analysys mason

Report for Chorus

Response to Commission

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1 Response to specific issues raised in the Commission's paper

As a result of requests from industry parties, the New Zealand Commerce Commission (NZCC) ("the Commission") is currently engaged in a process to set the price of unbundled copper local loop (UCLL) using the final pricing principle (FPP). At the same time, the Commission is also engaged in a process to set the price of unbundled bitstream access (UBA) using FPP.

This document has been written by Analysys Mason for Chorus, and is in response to the Commission's initial process and issues paper.[1] That paper sets out a number of positions and asks a number of questions, many of which are addressed in this document.

The remainder of this document is divided into a number of sections which cover the following specific issues:

- forward-looking costs
- the nature of the costing approach: service-based or element-based costing
- demand level
- technology/modern efficient asset
- adjustments to modelled costs
- depreciation
- assets shared with other utilities
- the need for coherent and internally consistent approach to the modelled hypothetical operator
- operating costs
- process points.

Whenever relevant questions from the Commission's paper apply to these issues, we treat them at that point. As a result, the Commission's questions are not listed sequentially.

1.1 Forward-looking costs

The forward-looking aspect of the total service long-run incremental cost (TSLRIC[2]) is a legal requirement, arising from the definition of TSLRIC in the 2001 Telecommunications Act.

> **TSLRIC**, in relation to a telecommunications service,—

[1] New Zealand Commerce Commission Friday 6 December 2013 *Process and issues paper for determining a TSLRIC price for Chorus' unbundled copper local loop service in accordance with the Final Pricing Principle*, at http://www.comcom.govt.nz/regulated-industries/telecommunications/standard-terms-determinations/unbundled-copper-local-loop-service/ucll-final-pricing-principle/

[2] We note that in the Act TSLRIC is defined as including common costs, so would be called TSLRIC+ in some countries. We use the New Zealand definition of TSLRIC in this document.

> (a) means the forward-looking costs over the long run of the total quantity of the facilities and functions that are directly attributable to, or reasonably identifiable as incremental to, the service, taking into account the service provider's provision of other telecommunications services; and
>
> (b) includes a reasonable allocation of forward-looking common costs.

Forward looking is not defined in the Act, but various regulatory sources show a reasonable degree of alignment, as discussed below.

According to the Australian Competition and Consumer Commission (ACCC):[3]

> "Forward-looking economic costs are the prospective costs a firm would incur in producing a service using best-inuse technology and production practices. When calculating forward-looking costs, costs are usually valued at current prices."

The Organisation for Economic Cooperation and Development (OECD) states[4]:

> "Long-run forward-looking methods value capital assets by the current costs of duplicating the functions of such assets in today's markets."

The UK telecommunications regulator Ofcom states[5]:

> "In its purest form, the concept of forward looking costs requires that assets are valued using the cost of replacement with the modern equivalent asset (MEA). The MEA is the lowest cost asset which serves the same function as the asset being valued. It will generally incorporate the latest available and proven technology and is the asset which a new entrant might be expected to employ."

The forward-looking costs requirement has a number of effects on the approach. Specifically, when modelling a hypothetical new entrant, the following aspects all need to be forward looking:

- technology deployed
- style of deployment (e.g. buried/ducted underground)
- demand
- asset counts (specific quantities of each asset type needed)
- asset unit costs
- depreciation

3 ACCC Access Pricing Principles 1997 p27.

4 http://www.oecd.org/regreform/sectors/27767944.pdf.

5 http://www.ofcom.org.uk/static/archive/oftel/publications/1995_98/pricing/netcha97/chap3.htm.

Technology deployed (modern equivalent asset, MEA)

The technology chosen by a hypothetical new entrant for the deployment should be that which would be deployed to meet the required specification today. In more detail, even if it was the same overall technology as a historical choice (e.g. copper to the home) it would use specific modern asset types appropriate to that technology (e.g. modern cabinets, cables).

The style of deployment

The style of deployment by a hypothetical new entrant is that required today. For example, cables should be buried or ducted underground if this is what is required by current planning rules. The modelled operator does not have a time machine with which to install assets in the past.

This "current day deployment" includes the extent to which a modern day network could be shared with other operators or utilities. If an operator deploying today could reduce its capex by sharing (and paying a fair price to do so) then it would be appropriate to consider this in the modelled deployment, as long as the assets to be shared are actually available in the required locations.

Demand

Current and expected (prospective) future demand levels should be used to size the hypothetical new entrant's network assets and estimate the unit costs.

Asset counts

Based on all the inputs above, the asset counts in the modelling (the specific quantities of each asset type needed) for the hypothetical new entrant should be those which would be deployed today to meet current and expected future demand, using today's efficient technology in the style of deployment that is permitted today.

Asset unit costs

The asset unit costs for a hypothetical new entrant should be forward looking, which is to say based on the costs of the assets today (see the Ofcom quote above from footnote 5).

A hypothetical new entrant is new and therefore must be modelled as building a network today to serve current and expected future demand; it does not have the option to buy the assets at historical prices. If the trenching is more expensive today than twenty years ago due to higher surface restoration costs caused by urban development in the last twenty years, then this needs to be reflected in the forward-looking asset unit costs.

Future asset unit price trends should also be prospective, based on today's best estimate of such future trends.

Depreciation

Accounting-based (top-down) approaches are inappropriate for a hypothetical new entrant (there is no past asset base to consider).

1.2 The nature of the costing approach: service-based or element-based costing

The costing approach described by the Commission is of a multi-service network, modelled via multiple service-specific increments. This service based approach is a choice; we describe an alternative element-based approach below.

Our preferred terminology

In an incremental cost model, we distinguish only three kinds of cost:

- incremental
- joint[6] – which is very rare in practice, requiring that the asset can produce one or more outputs only in fixed relative proportions
- common.

The illustrated "shared" cost items on the Commission's figure[7] are a common cost to services 1 and 2 (which we call C12 for brevity) and a common cost to services 3 and 4 (C34).

To calculate a TSLRIC using this method (small, service-specific increments) requires the model to be used to calculate the costs of all combinations of increments, so there would in practice be a significant number of additional common costs to be estimated (some of which might be zero): in a four-service model these would be: C13, C23, C14, C24, C123, C234, C124, and C134. A four-service market would therefore require four incremental costs, and 1+4+6 common costs, 15 calculations in all (assuming that zero demand has zero cost). A larger number of services leads to a larger number of combinations (5 services, 31 combinations; 6 services, 63 combinations).

Accordingly, the diagram of the full range of incremental and common costs in such a model would be as follows:

6 UK Competition Commission, Reports on references under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks Dec 2002 available at http: //www.ofcom.org.uk/static/archive/oftel/publications/mobile/ctm_2003/ctm3.pdf "When equipment can provide two or more services in variable proportions then the cost of this equipment is common. If, however, the equipment can provide two or more services in fixed proportions only, then the cost of the equipment is termed a joint cost."

7 The figure is not numbered, but follows paragraph 69 of the initial paper.

Figure 1: Illustration of the various common and incremental costs in a four-service model [Source: Analysys Mason, 2014]

Increment or common cost	Service 1	Service 2	Service 3	Service 4
Incremental	I1	I2	I3	I4
C12/C34	C12		C34	
C13/C24	C13	C24	C13	C24
C14/C23	C14	C23		C14
C123	C123			
C234		C234		
C134	C134		C134	
C124	C124			C124
C1234	C1234			

Difficulties with a combinatorial service-specific increment approach

The difficulties with an approach such as this are:

- **It adds complexity to the model.** To evaluate the values of all these incremental and common costs, it would be necessary to in effect run this four-service model 15 times, and to ensure that the model accurately represented the lowest cost means of providing each of these combinations of services, some of which might have very low demand density or clusters of demand and therefore merit different local loop architectures or even different technologies. There is considerable complexity which would result in relation to the common cost allocation between the different services. As noted above, a larger number of services leads to a larger number of combinations (5 services, 31 iterations; 6 services, 63 iterations).

- **It is much more costly and time-consuming to do this number of calculations, especially if each run of the model is itself materially costly or time-consuming.** If using a bottom-up model (and noting that a bottom-up model is required by such an approach in order to estimate all the common costs, because a top-down model always only gives the "all services" cost), certain parts of the access network modelling might be very compute-intensive. For example, it is common for the clustering and tree-building algorithms to be highly time-consuming; running such a calculation 15 times is going to significantly increase either the time required for the project or the cost of the computer resources required (e.g. 15 machines in parallel). Adding more services (which is eminently possible) would lead to an even higher requirement for computer time (it doubles with each service added).

- **It allows only limited "hybrid" calibration**. Calibration is not possible of the vast majority of these model runs, because only the "all services" version of the model can be meaningfully compared with current network asset counts.

The net effect of this additional complexity and cost is that modelling multi-service networks with service-specific increments is not usually undertaken.

Instead, an element-based approach is usually adopted. We describe such an approach below.

1.2.2 Element-based approach as an alternative

In an element-based approach, the entire access network between end-user premises and the main distribution frame location is treated as a single large increment.[8] The total incremental costs can then be allocated to the services (e.g. UCLL) using routing factors which reflect the service usage in respect of each class of network elements and service volumes (so, for example, services that do not use distribution duct do not get allocated any of the costs of distribution duct; services using twice the number of pairs in a cable get allocated twice as much cable cost). This is an "element-based" approach: we work out the cost of the elements, and then work out how much of each element's cost is allocated to a specific service.

The material advantages of an element-based approach are as follows:

- the common costs are as small as possible, minimising the impact of the common cost allocation method chosen
- reduced complexity
- reduced runtime
- additional flexibility in the future (e.g. adding a new service is nowhere near as complex).

An element-based approach was foreseen in past work by the Commission in 2004,[9] though in a slightly different form (assuming that non-network costs are allocated to elements before element costs are allocated to services; this difference is probably immaterial if using equi-proportionate mark-up (EPMU) for non-network common cost mark-ups).

The ACCC has also used an element-based approach to estimating TSLRIC, in the case of mobile termination (MTAS) where the WIK model used by the ACCC was element-based. Element-based approaches are extremely common in Europe: all the European Analysys Mason cost models cited by the Commission are element-based.

