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Effect of fibre on copper bitstream prices

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1 Overview

1. Chorus has entered into a contract with the Government to deploy and market a fibre access network to around 75 percent of the population. The ultra-fast broadband (UFB) policy is intended to encourage a faster migration from copper to fibre services than would have otherwise occurred in New Zealand. This accelerated migration of wholesale bitstream services from copper to fibre has important implications for the regulation of the unbundled bitstream access (UBA) service. In particular, we show in this report that the likely effect of accelerated migration is to increase the forward-looking unit costs. This occurs as utilisation of the copper network declines.

2. The pricing principles for the UBA service require that the Commission regulate prices so that they equal the current and efficient unit costs of providing the regulated service.[1] As customers migrate off the copper network and onto the fibre network, the opportunity to recover forward-looking costs from UBA customers will decline. This occurs because migration to fibre reduces scale on the assets used to provide the UBA service, pushing up prices. Chorus' ability to charge higher prices will be significantly constrained in the future because of the availability of fibre services at contracted prices. That is, the UFB prices will set a competitive 'cap' on the price that can be charged for the UBA services (how hard the cap bites will depend on how highly consumers value the higher service quality of fibre over copper based services).

3. The Commission faces a significant challenge in how to reflect the effects of the expected migration away from copper to fibre in forward-looking prices for the UBA service. Setting a price today that reflects 'forward-looking' costs within a TSLRIC framework means that the expected economic depreciation of the current value of the network used to supply UBA services must be reflected in prices for UBA services. In other words, forward-looking prices must be set in a manner that allows Chorus the opportunity to recover the forward-looking cost of the existing network. Alternatively, benchmarks must be adjusted to ensure they reflect forward-looking costs given the circumstances in New Zealand.

4. It is also important for maintaining investment incentives that Chorus be given an opportunity to recover its recent investment in bitstream equipment. Chorus has recently made significant investments in assets that are used to supply bitstream services including DSLAMs, fibre transmission and data switches. This investment has come in response to growing demand for wholesale bitstream services in recent years. That is, despite the growth in unbundling, demand for Chorus' wholesale bitstream service has grown significantly. However, that growth is slowing sharply

[1] This could be achieved by benchmarking (with appropriate adjustments) or by TSLRIC modelling.

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and demand is expected to fall significantly in coming years. It is fair and efficient that regulated prices provide an opportunity to recover costs taking into account expectations that demand will fall in the future.

5. We note that if the Commission were to do nothing, and leave consideration of these issues to the future, it may not be possible to set prices that in expectation are able to recover current forward-looking cost. As noted in the economic literature there is a 'window of opportunity' for cost recovery that will close due to competition and technology advancement (or in this case Government policy) that needs to be taken into account in regulated prices.

6. TSLRIC models and forward-looking prices observed in other jurisdictions can take such circumstances into account in the way they allow for the economic depreciation of assets. TSLRIC models allow economic depreciation by calculating the capital component of forward looking prices based on a 'tilted annuity'. That is, rather than having a constant annual charge to recover the asset value (in NPV terms) the capital charge goes up or down by a percentage to reflect the expected change in the replacement value of the network. If the future value of the network is expected to rise then the annual charge has an upward tilt – meaning that revenues are lower now on the expectation that they will track the value of the network upward in the future.

7. In addition, regulators also consider the future path of network traffic volumes, or utilisation, in considering the path of depreciation. If utilisation is expected to decline the annual charge is given a downward tilt – meaning the revenues are higher today on the expectation they will fall in the future as demand for services declines.

8. Tilted annuity depreciation is sometimes referred to as 'competition' depreciation because it reflects the level and path of prices that would be expected in a competitive market. Such interpretations are highly problematic in an environment in which the Government is facilitating competition in a market that might otherwise not be competitive. Nevertheless, in a policy environment in which there are external forces that will see accelerated migration from copper to fibre, the forward-looking benchmarks used by the Commission may need to be adjusted to reflect the accelerated depreciation. This is precisely the environment in New Zealand.

9. The current UBA proceeding may represent the best and perhaps only point at which to establish arrangements to allow forward-looking cost recovery since, in future years, the ability of Chorus to recover the costs of its copper network will be constrained. Given the knowledge and expectation of this the Commission will need to consider a path of depreciation that will be achievable and recover replacement costs in expectation.

10. This may also need to be the last such review of copper prices that the Commission undertakes. This is because in future there is a risk that Chorus may be unable to recover replacement cost due to migration of copper services to fibre and the pricing constraint from the fibre network. The Commission is unlikely to be able to greatly influence these factors if Chorus finds that it is unable to achieve cost recovery, but would nonetheless be bound to prevent over-recovery should it find that to be occurring. The result is an asymmetry that requires the Commission to commit now to a final re-determination of Chorus' UBA prices.

11. In this report we use a model of a New Zealand UBA asset to consider a number of ways the Commission might set prices to ensure recovery of forward-looking costs in circumstances where utilisation is declining and/or it is known that prices cannot be increased in the future because of a future competitive constraint. Two alternative approaches considered in this report include:

    i. tilting the annual capital depreciation to reflect the expected decline in utilisation of the regulated service; and

    ii. modelling the constraint that fibre prices will impose on future cost recovery.

12. Under conservative assumptions, the current UBA price will require upward revision of at least $2.75 per month in order to allow for the future combined effect of the price constraint from fibre bitstream services and migration away from copper. We consider that the results of this modelling have important practical implications for the Commission's consideration of UBA prices.

13. It is relevant to emphasise that the recognition of future constraints on prices (whether it be through competition, technological change or even government intervention) is entirely consistent with setting cost-based prices. That is, if the recovery of (current or forward-looking) costs *requires* that prices today be increased to recognise future constraints on cost recovery it does not involve setting prices above cost.

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2 Forward-looking prices for copper service

15. The Telecommunications Act 2001 requires that the Commission regulate prices for copper based services (UCLL and UBA) initially based on 'forward-looking prices'. If a final pricing regulation is required then a price based on total service long run incremental cost (TSLRIC) must be set.

