Costing methodology and the transition to next generation access

A report for ETNO

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March 2011

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Executive Summary

The European Commission has issued a recommendation on next generation access regulation and its "A Digital Agenda for Europe" of 2010 which proposes that "*the Commission will prioritise the provision of guidance on key regulatory concepts under the electronic communications rules, in particular costing methodologies [..]"*.

As an input to the development of this guidance the European Telecommunications Network Operators (ETNO) commissioned Plum to produce a report on costing methodology taking particular account of the transition from current to next generation access (NGA). In addition, Plum was asked to consider the interaction of *ex ante* price controls and margin squeeze. The focus of our analysis is on costing and pricing rather than on the overall regulatory approach.

Context in terms of next generation access goals and wider objectives

Europe has clear targets as part of the Digital Agenda and the EU2020 strategy in terms of next generation access: universal availability of at least 30 Mbps and take-up by 50% of households of 100 Mbps by 2020. Fibre (to the premise or cabinet), cable and wireless can all contribute to meeting these targets. However, there is a large gap between what has been achieved to date and the targets for 2020 and the capital investment required is substantial. In addition to consideration of investment required to achieve the Digital Agenda targets in our evaluation of alternatives we consider objectives in relation to competition, digital inclusion and furthering the single market.

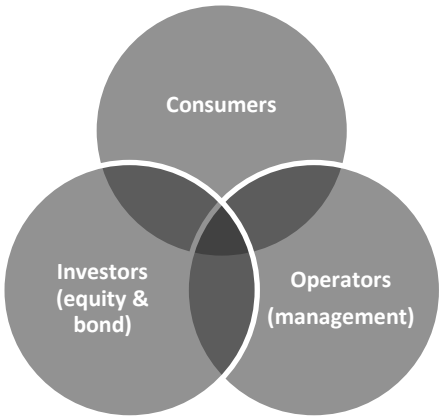
The transition challenge

During the transition existing and next generation access will compete with each other for customers. This has three implications relevant to our analysis:

- Additional competition between current and NGA during the transition should be taken into account in assessing the need for *ex ante* price controls for both copper and NGA.
- Price controls applied to copper will impact on the business case for NGA investment, as lower prices reduce consumers' incentive to switch from copper to NGA. Greater regard should therefore be given to both build/buy and consumer switching signals during the transition.
- There must be a reasonable prospect of recovery of the parallel running costs of copper and NGA networks to support investment in NGA.

Meeting the challenge by aligning interests

Decisions by consumers, operators and investors will determine the extent and timing of NGA investment. Aligning their interests with the achievement of European policy goals is essential to the achievement of these goals, particularly given the challenges identified above.



The above stakeholders have a range of options open to them, and adoption of and investment in NGA is not a foregone conclusion. The policy framework must provide incentives that align their interests with achievement of European goals in relation to NGA. We developed the following set of principles consistent with achieving such alignment.

Principles to guide analysis of options

1. Competition and neutrality both in terms of build/buy decisions and platform neutrality. The aim is not to distort efficient choices by access providers and access seekers.
2. Efficient network transition. The aim is to ensure there are incentives for end user switching to NGA and for on-going investment in NGA.
3. Protecting consumers' short-term and long interests. Consumers' have an interest in paying enough to align investors' interests with their preferences, but no more.
4. Protecting investors' interests over time. The approach must provide a reasonable prospect of cost recovery.
5. Furthering the single market via an appropriate level of harmonisation. Appropriate harmonisation may also support NRAs in providing regulatory commitment.
6. Commitment, consistency and transparency to ensure incentives are effective given the time frame over which investment must be recovered and to provide legitimacy to the regulatory framework.

The linkage between the price of copper and NGA investment

Some have argued that lower prices for copper would encourage NGA investment by making copper relatively less attractive to investors. However, this argument is flawed since fibre must be attractive as a stand-alone investment in absolute terms (since investors have a wide range of investment options). Further, consideration of other possible linkages between the price of copper and NGA investment in the following box implies the opposite conclusion, namely that a lower copper price would discourage NGA investment by encouraging customers to stay on copper and/or resulting in lower prices, thereby negatively impacting on the fibre business case.

Possible linkages between copper pricing and the NGA investment case

- A lower copper price will make it less likely that customers will voluntarily migrate to more expensive products and/or result in lower NGA retail prices, thereby undermining the business case for NGA.
- A lower copper price may stimulate broadband take-up and therefore increase the customer base that might transition to fibre. However, this linkage is unlikely to be material as there are important non-price barriers to Internet and broadband adoption, incremental adoption is increasingly dominated by mobile broadband and existing non Internet users are unlikely to be willing to pay for NGA.
- Lowering the price of copper may signal to potential investors that once fibre investment is sunk the price of fibre might also be lowered, thereby deterring investment.

The challenge of developing a costing and pricing methodology

Developing a costing methodology may appear straightforward - if one wanted to estimate the cost of, say, a cup of coffee one would take the market prices for the inputs such as coffee beans, rent, labour etc; add them up and divide by the number of cups of coffee sold. However, for both copper and fibre networks costs incurred up-front must be recovered over an extended period of time including an appropriate return on capital. In the case of fibre, costs must be estimated before they are incurred and demand is known.

Once a cost estimate is available it must in turn be translated into a price control. However, it may be desirable to apply different prices to different classes of customers to: (i) support investment, (ii) ensure neutrality with competitors who are free to price differentiate, and (iii) promote digital inclusion. Price differentiation may also be efficient across access seekers, for example, between those prepared to assume risk by committing to buying a number of access lines up-front versus those who lease them when and if they have a customer. Preserving such flexibility when applying cost orientation is desirable, but it is not straightforward.

We note that the additional competition between copper and NGA during transition and the twin challenges of applying a costing methodology to NGA and preserving incentives for efficient and timely investment may often be sufficient reason, at least at an initial stage, for not applying *ex ante* price regulation to NGA. However, our analysis focuses on what approach should be adopted in relation to both copper and NGA assuming a decision has been taken to apply *ex ante* price controls.

Common themes across cost modelling approaches

We found that the choice of modelling approach could be narrowed but not decided simply by *a priori* reasoning. Further, we found that good outcomes may be achieved with a range of methodologies provided certain conditions are met in terms of how the methodology is applied. In particular (and taking the protection of consumers against potential monopoly abuse as a given) the following common themes are identified.

Common requirements

- The cost of copper should not be arbitrarily reduced and should maintain parity with replacement cost.
- Joint and common costs such as duct and overheads are migrated to fibre as customers switch to fibre. A simple approach would be to reassign each customer's share of joint and common costs from copper to fibre as and when customers migrate. This approach would avoid any price discontinuity at the beginning or end of the transition.
- Actual network configurations and costs (including a return on and of capital) rather than hypothetical configurations and costs should be utilised where feasible. We note that there is little risk of cost inefficiency arising given the challenge of recovering the costs of NGA, let alone any inefficiently incurred costs.
- Costs incurred in maintaining two networks in parallel during the transition should be recoverable.
- For NGA, sufficient price flexibility to support recovery of costs over time and across customer segments in a manner that maximises the prospects for commercial success and therefore investment.

Preferred methodologies

We characterise the detailed costing methodology in terms of the approach to asset valuation (historic or replacement/current cost), whether the modelling/accounting approach is top down (from the accounts) or bottom up (based on a model of the network) and whether an incremental (LRIC) or fully allocated cost (FAC) approach to costing is adopted.

The discounted cash flow (DCF) approach is less familiar, though this approach is now used in the Netherlands to set fibre to the home (FTTH) prices. The aims of the DCF approach are to explicitly take into account the multi-year nature of cost recovery over the economic life of assets for NGA; recognise the need to utilise commercially viable price and volume assumptions and the interdependence between the two; and the need to schedule recovery over time in a manner that maximises the prospects for cost recovery.

Adopting the DCF approach would require greater dialogue between stakeholders in order to test the regulatory costing against business case modelling assumptions, and a prior and transparent commitment to the approach given the need for a price path commitment. We focus our assessment of the DCF approach on fibre rather than copper given the link to business planning and recovery of large up-front investment with demand uncertainty and low initial demand.

Assessment for copper

Top down and bottom up CCA and LRIC approaches have merit for copper in terms of competitive neutrality and efficient network transition. Bottom up LRIC is likely to provide a better signal for fibre investment, but top down approaches may also provide efficient signals, depending on the age of assets, approach to revaluation and treatment of fully depreciated assets. We found that in order to provide appropriate incentives for investment and ensure platform neutrality, the full set of assets should be included, not excluding fully depreciated assets. Historic cost for copper would not provide appropriate signals for fibre investment.

In the early years of the roll out of fibre, the value of assets and regulatory prices will be high under historic cost (HCA)/ top-down current cost (CCA) approach as the average age of the assets will be

near new (in the case of CCA this holds provided input prices are not increasing too fast). However, the value of copper assets will be low (due to both the age of assets and the fact that some assets are likely to be fully depreciated). This means that regulatory prices based on HCA/ top down CCA will produce low prices for copper and high prices for fibre, introducing a barrier to customer switching from copper to fibre, and will increase the risk of under-recovery of cost by investors.

