Next Generation Costing: Approaches to the Regulatory Costing of Next Generation Telecommunications Access Networks

Martin Duckworth and Jayanthi Batchelor

Frontier Economics Ltd

71 High Holborn

London

WC1V 6DA

United Kingdom

Telephone: +44 20 7031 7000

Fax: +44 20 7031 7001

Email: martin.duckworth@frontier-economics.com

Keywords: NGA, Telecommunications, Regulation, Costing

Abstract:

The roll out of fibre-based next generation access (NGA) networks in Europe and internationally has re-ignited interest in the issue of the appropriate approach to the costing of fixed telecoms networks for regulatory purposes. We consider the appropriate approach to the costing of the underlying network components, taking into account experience not only from the communications industry, but also other industries subject to access regulation.

Fixed access telecommunications networks are characterised by a high level of fixed costs which would make duplication of the network inefficient. This creates a barrier to entry and leads to incumbent fixed network operators having significant market power. This means that, under the EU regulatory framework, national regulatory authorities typically require incumbent operators to offer wholesale access at cost oriented prices. The EU framework has

attempted to introduce competition at the lowest level possible by mandating wholesale access at various points in the value chain.

In this context, regulators have a range of competing objectives when making decisions about the timing as well as the level of cost recovery. To date regulators have used a range of approaches to valuing assets including current cost accounting (CCA), historic cost accounting (HCA) or engineering models of networks ('bottom up' models). We consider both the economic case for different approaches, as well as the practical implications in the light of these competing objectives.

We find that there is significant variation in the characteristics of the main types of assets that make up the network and the regulatory objectives for setting charges for access to these assets. This could justify regulators adopting different costing methodologies by asset. Such an approach is consistent with the EU NGA Recommendation, which provides for the costing approach to vary between assets.

Introduction and summary

The roll out of next generation access (NGA) networks in Europe and internationally has re-ignited interest in the issue of the appropriate approach to the costing of fixed access networks for regulatory purposes.

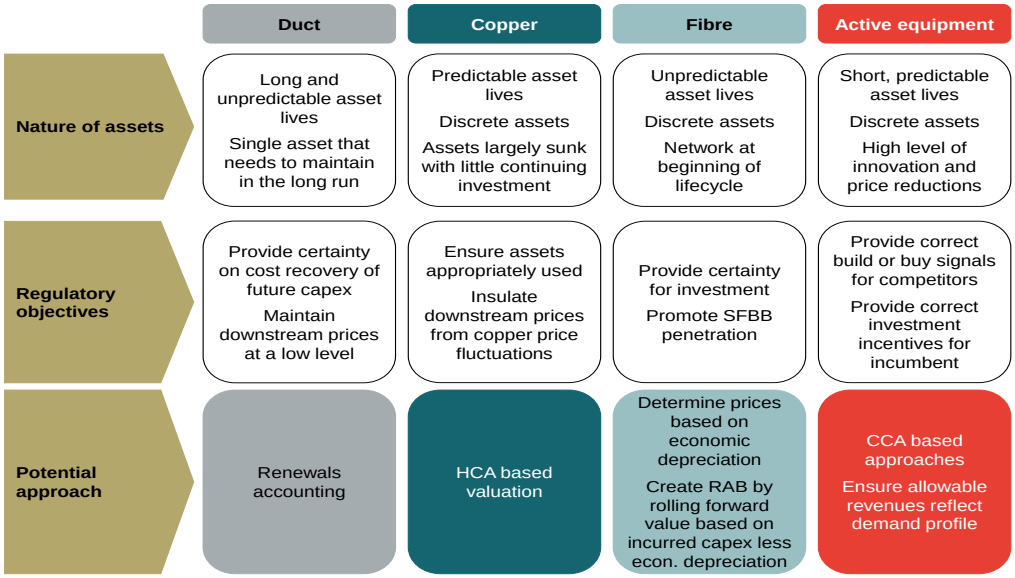
The largest element of the cost of access to fixed access networks relates to network assets and is an area where there is the greatest scope for differences in allowable revenues[1] under a price control in a given period, depending on the approach adopted as decisions need to be made about the timing as well as the level of cost recovery. In contrast operational expenditure can be directly included in allowable revenues in the year it is incurred. In this

[1] In this report we use the term 'allowable revenues' to refer to the cost oriented target level of revenues that a regulated company is allowed to earn under a price control. We make the distinction between 'allowable revenues' and 'cost' to emphasise that there is no single unique measure of cost.

report, we consider both the economic case for different approaches as well as the practical implications.