2.1 The TSLRIC regulatory regime

16. The use of forward-looking prices has been justified in a number of ways. Principally, it is intended to provide prices that reflect the outcome of a workably competitive (or at least contestable) market. That is, these prices reflect the cost that an efficient operator would incur in the long run.

17. For example, in summarising the principle that access prices be cost based, the Australian Competition and Consumer Commission's (ACCC's) 1997 Telecommunications Access Pricing Principles states:[2]

> *The price of a service should not exceed the minimum costs an efficient firm will incur in the long run in providing the service. The relevant costs are the economic costs of providing the service. These are the on-going (or forward looking) costs of providing the service, including a normal commercial return on efficient investment.*

18. In these pricing principles, the ACCC defines 'forward-looking economic costs' as:[3]

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

19. The use of forward-looking prices exposes investors and consumers to unexpected changes in input costs and technological change. This exposure arises because forward-looking prices are set periodically based on re-valued assets and the depreciation component of prices reflects expected changes in input prices and technological advancements. If those expectations are out of line with actual changes in input prices and technology shifts there will be windfall gains and losses to interested parties.

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2 ACCC, *Access Pricing Principles – Telecommunications*, 1997, p. 14

3 Ibid, p. 36

20. The Commerce Commission has also recently revisited its forward-looking cost based benchmarks for copper service. The movement in prices between reviews will reflect the change in forward-looking prices that has occurred in jurisdictions comparable jurisdictions to New Zealand.

21. A key motivation for the use of forward-looking prices is to give the service provider appropriate incentives to make efficient investment decisions and control costs by disassociating compensation from its actual expenditure and assets. However, with these incentives comes additional uncertainty for the regulated business, because the ability to re-value its assets and to set prices sits with the regulator, which is not constrained to allow the business to recover the costs that it has incurred. In order to ensure that the positive incentives for efficient expenditure (and not underinvestment) are maintained, a regulator setting forward-looking prices must commit to a stable and predictable methodology for this purpose.

22. The Commerce Commission has explored in some detail the principles and methods it would apply in estimating a TSLRIC price in accordance with its legislative requirements.[4] These principles and methods represent important precedent to the "implicit regulatory contract" that exists between investors, consumers and the Commission in the provision of services on the copper access network such as the UBA service.

23. For the purposes of this report, this precedent and practice can be distilled into two objectives publicised by the Commission:[5]

- to value assets for TSLRIC purposes at each pricing determination on an optimised replacement cost (ORC) basis; and
- to determine a depreciation profile that allows the access provider to recover the cost of prudent investment, without over-compensation.

24. The interaction of these features of the regulatory regime is discussed in greater detail below.

25. We note that whilst the initial pricing principle is based on benchmarking, it is based on benchmarking against prices that reflect forward-looking costs (i.e., that adopt ORC asset revaluations and forward-looking depreciation profiles). It is therefore equally relevant that these benchmark prices be adjusted to reflect New Zealand conditions and arrive at cost reflective prices (i.e., that would reasonably reflect the outcome in New Zealand of a final pricing principle in which a TSLRIC model was adopted in full).

4 http://www.comcom.govt.nz/total-service-long-run-incremental-cost-tslric/

5 Commerce Commission, *Application of a TSLRIC Pricing Methodology – Discussion Paper,* July 2002, pp. 44, 46

2.2 Economic depreciation

26. Economic depreciation is defined as the change in the value of assets over a defined period (which may be more than one year) where the value of an asset is the present value of net cash flows at prevailing prices, costs and output/input levels. Under the hypothesis of a competitive market the expectation would be that the price for the service is equal to cost. As a result the profile of economic depreciation will reflect the change in input costs and output levels over the economic life of the asset.

27. Economic depreciation is consistent with the repeated application of a TSLRIC approach because any other depreciation profile would give an expectation of over or under recovery of the value of assets over their life. This can readily be seen when it is understood that assets valued today will be re-valued on the same basis at the end of the regulatory period. As such, if we expect that the asset will be valued upwards or downwards at the end of the regulatory period (and prices in the next regulatory period will be based on that new asset value) then the allowance for depreciation must be equal to the expected change in the asset value. Allowing any other depreciation schedule (e.g., straight-line depreciation) would knowingly provide too little or too much compensation.

28. This is not to say that TSLRIC forms of regulation give certainty of cost recovery for the initial investment value. Far from it. Uncertainty occurs when replacement costs and utilisation move in an unexpected fashion.