This implies that it may be preferable to set copper prices in relation to bottom up long-run incremental cost (LRIC) whilst setting fibre prices on a DCF basis in order to promote migration. An implication of this is that consistency in methodological approach for copper and fibre, i.e. applying the same methodology for copper and fibre, may distort incentives for an efficient transition (though consistency over time and for copper and fibre methodologies considered separately is nevertheless desirable).

In addition, as copper will be progressively retired in delivering the 2020 targets, this provides a rationale for maintaining the status quo approach in member states. Further, switching methodologies may undermine expectations in relation to regulatory commitment for future fibre investment. We therefore propose a status quo based approach for copper.

Indicative assessment of approaches for copper

	Competition & Neutrality	Efficient network transition	Protecting consumers	Protecting investors	Commitment, consistency & transparency
Top Down FAC HCA	○	◔	◑	◔	◑
Top Down FAC CCA	◑	◑	◑	◕	◑
Top Down LRIC CCA	◑	◑	◑	◕	◑
Bottom Up LRIC CCA	●	●	◑	◑	◔

● supportive / ○ not supportive

Note: CCA is the most widely adopted approach so no change from this approach is consistent with harmonisation.

Assessment for fibre

Historic cost provides reasonable assurance of cost recovery provided allowance is made for inflation in setting prices. The failure to revalue assets under historic cost may result in a profile of cost recovery over time which does not provide accurate price signals for new investment and for investment in other platforms. Prices based on historic cost are likely to be high in the initial years and low in later years, discouraging an efficient transition.

Top down CCA based approaches should provide reasonable assurance of cost recovery with FCM (Financial Capital Maintenance). LRIC and FAC approaches result in 'optimisation' of costs and so undermine assurance of cost recovery. However, provided an appropriate approach to capital maintenance is followed, asset revaluations will be taken into account in setting prices and this will provide reasonable assurance of cost recovery.

Bottom up LRIC and DCF approaches provide superior price signals for network competition and for efficient network transition, as they allow the smoothing of cost recovery between the initial time period when penetration is low and later time periods when penetration is increased. Some smoothing is also possible under a CCA approach, but this is not likely to be sufficient to address demand related issues. All approaches have the potential to protect consumer interests by restricting potential abuse of market power (although at least in the short term there appears to be little prospect of abuse of market power given competition from copper, wireless and cable where available).

A bottom up LRIC approach is open to "re-optimisation" and revaluation over time, thereby exposing investors to regulatory action that may undermine prospects for cost recovery. This is likely to be of particular concern to fibre investors, given the high sunk cost of investment, long asset life and continuous technological change.

The DCF approach explicitly sets prices to recover investment over a specified time period (and any regulatory decision to adjust subsequent prices would be transparent and agreed in advance thereby improving commitment). However, it would require the separate calculation of joint and common costs to determine fibre pricing. Whilst it would in principle be possible to achieve some of the cost smoothing benefits of this approach by developing a price control for a multi-year period (e.g. 5 years) based on top down CCA cost data (if available), this approach may provide less assurance about recovery beyond the first price control period.

Indicative assessment of approaches for fibre

	Competition & Neutrality	Efficient network transition	Protecting consumers	Protecting investors	Commitment consistency & transparency
Top Down FAC HCA					
Top Down FAC CCA					
Top Down LRIC CCA					
Bottom Up LRIC CCA					
DCF					

The positive effects of the discussed approaches are dependent on an appropriate implementation of the respective models.

Recommended costing methodologies for copper, VDSL and fibre in transition

	Copper	VDSL	Fibre	Conditions
Top Down FAC HCA	✗	✗	✗	n/a
Top Down FAC CCA	✓	✓	?	Network is not heavily depreciated/fully depreciated assets not excluded Consistent approach to capital maintenance Reasonable basis for efficiency adjustment
Top Down LRIC CCA	✓	✓	?	Network is not heavily depreciated/fully depreciated assets not excluded Consistent approach to capital maintenance Reasonable basis for efficiency adjustment
Bottom Up LRIC CCA	✓	?	?	Realistic network topology Based on actual operating costs Consistent approach to efficiency over time Asset lives adjusted to reflect stranding risk
DCF	✗	✗	✓	Regulatory commitment Risk adjustment to allow for demand risk Incorporate actual costs over time Offset any under-recovery due to margin squeeze rules

Note: with regard to copper networks, switching methodologies carries the risk of denying cost recovery and may undermine investor confidence in relation to the approach adopted for NGA.

Risk, demand and the cost of capital

Investment in NGA is risky because substantial investment is required - the NGA must compete with copper, wireless and cable where available and because the incremental willingness to pay for next versus current generation access is uncertain and at least initially may be limited. NGA investment therefore involves risk in terms of demand and price.

One element of the approach to addressing such risk is to consider the appropriate weighted average cost of capital (WACC) to utilise in relation to NGA (as the EC propose in the next generation access recommendation). To the extent that returns on NGA are less certain and that such risk is non-diversifiable it should be reflected in the WACC calculation via the 'beta' factor that captures the degree of risk relative to the market as a whole. However, this adjustment does not capture much of the impact of risk since if anticipated volumes do not eventuate; it may not be possible to achieve the anticipated return. We therefore propose that separate provision for demand risk be provided either through a price premium; or a volume based reward (alongside the risk associated with a low demand outcome).

Of the two approaches the volume based reward, which requires a commitment to allow investors to profit from demand in excess of an agreed baseline, is more clearly contingent on achievement of a good outcome (high take-up).

Finally, in relation to risk and the cost of capital, regard should be had to the impact of any risk sharing or volume commitments entered into by access seekers. Such arrangements may raise expected demand (if the access seeker has some comparative advantage in retailing) or reduce risk to the

investor (if the access seeker is prepared to commit to a given level of demand in advance). Either way, the investor might be expected to share the benefits with the entrants and this should be taken into account in setting *ex ante* price controls and/or margin squeeze tests, i.e. the same benefit should not apply to access seekers who do not raise expected overall demand and/or share risk.

Avoiding double jeopardy in the application of margin squeeze

Operators with significant market power may be subject to both *ex ante* price regulation and a margin squeeze test applied *ex ante* by the regulator and also *ex post* under competition law. There is a risk that the application of multiple constraints will deny cost recovery (or raise the expectation of denial) even where individually the constraints might appear reasonable. In particular if retail prices are depressed due to competitive pressure (for copper due to competition from wireless and potentially cable, and for fibre due to competition from regulated copper in addition to wireless and potentially cable), then this may constitute grounds for not applying *ex ante* price controls rather than concluding that a margin squeeze exists.

Commitment and volume discounts raise a question as to whether the margin squeeze test should be applied to the wholesale charge excluding or including the discount. This raises the broader issue of whether to apply a 'reasonable efficient competitor' test (a reasonably efficient competitor) or an 'equally efficient competitor' test (a rival that is at least as efficient as the dominant firm). The Commission has recommended that a reasonably efficient competitor test is applied in the NGA recommendation as competitors may not enjoy the same benefits of economies of scale and scope as the firm with significant market power (SMP). However, this approach is inconsistent with competition law precedent, increases uncertainty for network operators and could result in inefficient competitors being protected or an operator being protected due to poor strategic decisions of competitors.

We see no reason to protect competitors who compete in a narrow range of services and, in particular the application of a margin squeeze to a single wholesale or retail product should be avoided, otherwise the ability to engage in price differentiation in the retail market will be constrained. It is both likely and desirable that margins on products will vary depending on consumer's willingness to pay. Further, the low incremental cost of adding an additional customer after the network is built out mean that it is economically efficient to attract low margin customers to the network, thereby improving expected revenues and the goal of digital inclusion.

In regard to volume discounts, we consider that it is the wholesale discounted price that provides the basis for the margin squeeze test. There may be a case for ensuring that such discounts could apply to more than one service provider, but it would be counter-productive to limit discounts to the size of the smallest firm in the market.

We recommend that regulators focus the margin squeeze test on the term commitment price and avoid application of the margin squeeze test to the short-term price by ensuring a competitive and transparent process for the take up of risk sharing commitments. Otherwise, there is risk that the application of the margin squeeze test to the price without a commitment discount may undermine the ability of parties to enter into risk sharing arrangements.

1 Introduction, context and goals

The European Commission has issued a recommendation on next generation access regulation and "A Digital Agenda for Europe" of 2010 proposes that "*the Commission will prioritise the provision of guidance on key regulatory concepts under the electronic communications rules, in particular costing methodologies and non-discrimination".* [1]

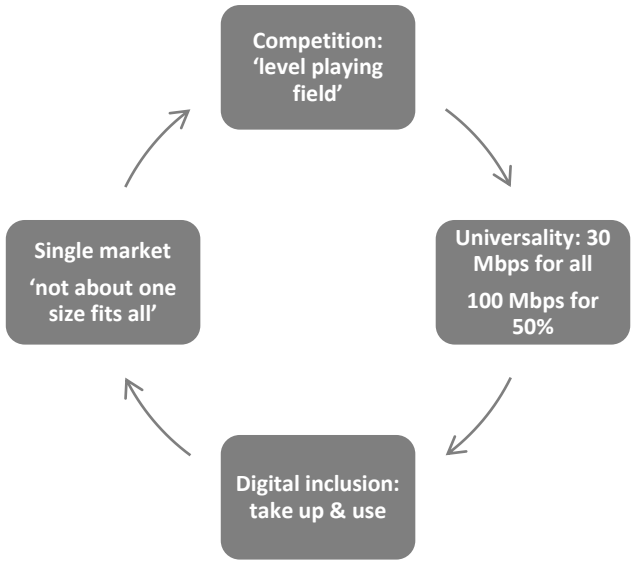
1.1 Our terms of reference

As an input to the development of this guidance the European Telecommunications Network Operators (ETNO) commissioned Plum to produce a report on costing methodology taking particular account of the transition from current to next generation access (NGA). In addition, Plum was asked to consider the interaction of *ex ante* price controls and margin squeeze. The focus of our analysis is on costing and pricing rather than on the overall regulatory approach.