We find that different elements of the network equipment required to offer fixed access services, each have sufficiently different characteristics to justify a different costing approach. Such an approach is consistent with the EU NGA Recommendation[2] which provides for the costing approach to vary between assets[3]. Our views in terms of the most appropriate cost based approach for each of the assets is summarised in the Figure below.

Figure S1: Summary of recommendations



Source: Frontier Economics

These recommendations are based on the principle of cost orientation and exclude the impact of any potential externalities which might justify a departure from these principles.

---

2 COMMISSION RECOMMENDATION of 20 September 2010 on regulated access to Next Generation Access Networks (NGA)

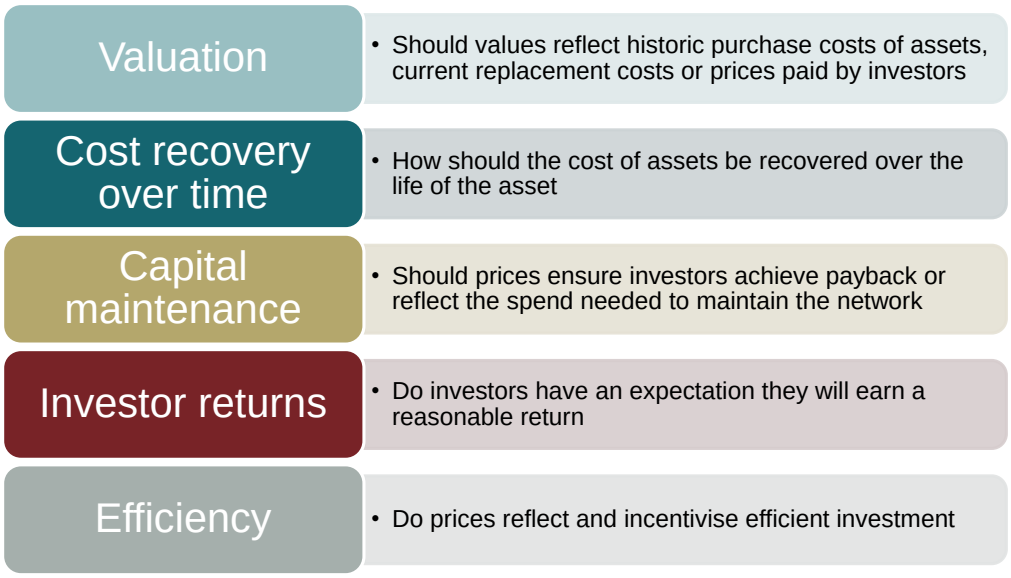
3 Annex I of the NGA Recommendation provides that a consistent regulatory approach may "imply that NRAs use different cost bases for the calculation of cost-oriented prices for replicable and non-replicable assets, or at least adjust the parameters underpinning their cost methodologies in the latter case." Where there are relevant differences in the character of assets, those differences can and should be taken into account in the regulatory approach.

Asset costing and regulatory objectives

Regulatory objectives

Choosing the methodology to determining costs requires typically striking an appropriate balance between competing objectives. There are a range of different decisions that need to be taken when determining asset summarised in **Figure 1**.

Figure 1. Objectives of access regulation



Source: Frontier Economics

The primary regulatory objective when costing methodologies were initially developed was to encourage the eventual deployment of competing fixed access infrastructures, where efficient for them to be deployed, with the ultimate aim of encouraging competition at the deepest level possible. In general, the most commonly used approach was a CCA-FAC method, which places weight on ensuring that prices match the regulator's current view of the 'competitive' level of prices, based on replacement costs in order to provide suitable entry signals. This was generally the case even where there was/is little prospect of the assets being duplicated by competitors.

Furthermore, regulatory costing in relation to access networks has commonly sought to use a 'one size fits all' approach, with all relevant assets being costed using a similar approach, with limited variations to reflect the underlying characteristics of the assets themselves, including their replicability.

As a result of developments in Next Generation Access technologies, and the need to consider expanding the capability of the fixed access network through the deployment of such technologies, there has now been a renewed interest in the appropriate approach to the costing of access network costs. This is considering not only the appropriate approach to the costing of the NGA assets, but also the 'legacy' copper access network assets.