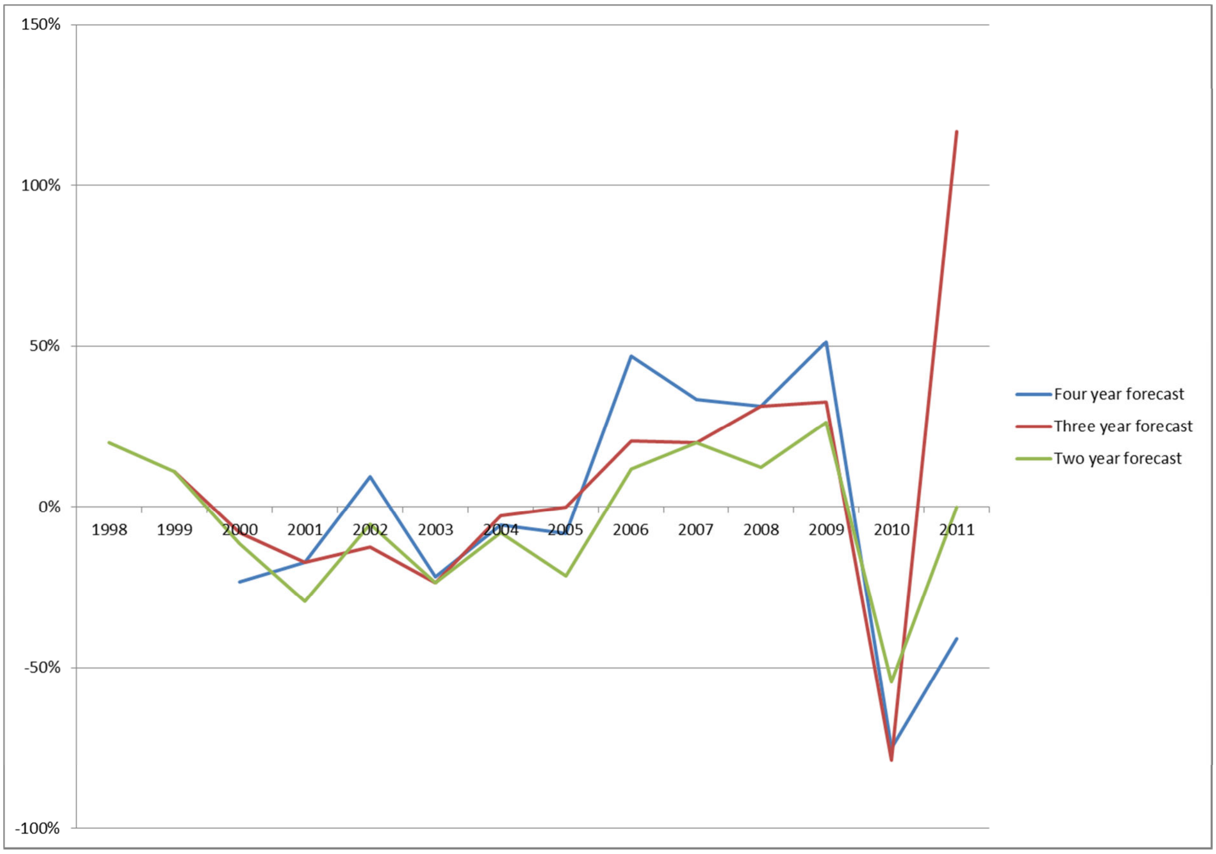
29. A simple example demonstrates the potential size of this volatility. A significant proportion of the value of the telecommunications local loop is in labour for trenching and laying cable. As such, in determining the optimised replacement cost of the network a forward looking price values that portion of the network equal to the optimal amount of labour hours multiplied by the current price of labour. It would then set future depreciation of that copper (in the tilted annuity) based on the change in labour prices expected over the life of the asset.

30. If the price of labour was expected to fall, there would be a higher depreciation allowance under the tilted annuity reflecting an expected large change in the optimised replacement cost of the copper portion of the network when it is re-valued next year.

31. However, if there is forecasting error (which there inevitably will be) then the actual change in labour prices will differ from the forecast. When it comes to the following year and the labour portion of the network is re-valued, if the price of labour did not fall by as much as previously forecast, the ORC of that portion of the network will be higher than forecast and the access provider will have received a windfall gain (because they will have received the depreciation allowance associated with a forecast fall in the price of labour that never happened).

32. The figure below graphically demonstrates the size of the problem by comparing the New Zealand Treasury's Budget forecast of the change in average hourly ordinary time earnings against actual changes. It shows an average forecasting error of around 18% for two year forecasts and up to 26% for four year forecasts.

Figure 2-1 Accuracy of NZ Treasury forecasts of change in average hourly ordinary time earnings



Source: CEG analysis

2.3 Tilted annuities as depreciation profiles

33. TSLRIC models typically use a proxy for economic depreciation in the form of a 'tilted annuity'. A tilted annuity is a variation on the standard annuity formula. Whereas the standard annuity formula calculates a constant annual charge to recover an initial investment, a tilted annuity places a trend in the annual charge that nonetheless continues to recover the initial investment, in present value terms, over the life of that investment.

34. The tilted annuity achieves consistency with the path of depreciation required under TSLRIC. As previously put by the Commission:[6]

> *If access providers are required at any point in time to provide access to their networks at prices that reflect the network costs valued on an ORC basis, then the only way to ensure that the costs of investments can be recovered (but not over-recovered) is to base depreciation on a tilted annuity, where the 'tilt' is based on the rate of change of the ORC.*

35. That is, a tilted annuity based on the rate of change of ORC is not just a way in which consistency can be achieved between the cost recovery profile and the repeated application of TSLRIC, but the *only way* in which such consistency can be achieved.

36. The importance of using a tilted annuity in a forward-looking cost model that re-values assets periodically has also been described by the Australian Competition Tribunal in the following terms:[7]

> *Under standard forward-looking cost models, this is performed by estimating what would be the efficient cost of providing the service if the network over which it is provided were to be built in the period(s) to which the undertakings relate. A standard forward-looking cost model would seek to consider how the network over which the ULLS was provided (the CAN) would be dimensioned if it was built anew in each of the three periods covered by the undertakings (1 January 2006 – 30 June 2006, 2006/2007 and 2007/2008). To avoid confusion, it should be noted that this does not mean that the capital costs associated with the construction of a hypothetical new network in each period covered by the undertakings would be modelled to be recovered, in full, in each of the periods in which the hypothetical new networks were modelled to be constructed. Rather, the capital costs would be annualised over the lifetime of the assets involved in constructing the network using a tilted annuity formula. Only those capital costs allocated to the first period using tilted annuity formula* [sic] *would be recovered in the first period in which the hypothetical new network was constructed.*

37. However, despite this theoretical consistency between the use of TSLRIC and depreciation based on a tilted annuity using the rate of change of ORC regulators have often been influenced by other considerations. In particular, a corollary of the use of the tilted annuity is that the total level of cost recovery in each year is

6 Commerce Commission, *Application of a TSLRIC Pricing Methodology – Discussion Paper,* July 2002, p. 49

7 *Re Telstra Corporation Ltd (No 3) [2007] ACompT 3 (17 May 2007)*, para. 340

independent of the expected level of volumes. This means that prices calculated on this basis may vary, sometimes significantly. For example:

- if volumes are expected to increase over time, the application of the tilted annuity will result in initially high prices, followed by lower prices in the future; or alternatively
- if volumes are expected to decrease to zero, then application of the tilted annuity will give rise to low prices initially, but with prices spiralling higher as volumes tend towards zero.