8 In the case of core network interconnection models, the increment is often considered to be "all traffic".

9 Commerce Commission, Implementation of TSLRIC Pricing Methodology for Access Determinations under the Telecommunications Act 2001, Principles Paper, 20 February 2004.

It is not easy to foresee whether an approach to TSLRIC based on small service increments applied in combination would have a similar result to the element-based approach; patently the total costs for all services would be the same, but it is possible that the different services might cost more or less (be allocated more or less cost) according to the incremental costs and the common cost mark-up method chosen.

1.2.3 Question 35: Is there benefit in segmenting common costs in this way i.e. as it allows for different allocation methodologies to be applied to different cost pools?

We agree that, if taking a combinatorial service-increment approach, it will be likely to be necessary to be able to allocate the inter-service common costs appropriately between the services and differently for different inter-service common costs. This is because some assets in the local loop network are only used by specific groups of services – for example distribution trench is not common to all access network services (e.g. it is not required for sub-loop extension service, SLES – except in cases where feeder and distribution may be in the same trench).

As discussed above, element-based approaches are arguably superior to small service increment approaches due to reduced model complexity, lower common costs and less difficulty in allocating those common costs.

1.2.4 Question 36: Is the distinction between shared and common costs necessary? Does the allocation methodology need to differ between shared and common costs?

As noted above, we would prefer to call the costs denoted "shared cost" "costs which are common to a subset of the services (rather than common to all services)".

As noted above, it is likely that such multiple-service common costs will exist in the UCLL model as we know that some assets with high fixed costs are used only by a subset of the services. It is therefore essential to take account of the difference (between "shared cost" and "common cost" in the Commission's terminology), and it will be necessary to consider ways in which these inter-service common costs can be allocated taking the different asset utilisation into account.

1.3 Demand

1.3.1 General

Total market demand for fixed connections

Total demand for fixed connections has been static in New Zealand and slowly falling for several years in many countries. This is as a result of a number of factors including lower demand for multiple lines (e.g. second phone lines for Internet or for supporting PABX) and competition from wireless services for that subset of customers whose voice and data needs are better met by wireless.

Local market share

In the future there will be multiple providers of fixed access networks in significant parts of New Zealand: the Chorus network is in parallel with the HFC cable television network, and there will be local fibre company (LFC) networks built and operated by other parties in some areas.

As a result we do not believe that it is appropriate to assume that future demand on the modelled network will be equal to current demand; it is likely to be lower due to both mobile substitution (for the subset of consumers for whom mobile-only is a viable option) and competition from alternative fixed access networks.

The assumed local market share of the hypothetical operator modelled is a choice for the Commission. However, this has to be feasible. As there are competing LFC networks in some geographies, any assumption of 100% local market share would result in a super-efficient cost level that cannot be reached by any of the actual operators.

Indeed the Commission has stated:

> "A TSLRIC price for UCLL should set the level an efficient market entrant would charge in competition with Chorus' UCLL Service – based on a variety of requirements, such as best-in-use technology, cost and coverage."

The effect of falling demand needs to be taken into account

If the Commission were to assume that demand is constant over time at the current level, then the price set will not allow prospective cost recovery if demand were to fall, and the incentives to invest will therefore be removed if investors believe that demand is falling. This can be corrected:

- either by using an additional tilt in the tilted annuity ("adjusted tilted annuity")[10] – which works if the assumed demand changes are small and act with a constant annual percentage rate of decline[11]
- or by using economic depreciation. Annex A contains a description of one form of economic depreciation.

We comment more on these points under the depreciation questions.

For clarity, we disagree with the Commission's view expressed in paragraph 164:

10 A closed-form expression for the initial value of the annuity is (Purchase_price × (WACC – K)) / (1 – ((1+K)/(1+WACC))^Lifetime), where K = ((1+Output_Trend)*(1+Price_Trend))-1. This formulation assumes end-of-year revenues. As can be seen, it reduces as required to a tilted annuity if the demand trend is zero.

11 This "adjusted tilted annuity" method has been built into various European cost models including those in Denmark and Italy; it has been used for setting regulated prices in Malta (http://www.mca.org.mt/consultations/mcas-new-bottom-cost-model-fixed-networks-and-proposed-interconnection-prices).

> "164. Our initial assessment (set out in the Demand section above) is that the TSLRIC modelling exercise should include demand from Chorus connections that will migrate to fibre. Given this view on demand, we expect some growth in the number of connections over the lifetime of the assets."

Reducing demand need not lead to an "inflationary volume effect"

In a situation where demand is decreasing, depreciation and unit costing approaches that do not take this into account can lead to increasing prices (e.g. a unit cost derived as an annuity, i.e. a constant annual cost, divided by a declining in-year demand will increase). However, this inflationary effect of declining volumes on unit costs is eliminated by the use of economic depreciation or adjusted tilted annuity (if demand changes are at a constant rate): the asset costs are recovered over the forecast future demand and preserve price stability[12] (prices reflecting simply the expected tilts in input costs), while maintaining expected net present value (NPV) neutrality.

1.3.2 Question 16: Is it appropriate to model demand for a single efficient next generation access network which includes end-users that may migrate to Chorus' fibre network?

No. Firstly, the level of demand serves two purposes - in dimensioning the network, and as the volume of usage over which the cost will be recovered. Users who will in future migrate to a fibre network are only relevant to one of these. Secondly migration is very important as, even done efficiently, it affects the average utilisation of the deployed assets. Finally, we note that the question includes an assumption that the MEA for UCLL is a next-generation access network: we raise a number of points about the MEA in answers to other questions.

Level of demand

The level of demand serves two purposes:

- it determines the dimensioning of the network i.e. sets the quantity of assets required to be built. This should be based on current and expected future demand for the assets being deployed
- it determines the denominator in the unit cost calculation.

In terms of the network dimensioning, if all that the Commission is saying is that today's market demand is likely to form the basis of the network dimensioning, we agree that as demand for fixed network connections is falling, today's demand is likely to be the peak for the total market (looking forward – of course it was higher in the past, but we are forward-looking). As regards the modelled network, the peak demand (i.e. sizing the number of loops in the network to be built) will depend on its market share over time.

[12] At a higher level of prices, but preserving expected NPV neutrality.

The second of these uses of demand (as the denominator in the unit cost calculation) is critically dependent on the value of the demand for the modelled assets. If modelling a copper network, but some of the demand will be moving to fibre, then the unit cost of the UCLL service needs to be based on the future level of demand for UCLL (and other services sharing the same network assets). In other words, there are network utilisation effects caused by migration from one technology to another.

Migration

Consider a hypothetical case where the modelled efficient technology today was a specific technology – say copper; but that it was likely that at a future date, the MEA would be a different technology. In reality, the modelled operator (whoever it is) cannot transition from one technology to another without stranding certain assets (in this case, copper cables); if the prices were set based on a tilted annuity assuming constant utilisation over the full asset lifetimes, the prospective future costs of that modelled network will not be recovered[13] (and the future costs of the future network might also not be recovered in turn, depending on the succeeding MEA – for example, a point-to-point (P2P) fibre-to-the-home (FTTH) network might in turn be replaced by wavelength division multiplexing (WDM) passive optical network (PON) FTTH network). Unless this is taken into account (by moving away from tilted annuity, or making adjustments to it), this lack of prospective cost recovery (expected NPV being negative) would deter investment.

Instead of assuming a constant level of demand, we are arguing for a demand level that is changing over time and an explicit acknowledgement that the technology used will also be changing over time (e.g. a migration from copper to FTTH P2P to WDM PON), which can either be implicit, just reflected in the copper demand dropping to zero over time, or explicit with two network technologies included in the modelling.

1.3.3 Question 17: Are there any circumstances specific to New Zealand that we should have regard to when deciding whether this modelling choice is appropriate?

We assume that by "this modelling choice" the question is referring to "to model demand for a single efficient next generation access network which includes end-users that may migrate to Chorus' fibre network". We have already raised above several relevant points which are highly linked to the circumstances in New Zealand, specifically the existence of HFC cable television and other (non-Chorus) LFC deployments.

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13 Actual cost recovery is not necessary: forecast errors can lead to gains or losses. What is important is that at the point of investment, looking forward, the investor perceives that it is a "fair bet" that the costs (including the cost of capital) will be recovered.

1.4 Technology/modern efficient asset

1.4.1 General principles

Approaches to selecting the MEA for a hypothetical new entrant

There are a variety of approaches which may potentially be used to choose the "modern equivalent asset" for a hypothetical new entrant:

- seeking the lowest-cost technology meeting the required specification
- looking at the network deployment behaviour of commercial "green field" entrants seeking to maximise the value of their investments.

Applying the first approach, of the lowest cost to meet a specified performance, may not result in the same choice of assets as the second approach.

The first approach is that used by, for example, Ofcom in 2005.[14] It is also the position of PTS (see footnote 22 for an EC restatement of the Swedish position), BEREC (as cited by the Commission in their paragraph 121) and the OECD (as noted above). We agree with this approach: the MEA for a hypothetical new entrant operator is the currently deployable solution meeting the required specification/service set which has the lowest forward-looking cost (i.e. is cheapest in NPV terms).

The second approach ("What are green field deployments doing") presents several difficulties:

- There are no such operators in New Zealand deploying commercial greenfield access networks to cover the whole population. The LFCs are taking advantage of Government subsidy which has pre-conditions and are not covering the whole population (whereas the price set for UCLL has to be national). As a result, the behaviour of the LFCs is therefore not necessarily good evidence in support of a particular technology choice.

- A commercial deployment may lead to a higher cost technology being deployed if the operator perceives a higher future value from a variety of higher value services. In the case of UCLL, it is possible that fibre to the home represents a higher cost solution which is also higher performance in certain ways (e.g. allows higher peak speed broadband services) and lower performance in others (no DC path, for example, although the ability to provide services during a power cut can be remedied by additional spending at the customer's premises).