1.2 European goals

The objectives of policy and regulation in Europe have been set out in Communications Framework and the Digital Agenda for Europe. Europe has clear targets as part of the Digital Agenda in terms of next generation access: universal availability of at least 30 Mbps and take up by 50% of European households of 100 Mbps by 2020. Other goals include the promotion of competition, digital inclusion (including internet adoption) and the single market. Figure 1-1 outlines the interaction between the Commission's objectives.

Figure 1-1: Delivering multiple European objectives



[1] EC. July 2010. "A Digital Agenda for Europe." http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF

The single market facilitates the development of competition, particularly between platforms and this in turn encourages investment in facilities. Investment in facilities is required to deliver the Commission's broadband targets and facilitate universal access to broadband.

A range of stakeholders including consumers, operators and investors, national regulators and the European Commission, have a role to play in achieving these goals. We return to the need to align these stakeholders' interests after briefly considering what has been achieved and remains to be done.

1.3 What has been achieved and remains to be done

A great deal has been achieved in Europe over the past decade without the need for public funding. A transition from dial-up internet to broadband has been achieved with the majority of households in Europe now having access to broadband and relatively high levels of take-up – predominantly of copper based DSL.[2] [3] However we note that approximately one-third of Europeans currently do not use the internet.[4]

Mobile broadband is also evolving rapidly with 3G service take-up and smart device take-up growing rapidly and early deployment of LTE networks underway. However, much remains to be done and, in some areas (the extent of fibre and LTE deployment), Europe lags some regions including the US.

Delivering high speed universal broadband will require substantial investment in new technologies. The Commission estimates that between €38bn and €58bn is needed to achieve the 30 Mbps coverage for all by 2020 (using a mix of VDSL and next generation wireless) and between €181bn and €268bn to provide sufficient coverage so that 50% of households are on 100 Mbps services.[5] We note, however, that the cost of genuine universality may be even higher when account is taken of what different technologies will deliver in practice. For example, the FCC estimate the public cost (the cost after allowing for forecast commercial deployments) of delivering 4 Mbps universally by 2020 in the US at $20 billion.[6]

1.4 The transition challenge

During the transition existing and next generation access will compete with one another for customers. This has three implications relevant to our analysis:

- Additional competition between current and NGA during the transition should be taken into account in assessing the need for *ex ante* price controls for both copper and NGA, in addition to taking it into account in the actual cost modelling exercise once cost-based regulation does apply.

[2] EC. December 2010. "Internet access and use in 2010". http://europa.eu/rapid/pressReleasesAction.do?reference=STAT/10/193&format=HTML&aged=0&language=EN&guiLanguage=en

[3] EC. 25 November 2010. "Digital Agenda: broadband speeds increasing but Europe must do more." http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/1602

[4] EC. http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Use_of_ICTs_and_use_of_on-line_services_(%25_of_individuals_aged_16_to_74).png&filetimestamp=20101210155012

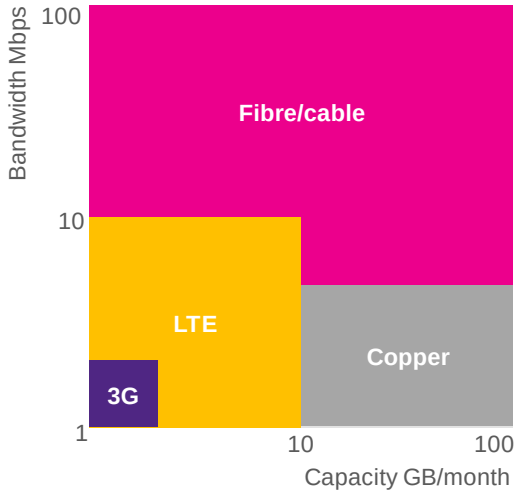
[5] EC. 20 September 2010. "European broadband – Investing in digitally driven growth", http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0472:FIN:EN:PDF

[6] FCC. April 2010. "The broadband availability gap". http://www.broadband.gov/plan/broadband-working-reports-technical-papers.html

- Price controls applied to copper will impact on the business case for NGA investment by reducing consumers' incentive to switch from copper to NGA. Greater regard should therefore be given to build/buy and consumer switching signals during the transition.
- There must be a reasonable prospect of recovery of the parallel running costs of copper and NGA networks to support investment in NGA.

Cable (where available) and fibre have been identified as competitors. However, during the transition to fibre, copper (subject to *ex ante* price controls), will be an important competitor to fibre. Further, advanced wireless technologies e.g. LTE and additional spectrum including UHF spectrum (freed up via analogue TV switch off) and 2.6 GHz spectrum will improve the capability of wireless to compete in the broadband access market over the next five years. LTE plus additional spectrum will offer higher speed and lower cost per GB carried than 3G. The relationship between capacity, speed and technology is illustrated in Figure 1-2.[7]

Figure 1-2: Capacity, speed and technology choice



A key question in terms of fibre demand is therefore what choices consumers will make in relation to the alternative access technologies represented in Figure 1-2.

These choices will depend on the costs of current versus next generation access and consumers' willingness to pay for differences in bandwidth and capacity. One recent study indicates high willingness to pay for a fast service, but low incremental willingness to pay for a very fast service.[8] This would imply a strong linkage between copper and wireless prices and the demand/price of NGA fixed access.

The above considerations imply that:

- The extent of NGA investment including geographical coverage, the timing of investment and the efficiency of investment in terms of competing technologies including cable and wireless will depend on the policy and regulatory framework applying to both copper and fibre.

[7] Brian Williamson. 2010. "Nomadicity and the evolution of networks, applications and policy". *Telecommunications Journal of Australia, Volume 60(4)*. http://www.plumconsulting.co.uk/pdfs/Plum_TJA_Nomadicity_Nov_2010.pdf

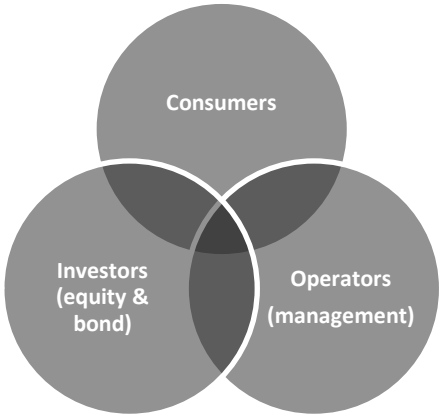
[8] Rosston, Savage and Waldman. 2010. "Household demand for broadband internet in 2010." *The B.E. Journal of Economic Analysis and Policy*. http://www.bepress.com/bejeap/vol10/iss1/art79/

- The expansion of competition during the transition calls into question the need for *ex ante* price controls on both copper and fibre.
- In relation to the choice and application of cost modelling
  - Greater regard should be given to build-buy signals and inter-platform competition in deciding on an appropriate costing and regulatory framework for copper and fibre.
  - Volume uncertainty is a key consideration that will need to be addressed
  - Actual network deployment and operating costs might reasonably be assumed to be efficient for fibre given market constraints on cost recovery.

1.5 Alignment of stakeholder interests to deliver desired outcomes

Figure 1-3 illustrates that in order to achieve the goals of the EC, whilst limiting the cost in terms of public expenditure, stakeholder interests need to be aligned with a competitive transition to universal next generation networks whilst delivering digital inclusion and progressing the single market.

Figure 1-3: Need for alignment



Investors need to see an opportunity to earn returns commensurate with other opportunities; customers must ultimately have an incentive to migrate from low speed (predominantly DSL) to high speed broadband; whilst operators will proceed with investment provided it is consistent with customers interests (in terms of willingness to pay and demand) and investors' interests (in terms of returns).

We note that consumers can chose between competing broadband access technologies including copper based DSL, NGA (including wireless and cable where available) and continued non-adoption. Operators (management) have an interest in the development of their business, but must make the case for investors who have a wide set of choices including investing in other sectors and investing in other regions.

1.6 The linkage between the price of copper and NGA investment

Copper based DSL is a key competitor to fibre and the regulated price of DSL lines will therefore be an important consideration in the investment case for fibre. In particular it has been suggested that incentives for network operators to invest in fibre are low – because operators prefer continued returns from the copper network.[9] Some have argued that lowering the price of copper further would make fibre relatively more attractive as an investment.

A key consideration in evaluating this argument is that investors have opportunities other than copper or fibre and that the investment case for fibre must stack up in its own right. The channels through which the price of copper might impact on the business case for fibre are considered in Figure 1-4.