38. Since regulators tend to prefer price stability, we often see the use of tilted annuities in the context of TSLRIC augmented by the addition of an 'utilisation tilt' that has the effect of loading cost recovery into periods proportionate to the level of demand. This additional assumption gives a 'double tilted' annuity that gives rise to path of prices (rather than revenues) that follows the rate of change of ORC over time.[8]

39. Given the future expected migration to fibre and the likely decline in copper volumes, the case of a utilisation tilt is particularly pertinent to the issue of determining future depreciation of the copper network.

2.4 Economic depreciation with competition

40. The UFB policy introduces a significant competitor to the copper-based UBA service that will constrain regulated prices. The effect of future competition on setting the appropriate rate of economic depreciation in regulated prices has been well explored in the literature.

41. It is shown in the literature that new technologies and/or potential future competition accelerate the depreciation of assets that is required in regulated prices. Crew and Kleindorfer show that:[9]

> *… under conditions of competition and technological progress, front-loading of capital recovery is essential if the regulated firm is to remain viable. In addition, if the introduction of accelerated capital recovery is delayed by regulators, they may effectively vitiate any opportunity of the firm to recover its invested capital. The breathing space, or period of time, that the regulators can delay introducing the application of efficient capital recovery*

8 Utilisation tilts are often applied in telecommunications cost modelling, for example Ofcom's recent mobile termination consultation applies a form of utilisation tilt in its economic depreciation calculation and WIK's Australian mobile cost model uses a simple utilisation tilt in its annuity formula.

9 Crew, Michael A & Kleindorfer, Paul R, 1992. "Economic Depreciation and the Regulated Firm under Competition and Technological Change," *Journal of Regulatory Economics*, Springer, vol. 4(1), pages 51-61, March.

without ultimately compromising the firm's ability to recover its invested capital is called the "Window of Opportunity" (WOO). This same window of opportunity requires that the level of depreciation initial be set optimally. There are limited opportunities in the future, under technological change and competition, to rectify mistakes made now. Thus, in the case of price-cap regulation, if depreciation is set solely based upon the status quo, the initial price cap may be set at too low a level to allow full capital recovery.

42. It is relevant to emphasise that the recognition of future constraints on prices (whether it be through competition, technological change or even government intervention) is entirely consistent with setting cost-based prices. That is, if the recovery of (current or forward-looking) costs *requires* that prices today be increased to recognise future constraints on cost recovery it does not involve setting prices above cost.

3 Migration to UFB

43. The UFB policy is a fundamental intervention in the market and is expected to significantly change the New Zealand telecommunications landscape.

44. Whilst the fibre deployment is ramping up, broadband growth in New Zealand is ahead of the deployment of fibre. Over the near future that demand will have to be met in large part by Chorus' fixed line copper network. This includes increasing demand for Chorus' wholesale bitstream service, UBA.

45. This has significant implications for the regulation of Chorus' fixed line copper network. In order to provide the UBA service in the manner required, Chorus has made significant investments in the past and will continue to do so even as the UFB policy is deployed.

46. It follows from the consistent application of the forward-looking price regulation that Chorus must expect to be able to recover the costs of these investments in future depreciation over the economic lives of these assets. That is, the government's announcement of the UFB initiative should not affect this basic component of the regulatory regime. However, as discussed in the next section, it may have important implications for how the objectives of the regulatory regime are to be achieved in the future.

3.1 The UFB policy

47. The New Zealand Government's ultrafast broadband initiative will be rolled out over 10 years, to 75% of New Zealanders, including:

- by 2015, to priority users, including 90% of businesses.
- by 2020, to residential homes and the remaining 10% of businesses.

48. In addition, the rural broadband initiative (RBI) is targeted at the approximately 25% of New Zealand's population that is considered to be rurally based. Over six years, this initiative will connect:

- over 80% of rural households to a minimum of 5Mbps.
- 85% of rural schools to 100Mbps fibre, and a further 5% of rural schools will get high bandwidth service delivered over digital microwave radio.

49. Prior to the announcement of the UFB initiative, Chorus had the opportunity to make investments in new technologies such as fibre in the amounts and at the time of its choosing to satisfy its best interests. In running the UFB tender, the New Zealand government effectively accelerated the full-scale implementation of fibre

compared to the status quo by offering subsidies to any party (including Chorus) that would agree to meet the terms of the UFB initiative on the best terms.

50. By winning the right to deploy fibre to around 70% of 75% of New Zealanders covered by the UFB Chorus agreed fibre prices and terms that were better than those offered by its competitors in the UFB tender. The effect of the tender is that Chorus has committed to installing and promoting fibre as if it did not own a copper network. However, the terms of the agreement and the fibre prices agreed by Chorus have significant implications for recovery of costs on its copper network. The fibre prices, once adjusted for their higher quality, effectively act as a 'cap' on the price that Chorus will be able to charge for services charged over its copper network, as if it were competing with itself. The concept of the 'fibre cap' is explored in greater detail at section 5.4 below.

51. Chorus remains the owner of the copper network and is subject to the same regulation that would have applied had it not been successful in the UFB tender. The form of regulation is forward-looking cost based prices. As discussed in section 2 above, the nature of this form of regulation is that Chorus would expect to be able to recover efficient investments that it has made and continues to make in the provision of copper services.

3.2 Recent investments in copper bitstream services

52. Despite the current deployment of UFB, Chorus has made recent and substantial investments in network elements that will be used to provide copper bitstream services. It will be likely to continue making such investments even as UFB is deployed.

53. For example, Chorus' cabinetisation program has required particularly high levels of capital expenditure since 2008. Telecom annual reports and management commentaries indicate that the total level of expenditure in this area is over $500m, which is likely to constitute just part of Chorus' capital expenditure programme on providing UBA services.

54. This indicates that Chorus has made and continues to make substantial investments in order to provider copper bitstream services. In the context of the TSLRIC regulatory contract described in section 2 above, Chorus would expect that, at the time it makes investments that it would have an opportunity to recover these in future prices provided that they were/are prudently incurred.