In relation to "best in-use technology" the Commission notes that it should be "a sufficiently modern technology and architecture to optimise, over the long term, investments made in civil

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14 See for example the summary in http: //stakeholders.ofcom.org.uk/binaries/consultations/copper/summary/copper2.pdf, discussing an Analysys Mason study of the MEA of the copper loop performed in 2005: "The constraints were chosen as the MEA must perform the same function as BT's existing network with the same capacity and reach. Additionally, it was decided to exclude those solutions which would require a change of CPE as the cost of this would have to be borne by the MEA and this would have the negative effect of rendering a large amount of existing CPE unusable with the MEA. In Ofcom's opinion a MEA which could not perform the same function as BT's copper access network, in terms of services, should not be used as a basis for valuing BT's network without including the cost impacts of the differences."

infrastructure”. We agree that optimising investments in civil infrastructure is an important point. The FPP needs to allow an investor a fair chance that investments in long-lived assets such as civil infrastructure will be sufficiently compensated; a process in which cost recovery is not foreseeable (is not a “fair bet”/no expected NPV neutrality) will be very negative for investment incentives. If for example the process is such that a future price control can assume a radically different MEA or service specification, or cost a different technology and apply value adjustments, then the investor will face materially more risk that the long-lived items may be stranded.

Availability

The modelled MEA needs to be nationally available (with possibly very small exceptions for ultra-high-cost sites[15]). Simply noting that FTTH is expensive in rural areas should not cause a reduction in the required specification in those areas.

All wireline solutions are expensive in rural areas, but wireless solutions do not meet the minimum specification of UCLL discussed in Section 1.4.3. They are blocking, they are not layer 1, and it is very likely that wireless solutions are also not capable of delivering the expected future average throughput required from fixed broadband connections at an economic level and with current constraints (e.g. currently available spectrum).[16]

1.4.2 Ultra-rural customers

Ultra-rural customers may be served using wireless, but this is a separate issue to the selection of the MEA to serve (say) 99% of the population. These ultra-rural customers are often not even provided with broadband services, and UCLL is not a product used to serve them. In general, cost modelling can (if required) take these ultra-rural customers into account. For example:

- The ACCC model built by Analysys Mason (since superseded by the use of the building block model (BBM) in Australia) did deploy fixed wireless access (FWA) wireless connections for approximately 1% of sites (as may be expected, in highly rural areas); it also used satellite connections for a small number of isolated sites (0.3% of sites).
- The Commission has commented on the use of FTTH and wireless in the Swedish model. We provide more detail on the Swedish case below.

The case of Sweden

The PTS choice of MEA is based on delivering the existing service set, at the lowest overall cost (in NPV terms). The PTS model deploys FTTH, with wireless deployed in the most rural geotype

15 We discuss the use of wireless as the MEA in the most rural geotype of the PTS model in Sweden in some detail below.

16 A commercial Analysys Mason Research report addresses this point: “LTE as a next-generation access platform in rural markets: cost–benefit analysis”; a summary of which is at http://mybroadband.co.za/news/broadband/84761-lte-not-a-fixed-broadband-replacement-analyst.html.

(a geotype with an average line density of less than 1 line per km^2). This last geotype in the Swedish model comprises approximately 50 000 households (a tiny fraction of the millions of households in Sweden).

Importantly, these choices were specifically directly relevant to Sweden where up-to-date PTS broadband coverage statistics[17] show approximately 44% coverage of residential premises by fibre networks, 98.04% coverage of residential premises by xDSL, and PTS reports[18] a plan from TeliaSonera to deinstall copper to approximately 50k households in favour of using wireless technologies (if necessary with fixed antennas mounted on the house). In other words, not only is fibre widely deployed in Sweden, the modelled use of wireless is consistent in outline with the operator's own stated plans for the future ultra-rural network and is likely to be in areas where the services currently offered do not include broadband (i.e. this geotype is beyond the 98% covered by xDSL). Indeed, if we examine the model we find it does not provision broadband services in this geotype.

This is also consistent with the European Commission's 2011 comments letter on the choice of MEA in Sweden,[19] specifically:

> "PTS also considers the wireless infrastructure to be the MEA to replace copper in low density areas where only voice or low capacity leased lines are provided and where high speed services are unlikely to be offered in the foreseeable future."

In other words, the PTS model does not attempt to build a wireless network capable of delivering a broadband service; it only uses wireless in extreme areas where the existing service set does not include broadband.

1.4.3 Question 22: What, in your view, are the important characteristics of Chorus' copper local loop network that must be also available from the MEA? Please outline the reasoning for your view.

The Commission's report states: "TSLRIC requires us to model a hypothetical access network, which as a minimum, should provide the same functionality as the existing UCLL service." We agree: it should provide the same functionality.

We believe that important criteria are:

- allows use of the same CPE
- allows voice services to function during a power outage

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17 PTS, report number PTS-ER 2013:7 dated 2013-03-19 "PTS Bredbandskartläggning 2012 – en geografisk översikt av bredbandstillgången i Sverige"(in Swedish).

18 PTS, Reference: Dnr: 10-420 /2.1.2 Dated: 2010-02-04 Samråd avseende kalkylmodellen för det fasta nätet vad avser - Förslag till reviderade riktlinjer för kalkylmodellens utformning (MRP) (in Swedish).

19 European Commission, Brussels, 12/05/2011 C(2011) 3431 SG-Greffe (2011) D/7587 Commission decision concerning Case SE/2011/1205: Further details of price control remedies – review of the LRIC model Comments pursuant to Article 7(3) of Directive 2002/21/EC.

- layer 1 (physical layer access)
- non-blocking
- the service should offer dedicated connectivity from the MDF site to a specific end user at a per-user price
- supports existing service set including POTS, voice (VoIP), broadband, and low-speed data (fax, dial-up Internet, alarm circuits) services, at current and forecast levels of end-user traffic demand
- efficient to deploy and operate.

We discuss the reasons for each criterion in more detail below:

Allows the use of the same CPE. UCLL based on copper (or "metallic path") enables provision of services to customers by access seekers which allow customers to use the same CPE as they currently use; it also allows access seekers to continue to use DSL equipment (e.g. DSLAMs). Use of the same CPE is an aspect of the MEA which Ofcom included in its definition of the MEA in 2005 (see footnote 14). This criterion is similar to that which the Commission raises in paragraph 101.1 regarding the relevance of electrical/optical interface conversion and its cost implications.

Interface conversion, at additional cost, is possible for voice: allowing the use of the same consumer voice CPE could be achieved by the use of an analogue terminal adapter (ATA) which can optionally be incorporated into broadband modems, although we note that such an approach is significantly more costly for customers who only buy voice services;[20] interface conversion is not a rational approach for DSL (it would be cheaper to replace the DSL modem with a consumer CPE designed for a fibre network than to try to convert the DSL modem's output to a format suitable for a fibre network).

This is just one of a series of ways in which any choice of technologies other than copper will drive costs on to end users (e.g. replace alarm system) or access seekers (replace DSLAM, fund battery back-up). Ofcom's comment from the extended quotation in footnote 14 is relevant:

> "In Ofcom's opinion a MEA which could not perform the same function as BT's copper access network, in terms of services, should not be used as a basis for valuing BT's network without including the cost impacts of the differences."

Allows voice services to function during a power outage. This is an important feature of the existing copper loop service. In order to meet this requirement, alternative non-metallic-path technologies would also need to provide additional facilities at the end-user's premises (e.g. analogue terminal adapter, battery back-up). These facilities would increase the cost of alternatives to metallic-path-based solutions.

[20] This point is relevant principally to UCLFS, but it affects UCLL not only through the relativity with UCLFS, but also because any increase in price of UCLFS is likely to affect demand for copper loops in total and hence UCLL through common cost allocation.

Layer 1 (physical layer access). This is currently provided by UCLL. The UCLL service currently allows access seekers to choose either to buy UBA or to provide services to end users by installing their own choice of layer 2 infrastructure (i.e. it should allow a "build or buy" decision for the layer 2 infrastructure). This means in practice that the UCLL service should be a layer 1 service at most.

This ability to choose the technology to deploy on the physical layer allows much more scope to the access seeker than a means of data transport. It includes the option to deploy completely different technologies (e.g. ISDN, G.shdsl, low-speed data modems for telemetry or alarm circuits), should the access seeker wish.

In contrast to the Commission, we do not believe that a layer 2 service is a functionally equivalent service. Such a service is not a suitable input for an access seeker looking to install infrastructure to provide a layer 2 service, not because it is impossible to provide layer 2 over layer 2, but because there is very little added value in so doing which means that the business case for seeking UCLL access and building infrastructure is no longer present. Put another way, it is not possible to buy UBA and use this as an input to compete with UBA in the wholesale market.

Non-blocking. The UCLL service should be non-blocking (traffic from other users should never block traffic to/from the wholesale customer). This means that the access seeker will be unconstrained in the quality of services it can offer (speed, throughput, price structure, etc.). This is similar to the Commission's criterion "no restriction on services offered by access seeker (providing compliance with the Interference Management Plan)". Physical layer access plus a point-to-point topology would automatically make the service non-blocking.

The service should offer dedicated connectivity from the MDF site to a specific end user at a per-user price. This could be met by a point-to-point topology, but it could also be met in practice by a PON layer 2 product (if timeslots are dedicated to a specific end user). Even if the other criteria are met, the business case for unbundling depends on the ability to reach many customers from the same point of interconnection at the same per-user cost. However, it cannot be met by unbundling a PON network at the splitter location, as the cost then does not scale per end user in the same way.

Supports existing service set including POTS, voice (VoIP), broadband, and low-speed data (fax, dial-up Internet, alarm circuits) services, at current and forecast levels of end-user traffic demand. In addition to voice and broadband services offering current peak speeds[21] and current and forecast levels of data throughput per end user, the specific low-speed data services to be supported should also include alarm circuits as well as fax and dial-up data services. Indeed, we see all Telecommunications Service Obligation (TSO) services currently provided over the copper local loop network as being essential for any technology to be able to provide.

21 It would not be reasonable for the minimum required speeds to be supported by the MEA to be faster than can be provided by copper, because copper is currently the means of providing UCLL.

The chosen solution needs to be **efficient to deploy and operate** given the target service set and constraints on deployment faced today. We believe that the appropriate choice for a hypothetical entrant is to seek the lowest (discounted) cost technology meeting the required specification. This agrees with the choice of Ofcom in 2005. It is also the position of PTS[22] and BEREC. For an existing operator, the appropriate choice is to migrate towards a lower cost solution at the time when such a migration minimises its future (discounted) costs.