Whilst the overall regulatory objective of encouraging competition at the deepest level of the network possible, to deliver long-term benefits to consumers, appears to continue to be an important objective, the consideration of the appropriate approach to costing needs to take into account two key developments:

- First, the deployment of NGA networks requires significant investment, which is expected to have a more risky profile than the previous access network investment into the legacy networks of today.
- Second, there is experience of the deployment of alternative fixed access infrastructures, which has led to a better understanding of the conditions under which fixed access infrastructures are replicable.

The need for significant new investment, and the improved understanding of replicability, suggests that a more refined approach to costing may now be desirable, with greater emphasis placed on the following objectives:

The need to provide greater regulatory certainty to **investors,** to enable efficient investment in next generation access networks by both incumbents and competitors; and

The need to ensure that **consumers** are not paying more than necessary for the use of legacy networks and do not disconnect or inefficiently switch to alternatives.

Potential methodologies

.A wide range of potential methodologies have been used and developed for determining the annual costs of assets in a regulatory context. These methodologies can be broadly classified into four groups:

- Approaches consistent with statutory accounting standards used by the regulated operator;
- Current cost accounting approaches that attempt to set prices that reflect the cost base of potential new entrant operators in order to ensure efficient entry;
- Economic depreciation approaches which attempt to set the the profile of cost recovery over time to reflect demand for services; and
- Regulatory asset valuation (RAV) approaches which focus on ensuring cost recovery over time.

Table 1 summarises the range of methodologies that have been used by regulators to determine costs for price control purposes with the most commonly used methodologies (in both telecommunications and other regulated sectors). Annex 2 provides a more extensive discussion of the different approaches.

Table 1. Approaches to asset valuation and determining allowable revenues

Approach	Valuation	Determining allowable revenues
Historic cost accounting	Valuation based on acquisition costs of individual assets used to provide regulated services	Allowable revenues consist of depreciation (typically straight line) and the cost of capital Constant depreciation charge and falling cost of capital leads to "front loading" of cost recovery
Current cost accounting (replacement costs)	Valuation based on replacement costs of individual assets used to provide regulated services	Allowable revenues consist of depreciation (typically straight line calculated as a percentage of the changing asset price), holding gain (loss) to reflect changing asset prices and the cost of capital Shifts cost recovery forwards (if

		asset prices are falling) or back (if asset prices are rising) compared to HCA
Annuities	Not required to estimate allowable revenues For an individual asset, derived using discounted future allowable revenues	Allowable revenues are constant over time in nominal or real terms
Economic depreciation	As for annuities	Allowable revenues may take account of the volume of output of assets in addition to changes in asset prices
Renewals accounting **(regulatory asset base)**	Changes in value calculated as capital expenditure less capital charges. Initial valuation may be exogenously determined, for example as price paid at acquisition.	Allowable revenues reflect capital expenditure required to maintain the asset base plus cost of capital employed

Source: Frontier Economics

Each of these approaches has strengths and weaknesses which may make them more or less applicable to a given set of assets as set out in **Table 2**. We consider these in the next section, where we provide our recommendations on the appropriate approaches to costing of fixed access networks.

Table 2. Strengths and weaknesses of approaches

Approach	Strengths	Weaknesses
Historic cost accounting	Costs can be precisely and objectively determined	Resulting prices do not reflect the changing costs of assets. Front loaded cost recovery may not be appropriate

Current cost accounting (replacement costs)	Costs reflect changes in underlying asset prices	Determining the replacement cost of assets introduces subjectivity and unpredictability Front loaded cost recovery may not be efficient
Annuities	No front loading of cost recovery Tilted annuities simple to implement in bottom up models	Allowable revenues are constant over time in nominal or real terms
Economic depreciation	Flexibility to profile cost recovery to reflect demand	High degree of subjectivity Valuations of existing assets may be highly sensitive to assumptions about future developments
Renewals accounting/regulatory asset base	Provides high certainty to investors that they will recover future investments	May be uncertainty over the correct level of maintenance expenditure Requires an initial valuation of existing assets