55. It is important to note that these expenditures are recent investments and that the forward-looking costs of providing the same capabilities today would likely be fairly close to the actual amounts spent by Chorus. It would be an unfortunate signal to continued investment on the copper network by Chorus (and investment generally) if the government-sponsored UFB program were to change its expectation of being

able to recover its replacement cost over the economic life of the copper related assets.

3.3 Rise and fall in bitstream services

56. Chorus has experienced significant growth in bitstream services in recent years, associated with its significant investments in providing these services. Growth in demand for Chorus' bitstream services is shown in Table 3-1 below.

Table 3-1 Historic growth in Chorus bitstream service (million)

Year	Bitstream connections (wholesale plus retail)
2008	0.74
2009	0.82
2010	0.89
2011	0.95
2012	1.04

Source: Telecom Annual Reports and Chorus Annual Reports

57. Broadband penetration is expected to grow in New Zealand. According to the IDC, broadband penetration in 2011 was around 28%. This is expected to grow to 33% by 2016.[10] This will see broadband connections rise from around 1.1 million in 2011 to around 1.3 million in 2016.[11] Not all of this growth in broadband/bitstream demand will be supplied by Chorus, but a significant portion of it will be.

58. However, the increasing demand for broadband will increasingly be met on the fibre network from about 2014, meaning that demand for regulated copper services will only increase in the short term. Deutsche Bank expects that take-up of regulated bitstream services (UBA) will grow from around 996,000 in 2011 to 1,002,000 in 2015, but then fall to 844,000 in 2020 and to 529,000 by 2025.[12]

59. Similarly, take up of the unbundled copper loop services is expected to continue to grow. For example, Deutsche Bank expects take up of UCLL lines in New Zealand to grow from around 93,000 in 2011 to 203,000 in 2015. However, as the fibre network is deployed, it is expected that the take up of UCLL lines will fall to 121,000 in 2020 and 44,000 in 2025.

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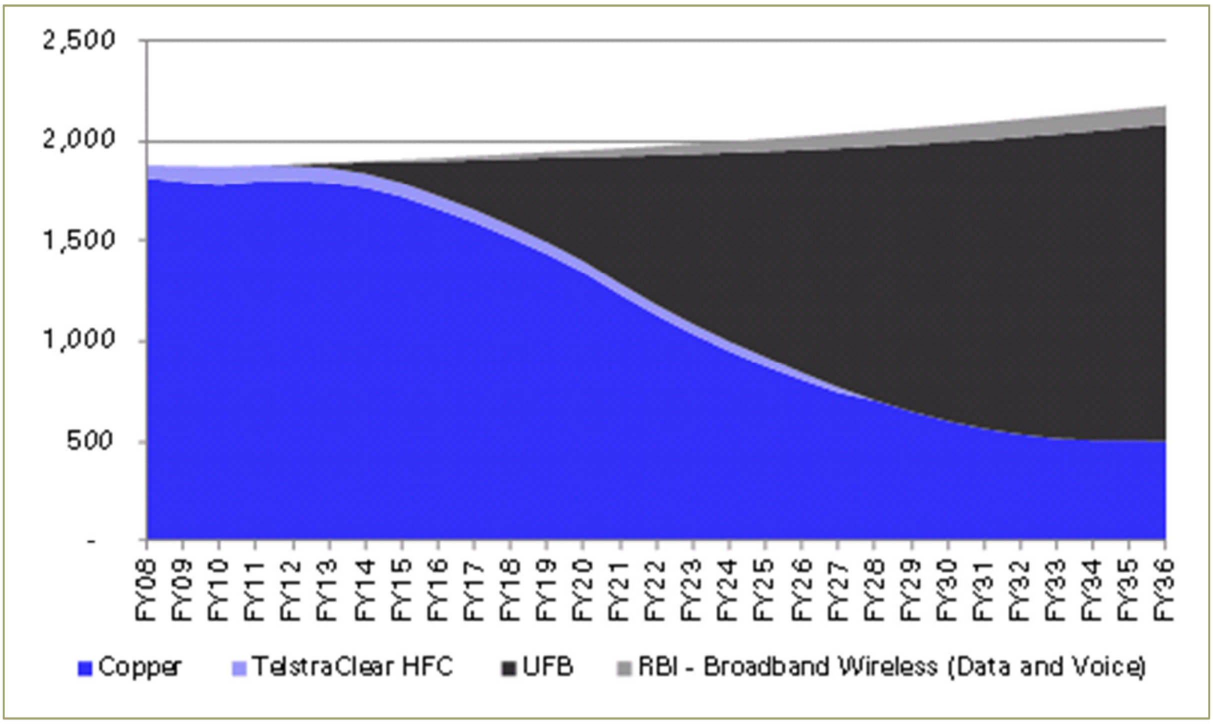
10 IDC, New Zealand Forecast September 2012 Deliverables.

11 Ibid.

12 Deutsche Bank analyst report on Chorus, 12 June 2012.

60. Deutsche Bank's forecast of total access lines for copper (UCLL plus UBA), fibre, HFC and wireless is summarised in Figure 3-1 below.

Figure 3-1 Deutsche Bank forecast of UBA demand[13]



Source: Deutsche Bank

61. The forecast decline in demand for regulated copper services has important implications for the TSLRIC regulatory regime and how prices should be determined in future years. The following section discusses these issues in more detail.

13 Deutsche Bank Market Research, Retail Hold recommendation following a coverage change, 12 June 2012.

4 Ensuring forward-looking costs can be recovered

62. Section 2 described a regulatory regime wherein the regulator is committed to ongoing re-valuation of assets to provide the regulated services and the depreciation profile that is consistent with this practice. This arrangement is maintained by the regulator periodically revaluing the assets required to provide the regulated services and re-determining forward-looking prices on this basis.