1.4.4 Question 23: Do you consider that the criteria we have identified will enable us to make the most appropriate MEA selection?

The Commission's report states: "TSLRIC requires us to model a hypothetical access network, which as a minimum, should provide the same functionality as the existing UCLL service." We agree: it should provide the same functionality. The question is how to characterise this functionality in a useful way.

The Commission then set out a number of specific characteristics (for clarity we have separated one of the Commission's own criteria into more characteristics below).

- 1. copper
- 2. suitable input for a layer 2 service
- 3. point to point path from MDF site to end user
- 4. passivity (i.e. no active electronics)
- 5a. no restriction on services offered by access seeker (providing compliance with the Interference Management Plan)
- 5b. supports existing service set including POTS, voice (VoIP), broadband, and low-speed data (fax and dial-up internet) services
- 6. capable of providing a DC power path.

Separately the Commission also adds additional considerations, being:

- 7. more cost-efficient than the current technology in producing the services of the current technology
- 8. best in use technology
- 9. may use alternate infrastructure (e.g. other utility poles) if appropriate.

We summarise our views on the Commission's discussion of the criteria and considerations below.

22 European Commission, Brussels, 12/05/2011 C(2011) 3431 SG-Greffe (2011) D/7587 Commission decision concerning Case SE/2011/1205: Further details of price control remedies – review of the LRIC model Comments pursuant to Article 7(3) of Directive 2002/21/EC, Footnote 12 they state: "12 According to the guidelines set by PTS for the LRIC bottom-up and top-down models, the MEA may be defined as the asset with the required capacity and functionality that, for the incoming years, has the lowest (discounted) cost. Equivalently, the MEA is the asset that produces the same outputs provided by the existing asset, at the lowest cost. The aim of PTS in setting the MEA is to create neutral incentives for infrastructure investment."

Copper

The Commission does not offer arguments for rejecting copper as a criterion. It correctly draws the conclusion that to accept it as a criterion would be to reject other technologies, but it does not offer a reason why the "metallic path" character of the existing network is not essential.

We do not agree with the Commission's argument to place more emphasis on "modern" at the expense of "equivalence". The modern equivalent asset is the lowest forward-looking cost (in NPV terms) solution available today meeting the requirements. Copper is available today, as are FTTH PON and FTTH P2P – they are all modern. If the requirements are such that copper does not meet them at the lowest cost (lowest discounted future costs), it can be rejected, but "being more modern" is not a criterion in itself.

We comment on the Commission's discussion of electrical interface conversion under our criterion "allows use of existing CPE" above.

A suitable input for layer 2 service

The Commission's view is that:

> "…the ability for access seekers to provide a layer 2 (or higher) service is fundamental to the UCLL Service, and should therefore form part of the MEA selection criteria. Importantly, this leaves open the possibility of a layer 1 or layer 2 MEA."

Our view is very different. We agree that the ability for access seekers to provide a layer 2 service is critical. However, a layer 2 service is not in our view a suitable input for an access seeker looking to install infrastructure to provide a service competing with that layer 2 service; whilst it is possible to provide layer 2 over layer 2, there is very little added value in so doing which means that the business case for seeking UCLL access is no longer present. In other words: if UBA could be used to offer a service competing in the wholesale market with UBA (which we believe is not the case), then there would be no need for regulated access to UCLL. And if there were no need, then it would be disproportionate to impose it as a remedy.

This means that PON and point-to-multipoint wireless solutions (which do not offer layer 1 access) do not meet this criterion.

Point to point path from MDF site to end user

The Commission states:

> "Similar to the Layer 2 input criterion, point-to-point is a relevant feature of the MEA as it enables access seekers to scale and customise end user connections."

We agree that the important factors are:

- that the cost should scale in an appropriate way (be priced per user connected, giving all access seekers the benefit of the UCLL network scale)
- instead of "customisation" we say the ability to dedicate capacity to a specific user is important. This is comparable to the Commission's own criterion "No restriction on services offered by access seeker".

Our own criterion "The service should offer dedicated connectivity from the MDF site to a specific end user at a per-user price" above takes a slightly different approach, directly addressing the key points of scaling and dedicated capacity.

Copper from the MDF, copper from the cabinet and FTTH P2P meet this requirement. FTTH PON end-to-end and point-to-multipoint wireless (e.g. long-term evolution (LTE)) connections are not point to point. FTTH PON end to end, however, has sufficient capacity that it is often provisioned with dedicated capacity to the end user and could meet our version of this criterion, even though it is not "point to point".

Point-to-multipoint wireless solutions cannot currently provide dedicated capacity to specific end users in an economic fashion: the level of peak speed they offer is only possible if the users share the cell capacity (if the capacity was dedicated to individual users their individual peak speeds would be very low) and they therefore fail to meet this criterion, especially if in combination with the criterion "Supports existing service set".

Passivity (i.e. no active electronics)

The Commission states:

> "In our view, passivity should not be a determinative feature of the MEA. However, this assessment does not rule out passive technologies. It allows for both passive and active technologies."

No evidence is offered by the Commission as to why this feature of UCLL is not determinative.

No restriction on services offered by access seeker (providing compliance with the Interference Management Plan)

"No restriction on services offered by access seeker" is indeed a key feature of UCLL.

The ability to carry the required traffic would already be provided by the "non-blocking" criterion in our list; the "layer 1" criterion on our list also gives the ability to choose the technology to deploy on the physical layer, allowing much more scope to the access seeker than a means of data transport. It includes the option to deploy completely different technologies (e.g. PSTN, ISDN, G.shdsl, low-speed data modems for telemetry or alarm circuits), should the access seeker wish.

A particular problem arises in the context of any solutions using active electronics and a shared medium such as FTTH PON and point-to-multipoint wireless, which is that inevitably the central electronics are shared (these would not be shared in a WDM PON). In the context of PON, the total capacity is so large that a significant capacity can be dedicated to each of the end users, which makes this point debatable (there is a limit to the services which can be provided, but it may not be significant in practice); however this is not the case with wireless – contention with other users is inevitable (e.g. the peak speed cannot be met if the spectrum is sliced up between all the end users). It is therefore inevitable that in the case of wireless there would be restrictions, and that this criterion would not be met.

The "meeting the Interference Management Plan" is metallic-path-specific and could be generalised to "the service should not permit access seekers to either damage the network or cause unwarranted interference to the services purchased by other access seekers".

Supports existing service set including POTS, voice (VoIP), broadband, and low-speed data (fax and dial-up internet) services

The Commission states:

> "The delivery of services is to a large extent determined by the transmission capacity of the given link. Our view is that services and transmission capacity is a relevant consideration for determining the MEA. However, we note that there may be some services currently provided over UCLL lines that may not be able to be provided over other technology platforms e.g. fax over a fixed wireless connection."

As can be seen from our own criterion, we agree that the ability to provide the existing service set (including the required level of throughput i.e. capacity and all current TSO services including fax and dial-up data services) is essential.

It is not appropriate to give some technologies a "free pass" if they cannot manage a specific service (i.e. it is either essential or it is not).

We believe that point-to-multipoint wireless solutions are not capable of delivering the expected future average throughput required from fixed broadband connections at an economic level (e.g. without an uneconomic increase in the number of sites required), with currently available spectrum.[23] As a result, we do not see point-to-multipoint wireless solutions as an option, except possibly for a small number of ultra-rural end users.

Capable of providing a DC power path

The Commission states:

23 We discuss the use of wireless as the MEA in the most rural geotype of the PTS model in Sweden in some detail in Section 1.4.2.

> "Our preliminary view is that a DC path should not be a necessary requirement of a MEA, as this capability is a historical aspect of copper networks, rather than an important feature of the UCLL Service for access seekers."

We disagree that it is unimportant. While users of UCLL as an input to broadband services have the option of using VoBB, this DC path is a particular concern of buyers of UCLFS who use this to provide resilient voice services using existing CPE to users including those who do not have broadband services. UCLFS is important for two reasons:

- UCLFS and UCLL prices are related. If UCLL were to have a lower specification than UCLFS in this regard, then the costing will need to allow for the simultaneous existence of UCLFS with a different set of needs, which is likely to mean that the costs of UCLFS will exceed those of UCLL (see below for details); this could cause problems for the relativity of these two service prices (currently the price of UCLFS is set to be equal to the UCLL cost).
- UCLFS shares common costs with UCLL. Providing a voice input solution similar to UCLFS on a fibre network would require:
  - at the customer site, in addition to the existing voice CPE, a broadband modem, an ATA (if not integrated into the modem), and a battery back-up solution sufficient to power the telephone, ATA and modem
  - at the MDF site, broadband electronics (e.g. Ethernet switch or IP router and optical drivers) as well as battery back-up for the equipment at the MDF site), and some kind of carriage of the voice traffic into the core voice network.

The likely net effect of these extra required facilities is that UCLFS would cost substantially more, which would have a very material effect on the price of retail voice lines – it would in effect make a single play service uneconomic to offer and would probably lead to a significant change in demand (e.g. increased single play voice prices would probably lead to additional mobile substitution). This change in demand for UCLFS would in turn increase the unit cost of UCLL due to the common cost allocation.

Cost-efficiency

In relation to "more cost-efficient than the current technology in producing the services of the current technology", we believe this consideration could be better expressed as "the solution which minimises the forward-looking costs for the modelled operator in producing the required services whilst meeting the required constraints", allowing the current technology to prevail if it is the most cost-efficient.

However in relation to cost-efficiency, the Commission also states that "Efficiency here includes both quality and quantity considerations". We believe that this statement risks pre-judging an important definitional issue in relation to the MEA, specifically whether it is appropriate to model a more expensive but more capable network and then adjust the costs of that more expensive network downwards based on the added value; we believe that such value-based adjustments are not appropriate, as we discuss in Section 1.5 below.

Best in use technology

The Commission states:

> "The MEA should be of a sufficiently modern technology and architecture to optimise, over the long term, investments made in civil infrastructure, while being a readily available, best-in-use, technology."

We have already addressed (and rejected) the issue of "modernness" in Section 1.4.4 above. The consideration "best in-use" should simply mean the currently deployable technology that meets the required specification while minimising forward-looking costs for the modelled operator.