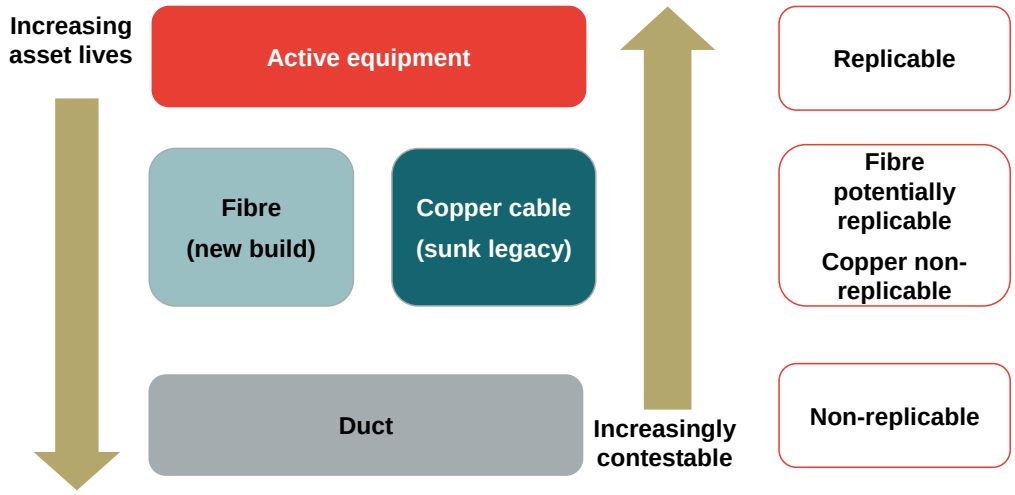
Source: Frontier Economics

Recommendations

The review of different methodologies available highlights that there is no single methodology that will necessarily achieve the best balance of the differing objectives for all assets. Thus the choice of methodology should follow an analysis of both the characteristics of the assets themselves and the regulatory and market context.

In this respect, it is useful to consider the 'supply chain' of the network access services, and analyse the factors that will affect the choice of methodology for each of the different groups of assets, as illustrated in **Figure 2** below.

Figure 2. Network access asset groups - with NGA



Source: Frontier Economics

Our view is that different elements of the network equipment required to offer fixed access services have sufficiently different characteristics to justify a different costing approach for the different elements. Regulation based on differential approaches reflecting the characteristics of each class of asset are widely used in both fixed telecommunications and

other sectors[4], with the EU explicitly recognising this possibility in Annex I of the NGA Recommendation.

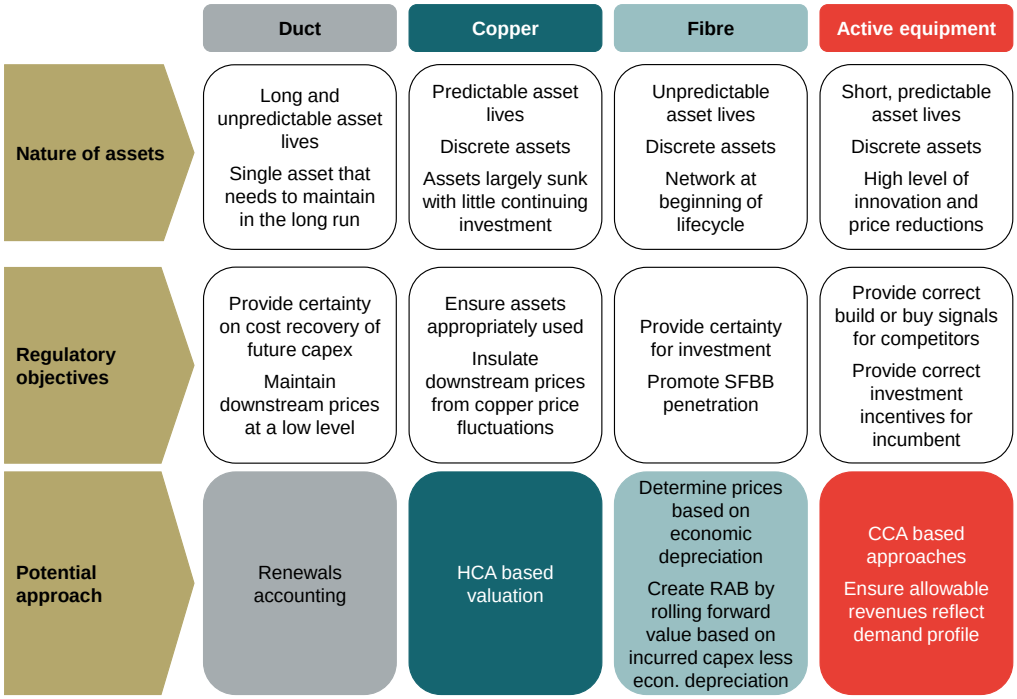
With the increasing complexity of regulated wholesale access in the EU, assets such as duct are inputs for a range of regulated services using different technology, for example fibre or copper, and for wholesale services in different parts of the value chain, such as active and passive services. Using different costing approaches for different assets should not lead to arbitrage opportunities between the prices set for those services provided regulators ensure consistency between services in both the determination of costs and the recovery of fixed and common costs.[5]