Figure 1-4: Possible linkages between copper pricing and the NGA investment case

- A lower copper price will make it less likely that customers will voluntarily migrate to more expensive products and/or result in lower NGA retail, thereby undermining the business case for NGA.
- A lower copper price may stimulate broadband take-up and therefore increase the customer base that might transition to fibre. However, this linkage is unlikely to be material as there are important non-price barriers to Internet and broadband adoption, [10] incremental adoption is increasingly dominated by mobile broadband and existing non Internet users are unlikely to be willing to pay for NGA.
- Lowering the price of copper may signal to potential investors that once fibre investment is sunk the price of fibre might also be lowered, thereby deterring investment.

In conclusion, we find that a higher/lower copper price will encourage/discourage investment in fibre and other access technologies by network operators and others. However, we note that ensuring that other objectives including customer protection and digital inclusion are met is likely to require non-price mechanisms (in addition to a shift in relative prices) to support a copper fibre transition and the eventual retirement of copper.

[9] WIK. June 2010. "Regulating NGA: Current approaches and market outcomes." ECTA Conference "High Speed Internet for All".

[10] Plum. March 2010. "Demand-side measures to stimulate Internet and broadband take-up." In Vodafone Public Policy Series - Developing Government objectives for broadband.
http://www.vodafone.com/content/dam/vodafone/about/public_policy/policy_papers/public_policy_series_10.pdf

2 Principles

To bridge the gap between high level objectives and the assessment of detailed issues in relation to costing methodology we developed the following set of high level principles to guide our analysis (Figure 2-1). The principles are used in our evaluation of alternative methodologies in subsequent sections.

Figure 2-1: Principles to guide analysis of options

1. Competition and neutrality both in terms of build/buy decisions and platform neutrality. The aim is not to distort efficient choices by access providers and access seekers.
2. Efficient network transition. The aim is to ensure there are incentives for end user switching to NGA and for on-going investment in NGA.
3. Protecting consumers' short-term and long interests. Consumers' have an interest in paying enough to align investors' interests with their preferences, but no more.
4. Protecting investors' interests over time. The approach must provide a reasonable prospect of cost recovery.
5. Furthering the single market via an appropriate level of harmonisation. Appropriate harmonisation may also support NRAs in providing regulatory commitment.
6. Commitment, consistency and transparency to ensure incentives are effective given the time frame over which investment must be recovered and to provide legitimacy to the regulatory framework.

We now discuss each of the principle in turn.

2.1 Competition and neutrality

Competition will increase in the transition to NGA with copper competing with NGA in addition to enhanced wireless (LTE plus more spectrum) and cable where available. The extent and pace of deployment of different access technologies and the evolution over time will therefore depend on the incentives in place including the regulatory framework for both copper and fibre. An approach which is as neutral as possible across this set of options is therefore desirable consistent with the European Framework objective of "*(c) safeguarding competition to the benefit of consumers and promoting, where appropriate, infrastructure-based competition".* [11] The reason for this is that such an approach is needed to underpin investment in and upgrades to access networks including fibre, cable and wireless access networks.

We also note that competition depends not only on the access technologies deployed, but also on the ease of customer switching between competing technologies and providers. In this regard active access products including virtual unbundled products may lower customer switching costs. This is because switching providers using active wholesale products does not require physical intervention at an exchange, but instead enables electronic switching of customers. This could make switching easier and facilitate competition in the retail market. In terms of services and applications, over-the-top internet based services are likely to play a more prominent role in future, introducing an additional form of competition at the retail level.

[11] Directive 2009/140/EC. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF

2.2 Efficient network transition

We evaluate network transition in relation to the objectives of the Digital Agenda, namely does the proposed approach to regulation and cost orientation where *ex ante* regulation is applied support an efficient transition to high speed broadband in Europe? Meeting this objective requires both that investors invest in new infrastructure and that consumers (who are predominantly on DSL at present) switch to NGA. This also relates closely to the European Framework objective of:[12]

> "*(d) promoting efficient investment and innovation in new and enhanced infrastructures, including by ensuring that any access obligation takes appropriate account of the risk incurred by the investing undertakings and by permitting various cooperative arrangements between investors and parties seeking access to diversify the risk of investment, whilst ensuring that competition in the market and the principle of non-discrimination are preserved.*"

We also note, in relation to the principle of non-discrimination, that the desire to promote demand for NGA should see greater alignment of the interests of access providers and access seekers, in particular where access seekers are better able to reach particular market segments or offer to reduce investment risk by offering to commit to a given level of demand. To be sustainable this may imply different terms of access depending on the level of commitment by access seekers.

Efficient network transition would also be supported by price differentiation at the access level. The reason for this is that incentives to invest need to be aligned with consumer willingness to pay, which will not be uniform. If higher and lower prices cannot be charged for differentiated access products then those end consumers with low willingness to pay will be deterred from adopting NGA whilst those with high willingness to pay will make a comparatively smaller contribution to covering up-front investment costs.[13] Opportunities for price differentiation would also support competition and neutrality (since unregulated competing platforms are free to price differentiate) and may be increasingly important to access providers and seekers who may otherwise be unable to compete with rival platforms.

2.3 Protecting consumers

Consumers and producers both have an interest in protection against potential abuse. Consumers are interested in protection against excessive prices, either via competition or regulation. However consumers' interests are served by having prices that are sufficient to incentivise investment in new networks and services that they value. Consumers also have an interest in minimising the risk of regulatory opportunism that might otherwise prevent investment in such networks and services.

2.4 Protecting investors

Given that potential investors have a range of choices over what to invest in and when to invest, investment is not a simple knife edge problem and, for consumers' interests to be met, the value of alternatives and well as their costs should somehow be reflected in investment decisions. This may require some flexibility relative to a strict cost orientation approach, for example, by leaving in place

[12] Directive 2009/140/EC. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF

[13] Brian Williamson. 2009. "The regulation of next generation access networks and the draft Commission Recommendation". In NEREC "Monitoring EU Telecoms Policy". http://www.nerec.es/wp-content/files/NEREC_report.pdf

incentives to out-perform on assumed demand levels utilised in calculating unit prices within a cost model. Commitment to the preferred approach is also required (principle 6) to assure investors of reasonable returns.

2.5 Harmonisation

The Digital Agenda is common across Europe. The principles that guide policy development should also be common. However, we would not expect costs and prices for NGA to necessarily be uniform either between or within member states for the following reasons:

- Market demand for NGA is likely to differ depending on the extent of existing internet and broadband adoption (which varies significantly) and on factors such as income per capita and the development of the media market and internet based services which also differ materially.
- Competition – which will impact on the share of NGA demand captured by individual providers – differs materially both between and within member states. In particular, some countries have extensive cable networks whilst others do not.
- Input costs will differ due to differences in circumstances including population density and specific local factors. For example, duct capacity may be available (or not) and duct may (or may not) be required – as in the Netherlands where fibre is buried directly.

In between objectives and principles and the level of prices one might expect a degree of harmonisation of methodology and approach, though not necessarily complete harmonisation. In relation to national differences the history of methodology choice and circumstances (for example, in the Netherlands Reggefiber and KPN costs are separate so separate cost models are utilised) may differ and justify some difference in approach. Further, differences between new investment and existing infrastructure may justify different cost methodologies for copper versus fibre.

The case for harmonisation of methodology applies to both copper and fibre, however, harmonisation is potentially easier and lower cost for fibre. This is because NRAs have well established methodologies for pricing copper, which have been developed over a period of time. This means that there may be a high cost in moving from one methodology to another and changing methodologies for existing services increases regulatory uncertainty and scope for windfall gains and losses. Fibre regulation is at a relatively early stage and it may be possible to harmonise approaches prior to the full implementation of NGA regulation in many member states.

In conclusion, the right balance in terms of harmonisation is likely to be somewhere between “one-size-fits-all” and “27-sizes-do-not-fit-Europe”. However, the greater the degree of harmonisation and guidance, the more important it is to get it right.

2.6 Commitment, consistency and transparency

Commitment and consistency are crucial to achieving an alignment of interests between investors and consumers when investment in long lived assets is appropriate. In competitive markets where independent parties must both invest in long-lived assets to achieve an efficient outcome, co-investment and/or a contractual relationship are often observed. Further, in the broadcast

transmission market long-term relationships are also observed, including in markets which are regulated.[14]

With regulation, the threat of regulatory opportunism must somehow be constrained via the adoption of a principled approach, clarity at the outset and institutional mechanisms including transparency at the national and European level. Harmonisation at the European level may also support national regulators in efforts to provide credible commitment. Finally, commitment is also likely to require that mechanisms are in place to constrain potential abuse of market power in order to ensure that regulation is seen as legitimate i.e. in the interests of both investors and consumers.

[14] http://adjudicator-bts.org.uk/index.htm

3 Costing methodology

In this section we set out alternative approaches to estimating the cost of copper and fibre (costing methodologies enable regulators to set prices that are *"cost oriented"* in terms of *ex ante* regulation and/or margin squeeze tests – we discuss the concept of cost orientation in Appendix A).

We also note that costing methodology and cost orientation should only be applied where the anticipated benefits (consumer protection and promotion of competition via access to infrastructure bottlenecks) outweigh the costs (of implementing the method and in terms of harm to incentives for efficient and timely investment).

Whilst we do not evaluate whether cost orientation is justified we note that, in relation to NGA investment, (i) implementation of cost orientation is more challenging due to demand uncertainty and costs that are initially unknown, (ii) potential harm in terms of foregone investment should receive appropriate weight in the decision given that all of the prospective investment is new and investment is an explicit policy goal, (iii) investors will have an incentive to work with access seekers to maximise demand, and (iv) competition during the transition to NGA is greater due to competition between regulated copper and NGA (in addition to enhanced wireless and, where available cable).