If the implication is that the civil infrastructure needs to be built so as to be recoverable over the long term, then we agree that the ability to recover costs over the asset lifetimes is very important; this is closely related to the need to take future migration between technologies into account and the way in which cost recovery over time needs to be achievable as explained in Section 1.3.2 above.

May use alternate infrastructure (e.g. other utility poles) if appropriate

The Commission notes that:

> "The MEA technology may involve the use of layer 0 infrastructure (such as ducts and poles) owned by other network operators (telecommunications or otherwise) so that investment costs are minimised."

We agree that sharing of certain assets which could practically be shared when and where the hypothesised network is built is potentially appropriate. It is not appropriate to assume that assets in the wrong location or which do not exist can be so shared. The costs of such shared assets (e.g. pole attachment payments) also need to be taken into account in a consistent way.

However, the aim of sharing is not to minimise investment costs, but to minimise total costs (i.e. not just capex, but also opex, including rental of shared facilities).

1.4.5 Question 24: What additional criteria, if any, should we consider for determining the MEA for UCLL?

As noted above, additional specification criteria and service set items we believe are appropriate are:

- allows use of the same CPE

- allows voice services to function during a power outage
- layer 1 (physical layer access)
- non-blocking
- the service should offer dedicated connectivity from the MDF site to a specific end user at a per-user price
- supports existing service set including POTS, voice (VoIP), broadband, and low-speed data (fax, dial-up Internet, alarm circuits) services, at current and forecast levels of end-user traffic demand
- our consideration of cost efficiency is (as noted above) different in detail to that of the Commission.

1.4.6 Question 25: What criteria do you consider to be of most importance in the selection of the MEA for UCLL?

The criteria are not items which are more or less important to be weighted together: once selected, they are pass/fail criteria. A technology is either the lowest cost for the modelled operator or it is not; it is either non-blocking or it is not; it either allows the access seeker to install their own electronics to provide a competing layer 2 service, or it does not; it is either offering dedicated connectivity to a specific end user at a per-user price or it is not.

1.4.7 Question 26: Are there other MEA options that should also be considered?

The Commission has not considered copper (without FTTC) as an option. It is demonstrably possible to provide the required services using copper. In addition, there are areas of New Zealand where FTTC (i.e. VDSL) does not make sense as a broadband solution – it needs end users in clusters of a certain size and density of premises, which is why very rural deployments of FTTC are rare. We also note that if the Commission is only interested in setting the price of NCUCLL (as implied in its workshop presentation), then such a costing is inconsistent with the use of FTTC everywhere.

WDM PON is conceivable as an MEA option, but it should be rejected as it is not yet commercially deployable.

Unbundling of PON at the splitter location is conceivable (i.e. renting a dedicated fibre to a separate splitter at the same location as the modelled operator's splitter[24]), but we believe it should be rejected as an option because it is not dedicated connectivity from the MDF site to a specific end user at a per-user price; as a result it is not directly comparable to or a potential direct substitute for UCLL. The business case for such unbundling is very different to that for UCLL as it relies on gaining market share in very small clusters of end users.

[24] This option is available in Japan, but we believe it is not used in practice by access seekers in Japan due to the difficulty in capturing multiple adjacent customers at the scale of a single splitter.

1.4.8 Question 27: What are the pros and cons of the options that we have identified and any further options that you may have identified?

Copper

Copper meets all the constraints.

FTTC/Copper

If the Commission is only interested in costing NCUCLL this option is moot:

- it is irrelevant whether lines on cabinets served with FTTC meet the criteria
- UCLL as such is not available on lines on cabinets served with FTTC. However, both UCLFS and the combination of SLU and SLES (where available) exist.

FTTH P2P

There are several reasons why FTTH P2P is not the MEA for UCLL:

- FTTH P2P does not provide a DC power path. This could be remedied at additional cost by battery back-up.

- FTTH P2P does not on its own allow the use of existing voice CPE In the case of voice customers who also buy broadband, the additional costs to support existing CPE would include an ATA. Customers who wanted only voice would also need to be provided with a broadband modem (which is not the case on copper). This option therefore places significant additional constraints on the technology used and services to be offered by the access seeker.

- The use of existing broadband CPE (DSL modems) is not possible using FTTH-P2P. In this case the additional costs of DSLAM and broadband CPE replacement falling on access seekers and end users would need to be considered.

If the Commission does not accept these reasons, then, in the alternative, it must at least take into account the cost increases that would result to remedy these failings.

FTTH PON end to end

There are a number of reasons why FTTH PON is not the MEA for UCLL:

- FTTH PON does not provide a layer 1 input with economic space for a competing layer 2 provider (because it already provides a fully functional layer 2 product).
- FTTH PON does not provide a DC power path. This could be remedied by battery back-up at extra cost.
- FTTH PON does not allow the use of existing voice CPE. This could be remedied by use of an ATA for those customers buying broadband as well. Customers who wanted only voice would

also need to be provided with a broadband modem (which is not the case on copper). This option therefore places significant additional constraints on the technology used and services to be offered by the access seeker.

- The use of existing broadband CPE (DSL modems) is not possible using FTTH-PON. In this case the additional costs of DSLAM and broadband CPE replacement falling on access seekers and end users would need to be considered.
- FTTH-PON is not non-blocking: however, as we have noted, the nature of PON is such that the end users can probably obtain sufficiently large amounts of quasi-dedicated capacity.
- FTTH-PON would place some restrictions on services offered by access seeker (the operator of the shared electronics at the central site would offer specific wholesale products with specific speed and throughput at specified prices).

If the Commission does not accept that the lack of DC path and support for existing CPE eliminates these technologies as MEA candidates, then, in the alternative, it must at least take into account the cost increases that would result to remedy these failings.

Wireless

The kinds of wireless solutions we are discussing here are point-to-multipoint solutions such as UMTS, LTE and WiMAX, with a centralised base station and remote CPE.

There are many reasons why point-to-multipoint wireless solutions are not the MEA for UCLL.

- All such point-to-multipoint wireless solutions cannot provide a layer 1 input which is at all comparable to UCLL.
- They are intrinsically blocking solutions.
- Point-to-multipoint wireless solutions will place restrictions on services offered by access seekers (the operator of the shared electronics at the central site would offer specific wholesale products with specific speed and throughput at specified prices).
- Point-to-multipoint wireless services do not provide a layer 1 input with economic space for a competing layer 2 provider (because they already provide a fully functional layer 2 product).
- Wireless services do not offer dedicated connectivity from the MDF site to a specific end user at a per-user price. It is not possible to both offer dedicated throughput for specific end users and retain the peak speed offered; the cell capacity is able to offer high peak speeds only by being shared with all other users.
- Wireless solutions do not provide a DC power path, which could be remedied by battery back-up.
- Wireless solutions do not allow the use of existing voice CPE. The use of an ATA for those customers buying broadband as well might be possible (see comments below about fax and

low-speed data services), but may be less cost-effective than a replacement voice CPE using the wireless protocols directly.

- Wireless solutions do not allow the use of existing DSL CPE.
- We also believe that wireless services will not meet the criterion of providing the existing service set. Specifically, they will fail to provide the level of per-user broadband throughput in the busy-hour required by the services consumed by fixed broadband customers (specifically, streaming video) at economic prices. The ability to offer fax and other low-speed data services may also be an issue, as mentioned by the Commission.

Combinations of technologies

The Commission has suggested that there might be combinations of technologies proposed as the MEA. The Commission has suggested an option with the use of wireless technologies combined with FTTH.[25] We caution that specific additional costs would be caused by such a mix of technologies; retail service providers (i.e. access seekers or their own customers) have a strong preference for a national service, offering the same capabilities and the same provisioning interfaces on a national basis.[26] Any gaps between the different service capabilities in different areas make provisioning, fault finding, staff training, advertising and sales harder. We understand that work is going on at the moment to minimise differences in the interfaces of the LFC networks for this very reason.

Actions taken to make the provisioned service and its interfaces more similar (to avoid pushing these costs on to access seekers) will cause additional costs to be incurred in the modelled operator, and these will need to be taken in to account; the modelled operator would therefore only use a mix of technologies if the cost benefits of so doing were high.

These points do still apply for ultra-rural customers, even where the network does not support such a variety of services. Making the service offered as similar as possible for the access seeker will involve additional costs, especially in the IT systems supporting provisioning, maintenance and billing; these costs could be especially significant given the limited number of customers over which the costs will need to be recovered.

Summary

The table below summarises the performance of the individual technology options against the criteria:

25 We note the unsuitability of point-to-multipoint wireless services to provide the UCLL functionality elsewhere.

26 Different provisioning interfaces and processes for different systems will cause additional costs in the access seekers' networks and processes.

Figure 1.2: Performance of MEA options against criteria [Source: Analysys Mason, 2014]

	Copper to the home	**Copper from cabinet to the home (at FTTC nodes)**	**FTTH PON end to end**	**FTTH P2P**	**Wireless (e.g. LTE)**
Uses existing voice CPE	Yes	Yes (multiple solutions possible: UCLFS, sub-loop+ sub-loop extension service, or sub-loop with PSTN line card at the cabinet)	No. May require ATA to use voice (i.e. POTS would be provided via VoBB)	No. May require ATA to use voice (i.e. POTS would be provided via VoBB)	No. Likely to need different CPE (supporting relevant wireless protocols) rather than ATA
Uses existing broadband CPE (DSL modem)	Yes	Yes	No	No	No
Allows voice services to function during a power outage	Yes	Yes if from the MDF using UCLFS or sub-loop+ sub-loop extension service; if from the cabinet, requires back-up for cabinet electronics	No (could add battery back-up)	No (could add battery back-up)	No (could add battery back-up)
Offers suitable layer 1 input for an access seeker seeking to build its own infrastructure to provide a layer 2 service	Yes, can economically build DSL on top	Yes, either at cabinet using sub-loop UCLL or at MDF using sub-loop UCLL and sub-loop extension service	No, because offers layer 2 already. Adding a further layer 2 adds cost with minimal functionality not present in the existing layer 2	Yes, can build e.g. point-to-point Ethernet	No, because offers layer 2 already. Adding a further layer 2 adds cost with minimal functionality not present in the existing layer 2