63. In the current circumstances, forward-looking prices are likely to be 'capped', or at least heavily influenced by the prices charged for fibre, which are not determined using TSLRIC principles and at least partly reflect government support for the UFB initiative. These factors place the existing regulatory regime at risk if they are not appropriately accounted for. Ignoring the UFB development will likely mean that, in the future, the unadjusted TSLRIC methodology will not be able to be used to set prices for the copper network or, at least to the extent that it is used, Chorus will not be able to achieve these prices. However, the current application of the TSLRIC methodology relies upon it continuing to be applied indefinitely.

64. This places the Commerce Commission in a difficult position. Given the UFB initiative, which prevents the copper TSLRIC regulatory regime from continuing in its present form, it must find a way to 'close out' the current arrangement in a way that is fair to both Chorus and its customers, and consistent with how the regime has operated previously.

4.1 UFB places the regulatory regime at risk

65. The TSLRIC thought experiment requires that the regulatory regime or contract be indefinite. That is, there is always an expectation that services will continue to be supplied and that the regulator will continue to periodically revalue the assets and set prices so as to recover the current value of the assets.

66. The UFB initiative places this part of the regime at risk. By sponsoring the deployment of a fibre network, the Government has accelerated the uptake of a competing technology beyond what would have been the case absent subsidies and resulted in Chorus committing to the construction of a network that will ultimately compete with its existing copper network.

67. The prices at which Chorus has agreed to supply fibre services have not been determined on a TSLRIC basis and they do not necessarily reflect the path of depreciation that would be consistent with application of TSLRIC. Nonetheless, fibre prices will prove to be an increasing constraint on the ability of Chorus to recover its copper costs.

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68. In addition to the competitive constraint posed by fibre, there is also the practical reality that Chorus is expected to migrate customers from its copper network across to its fibre network. This means that in the future there might be considerably fewer customers served on the copper network than there are today, as reflected in the Deutsche Bank forecasts shown in Figure 3-1 above.

69. The Commission faces a significant challenge in how to reflect the effects of the expected migration away from copper to fibre in forward-looking prices for the UBA service. It must do so within the context of a regulatory contract whereby it has committed to allowing the recovery of the current efficient forward-looking costs of the UBA service over the economic life of the relevant assets. As discussed above, these challenges include:

- declining utilisation of the copper network as customers migrate (or are migrated) across to fibre; and
- the competitive constraint imposed by prices of the fibre network, which have been determined independently of the TSLRIC standard that must apply to copper pricing.

70. These factors, separately and collectively, suggest that the regulatory contract can no longer be renewed in its current fashion. There can no longer be an expectation that the Commission can continue to set (or that Chorus can achieve) unadjusted TSLRIC-level cost recovery from the copper network indefinitely into the future. This places great importance on the Commission's current decision in terms of the recovery of costs that Chorus can expect from the copper network over the next few years.

4.2 A final arrangement for forward-looking cost based prices

71. The current regulatory regime, as described at section 2.1 above, embodies two commitments, being:

- to value assets for TSLRIC purposes at each pricing determination on an optimised replacement cost (ORC) basis; and
- to determine a depreciation profile that allows the access provider to recover the cost of prudent investment, without over-compensation.

72. The first part of this regime envisages that the Commission will periodically revalue the network at each subsequent pricing determination and re-determine prices at that time. However, future re-determinations may be redundant if copper bitstream prices are effectively 'capped' beneath TSLRIC levels by a constraint from fibre prices. The Commission will not be able to commit to allowing Chorus the

opportunity to recover efficient forward-looking costs (the ORC) when this is known by both parties that this is unachievable.

73. The Commission needs a way in which to 'close out' the current TSLRIC arrangement in its current process for the UBA service in a way that is fair for both Chorus and its customers and complies with the spirit of the current arrangements (that is, setting prices based on forward-looking costs). In particular, any determination must continue to give Chorus the expectation that it would be able to recover the ORC of assets required to provide UBA over the remaining economic life of the network.

74. The current determination appears to represent the best and perhaps only point at which to 'close out' the arrangement because, as discussed above, in future years the ability of Chorus to recover the costs of its copper network will be constrained. Given the knowledge and expectation of this, the Commission will need to consider a path of depreciation that will be achievable for Chorus to recover. A depreciation profile that plans to recover the majority of network costs more than 10 years in the future is unlikely to be achievable for Chorus.

75. The only alternative to this is to "let the chips lie" subsequent to the current determination – that is, to commit to not make further price determinations or at least not to amend the path of prices set at this determination. The reason for this is clear: For the Commission to revisit prices in the future must harm Chorus' current expectation of achieving ORC over that time period. If, by the next review, utilisation on the copper network falls away more quickly than expected, or the constraint from fibre is more restrictive than expected, there is likely to be very little that the Commission can do to place Chorus back on the path to recovery of replacement costs.

76. However, if Chorus over-recovers relative to expectations, then the Commission in reviewing prices as part of an unchanged regulatory contract would be bound to reset this by reducing prices. This asymmetry, where the Commission cannot influence the factors that may prevent Chorus from attaining replacement costs but can nonetheless prevent over-recovery, requires that the Commission commit now to a final re-determination of Chorus' UBA prices.

77. This means that the Commission's focus in this determination should be to determine what prices Chorus needs to be able to charge now and in the future such that it can expect to recover the ORC of the assets for serving bitstream over the economic life of those assets. The considerations discussed above suggest that depreciation of the bitstream (UBA) assets will need to be front-loaded in order to achieve this. Section 5 below discusses these considerations and possible solutions using a stylised example.

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5 Adjusting bitstream prices

78. The Commission has benchmarked against jurisdictions, in Denmark and Sweden that use tilted annuities to convert asset values into annual charges. Tilted annuities allow present value neutral recovery of an initial cost with a sequence of payments that grow (or decline) at a constant rate. The tilted annuities applied in the benchmarked models do not take into account the imposition of a competitive constraint as is expected in New Zealand.