A summary of our recommendations on the most appropriate cost based approach for each of the assets is summarised in **Figure 3** and explained in more detail in sections 0 to 0. These recommendations are based on the principle of cost orientation and therefore exclude the impact of any potential externalities on pricing. Section 0 discusses how externalities may be taken into account by policy makers.

Figure 3. Summary of recommendations

4 For example in the UK water industry 'underground' assets are accounted for on a renewals accounting basis while 'above ground' assets are accounted for on a CCA basis.

5 We note for instance that the NGA Recommendation provides that IT and system costs fixed and common to different services should be allocated on a 'proportionate' basis across all access seekers including the downstream arm of the SMP operator. It also provides that costs for civil infrastructure access should be 'consistent' with the methodology used for pricing access to the copper loop. However, as noted in footnote [3] above, consistency does not imply an identical treatment particularly if there are relevant differences in the nature of the assets.



Source: Frontier Economics

Duct

Nature of the assets

Duct assets are typically the longest lived assets in telecommunications network, with asset lives typically determined by regulators to be of the order of 40 years, although there is considerable variation in assumptions. The asset base is also not a collection of discrete assets as ducts are by their nature a continuous network. For example when a section of duct is replaced, it is not immediately obvious which, if any, part of the existing duct asset has been retired.

The asset valuation largely relates to the capitalised labour costs involved in installing and maintaining the duct network, rather than the underlying physical inputs, which also increases the difficultly of assigning value to individual assets. A single entry in the asset register for capitalised costs may related to a installation and maintenance activities across a range of duct assets.

Regulatory objectives

Given the very long life of access assets, the risk of setting allowable revenues which result in over- or under-recovery of efficient costs is considerable. This is accentuated by the difficulties of accurately measuring the installed asset base or accurately modelling the assets required for a hypothetical "efficient" operator through a model.

In addition, the roll out of NGA may require significant forward expenditure in upgrading the existing duct network to allow fibre rollout. Ensuring these investments are made will require providing investors with certainty on the future recovery of these asset costs.

As duct will be used for both current broadband services and SFBB services, keeping prices as low as possible consistent with efficient investment, and providing a smooth and predictable profile of allowable revenues appears to be the more important objective.

To the extent that ducts are largely non-replicable, setting prices to reflect the "competitive' level of prices based on replacement cost should not be one of the objectives.

Potential approach

A renewals accounting based approach seems consistent with both the nature of the asset and the need to provide regulatory certainty. Such an approach raises some challenges in terms of:

- Determining the opening valuation;
- Determining the operational capital maintenance based depreciation charge; and
- Ensuring that additions to the asset base are efficient and justified.

The most contentious issue is likely to be the opening valuation. A book value (HCA) based approach may be appropriate in many jurisdictions for a number of reasons.

First, there seems little reason to base an initial valuation on an estimate of net replacement cost for competition reasons to the extent that the network is assessed to be largely non-replicable.

Second, even where regulated prices are currently set based upon CCA this change is likely to have been made relatively recently. Thus any holding loss in moving from a CCA valuation to a HCA valuation will to a large extent be a reversal of the holding gain made when regulation moved to CCA.

Third, HCA based approaches are likely to result in relatively low prices in the future which is consistent with the objectives of ensuring high penetration of broadband services and ensuring productive efficiency by making full use of sunk assets.

Where evidence suggests that the book value of the network is overstated due to previous inefficiencies, additional downwards efficiency adjustments could be considered to the valuation.[6]

In theory, if the duct network is in a steady state, the average capital expenditure required to maintain the network should be approximately equal to a depreciation charge based on replacement costs. Thus, a move to a renewals accounting approach should not significantly alter the level of prices. In practical terms, basing prices on the directly observable level of capital expenditure, rather than a series of highly uncertain estimates of duct asset lives and the replacement cost of the complete network, are likely to provide far greater certainty to both regulators and to investors.[7]

Copper cable

Nature of the assets

The asset life of copper cable is typically determined to be of the order of 20 years, reflecting degradation in the cable over time. While the cable network forms an end-to-end network, it can be broken down into individual assets in a way that is not possible with duct, for example. This is because the physical materials are a high proportion of the costs of copper cable and each cable will generally be replaced in its entirety at the end of its useful life.