	Copper to the home	Copper from cabinet to the home (at FTTC nodes)	FTTH PON end to end	FTTH P2P	Wireless (e.g. LTE)
Non-blocking	Yes, non-blocking	Yes, non-blocking on sub-loop; sub-loop extension service is non-blocking; UCLFS is non-blocking	Although shared assets are used, in practice, likely to be non-blocking if the desired service speed is not excessive (e.g. up to 80Mbit/s per end connection)	Yes, non-blocking	No, blocking. Cell has maximum capacity and other users traffic may cause your traffic to be delayed
Dedicated connectivity from the MDF site to a specific end user at a per-user price	Yes	Yes if using sub-loop alone (but from cabinet site not MDF). Yes for using combination of sub-loop and sub-loop extension service	Shared, but in practice can provide quasi-dedicated capacity	Yes	No. Cell has maximum capacity and other users traffic may cause your traffic to be delayed
Supports existing service set including POTS, voice (VoIP), broadband, and low-speed data	Yes	Yes	Broadband yes. Voice, fax, and low-speed data can be provided using an ATA. This depends on the capabilities of the ATA and the configuration of the fax or low speed modem.	Broadband yes. Voice, fax, and low-speed data can be provided using an ATA. This depends on the capabilities of the ATA and the configuration of the fax or low speed modem.	Broadband throughput is too low for typical current fixed broadband demand. Fax and low-speed data can be an issue

Our conclusions are that:

- Copper meets all the criteria.
- FTTH P2P meets most of the criteria, other than:

- — the ability to provide voice services during a power cut (the DC power path), which could be remedied by battery back-up
- — the use of existing voice CPE, which could be remedied by use of an ATA
- — the use of existing broadband CPE (DSL modems) is not possible using FTTH
- — provision of the required fax and low-speed data services may be restricted even if an ATA can be provided. This depends on the capabilities of the ATA and the configuration of the fax or low speed modem.

- FTTC is irrelevant if costing NCUCLL; while UCLL is not available on loops served with FTTC, a combination of sub-loop UCLL and sub-loop extension service (where available) would be almost equivalent and meets all the criteria.

- Other options including wireless and FTTH PON fail to meet many of the criteria.

Comparison of copper and FTTH-P2P costs

If deployed in the same manner (e.g. buried), Copper and FTTH P2P networks will have very similar capital costs; the trench and duct network (comprising most of the capital costs) is likely to be very similar, but the cables and jointing costs will have different capital costs (copper vs. fibre). The cables and joints may also have different operating costs over time. Asset lifetimes are likely to be similar.

However, once we consider the additional costs that an FTTH-P2P network would have to bear to provide a service comparable to the existing UCLL (specifically, battery back-up for every end user, ATA for voice users, and additional broadband modems – both to replace DSL modems and for voice-only users to allow the use of voice over broadband (VoBB)), it is very likely in our view that copper remains the MEA for UCLL.

Copper would also be favoured by an approach seeking to be cautious in selecting a new technology as the MEA in the face of an uncertain transition. Ofcom has previously considered whether this caution may be appropriate in a slightly different context, and chose to stay with the existing technology.[27]

1.4.9 Question 30: Should a technology's inability to deliver TSO services disqualify it from consideration as an MEA? Or is it more important to have a forward-looking MEA than to preserve the ability to carry legacy services?

The requirement of the MEA is that it should be the lowest forward-looking cost means of the modelled operator delivering the required service set as specified. If the "legacy services" are part

[27] Para 3.42 and 3.43 of http://stakeholders.ofcom.org.uk/binaries/consultations/823069/summary/condoc.pdf
In 2011, Ofcom used this thinking when setting the regulated price cap for wholesale broadband access in rural areas (about the last ~10% of UK homes, where LLU is not active), which was based on used BT's actual technology in the areas of interest (so-called 20CN, i.e. ADSL/ATM/SDH) rather than the MEA as deployed by BT and other operators in other areas of the UK (so-called 21CN, ADSL2+/IP/Ethernet). Ofcom is currently updating this work, and its current proposal is along similar lines (i.e. actual technology)
http://stakeholders.ofcom.org.uk/binaries/consultations/wba-review-update/summary/wba-review-update.pdf.

of the specification, then they are required; if not then they are not. So the question reduces to whether the "legacy services" or "TSO services" are in the minimum service set.

We believe that the TSO services are currently provided over the Chorus local loop network and should therefore be a part of the minimum set.

1.5 Adjustments to modelled costs

1.5.1 Question 28: Should performance adjustments on the MEA value be made to reflect the differing performance attributes of the MEA technology relative to the current UCLL technology?

Summary

No. In our view such approaches are not consistent with the requirement of the Act for a TSLRIC approach to FPP. The performance adjustment approach does not provide correct incentives for investment by Chorus (or a hypothetical new entrant) as it does not lead to expected NPV neutrality (due to the cap of the copper price at LRIC+ if willingness to pay is low), and the willingness to pay "delta" is likely to vary over time and be small. It is inconsistent with the existence of the LFCs selling services at negotiated prices. Finally it is also more costly to undertake.

Position of other regulators

The "value adjustment" approach has not been adopted by other regulators. It has been consulted on as an option in Switzerland, but in Switzerland the revised post-consultation Telecoms Ordinance is yet to be published or adopted.

PTS in Sweden does model a different technology, but does not apply a performance adjustment.

The position of DBA in Denmark and the European Commission is similar: it is to model fibre (FTTH in Denmark, FTTC for the European Commission) and then adjust for the cost difference with copper. However to do so is to model the cost of a copper network indirectly (by modelling FTTC and taking away the cost of fibre and adding the cost of copper, all you are doing is costing a copper network with the topology of a FTTC network).

Inconsistent with position of Chorus and current regulation of UCLL

The use of a performance adjustment based on value is inappropriate because it is based on an inconsistent hypothetical. Chorus faces specific constraints:

- Firstly, it is structurally separated and not present in the retail market; it would only deploy a higher performance solution if it believed that its wholesale revenues would be sufficient.

- Secondly, Chorus is regulated in a specific way which constrains its wholesale revenues.
  - UCLL is offered at a uniform price irrespective of the speed of the service offered over that loop
  - The price of UBA will in future be based on the price of UCLL plus the cost of the additional network elements required.

In a hypothetical case where Chorus had built a higher performance FTTH network and was providing a service like UCLL over that network,[28] then it would lose money unless the UCLL price covered the costs of those higher performance assets.

Due to the products it is obliged to sell, and the way in which these have to be priced, Chorus does not have the option of providing (and being paid for) a higher-priced UCLL which is higher performance (e.g. shorter loops, supporting higher speeds).[29]

The network of a hypothetical new entrant could constrain Chorus' wholesale prices for UCLL based on copper. However, if customers were by design indifferent to the price/performance difference, then the hypothesised new entrant network would never achieve a very high share of fixed access customers.

FTTH exists in New Zealand

The design aim of a value-based adjustment is to make a customer indifferent to the choice between copper and fibre access. However, the LFC FTTH networks that are being built in New Zealand already offer real fibre services at prices which have been negotiated with the Government (which change over time).

Consequently, the (real world) price of copper that results from applying the value based adjustment would in practice be compared by a customer to the (real world) negotiated LFC fibre price. The design aim of the value-based adjustment will therefore not be met in practice unless the value adjustment delta is taken away from the LFC prices. This LFC fibre price is very unlikely to be the price that comes out of the Commission's fibre model as that model must cover all the country, not the 70% covered by UFB.

A calculation based on the negotiated LFC prices therefore cannot be the TSLRIC.

Willingness to pay for fibre will change over time

TERA[30] notes in its report for DBA that there are material practical and conceptual difficulties with a value-based adjustment:

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28 For clarity, the Chorus LFC network is not used to offer UCLL.

29 Not all kinds of performance difference would be so restricted. For example, Openreach in the UK does offer local loop unbundling products with better repair time SLAs for a higher monthly fee, but this does not affect the line characteristics (e.g. the speed of the data service which can be provided), and is an option rather than compulsory.

30 Danish Business Authority Ref: 2012-55-DB-DBA-v2.3 Modification and development of the LRAIC model for fixed networks 2012-2014 in Denmark MEA ASSESSMENT May 2013

> "However, this methodology has drawbacks and especially the fact that it might be difficult to calculate consumer willingness precisely and that the willingness to pay extra for FTTH is likely to change over time."

This last point is likely to be true, based on historical evidence, as end user demand for high-speed broadband services has been slowly developing and the utility of high speeds increases as content providers in turn develop applications that can use such speeds in response to the higher installed base of high-speed access customers. For example, Netflix makes broadband more valuable, but it needed broadband customers to exist before it could succeed.

It is also the case that the willingness to pay extra for FTTH (over, say, FTTC) is currently likely to be rather small. Two pieces of evidence can be offered in this respect:

- Consumer take-up of ultra-high speed services in countries where they are made available at a premium is as yet relatively low (at least compared to the "indifference" sought).[31]
- The minimum take-up commitment of Chorus' LFC network is just 20% in 2020. This was negotiated at a point when the UBA including UCLL price was $46.03 and the entry level 30Mbit/s LFC price in 2020 was to be $42.50.[32] This modest level of commitment does not suggest that the willingness to pay for FTTH over FTTC is high.

Neumann and Vogelsang note that if the value adjustment is low, leading to an implied copper price above the LRIC+ level, then the copper price should be capped at LRIC+.[33] The Commission has not picked up this feature of the Neumann and Vogelsang approach in their proposal.

The value adjustment may deter investment because the adjusted price is not related to the LRIC+ of the copper network

TERA also notes:

> "Also, it may not encourage investing in the most cost-efficient technology since the differential of prices between copper or cable TV and FTTH does not represent the differential of costs."

This is a point that Neumann and Vogelsang do not address.

31 See for example take-up of 100Mbit/s or faster services in Finland, which are 13% of broadband subscriptions. https://www.viestintavirasto.fi/en/aboutthesector/statistics/internetandtelephone/fixed-linebroadbandsubscriptionsbyconnectionspeed.html; the retail price premium for 100Mbit over 24Mbit is typically EUR6–10/month (but varies strongly by municipality and ISP).

32 See http://www.crownfibre.govt.nz/wp-content/uploads/2013/03/Chorus-Published-UFB-Price-Caps-Document-3-October-2012.pdf.