79. The Danish model incorporates a mechanism to further tilt the annual recovery for declining (or increasing) utilisation of the asset but it is set to zero. That is, the Danish model (and the Swedish model) assumes a constant utilisation over the life of the asset. Moreover, because these models use simple tilted annuity depreciation they make no adjustment to current prices to reflect future price constraints imposed by competing fibre networks.

80. In this section we introduce a model of the assets used to provide UBA in New Zealand with declining utilisation and facing a competitive constraint. We use this model to illustrate the issues that arise and the type of adjustment that would need to be made to the typical tilted annuity calculation to estimate depreciation consistent with the TSLRIC requirement for the recovery of ORC.

81. The model shows that as utilisation of the copper network declines, UBA prices will need to increase significantly in order to allow recovery of a tilted annuity of the type benchmarked by the Commission. However, the threat of price constraint from a competing network in the future means that it is not realistic to expect increasing copper prices over time since these will be constrained by the prices that consumers can pay for fibre-based services. Expectation of recovery of forward-looking costs can only be achieved by front-loading cost recovery relative to the path of prices that would be calculated absent these considerations.

5.1 Modelling cost recovery

82. To represent the UBA assets[14] and calculate prices consistent with expected declining utilisation and a fibre constraint and illustrate the effects described above, we require estimates of:

- the value of the copper asset;
- the life of the asset;
- the expected change in cost of the asset over time (price tilt);

14 For simplicity we treat the assets used to provide the UBA as unitary asset.

- a cost of capital;
- the level of operating costs associated with the asset;
- a path of UBA volumes over the life of the asset; and
- the price constraint imposed by the competing fibre network.

83. Based on a survey of the Danish and Swedish cost models we assume an asset life of 20 years, a price tilt of 0% and annual operating costs at 8% of annual asset values.[15] We further assume a cost of capital of 9%.[16]

84. An analyst report by Deutsche Bank from June 2012 provides estimates and forecasts of copper UBA volumes.[17] This are reproduced at Table 5-1 below. For the purpose of calculations later in this section we have used straight-line interpolation to determined volumes for the years that lie between these estimates.

Table 5-1 Forecast UBA volumes (000 lines)

Year ending 30 June	UBA subscriber lines
2013	1,015
2014	997
2015	1,002
2020	844
2025	529
2032	331*

Source: Deutsche Bank Figure 19
** 2032 estimate based on Figure 18 indicating market share of copper declining from 40% to approximately 25% from 2025 to 2032.*

85. Given an asset life, price tilt, cost of capital, operating costs and current UBA volumes, we can calculate an asset value implied by a given price, such as that proposed by the Commission in its draft decision. The Commission has proposed a UBA increment of $8.93 per month. Based on 2013 volumes, this is consistent with an annual recovery of $108.77 million.

15 We calculate the weighted average asset life for core network bitstream assets to be 16 years in the Danish model and 32 years in the Swedish model. The weighted average price tilt is -0.65% and +0.35% respectively in these models. The total operating costs pertaining to core network bitstream assets amount to 13% of asset values in the Danish model and 3% in the Swedish model.

16 This does not constitute CEG's view of Chorus' cost of capital, but a figure used for the purpose of this calculation. We note that it is similar to the WACC of 8.77% applied recently by the Commission its regulation of electricity distribution businesses.

17 Deutsche Bank Markets Research report on Chorus, 12 June 2012, Figure 18 and Figure 19

86. This level of annual recovery is related to an asset value based on the following formula:

$$R_t = ORC\left[\frac{(1+\alpha)^{t-1}(r-\alpha)}{1-\left(\frac{1+\alpha}{1+r}\right)^L} + OPEX\right]$$

87. In this equation:

ORC is the initial optimised replacement cost;

r is the weighted average cost of capital;

α is the rate of change in the value of ORC (the average price tilt/trend);

L is the useful life of the asset; and

$OPEX$ is the operating cost multiplier.

88. Given the values for these other parameters selected above, recovery of $108.77 million is consistent with an asset value of $573.80 million and annual operating costs of $45.91 million.

89. We have separately provided a report for Chorus that proposes adjustments to the benchmarking of additional costs of the UBA service, which would imply a larger asset value. However, the Commission's draft UBA price is used here for the purposes of demonstrating the effect of fibre on copper prices. Of course, the model can be re-run using an adjusted benchmark cost figure.

90. In the remainder of this section we investigate three scenarios for recovery of this asset value and the associated operating costs over time:

- using a tilted annuity consistent with the assumptions of the benchmarked prices;
- adding a utilisation tilt in the calculation of the tilted annuity; and
- setting an initial price and price path that allows recovery of forward-looking costs given the price constraint imposed by the fibre network.

5.2 Base case tilted annuity

91. Under the base case tilted annuity scenario, the UBA increment is calculated based on cost recovery derived using the standard tilted annuity formula (plus operating costs) expressed above. Cost recovery is calculated over a useful life of 20 years and then divided by volumes in each year to calculate the implied price. The results, shown in Table A-1 below, is a UBA increment that starts at $8.93 and increases, at first gradually, and ultimately more quickly as volumes decline more rapidly. By

2033 the UBA increment per unit must be $27.41, more than three times its initial value, to recover the tilted annuity for that year. The full time series of prices over the 20 year life of the asset can be seen in Table A-1 below.

92. The series of UBA increments derived using this methodology is idiosyncratic, in the sense that it results in an upward 'spiral' of prices. The extent of this upward spiral would be further exaggerated were we to take into account a price response in this modelling exercise – whether as an own price effect in response to the higher charge for the UBA increment or as a substitution effect as the extent of the fibre constraint increases.

5.3 Utilisation tilt

93. As described at section 2.3 above, a tilted annuity can be 'double tilted' in the sense that it can be adjusted so that *unit cost recovery*, rather than *total cost recovery*, increases at the rate of change of ORC.

94. In the context of increasing volumes, this adjustment results in a lower initial unit cost compared to the simple tilted annuity because cost recovery is back-loaded to be recovered in proportionately greater volumes in the future. However, in this example where copper UBA volumes are declining, the implementation of a utilisation tilt requires initial prices to be greater than would be under the simple tilted annuity. This is because there is lower UBA volume in the future over which to recover overall ORC, such that cost recovery must be concentrated in the initial years of the network in which utilisation is high.

