparison purposes we think it is reasonable to assume that the Analysys distribution cable rural and urban routes correlate to TERA's "S" and "M" trenches, the Analysys feeder cable rural and urban routes correlate to TERA's "M" to "XXL" trenches.

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[201] See Commission, UCLL, para. 302 and Commission, UBA, para. 270.

Table 7-3: Analysys Model, trenching prices

Asset ID	Category	Price per meter [NZD] CNZRI
	Distribution Cable route	
159	trench, urban (directly fed, copper)	[...]
160	trench, urban (from active cabinet, copper)	[...]
161	trench, urban (from passive cabinet, copper)	[...]
163	trench, rural (directly fed, copper)	[...]
163	trench, rural (from active cabinet, copper)	[...]
165	trench, rural (from passive cabinet, copper)	[...]
	Feeder Cable route	
176	trench, urban (to active cabinet, copper)	[...]
177	trench, urban (to active cabinet, fibre)	[...]
178	trench, urban (to passive cabinet, copper)	[...]
180	trench, rural (to active cabinet, copper)	[...]
181	trench, rural (to active cabinet, fibre)	[...]
182	trench, rural (to passive cabinet, copper)	[...]

Source: Taken from UCLL Model CI sheet MTAD, rows 3934:3961; Topic: Labour Gross replacement costs column K (featuring asset.list.unit.capex.labour); rows 2427:2454; Topic: Material Gross replacement costs column K (featuring asset.list.unit.capex.material)

Table 7-4: TERA model, national average trench prices

Trenching prices per meter	Size	National (NZD/ M) CNZRI
Small trench (for one 50 mm duct)	Trench_S	[...]
Medium trench (< 2*110 mm ducts)	Trench_M	[...]
Large trench (< 3*110 mm ducts)	Trench_L	[...]
Very large trench (< 4*110 mm ducts)	Trench_XL	[...]
Extremely large trench (>= 4*110 mm ducts)	Trench_XXL	[...]

Thus, the trenching prices in the Analysys model significantly overestimate the trenching cost in New Zealand.

7.2.7 Double-counting of costs

483. The lack of transparency in the model does not allow to check whether Chorus' model has excluded the double-recovery of costs. Nevertheless, there are indications that at least the danger of double-recovery is highly relevant.

484. The model represents copper and fibre access. We have already identified and described the inherent cross-subsidization of the fibre networks by users of the copper network following from the allocation rules (see para. 460). We assume an additional high risk of double-recovery of costs due to the modelling approach chosen, in particular, because the separation and allocation of assets to network services is not transparent and remains an area of great uncertainty.

485. The way in which OPEX have been identified and modelled does not demonstrate that the cost of providing transaction services are separated from network OPEX. Furthermore, there seems to be no clear distinction between OPEX and common cost, which contains a high risk and probability of double-recovery.

7.2.8 Model results implausible

486. The Analysys Mason model generates a unit cost for UCLL of $ 74.10 and of $ 84.87 for UCLFS. These numbers would signal that the access costs in New Zealand would be higher by a factor of five (or even more) compared to the benchmark which the Commission used in its 2012 IPP benchmark decision of

2012.[202] Given the degree of urbanisation and population density in New Zealand compared to the benchmark countries there is no relevant cost driver which could generate such discrepancies of access costs calculated on a TSLRIC basis. The results are simply unsupportable in the context of a TSLRIC model and indicate major conceptual flaws and the use of cost inflating input parameters.

487. Not only the overall level of results look highly implausible, the models inherently contain an unexplained inflation of capital cost by a factor of two. The model starts its cost considerations with the total annual CAPEX which is determined by quantities times asset prices and amounts to roughly $ [...] CNZRI billion per year. With some transformation within the model the total annual cost, being the base for the UCLL unit cost determination amounts to $ [...] CNZRI billion. Reducing this figure by OPEX and common cost ($ [...] CNZRI million respectively $ [...] CNZRI million) results in $ [...] CNZRI billion CAPEX. Thus, CAPEX has nearly doubled during the transformation, which has neither been explained in the model documentation nor in the model. This means, it remains unclear, unverifiable, and unjustified. The level of the resulting monthly unit cost consequently are already inflated by a factor of two just for this reason.