33 Neumann, Karl-Heinz; Vogelsang, Ingo (2013) : How to price the unbundled local loop in the transition from copper to fiber access networks?, 24th European Regional Conference of the International Telecommunication Society, Florence, Italy, 20-23 October 2013, section 4.4.4.

Indeed, having acknowledged that the additional willingness to pay for fibre access over copper may be low and suggesting that in such cases the copper price be capped at the LRIC+ of copper, Neumann and Vogelsang are creating a "one-way bet" which will not lead to expected NPV neutrality. That is, it is possible that today's investors will have their revenue cut to below LRIC+ by a future regulatory decision in relation to a future technology, with no equivalent possibility of an upside.

Significantly increased cost of modelling

In addition to the difficulty in measuring the additional value offered to UCLL users by the additional capabilities of a fibre network, the potential need for a copper price cap at LRIC+ if the willingness to pay is low noted by Neumann and Vogelsang means that any such modelling would have to model two technologies: both copper and the higher performance (fibre) technology.

The additional modelling required would significantly increase (albeit probably not double) the cost of the modelling, the time required to develop and review the modelling, and the computing resources required.

1.5.2 Question 29: What are the potential adjustment options that we should consider? What are the advantages and disadvantages of these options i.e. willingness to pay, technologies and performance, and costs?

None. If the correct MEA is chosen then this is the solution with the lowest forward-looking costs for the operator modelled which meets the required service set, and no adjustment is needed.

Cost adjustment

If a different, more expensive network is modelled, then it is potentially legitimate (if a somewhat indirect method of modelling copper) to adjust the modelled costs so as to proxy the result of a model of the lowest forward-looking cost solution, and indeed this is an option offered by the European Commission, as discussed by the Commission in paragraph 124. However, doing so (e.g. modelling FTTC, and correcting for the different cost of copper by adding the cost of copper feeder and removing the cost of fibre feeder, power in the cabinet and remote DSLAM) is significantly less transparent and less accurate than modelling the cost of the copper technology directly because:

- The network might be slightly different. For example, the constraints on the placement of cabinets may be rather different in an FTTC network (the maximum loop length constraint is different for FTTC and copper).
- Hybrid calibration of a copper network model (i.e. comparison to reality) is much more feasible.

We believe therefore that a cost model with some kind of adjustment to proxy the cost of a different technology is not a good solution and it would be better to model what is being costed (copper) directly.

Adjusting for higher performance per se

Both the TERA report for DBA and the Neumann and Vogelsang paper discussed above note that arguments directly based on the performance (e.g. higher peak speed) ratio between fibre-based and copper-based technologies are useless. TERA states:

> "The main drawback of this methodology is that current price of copper and cable TV would be completely uncorrelated from their associated cost. Indeed, the cost of copper is not 100 times lower than FTTH …. The use of this methodology would therefore lead to regulatory inconsistencies as it contradicts one of DBA's objectives which is to incentive efficient investment infrastructure, i.e. allow efficient costs to be recovered. From a dynamic point of view, capacities improvement can also occur faster than price changes. On top of that, copper and cable TV capacities may still increase due to improvements and lead to price increase which would be inconsistent. For all these reasons, this adjustment methodology has never been used by any NRA and is not proposed to be used in the context of Denmark."

This is therefore not a method that should be considered.

Adjusting for higher willingness to pay or "value"

As discussed at length above, adjustments based on willingness to pay or value generated are not TSLRIC. They are not based on the cost of provision, and they risk under-compensating investors. TERA points this out in its report (see footnote 30) – if it leads to a situation where the copper price is below the actual costs of provision of copper, then the incentives for investment in one technology or the other are biased:

> "Also, it may not encourage investing in the most cost-efficient technology since the differential of prices between copper or cable TV and FTTH does not represent the differential of costs."

The Commission states "The objective of applying a performance adjustment is to achieve competitive neutrality across technology platforms." This is in our view an inappropriate attempt to add to the FPP process something that is outside the definition of TSLRIC.

1.6 Depreciation

1.6.1 Question 37: Should we use an alternative depreciation approach to tilted annuity and if so, why is this preferable?

We believe "adjusted tilted annuity" (with an additional tilt for demand changes) or economic depreciation are superior to tilted annuity if, as here, demand levels are changing over time. This is directly contrary to the Commission's own conclusion in paragraph 165:

> "165. Accordingly, our preliminary assessment is that expected changes in demand do not provide a reason for selecting one depreciation method over another."

The Commission's conclusion appears to be based on the premise that demand for fixed copper loop connections is increasing (with which we do not agree) and that any such increase would result in over-recovery.

We also believe further that economic depreciation methods (as the Commission's own footnote 51 has noted are used in other Analysys Mason cost models) are superior to adjusted tilted annuity where there is, as here, the possibility of a future migration to an alternative access technology (which could be a currently available option such as FTTH P2P, or another future form of fibre such as WDM PON).[34]

The Commission notes a hypothesised *"*risk of creating a circular argument*"*, as a feature of economic depreciation;[35] we can assure the Commission that this has been a non-issue for the many European regulators that have adopted economic depreciation approaches (for example, in the models cited by the Commission).

The Commission's preliminary assessment is that "on practicality and transparency grounds, our preliminary assessment is that it is better to use a less information intensive accounting-based approach to depreciation". We agree that tilted annuity has several good features and that "economic depreciation" requires more information in relation to future demand. However, the risk of demand changes and the risk of a future change in MEA both mean that without great care, a tilted annuity will lead to a failure to ensure expected NPV neutrality (i.e. investment would not be a "fair bet").

We disagree that accounting methods are appropriate because they are by definition not applicable to a hypothetical new entrant. However, we also believe that tilted annuity is not an accounting method; we would classify it as an economic method.

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34 BEREC comes to a similar conclusion in BoR (11) 65, BEREC response to the Commission's Questionnaire on costing methodologies for key wholesale access prices in electronic communications "The "economic depreciation" and the "discounted cash flows" methodologies may be particularly suited for the treatment of transition phases as they allow smoothing the increase of unit costs forecasting for market demand."

35 "As the calculation of economic depreciation depends on the expected development in revenue, which in turn depends on the calculated depreciation charge included in the regulated prices. The economic depreciation calculation used in the European models cited is self-consistent and this issue does not arise.

1.6.2 Question 38: If we adopt a tilted annuity approach, what factors reflect how the tilt should be set?

In element-based approaches the tilt is separate for each asset class, and is driven by asset unit cost evolution.

If using an "adjusted tilted annuity", in addition to the asset unit cost trends, then we need to also tilt for the rate of change of demand (e.g. number of active copper loops). If using economic depreciation, we need the forecast demand over time for the modelled services (which is equivalent to adjusted tilted annuity if the demand is changing at a constant annual percentage rate).

In a situation where the MEA may change in the future, the depreciation needs to take this possibility into account, because assets may be stranded by future MEA choices. In our view, the use of economic depreciation and an assumed migration profile (with demand moving to a future technology over time) would be a suitable solution to take this problem into account for the hypothetical new entrant.

1.7 Assets shared with other utilities

1.7.1 Question 15: Is it reasonable for us to account for costs shared with other utilities such as electricity poles?

Using such deployment methods in a bottom-up method is acceptable only if such assets exist at the required location and can be used by the hypothetical operator. The feasibility of such sharing may depend on the current rules reflecting the built environment in New Zealand.

Patently, there would be little incentive for utilities to allow sharing if the costs of these shared assets were not contributed to by the telecoms network provider e.g. by renting space on the pole; and we would want this cost to be included otherwise the approach is inconsistent (it would be incorrect if the Commission were to assume that some of the infrastructure can be obtained from elsewhere for only incremental cost).

Coordination with the pricing approaches of other utility regulators might be needed.

1.8 Need for coherent and internally consistent approach to the modelled hypothetical operator

1.8.1 Timing of expenditures and revenues

In practice, there will in any real deployment be a difference in timing between the network construction expenditures and the revenues from the use of the assets. It is very common within bottom-up models for the network build to be assumed to be completed somewhat ahead of the demand allowing for a practical lead time or planning period. This feature is present for example in the Analysys Mason BULRIC models of FTTH in Denmark and of copper in Norway.

1.8.2 Question 18: Should we use a modified scorched node approach in the TSLRIC model for UCLL? What are the advantages and disadvantages of this approach compared to alternative approaches?

Yes. A scorched-node approach is appropriate for a hypothetical new entrant.

Scorched-earth models are more time-consuming and more expensive to implement than scorched-node models. Scorched-node approaches are much more practical to model (which is why the bottom-up models Analysys Mason has built of copper access in Australia, Norway and of FTTH in Denmark are all scorched node). The additional expense in a scorched-earth approach arises because if a scorched-earth approach is taken to MDF locations, then the first task in the modelling will be to cluster demand according to various constraints so as to locate the MDFs and their served areas. Such clustering algorithms are computationally expensive and their cost increases sharply as the number of points clustered increases. The constraints in the location of MDFs also need to be taken into account (e.g. wishing to avoid having local loops crossing major rivers, railways, etc.)

We believe that scorched-node or modified scorched-node methods will in practice be likely to give a similar result to scorched-earth models, as there is likely to be a low dependence of the total cost on the exact locations of MDFs, which were in any case chosen (admittedly at past dates) in order to minimise the network cost.

In addition, scorched-node models can be compared to real data more easily for hybrid calibration, for example if the bottom-up models use a sampling approach then the same areas can in principle be examined in the real world. If the MDF areas were completely different, then it would be harder to generate comparison data sets as there would be differences in the areas served.

The "scorched-node" assumption for MDF locations also helps keep the boundary between core and access network constant; models in which this could vary would need to take account of higher core network costs if the access network were to be made smaller (or vice versa). The same argument applies to the locations of the cabinets because we expect that the Commission will at the same time seek to determine unit costs for sub-loop unbundling. It would be inappropriate to set a price for sub-loops based on a network design where the points of interconnection were closer to, or further away from, the end user than the existing sub-loop network.

However, even if the Commission were seeking to set a price for non-cabinetised UCLL only (NCUCLL) then it would be necessary also to use a scorched-node approach to identify the non-cabinetised (NC) lines and avoid the possibility of costing a different subset of end-user locations (e.g. imagine a deployment that served half as many lines in a non-cabinetised way; these loops might be much shorter than the current set of NCUCLL lines and would not be a representative basis on which to cost NCUCLL).