Finally, we observe that, in the UK, Ofcom has chosen not to apply cost oriented *ex ante* price controls to NGA investment and, in Germany, the Federal Network Agency proposed *ex post* regulation of fibre loops with prior scrutiny of prices.

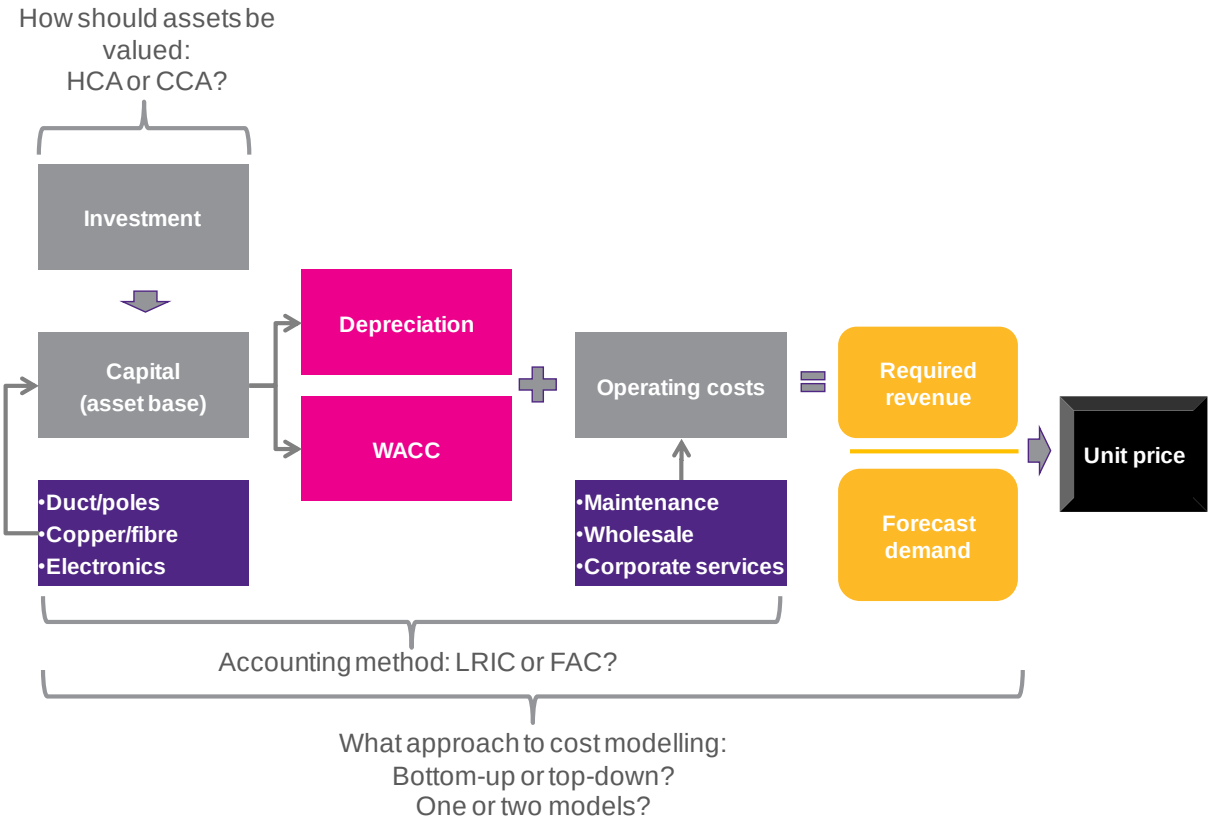
3.1 Key elements of access costing

Costing approaches distinguish between capital and operating costs. Capital costs are costs which involve the acquisition and installation of assets which generate a stream of services over a number of years. Capital costs need to be recovered over the relevant time period by an annual depreciation charge and a return on capital. The determination of depreciation and the capital charge raises issues such as the life of the asset and the appropriate time period to recover cost and whether an equal amount should be recovered in each time period. Civil infrastructure may be shared between copper and fibre loops and other services such as leased lines. These are joint costs and must be allocated between services.

Operating costs are the annual costs relevant to the provision of copper or fibre access which must be identified and attributed to the cost of the product. For some types of cost, such as the salary costs of a maintenance engineer who works exclusively on copper access, this may be relatively simple. Other operating costs such as the human resource costs involved in recruiting the engineer it may be more difficult to attribute to services as the human resource staff may serve various other parts of an operators business.

Figure 3-1 provides a simplified overview of the costing of a regulated access service.

Figure 3-1: Overview of costing access services



Note: Joint and common costs should be included, for example, in relation to duct.

3.2 Key methodological choices

Copper access has been regulated in Europe for over a decade. In determining the cost of copper access, regulators have made choices about the appropriate methodology for addressing costing issues. The methodological questions are set out below:

- How should assets be valued?
  - This relates to whether to use historic (HCA) or current cost (CCA) values. Historic cost values are based what is paid for assets at the date of acquisition whereas CCA costs show what would be paid for the assets if they were acquired now.
- Which approach to cost modelling should be used?
  - This involves deciding whether to use a top down approach based on a firm's accounting data or a bottom up cost model.
  - It also raises the question as to whether one model should be used for both copper and fibre or whether separate models should be used for each network.
- Which costing methodology should be used?
  - This involves deciding whether to use fully allocated cost (FAC) or LRIC. FAC is an accounting methodology based on allocating the costs in a firm's financial accounts. It can

therefore only be used with a top down approach (although many bottom up models do involve some cost allocation), but could utilise either HCA or CCA costs. LRIC calculates the cost of providing a defined increment of output on the basis of forward looking cost of an efficient operator (depending on the definition of LRIC used, it may be necessary to allocate costs within the defined increment to determine the costs of individual services).

The relationship between the methodological options means that the combinations of those options are limited. LRIC costing is usually undertaken with CCA rather than HCA, as it is generally assumed that LRIC costs are forward looking. FAC is only compatible with a top down approach to cost allocation although bottom up models often involve allocating costs between services. These combinations suggest that the following methodological choices are possible.[15]

Table 3-1: Methodological options for pricing access

Accounting Method	Modelling approach	Historic cost	Current cost	Operating cost approach
FAC	Top down	✓	✓	Tends towards actual
LRIC	Top down		✓	Tends towards actual
LRIC	Bottom up		✓	Tends towards hypothetical
LRIC/FAC	DCF	✓		Tends towards actual

The top down and bottom up, FAC and LRIC approaches are well established for modelling copper. The discounted cash flow (DCF) approach is less familiar, though this approach is now used in the Netherlands to set FTTH prices. We therefore describe this approach before evaluating the alternatives. The aims of the DCF approach are to explicitly take into account the multi-year nature of cost recovery over the economic life of assets for NGA; to recognise the need to utilise commercially viable price and volume assumptions and the interdependence between the two; and the need to schedule recovery over time in a manner that maximises the prospects for cost recovery.

Adopting the DCF approach would require greater dialogue between stakeholders in order to test the regulatory costing against business case modelling assumptions, and a prior and transparent commitment to the approach given the need for a price path commitment. We focus our assessment of the DCF approach on fibre rather than copper given the link to business planning and recovery of large up-front investment with demand uncertainty and low initial demand.

3.3 Asset valuation

3.3.1 Historic cost

Under the historic cost approach, the value of assets is determined on the basis of the acquisition cost of the asset, either at the date of purchase of the asset or the date the asset was transferred to the

[15] These combinations are a simplified version of the available choices. Some countries have developed alternative methodologies such as the use of indexed historic cost with economic depreciation in France. Arcep, Décision number 05-0834, http://www.arcep.fr/uploads/tx_gsavis/05-0834.pdf

entity. Values are not adjusted over time to reflect changes in prices of the asset. There might be a question as to whether historic cost approach can recover cost of asset over time given the impact of inflation. However, provided a nominal cost of capital is used to determine return on capital, the historic cost approach can fully recover cost over time, as the use of the nominal cost of capital will take account of the impact of inflation. However, the profile of cost recovery over time will differ between the historic and current cost approaches.

3.3.2 Current cost

Under a current cost approach, assets are re-valued on an annual basis. In practice, assets may be re-valued: (i) on the basis of price indices for the relevant group of assets (indexed historic valuations), (ii) on the basis of the replacement cost of a similar asset, or (iii) on the basis of the replacement cost of a modern equivalent asset (MEA).[16] Finally, assets may be valued on the basis of their market values, although in the telecoms industry this approach is only applicable to a limited range of assets, such as office buildings.

In general, replacement cost valuations are preferable to indexed historic valuations because they provide greater transparency (the quantity of assets purchased is known under the replacement cost methodology but not under indexed historic valuations). However, there is considerable room for interpretation in the way in which replacement cost valuations are made. For example, in the case of duct the quantity of duct and trenching could reflect the amount required to meet current and anticipated demand. Alternatively, the quantity of duct and trenching valued could be based on the actual amount of duct and trenching provided in the past. The two valuation bases could produce very different results if routes have been dug up on two or more occasions as a result of unanticipated demand changes.