95. The initial price of $11.36 has been calculated such that with prices remaining constant and volumes following the assumed path, the initial ORC will be recovered in present value terms over the useful life of the network.[18] That is, this scenario which, unlike the base case tilted annuity, does not require increasing prices in the future requires prices now to be $2.43 per line per month higher than the $8.93 in the base case scenario, as shown in Table A-1 below.

5.4 UFB contract acts as a cap

96. Finally, we consider the implications of a fibre network operating alongside the copper network. We expect that given the greater quality of service able to be provided on a fibre network, even if the price for these services were to be higher than copper, it is likely that such prices would nonetheless provide a competitive constraint on the pricing of the copper UBA increment.

18 While it is possible to express a double tilted annuity as a closed form expression when the change in volume is proportional in each year, this is not the case in this example and the result has been estimated numerically.

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97. We have modelled the pricing constraint imposed by the fibre network as initially absent and then tightening as the fibre network is rolled out to more subscribers. This requires two assumptions:

- the ultimate price constraint imposed on the UBA increment once the fibre network is fully deployed; and
- the length of time for the deployment of the fibre network.

98. We further assume that the price constraint throughout the deployment period of the network tightens linearly, dropping from the initial price down to the ultimate price constraint at the final deployment and for all subsequent years. The modelling scenario is completed by computing the initial price that results in present value recovery of the initial capital cost over the life of the asset.

99. Because of the inherent uncertainty in the two key assumptions above, we consider the 2013 UBA increment calculated under a range of scenarios for these variables in Table 5-2 below.

Table 5-2 Initial UBA increment under alternative UFB cap scenarios

Ultimate fibre network constraint	Fibre network roll-out period (years)		
	6	8	10
$6	$20.03	$17.63	$16.16
$7	$18.41	$16.46	$15.26
$8	$16.79	$15.29	$14.37
$9	$15.18	$14.12	$13.47
$10	$13.56	$12.95	$12.58
$11	$11.94	$11.78	$11.68

Source: CEG analysis

100. The range of values for the fibre network constraint reflects levels that impose a binding constraint on the future pricing of the copper UBA increment. We believe that this is realistic. At constraints of $12 or higher, the UBA prices would actually *increase* from 2013 as a result of the constraint tightening, evoking a scenario where fibre prices are sufficiently high (even adjusted for quality) that copper prices are not constrained by them at their current levels. It is difficult to reconcile this with large-scale migration to the fibre network, as forecast by Deutsche Bank and expected by government policy.

101. Even the most conservative set of assumptions in Table 5-2 (a fibre constraint of $11 and a roll-out period of 10 years) still requires an initial price of $11.68 in order to recover forward-looking costs over the life of the network. This is $2.75 more than the $8.93 implied by the use of the tilted annuity. Table A-1 below shows the full series of prices and cost recovery calculated over the life of the asset.

102. It is important to note that the assumption of a cap imposed by UFB prices if applied to the base case tilted annuity or the utilisation tilt scenarios would result in costs in these scenarios being under-recovered over the life of the asset, since they both rely on prices of greater than $11 into the future. That is, if the Commission does not consider an adjustment to the benchmarked UBA prices as modelled above, then Chorus cannot expect to recover its forward looking costs.

5.5 Conclusion

103. The Commission's purpose for undertaking benchmarking is to approximate the outcome of undertaking cost modelling, without going to the time and expense of such an exercise. However, benchmarking against models that utilise particular cost recovery schedules that do not reflect issues that are important to the timing of cost recovery in New Zealand will lead to under/over recovery.

104. We have shown in this section that the constraint imposed by fibre prices and declining utilisation of the copper network will have significant effects on the path of cost recovery over the remaining life of the UBA asset. We have implemented a model for New Zealand that indicates that the Commission's draft benchmark UBA increment of $8.93 should be increased by $2.75 under conservative scenarios for the future fibre price constraint (quality adjusted) and the rollout period for the fibre network.

Appendix A Modelling results

105. Table A- below shows the full results of each of the three scenarios modelled as described in section 5 above, in terms of the level and changes of prices over time and the path of cost recovery.

Table A-1 Time series of modelled price and cost recovery

Year	Copper volumes	Prices ($)			Cost recovery ($m)		
		Base case tilted annuity	Utilisation tilt	Capped by UFB contract	Base case tilted annuity	Utilisation tilt	Capped by UFB contract
2013	1015	8.93	11.36	11.68	108,767	138,371	142,299
2014	997	9.09	11.36	11.61	108,767	135,917	138,958
2015	1002	9.05	11.36	11.55	108,767	136,598	138,834
2016	970	9.34	11.36	11.48	108,767	132,291	133,660
2017	939	9.65	11.36	11.41	108,767	127,983	128,538
2018	907	9.99	11.36	11.34	108,767	123,675	123,468
2019	876	10.35	11.36	11.27	108,767	119,367	118,450
2020	844	10.74	11.36	11.20	108,767	115,059	113,483
2021	781	11.61	11.36	11.14	108,767	106,470	104,372
2022	718	12.62	11.36	11.07	108,767	97,882	95,364
2023	655	13.84	11.36	11.00	108,767	89,293	86,460
2024	592	15.31	11.36	11.00	108,767	80,705	78,144
2025	529	17.13	11.36	11.00	108,767	72,116	69,828
2026	501	18.10	11.36	11.00	108,767	68,253	66,087
2027	472	19.19	11.36	11.00	108,767	64,390	62,346
2028	444	20.42	11.36	11.00	108,767	60,526	58,606
2029	416	21.81	11.36	11.00	108,767	56,663	54,865
2030	387	23.40	11.36	11.00	108,767	52,799	51,124
2031	359	25.25	11.36	11.00	108,767	48,936	47,383
2032	331	27.41	11.36	11.00	108,767	45,073	43,643

Source: CEG analysis