Retaining the cabinet locations would also aid consistency between the UCLL modelling and any UBA model of VDSL.

1.8.3 Question 19: What forms of modification should be adopted? What are the advantages and disadvantages of your modification suggestions?

The “Modifications” in “modified scorched node” are usually limited to changes to the role of nodes (e.g. cabinet, MDF, aggregation node). In this case, there may be no need for “modification” of the roles of nodes (for example, it is very unlikely that a cabinet is a suitable site for an MDF).

However, it is sometimes appropriate to combine MDF sites within the modelling if there are multiple MDFs in very close proximity (say within 250 metres) where a single site would be capable of meeting the current constraints. As an example, the Analysys Mason model of copper access network in Norway does this type of rationalisation.

1.8.4 Question 20: Please explain the trade-offs between efficiency and ‘real-world’ considerations in your assessment of the most appropriate approach to modelling the network?

If by “efficiency” the Commission means the appropriate nature of the modelling choices to be made so as to achieve an effective and sufficiently accurate UCLL FPP, then:

- We favour a bottom-up scorched-node approach, retaining the MDF and cabinet locations with network assets modelled in a single year[36] but with depreciation applied over a multiple year period using economic depreciation making an allowance for reducing demand over time and the possibility of an eventual migration away from the initial technology (e.g. to WDM PON).
- We would be open to a hybrid approach using the actual asset counts (km of trench, km of cable, cabinets, poles, NTE, etc.) from the Chorus network as an equivalent of the forward-looking asset count, rather than a different form of hybrid approach based on an algorithm later adjusted to be sufficiently in agreement with the actual asset counts.
- We favour an element-based approach rather than one based on multiple service-specific increments.

All of these choices will result in no substantial loss of accuracy in our view, but each would simplify the process.

If “efficiency” means the efficiency of the modelled network, then this is a false dichotomy. Any efficiency included in the modelled network has to be one which can be implemented in the real world by a hypothetical new entrant (i.e. entering today) - any unimplementable efficiency is not actually efficient, it is impossible.

36 Network build may need to be ahead of the first demand carried by some “lead time” or “planning period”.

1.9 Operating costs

1.9.1 Question 43: Which approaches to estimating operating expenditure are most appropriate in the UCLL TSLRIC modelling exercise?

We believe that truly bottom-up cost estimates for operating costs (based on asset counts and other inputs) are not currently feasible to provide. These would entail for example the prediction of fault rates over time based on e.g. weather conditions and construction activity, a prediction of the size of the field force needed to rectify faults within target repair times, and the costing of that field force.[37]

Local loop cost models in other countries do use actual operating expenditure figures to inform their estimates to a large extent (e.g. via hybrid calibration). Existing network operating expenditure values are realistic and operators do face incentives to minimise costs (e.g. mobile substitution as well as LFC fibre and HFC cable television competition); the majority of network operating costs are also outsourced by Chorus, so they are provided in a relatively competitive market.

Existing opex costs may need to be adjusted to represent chosen modern technology and deployment style (e.g. a more underground deployment may have a lower fault rate; a more aerial one may have a higher fault rate driving higher opex levels).

1.10 Process points

1.10.1 Question 21: If parties develop top-down models independently, how should we audit and reconcile the different models?

Top down can carry two possible meanings:

- based on accounting information
- based on information from the real network about network asset counts (which might be as a “hybrid approach”, calibrating a bottom-up model).

We think that multiple accounting-based top-down models are unlikely given the fact that the input data to top-down models is usually only available to the operator and the regulator, and the fact that the LFC operators are still in a start-up phase so their unit costing is unlikely to be representative of their long-term results.

If the reference to top down refers to hybrid models, then multiple parties hybrid calibrated bottom-up models can be compared both in terms of their inputs (e.g. unit costs, asset economic lifetimes), their intermediate outputs (e.g. asset counts by geotype or MDF area) as well as their final outputs (e.g. service unit costs).

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37 We are aware of some relevant work in this direction going on in the UK, but it is not yet at a stage where a bottom-up model of access network operating costs can be contemplated.

Excel and procedural code used in those models could also be audited for correctness, although this is likely to be a significantly time-consuming task for bottom-up models using sophisticated algorithms. Nevertheless, we view it as essential that the algorithms used and their inputs can in principle be inspected by the parties in the process; NDAs or licence conditions on software or data that restrict such a level of transparency should be avoided.

Reconciliation would be aided if all models could provide summary outputs at the same level of granularity. In order to allow this, it might assist if the parties had clear guidance from the Commission on:

- the level of granularity to be examined in terms of asset types (e.g. should manholes/footway boxes be counted as separate assets, or included in the trench asset class; should jointing costs be allocated to cable, or retained separately)
- geographical areas of interest (or sets of similar geographical areas) and their definitions.

1.10.2 Question 34: Do you agree that the TSO area is an appropriate area to consider when calculating the cost of UCLL? If not, what would you consider to be a better alternative?

The TSO area is a potentially misleading indication of the appropriate area. The TSO area may include ultra-rural premises currently served with radio, whereas ~~the extent of~~ Chorus' obligations to supply UCLL ~~is described by~~are limited to the extent of the copper network.

Annex A Simple economic depreciation

A.1 Overview of economic depreciation

Below we describe the conceptual approach and the implementation principles of the economic depreciation method we are proposing, which is known as "simple economic depreciation"[38] and which Analysys Mason has used in a number of fixed and mobile bottom-up cost models.

A.1.1 Conceptual approach

Depreciation algorithms spread the recovery of costs over time. All depreciation algorithms seek that (efficiently incurred) costs are recovered over time by ensuring that the total of the cost recovery generated across the lifetime of the business is equal to the efficiently incurred costs, including cost of capital, in present value (PV) terms.[39]

Simple economic depreciation seeks to do this by recovering these costs in a rational way from the economic output (e.g. active copper local loop feeder segment) generated by each class of assets (e.g. 500 pair copper cable). This focus on output is different to other depreciation methods which, for example, recover a specified amount per annum.

The constraint on cost recovery over time (PV of costs = PV of output × calculated unit costs) for each class of asset can in theory be satisfied by an infinite number of possible paths of unit cost over time. However, it would be impractical and undesirable from a regulatory pricing perspective to choose an arbitrary or highly fluctuating unit cost profile.[40] Therefore, we choose a cost-recovery profile that is in line with the constraint imposed by competition when technology is evolving. In a competitive and contestable market, the revenue that can be generated is a function of the lowest prevailing cost of supporting that unit of demand, thus the price of a unit of output will change in accordance with the costs of the MEA for providing the service.[41]

The unit cost is therefore assumed to follow the MEA unit asset cost trend for that asset class. The cost-recovery profile for each asset class is the product of the demand supported by the asset (i.e. its economic output) and the MEA unit asset cost trend. This gives a unique solution, which is equivalent to a tilted annuity in the case where the demand (asset output) is constant over time, and equivalent to adjusted tilted annuity if demand is changing at a constant annual growth rate.

38 Ofcom uses a more complex form called "Original Economic Depreciation".

39 The calculation of the cost recovered needs to reflect the time value of money. This is accounted for by the application of a discount factor on future cashflows, which is equal to the WACC of the modelled operator.

40 For example, because it would be difficult to send efficient pricing signals to access seekers and their end customers with an irrational (but NPV=0) recovery profile.

41 The argument is that in a competitive and contestable market, if incumbents were to charge a price in excess of that which reflected the MEA prices for supplying the same service, then competing entry would occur and demand would migrate to the entrant which offered the cost-oriented price.

A terminal value calculation is optional; instead we often approximate the cashflows by explicitly modelling a long period (e.g. 50 years). At the typical WACC discount rate applied, the PV of the cashflows in the last year of the model is very small and thus the effect of any terminal value (to perpetuity beyond 50 years) is immaterial.

The costs that are recovered are not forced to be recovered within the lifetime of a specific asset (a specific 500 pair cable), but rather throughout the period when that asset class is generating useful output.

The efficient expenditure of the operator comprises all the operator's efficient cash outflows over the lifetime of the business, meaning that capex and opex are not differentiated for the purposes of cost recovery. Economic depreciation considers costs incurred across the lifetime of the business to be recovered by (cost-oriented) revenues across the lifetime of the business. This principle implies that the treatment of capex and opex should be consistent, since they both contribute to supporting the revenues generated across the lifetime of the business.

A.1.2 Principles of implementation

The PV of the total expenditure is the amount which must be recovered by the revenue stream (unit costs * output). The revenues in each future year must be discounted (delaying cost recovery from one year to the next accumulates a further year of cost of capital employed). This leads to the fundamental equation of the economic depreciation calculation that is:

$$PV\ (expenditures) = PV\ (unit\ cost \times output)$$

- **output** – the service volume carried by the network asset class

The right hand side of the equation is discounted because it reflects future cost recovery, and must be discounted by the WACC in order that the cost of capital employed is returned to the operator. The *unit cost* $\times$ *output* which the operator gains from the service in order to recover its expenditures plus the cost of capital employed is modelled as

$$output\ (year\ n) \times year\ 1\ unit\ cost \times MEA\ price\ index\ (year\ n).$$

- **MEA price index** – the cumulated input price trend for the network element (effectively, the cumulated percentage change to the cost of each unit of output over time).

The cost recovery over time is:

$$cost\ recovery\ (year\ n) = unit\ cost\ in\ year\ 1 \times output\ (year\ n) \times MEA\ price\ index\ (year\ n)$$

Substituting into the fundamental equation above we obtain:

$$PV\ (expenditure) = PV\ (unit\ cost\ in\ year\ 1 \times output \times MEA\ price\ index)$$

This equation can be rearranged as follows:

$$\textit{unit cost in year 1} = PV\ (\textit{expenditure}) \,/\, PV\ (\textit{output} \times \textit{MEA price index})$$

Then, returning to the equation for cost recovery in year *n*, the yearly price over time is simply calculated as:

$$\underline{\textit{unit cost in year n}} = \textit{unit cost in year 1} \times \textit{MEA price index (year n)}$$