---

6 Such evidence may come from, for example, bottom-up cost models.

7 This should help achieve the objective of the NGA Recommendation which provides that access prices 'reflect the costs effectively borne by the SMP operator' taking account of actual asset lifetimes.

Regulatory objectives

Copper cable is no longer likely to be the Modern Equivalent Asset (MEA), which can be observed by the increasing use of fibre only networks in new build property developments. Setting regulated prices based on the replacement cost of copper cable would not seem therefore to provide appropriate price signals for future investments by potential entrants or existing competitors to the incumbent network. Indeed, using replacement costs could mean that wholesale access prices would be driven by volatility in the prices of copper in commodity markets and could lead to a disincentive to invest in downstream markets as future profitability would be dependent on the price of copper. Linking regulated prices to volatile copper prices may also lead to significant under or over recovery of costs, compared to the valuation of existing assets.

Where the likelihood of future investment in copper cables is limited, incentivising future investment in copper is not likely to be a primary consideration. A more important consideration is likely to be maximising overall productive efficiency by ensuring that this existing asset is adequately utilised.

In areas where fibre is either already rolled out or could be rolled out, the level of prices determined for copper based services will have an effect both on the incentives for fibre investment and the penetration of fibre in the areas where it is rolled out. The exact relationships will be complex, depending on current and future parameters (such as cross price elasticities of demand between copper and fibre based products) which cannot be determined with any level of certainty at present.

In the absence of significant externalities, the regulator may not need to directly address issues of fibre investment when setting prices for copper based prices. If the regulator commits to setting prices that reflect forward looking costs for both copper and fibre based products, investors can internalise the decision as to whether a given fibre based investment is efficient or not. This case is addressed further below.

If NGA generates significant positive externalities, regulators may choose to set prices in a way to realise these gains by incentivising investment in NGA above a level that would occur when prices are set to solely reflect costs. This is addressed further below

Potential approach

In the absence of any externalities, productive and allocative efficiency would suggest setting prices at a level that reflects the forward looking costs of operating and maintaining the network.

In terms of allocative efficiency, setting prices at this level would ensure that the existing sunk asset was efficiently utilised, avoiding the risk that demand that could be met went unserved, for example broadband customers leaving the network. In terms of productive efficiency, it would incentivise future investment in substitute networks where such alternative networks offered some combination of lower forward looking costs and increased capability.

However, setting prices to only reflect forward looking costs, if leading to an implicit writing off of the remaining value of past investments, would set a precedent which could discourage future investment. Thus, some account must be taken of the value of the existing assets. An HCA valuation of the existing network may be a reasonable opening RAV (Regulatory Asset Value), where this allows the operator to make a reasonable return on their past investment, without pricing copper based services significantly above forward looking cost.

Access fibre

Nature of the assets

Given the limited experience of operating mass market fibre access networks, the economic and engineering life of fibre cables may not be readily determined. Regulatory precedent for core transmission fibre and fibre serving large enterprises suggest an asset life similar to copper cable.

Similarly to copper cable, it should be possible to easily identify individual components of a fibre network, and given the availability of geographic information systems, as the fibre network is being rolled out, operators should have an accurate inventory of the network.

Regulatory objectives

The Commission has dual objectives of ensuring widespread availability of SFBB and encourage take up. This requires a balance between investment incentives for efficient roll out and maintain prices at a level that allows for rapid take up.

There is potential for competition for fibre based wholesale services, both from alternative networks and from operators using regulated access to the duct network. However, given the nascent stage of the market and the long pay back periods for competing networks, competitors' investment decisions may be less dependent on the level of prices in the period of network roll out and more dependent on certainty on the regulatory regime going forwards.

Potential approach

While the nature of the asset base means that it would be relatively straightforward to develop CCA estimates for fibre networks, on a straight line basis or a tilted annuity basis, the relative low utilisation of networks in the early years of roll out may result in achievable revenues being below the calculated allowable revenues based on a CCA straight line or annuity approach initially. This may lead to under-recovery over the longer term as the operator would never be able to recover the allowable revenues 'foregone' in the initial period.

An economic depreciation approach could be used initially to allow allowable revenues to reflect the limited demand during the phase when the network was being rolled out.