Changes in asset prices under MEA will impact on the level of costs. Where asset prices are increasing (decreasing), current cost valuations will be higher (lower) than historic cost valuations. This would appear at first sight to suggest that where asset prices are increasing (decreasing) costs measured in current cost terms are higher (lower) than costs measured in historic cost terms. In practice, however, this is not necessarily the case provided capital maintenance is applied (see Appendix B where we conclude that Financial Capital Maintenance (FCM) is the more appropriate approach).

Replacement cost valuations can be made on either a 'like for like' basis or on a MEA basis. Valuations made on a 'like for like' basis are appropriate where the existing asset would be replaced by a similar asset. On the other hand, where the asset would be replaced by a different asset, the MEA approach may be used. The MEA is that asset which has the same service potential as the existing asset, and as a result, can produce the same stream of services at the same level of quality.

In cases where the MEA provides additional functionality, capacity or quality, adjustments should be considered for these differences. For example, a new higher capacity switch may offer a lower cost way of carrying the traffic carried by a number of previous generation switches. However, in relation to access networks, the comparison is not as straightforward. First, unlike a switch a single higher capacity fibre access line cannot replace multiple copper access lines. Second, fixed and wireless

[16] In practice, a company's accounts may contain a mixture of historic cost valuations. For example, Fair Value Accounting involves the use of market valuations for certain classes of assets and historic cost valuations for others. Further, even where Current Cost Accounting is used many assets are likely to be valued on an historic cost basis.

access technologies have fundamentally different cost functions. Third, different access technologies have different service characteristics (and consumers valuation of these is uncertain and changing).

To illustrate we compare wireless and fibre to copper taking account of the dimensions of cost and service considered in the previous Figure 1-2, namely capacity and speed:

- In relation to wireless costs are highly dependent on traffic volumes (since more spectrum/base stations are required to support additional traffic) whereas for fixed access they are not (aside from the back-haul element which is common to fixed and wireless). An assumption regarding traffic per customer (GB/month) would therefore be required in order to compare costs on a like-for-like basis. In terms of speed, next generation wireless may be comparable to copper based DSL but does not have the same service potential in relation to the provision of the wholesale service in question, the unbundled local loop, or in relation to quality of service. Overall, for those who remain on copper, a wireless equivalent may imply similar or even higher costs for copper, once account is taken of traffic levels and associated costs. Further, we note that were wireless considered to be an MEA asset for copper, this implies the possibility of substitution which should be taken into account in an assessment of retail market competition.
- In relation to fibre the costs of a replacement network may be close to those for copper (although we note that in practice estimates of fibre network costs tend to be significantly above allowed copper prices, for example, in the Netherlands where fibre loops are around €17 per month compared to a copper loop price of €6.50 per month – low by European standards). Capacity is the same since both fibre and copper to the exchange is un-contended and in principle equivalent in relation to back-haul. In relation to speed fibre can deliver a significantly higher performance, though the relevant consideration is incremental consumer willingness to pay for this service attribute which may be relatively low at present.[17]

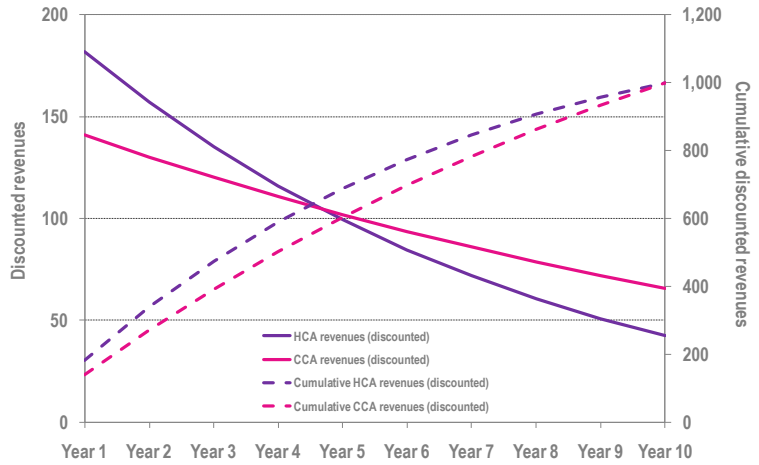
A number of assumptions are required to compare costs, the ability to produce the same stream of services levels and incremental consumer willingness to pay for differences in service levels for copper, wireless and fibre. Overall we would not consider wireless as a suitable MEA asset for copper and it is unclear whether fibre would be. In any case a comparison is dependent on a number of assumptions.

3.3.3 Copper valuation and switching between methodologies

Switching asset valuation methods during the life of an asset raises the possibility that cost recovery will be denied. Switching methodology may also signal a lack of commitment. A switch away from CCA valuation to historic valuation could mean that an operator may be unable to recover the cost of their investments as illustrated in Figure 3-2 (with an asset value with a value of €1,000, a life of 10 years, asset prices rising by 5% per year and the cost of capital assumed to be 10%).

[17] Rosston, Savage and Waldman. 2010. "Household demand for broadband internet in 2010." *The B.E. Journal of Economic Analysis and Policy*. http://www.bepress.com/bejeap/vol10/iss1/art79/

Figure 3-2: Impact of historic versus current cost on price over asset life



Whilst the asset costs are the same for CCA and HCA curves the starting point differ since the dynamics of recovery differ (consistent with the same NPV). CCA revenues are lower than HCA revenues until around Year 5. Hence, shifting from CCA to HCA would mean that the operator would not recover the full cost of the asset over its 10 year life. In principle, this problem can be addressed by taking account of the holding losses associated with the change in valuation methodologies in the calculation of costs. However, this approach would result in a jump in charges in Years 5 and 6.[18] This would distort price signals and might be denied either by the regulator or through competitive pressure.

The difficulties in identifying the impact of revaluation in practice are illustrated by the UK experience with revaluation of copper in 1997 and 2005, discussed in Figure 3-3.

Figure 3-3: UK copper revaluation

In 1997 Oftel decided to move from HCA Fully Allocated Cost (FAC) to a CCA Long Run Incremental Cost (LRIC) cost basis for determining BT's network access charges.[19] The rationale for the change in accounting basis was to set efficient entry price signals to competing infrastructure providers (Oftel Paragraph 1.1.3). At the time, Oftel developed a simple model to assess whether under-recovery of costs would occur due to the switch to CCA accounting. They concluded on the basis of analysis of the model that under-recovery was unlikely to occur due to the switch from HCA accounting to CCA accounting (Table D.2, para. D.17 and D.19 in Annex D). Subsequently, in 2005 Ofcom reversed the revaluation for pre-1997 assets, on the basis that costs might be over-recovered due to the switch on valuation methodologies.[20] The Oftel/Ofcom experience illustrates the difficulty in switching approaches to valuing assets. It is difficult to assess and avoid windfall gains or losses.

[18] Similar problems arise if there a change in the replacement cost methodology. For example, if copper assets were valued on a 'like for like' basis for years 1 to 5 and on an MEA basis for remaining years the firm would make a return less than its cost of capital, if functionality adjustments were made. While this problem would not arise if the holding losses arising from the change in methodology were recognised, to do so would result in a spike in the charging profile.

[19] Oftel. July 1997. "Network charges from 1997."
http://www.ofcom.org.uk/static/archive/oftel/publications/1995_98/pricing/nccjul97.htm

[20] Ofcom. August 2005. "Valuing Copper Access - Final Statement".
http://stakeholders.ofcom.org.uk/consultations/copper/value2/statement/

3.3.4 Competitive neutrality and transition

Under both top-down, current cost and historic costs, prices will tend to fall over time in discounted terms (leaving aside the impact of operating costs), except where asset prices are rising very rapidly in a current cost approach. This is because the return on capital will be based on a declining asset value due to depreciation, an effect which is accentuated as a result of discounting. However, the prices resulting from current cost valuation will begin at a lower level and decrease less quickly over time when asset prices increase, as would be the case in a competitive market. The reverse applies, if asset prices are falling, top-down CCA prices will begin higher and finish lower than HCA.

The difference in the profile of cost recovery arises for two reasons. Firstly, under the FCM approach, the depreciation charge will initially be lower than the HCA charge (where asset prices are rising) but will rise over time (before discounting) and eventually exceed the HCA charge. This is because the depreciation charge is partly offset by the gain in asset value. Secondly, the cost per unit of additional vintages will increase where asset prices are increasing. While the second factor comes into play whether historic cost or current cost valuations are used, the first factor only arises where current cost valuations are used.

Current cost valuation will produce a valuation which is more closely in keeping with those in a competitive market than historic cost valuation, particularly where an annuity rather than the straight line method is used for depreciation. In consequence, CCA will help to promote competitive neutrality between copper and fibre and other platforms such as cable and wireless.

Many of the arguments that apply to copper also apply to VDSL. Setting the appropriate price signals for other network investment is important for VDSL. Next to volume uncertainty, specific issues for VDSL regulation are the high level of uncertainty around the expected life of VDSL investment, given potential future moves to FTTH. A current cost approach would deal better with this uncertainty by allowing for more rapid recovery of cost where future network deployment is likely to erode future cost recovery i.e. result in decreasing asset prices.