488. The results represent some overall inconsistencies which also support our general conclusion and assessment that the Chorus model is not suitable to inform the Commission’s UBA and UCLL price determination. As an example, the UCLL model produces an SLU price that is slightly higher than the UCLL price although UCLL includes more network elements. This is implausible. It is also implausible that the costs for UCLFS are about 15% higher than the cost of UCLL although this service uses less network elements than UCLL and supports just low bandwidth services.

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[202] See Commerce Commission, Final determination on the benchmarking review for the unbundled copper local loop service, page 102, table 20.

Annex 1: Calculation of power supply and cooling costs

In Section 5.8.13 we showed that the calculations of power supply and cooling costs are not appropriate.

The excel file CI_ComCom-UBA Inputs v1.0.xlsx, sheet “Input – Assets of the model” contains input data for power supply and cooling (lines 37 – 54):

[...

[redacted]

] CNZRI

The sheets “Q 6.15.3 Power” and “Q 6.15.3 Infrastructures”, which are linked with this input, contain calculations without further explanations. In order to clarify this and other unspecified content, we asked the Commission:

- Which equipment units do the positions 272 to 279 below contain?
- Are the numbers of the positions 272-277 given in “NZD per kW”?
- What does any exchange mean? Are exchanges cabinets, exchanges and FDS? Or just “DSLAM exchanges”? If the last one is meant: Why do only the “DSLAM exchanges” have a fixed power component and security asset component?
- How was the input of the positions 272 to 279 calculated ? There are links to the sheets “Q 6.15.3 Power” and “Q 6.15.3 Infrastructures” in the same excel-file, but we can’t find an explanation for the calculations on these sheets. “

Referring to the answers provided we have to conclude that the calculations and its description are inappropriate:

a. Definition “any exchange”

TERAs answer answered, that the fixed investment for power supply is not only considered for local exchange locations.

“In the context of worksheet “Input - Assets” in "CI_ComCom-UBA Inputs v1.0.xlsx" , "Any Exchanges" relates to all sites - cabinets, exchanges and exchanges with EASs.” Thus description in the Excel map is misleading.

Taking this information into account the value of the input parameter, a fix investment of 100.000 NZD even for small cabinet locations, is inadequately oversized.

b. Linear regression

The fixed investment for power supply and other parameters are calculated by a linear regression. Asking TERA for more clarifying details of this calculation, they answered:

> “*These parameters are determined by linear regression. The graphs contained in the worksheets “Q 6.15.3 Power” and “Q 6.15.3 Infrastructures” within "CI_ComCom-UBA Inputs v1.0.xlsx" contain the regression parameters.*”

Analysing the unspecified calculations on these sheets we found, that this calculation just bases on a sample of n=4 locations: Shannon, Johnsonville, Masterton and Ellerslie respectively Wellington (see sheet “ 6.15.3 Power” and “Q 6.15.3 Infrastructures”). A sample of 4 sites out of hundreds of sites is unreliable and statistically inappropriate. Moreover there are no explanations why these 4 sites are representative, and how its data has been prepared for the regression analysis. Additionally we cannot see anywhere the statistical information and the tests one would expect to be provided as part of a proper process in performing regression analysis. Thus the applied methodology is inappropriate and results in significantly overestimating the specific cost.

c. Dimensioning drivers

The description of the dimensioning drivers is also misleading. For power supply and cooling the units are stated in “kWh”. The physical unit represents an energy consumption. TERA answered to our respective question:

> “*The dimensioning drivers are listed in column H of the worksheet “Input - Assets” in "CI_ComCom-UBA Inputs v1.0.xlsx*".

Taking a deeper look into the regression analysis, it appeared that the adequate dimensioning driver, “kW” for power, was used:

“Actual Site Equipment Load (Kw)” (see cell B1 in the sheet “Q 6.15.3 Power”)

Furthermore: The final input of power supply and cooling on the sheet “Input - Assets” is not linked to further calculations. The Excel formula detective does not find following cells for the eight input parameters above. There is also no hint on this sheet, if this input parameters have to be transferred by “copy and paste” to other model parts for the further calculation. So we are not able to check the further calculations for appropriateness, especially we are not able to check, if the variable cost positions are multiplied with a consumption value, which would be wrong. Such a wrong calculation is quite likely bearing in mind, that the dimensioning drivers are not appropriately stated.

This demonstrates the misleading and inappropriate description of TERAs costs tools again. An efficient analysis for appropriateness of the models thus is difficult or even impossible.

Annex 2: Specification of switches ESS-7450

[...

[redacted]

] CNZRI

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