The main weakness of an economic depreciation approach which is dependent on judgemental assumptions about future developments, is the increased regulatory risk to investors. This risk is likely to be especially great for fibre roll out, given the high degree of uncertainty about future demand and costs. Under many economic depreciation approaches both the forward looking allowable revenues and the (implied) opening valuation of assets in

each price control period will differ from the closing value from the previous control, reflecting the new information available since the previous price control. This could result in significant holding gains and losses at the beginning of each price control period as new data and revised forecasts of future market developments are included in the valuation. These holding gains or losses could in turn lead to under- or over-recovery of investments.

The regulatory risk due to resetting the valuation at the beginning of each price control period could be significantly reduced by using a RAV approach. Rather than independently setting the opening valuation for each price control, the opening regulatory valuation for successive price control periods would be calculated by "rolling forwards' the previously determined opening valuation adding the capital expenditure incurred and subtracting the determined depreciation charges in the previous period. This would remove the risk of significant holding gains or losses.

Such an approach would require three elements to be determined by the regulator:

- The opening RAV when the price control was first introduced;
- The depreciation charges used to set the allowable revenues; and
- The level of capital expenditure to include when the RAV is rolled forwards to the next period.

As investment in Next Generation Access networks has been relatively recent and to date has been limited, setting the opening RAV may not be critical, as the valuation should be relatively close to the expenditure to date, less an allowance for the costs recovered to date.

Depreciation charges can be determined according to an economic depreciation calculation, similar to that used in MTR determinations in many jurisdictions. This would be a two stage process:

- Setting the profile of future allowable revenues for existing assets to reflect expected changes in asset prices and demand; and

- Scaling this profile so that the net present value of the future allowable revenues equals the current RAV for the asset.

Setting forward looking prices controls will require some forecasting of future capital expenditure. In some regulated industries, for example UK water, forecasts have been included as an input when setting the RAV in order to provide incentives for the regulated company to ensure capital expenditure is efficiently incurred. However given the uncertainties surrounding investments in NGA, any regulatory forecasts are likely to be subject to a high degree of uncertainty and the incentive effects of giving weight to such forecasts is likely to be small. Thus it is likely to be appropriate to include actually incurred capital expenditure in the RAV.

Including actual capital expenditure would provide both investor certainty and protect consumers from over-recovery. Using an economic depreciation approach would set prices at a level that reflected the need to increase penetration in the medium term.

Active assets

Nature of the assets

Active assets used for providing broadband and/or narrowband services over the fixed access networks typically have relatively short economic lives, driven by technological developments making existing assets obsolete. Equipment may be in service for say 10 years, but for some of the operational life, the equipment may be used to provide support for legacy services in parallel with the latest generation of equipment. Thus some allowance may need to be made for the fact the equipment is not fully utilised for the whole of its operational life. Technological development typically results in comparable equipment either falling in price in real terms over time, or increasing in capability (on a MEA basis resulting in falling unit costs).

Compared to the passive elements of the access network, the number of active components is relatively small and the components are discrete, rather than continuous.

Regulatory objectives

Many active components may be considered to be replicable. For these components the regulator's objectives will need to balance allocative and productive efficiency with the benefits resulting from greater competition.

Recommendation

Given that assets are likely to be determined to be replicable a CCA based approach reflecting replacement costs is likely to be appropriate. The exact choice of methodology will need to take into account a number of factors including:

- Whether the network is in a "steady state' with an even mix of asset lives and steady demand or whether the allowable revenue profile needs to take account of rapidly changing utilisation; and
- The need to allow for the additional costs of dual running technologies.

Setting copper and fibre prices to account for externalities

If there are significant externalities associated with NGA roll out, then setting regulated prices on the basis of forward looking costs alone could lead to welfare enhancing investment not being undertaken. This is because investors would only take account of the potential increase in revenues due to the availability of fibre based services relative to the increase in cost of rolling out fibre. Thus there may be cases where the increase in revenues due to fibre is not sufficient, even where overall economic welfare would be enhanced by the investment being made. In these circumstances an efficient outcome may require the policymaker to provide a subsidy to the operator for rolling out fibre in these areas, which would reflect identified externalities. These subsidies could be funded from outside the industry, for example through general taxation, or within the industry if a direct subsidy from government was not available. Any subsidies would need to be directly linked to increased roll out, rather than simply increasing the revenues of fixed access operators.