Determining the approach to valuing fibre prior to its installation avoids some of the issues associated with revaluing copper part way through its useful life, as it avoids the appearance of regulatory opportunism and the risk of over or under-recovery. Regulators and the industry have a clean slate to determine the appropriate approach to setting asset values. Initially, the historic and current cost asset value (but not necessarily prices, as noted earlier the schedule of recovery over time differs) of fibre will be the same; the difference between the two approaches will emerge over time when assets under current cost approach are revalued in line with changes in replacement cost.

Both historic and FCM based current cost approaches should in principle enable investors to recover the cost of investment, provided in the case of current costs, that a consistent approach to capital maintenance, i.e. FCM, is undertaken and in the case of historic cost that a nominal cost of capital is used to determine prices (assuming market demand is sufficient to allow pricing up to the regulated level). A current cost approach may increase uncertainty for investors, however, this should be manageable, as current cost is a well-established methodology in many jurisdictions. The use of current cost may also enhance regulatory commitment in countries where the same approach has been adopted for copper.

The key benefit of a current cost approach is that it will provide a more accurate build/buy signal to access seekers and platform investors over time. The future evolution of fibre, cable and wireless industry is highly uncertain and network investors are faced with a continual series of decisions on

upgrading networks such as from copper to FTTC to FTTH and further enhancement of fibre capacity, while cable continues to enhance network speeds and wireless continues to develop over time. It will be important to set prices for wholesale access to fibre in a way which does not distort the investment decisions of other players. If historic cost is used, then at some point in the future, fibre access prices will not reflect the current cost of providing the service and either prices will be too low and efficient investment in alternative infrastructure will be deterred or too high and inefficient investment may result.

3.3.5 Civil infrastructure and the terminating segment

The Commission's NGA recommendation refers to pricing existing civil infrastructure and the terminating segment on the basis of "*access prices effectively reflecting the costs borne by SMP operators*". The costs for these assets "*borne by SMP operators*" need to be determined in the light of the principles of competition and platform neutrality and of ensuring ongoing investment in NGA in line with the objective of the EU regulatory framework. The calculation will depend on the approach to costing methodology, in particular whether a backward looking approach based on historic cost or a forward looking approach based on current cost (top down LRIC/FAC) or bottom up LRIC is used.

The NGA recommendation discusses the pricing of civil engineering infrastructure and the terminating segments. The Recitals to the recommendation claim that duplication of the terminating segment will be "costly and inefficient". However, fibre loops are subject of innovation, for example, the development of fibre that is more readily bendable to facilitate the deployment of fibre within apartment blocks.[21] Duct infrastructure has been duplicated in the past by utility companies and also cable operators. Moreover, developments in wireless technology may provide alternative solutions for providing terminating segments. All this suggests that regulators should be cautious about assuming that competition will not develop in this element of the market or that barriers to entry are high.

NRAs should base price regulation of civil infrastructure and terminating segments on a thorough assessment of the market circumstances. This suggests that the appropriate approach to setting cost orientated prices (if that is the appropriate remedy) should be based on pricing methodologies appropriate for the rest of the local loop. This is also stated in the NGA Recommendation.[22]

The NGA recommendation also proposes that NRAs encourage or require operators to provide multiple fibre lines in the terminating segment where they have SMP. If the regulator intervenes to require installation of multiple fibre, then the cost of the additional spare capacity must be reflected in wholesale charges. If capacity is not effectively utilised, then prices will be higher than in the absence of regulatory intervention to require duplication.

[21] Corning. 7 February 2008. "Verizon Purchases Corning® ClearCurveTM Cable Solution Following Successful Field Trials", http://www.corning.com/opticalfiber/news_and_events/news_releases/2008/2008020701.aspx

[22] Commission Recommendation of 20/09/2010 on regulated access to Next Generation Access Networks (NGA). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0035:0048:EN:PDF

Annex I (2) "*NRAs should regulate access prices to civil engineering infrastructure consistently with the methodology used for pricing access to the unbundled local copper loop*."

3.4 Top-Down and Bottom-up models

3.4.1 Top-Down model

The starting point for a top-down model is the company's accounting records. Under a CCA approach assets are re-valued using price indices, open market valuations or replacement cost. In addition, the application of CCA has implications for the depreciation charge.

Under a FAC approach, the next stage of the top-down process involves attributing costs to the different services using the network. In the telecoms industry a large percentage of costs are not directly driven by a particular service and therefore need to be apportioned to services. For example, exchange related costs drive all types of call services[23]. Apportionment bases should, as far as possible, be based on cost causation principles although, in practice, a degree of arbitrariness arises (for example, only a small proportion of duct costs are strictly speaking driven by any individual service). Activity Based Costing (ABC) may be used to enhance the accuracy of cost apportionment compared with the results of traditional costing methodologies.

To move from an FAC to LRIC basis requires the development of Cost Volume Relationships which show how costs change as volumes of service change[24]. Using FAC outputs as the volume measure in conjunction with CVRs allows the user to determine how costs will change as a result of volume movements i.e. incremental costs. Top-down models generally estimate the annualisation charge (the sum of depreciation and the capital charge) on the basis of straight line depreciation or tilted straight line depreciation. The annualisation charge will generally decline as the asset ages. This is because the depreciation charge is constant while capital employed decreases. The issues and implications of this approach to annualisation are further discussed in Appendix C.

3.4.2 Bottom-Up model

The starting point for developing a bottom-up model is to dimension the network to provide a given level of output. This can be done by taking current and forecast demand levels, converting them into an appropriate traffic measure (such as Mbits) and then considering what equipment is needed to provide that level of traffic. Typically this dimensioning process is constrained in some way, both in terms of the deployed technology (such as copper lines) and the design of the network. For example, a widely used constraint is the 'scorched node' constraint under which all existing nodes (e.g. MDF sites) in an operator's network will be used.

Dimensioned quantities are then multiplied by associated prices to produce total investment costs which are usually separately identified for each network component. These are then annualised using a methodology. Annuities result in a constant annual charge over time, unless a tilt rate is set to alter the profile of cost recovery (discussed in Appendix C). Operating costs are then added to the annualised capital costs to produce total annualised costs. Service costs are then normally determined by multiplying network component costs by routing factors, an approach similar to that

[23] The movement to NGN increases the complexity of the process since many NGN assets drive a wider range of services than 'traditional' assets. For example, a router is used for both voice and data services.

[24] Typically, CVRs reflect the impact of volume changes in the very long run. They may therefore provide limited guidance on how costs change in the short to medium run as a result of volume changes.

employed in top-down models. Bottom-up models can be developed either for a short period or for much longer periods.

3.4.3 Comparison of top and bottom up models

Bottom up models may provide better price signals for competing platforms and for the transition from copper to fibre as they are more likely to represent the cost of an operator entering the market than a top down model. However, there is a danger that these models are based on simplified assumptions about the nature of the network and unrealistic assumptions about the degree of optimisation possible. To some extent these problems can be addressed by detailed cross-checking of modelling assumptions with reality[25].

A further problem arises in top down models where assets are approaching or have reached the end of their book lives. In this case the prices generated by top-down CCA models may understate the true economic cost of the assets deployed.

In this respect, bottom up models which reflect actual network architectures and costs appear particularly relevant to copper, as the price signal of copper will impact on fibre roll out and competing access network investment, and the long established nature of copper means that top down approaches are unlikely to provide an appropriate price signal. To provide appropriate price signals, bottom-up models, if applied, should include the full set of assets (see Section 5.3) and be based on a realistic network topology as well as use a technology that is already deployed.

A bottom up approach is less likely to provide regulatory commitment or consistency over time, due to the issues with optimisation and re-valuation of assets over time. A network operator is exposed to considerable regulatory risk around the application of LRIC models. LRIC models have been criticised for the high level of discretion left to the regulator, making unrealistic assumptions about network design and providing poor incentives for dynamic efficiency.[26] An NRA may try to compensate for the risks associated with bottom up models by using shorter asset lives and/or tilted annuities to allow early recovery of capital costs. Nonetheless, network operators face higher risks and less regulatory commitment under a bottom up approach.

A top down model, particularly when combined with a rigorous approach to capital maintenance, will provide more certainty to operators about the recovery of cost. Neither approach provides full transparency in itself. Bottom up models may be a “black box”, while the allocation of costs in a top down approach may not be fully transparent. However, auditing and publishing of detailed cost criteria may assist with transparency under either approach.

The weakness of bottom up approaches in providing commitment will matter most for fibre networks, where investors are contemplating large scale investments with long pay back periods. However, a problem with applying the top down approach to set initial fibre prices is that accounting data is backward looking and may not be available to set prices until sometime after the launch of services.

Both top down and bottom up approaches have merits for setting access prices. A bottom up approach grounded in actual network architecture and costs is most likely to be appropriate for copper, given the importance of getting the appropriate price signals in the transition to fibre.

[25] For example, bottom-up access models are typically based on simplified assumptions about dwelling layout. It may be possible to test the robustness of results to alternative network layouts, particularly if the operators have well developed geographical information systems (GIS) systems which allow cross-checks between modelled and actual deployments.

[26] Jean-Jacques Laffont and Jean Tirole, 2001. *Competition in Telecommunications*, MIT Press.

A bottom up approach could be combined with a long term DCF approach for fibre to provide regulatory commitment and promote consistency; we discuss this approach as a separate model below. We note, however, that there is merit for the regulator in maintaining a stable approach to copper as switching methodologies can produce unintended windfall gains or losses and undermine expectations in relation to regulatory commitment for future fibre investment.

3.5 Costing methodology: FAC and LRIC

Regulators may use either FAC or LRIC to determine the cost of access services. Under a FAC methodology all costs are attributed to one or another service. By way of contrast under a LRIC approach the costs associated with an increment of output are measured. At first sight this appears to be a significant difference from fully allocated costs. However, in practice the extent of the difference is dependent on the increment under consideration.

From an economic perspective there may be benefits from using narrowly defined increments instead of broadly defined increments, such as the core and access increment. However, economic theory also suggests that the appropriate approach is to mark-up these costs on the basis of Ramsey pricing to take account of common costs. In the absence of such mark-ups the benefits of setting charges on the basis of increment cost is questionable.

The traditional approach to regulatory accounting has been to measure the incremental cost of very large increments such as the core (exchanges and the links between these exchanges) and the access increments (all links between subscribers and the exchange including the line card in the exchanges) in fixed networks. However, since there are a large number of services within both of these increments, it is necessary to use attribution methodologies to determine the cost of individual services. For example, the cost of the exchanges in the core network needs to be attributed amongst call services while the cost of the transmission network needs to be split amongst call and data services. Hence, the use of broadly defined increments gives rise to many of the issues which also arise in relation to fully allocated costing systems.[27]

It might be argued that there is nevertheless a key difference between the two methodologies due to the existence of common costs between the core and access increments. However, at least in the past, there has been a tendency to allocate these costs on an equi-proportional basis to core and access networks.

It is potentially better to attribute common costs on some reasonable basis such as usage rather than pro-rata to core or access costs particularly where the mark-ups are applied on the basis of the total costs of the core and access increments. This is because mark ups based on usage may better reflect demand elasticities than a mark-up on total cost. This would mean that costs are recovered from wholesale and retail customers on a more efficient basis and promote a higher take up of services.

LRIC costing is potentially more transparent than the fully allocated costing methodology as it is possible to see how common costs are allocated. Overall, comparing FAC with LRIC defined with broad increments we do not believe that either approach is superior to the other.

[27] This comment is even more relevant in relation to mobile networks since many models assume that there is just a single increment.

3.6 Discounted Cash Flow (DCF)

The aim of the DCF approach is to explicitly take into account the multi-year nature of cost recovery over the economic life of assets for NGA and the need to utilise commercially viable price and volume assumptions. It also recognises the interdependence between the two factors given the competitive pressure on fibre from copper, next generation wireless and cable where available; and the need to schedule recovery over time in a manner that maximises the prospects for cost recovery. Key elements of the approach are summarised in Figure 3-4.

Figure 3-4: Key elements of DCF approach

Look at expected costs-revenues over business planning horizon

- Consider business plan inputs as basis for modelling i.e. not based on hypothetical cost model
- Consider price profile over time which maximises prospects of success

Explicitly address demand risk considering upside and downside

- Potentially allow retention of profit from sales above agreed threshold

Announce "contingent contract" in advance

Any revision should be NPV neutral

- Potentially allow credit for prices below cap to be carried forward

Add common costs with copper network

3.6.1 Change of approach required

Given the potential difficulty in making the business case for NGA it is important that any price control reflects commercial reality in terms of anticipated volumes and the ideal price path over time to maximise the prospects for cost recovery. Further, it should address risk in an appropriate manner including the assumed WACC, time frame for cost recovery and treatment of variances from assumptions. Addressing these issues will require a dialogue between the regulator and investor/s.

Further, given the need for commitment and the possibility that what amounts to a contingent contract is agreed by the regulator, the approach including any potential review terms should be decided in advance and as far as is feasible entered into as a transparent multi-year commitment.

3.6.2 Description of methodology

A DCF approach requires a forward view of capital and operating costs, demand and take-up, the price path and the discount rate over the business planning horizon for the investment. These assumptions would be combined to ensure that the net present value (NPV) was positive, otherwise investment would not be expected.

However, a positive NPV is not sufficient as the assumptions must also be commercially realistic. Unrealistic volume assumptions or an assumption that market prices will necessarily be able to match the price cap without consideration of consumer willingness to pay and the competitive environment

might deliver a positive NPV from the model, but would not be expected to result in investment. It is for this reason that the change of approach proposed above is put forward.

The structure of regulatory prices will be reflected in the DCF calculation; if upfront payments are made by an access seeker, then this will reduce the total revenue required, as earlier payments will have a higher value than later payments under a DCF approach. This is likely to be reflected in a lower price for upfront payment.

The investment analysis should include an appropriate portion of joint and common costs. In many countries, the largest source of joint costs will relate to duct costs. These in turn fall into two categories, namely: (i) existing duct shared with other access products; and, (ii) existing duct shared both with other access products and with the core network. A very simple approach would be to take the annualised cost of this duct, including any operating costs, from a top-down model and assume that it increases in line with input prices and, perhaps, other factors, such as the changing age profile of ducts (Section 5.1 discusses the allocation of joint and common costs).

3.6.3 Treatment of uncertainty and contingency

Given the uncertainty involved in assessing costs, demand and feasible pricing in advance of investment in NGA, it is probable that outcomes will differ from expectations and there will be an opportunity for both the regulator and investors to learn.

However, there are potential trade-offs involved in taking into account new information including the risk that doing so unravels the implicit or explicit "regulatory contract" and is perceived as exposing the investors to regulatory opportunism, and the risk that doing so undermines incentives to maximise take-up and/or efficiency (though, at least early on, this seems highly unlikely given the difficulty in making the business case for extensive NGA investment). There are three broad approaches in considering new information:

- Ignore new information and stick to original price control. This approach involves strong commitment and maintains incentives to maximise take-up and minimise costs, but might not be credible, particularly if it results in no further investment in the event that assumed volumes do not materialise and/or costs turn out to be higher than assumed.
- Take new information into account but only for new investment in new locations. This approach maintains a commitment in relation to what has gone before but allows learning to be incorporated into future planning and price controls.
- Take new information into account – potentially on a basis agreed in advance (a contingent contract). For example, an index of construction costs might be included in the capital expenditure element of the model or variations in volumes from those assumed might be fully or partially taken into account. There are commercial precedents for these sorts of arrangements.

Demand uncertainty (linked to pricing) is likely to be a key consideration, and we have suggested in this report that a volume assumption might in effect be agreed with both upside and downside around this resting with the investor.

Further, an agreed price cap profile over time might with hindsight turn out to be sub-optimal, for example, placing too much weight on the opportunity to sustain higher prices in the early years following investment. One option for addressing this would be to provide some opportunity for

discounts below the price cap in the early years to be carried forward as credits that could be added to the price cap in later years (in a net present value neutral manner).

3.6.4 Appropriate time horizon

Linked to risk is the choice of time horizon over which to calculate the DCF:

- A long horizon would imply a lower price consistent with cost recovery, but would potentially defer cost recovery to the point where investors would give it little if any weight. Feasible time horizons that would be consistent with commercial reality are likely to be significantly shorter than some of the accounting asset lives involved.
- A short horizon would imply a higher price, potentially to the point where investors would not expect to be able to price up to the price cap due to a lack of consumer willingness to pay and competitive pressure (including having to compete with a regulated copper access price).

A preliminary view is that realistic timescales might be around 15 to 20 years, though this should be checked against investor expectations and business planning assumptions.

3.6.5 Comparison of DCF approach with other methodologies

In addition to the need for a different process and working relationship in developing the DCF model, the following differences in comparison with alternative specific cost modelling approaches apply to the DCF approach.

The key differences with a bottom-up modelling approach are the following:

- The DCF approach takes account of anticipated incremental expenditure. In comparison, a bottom-up may produce higher or lower costs for NGA since it does not necessarily take account of the practical realities which face the operator and may omit important costs, for example, investment in access fibre may require remediation work on ducts or may require new ducts to be installed and the labour work associated with this additional duct investment, may to a large degree, be excluded in a bottom-up model.
- The DCF approach determines the regulated price for the required investment in access fibre given the current network of the operator. In contrast, bottom-up access models focus on the incremental costs of the access network as a whole from which the annualised cost of the access fibre investment would then be determined and will therefore explicitly include common costs. Common costs need to be explicitly added into the DCF model.
- The bottom-up approach would normally focus on the access network for the country as a whole whereas the DCF approach can look at individual investment projects or regions.

The key differences with a top down FAC/LRIC model are the following:

- Cost and demand parameters will be derived from the business plan rather than historic accounting data.
- DCF will spread cost recovery evenly over time taking account of anticipated increases in volumes. In contrast, top down models tend to use straight line depreciation, which will spread costs equally over time and result in higher prices initially when volumes are low.

- Allocation of joint and common costs needs to be determined in a DCF model.

Key differences with HCA are the following:

- HCA would base prices on regulatory accounting data reflecting historic costs incurred, whereas the DCF approach will use parameters from the business plan to project costs over time.
- HCA will generally use straight line depreciation therefore resulting in higher prices in earlier periods with low volumes and lower prices in later periods with higher volumes.
- Under a HCA approach, prices will be reset periodically reflecting updated accounting data and actual volumes, whereas under DCF approach prices may be set on the basis of projected volume over business plan period.

3.6.6 Assessment of DCF approach

A DCF approach would enable a competitive price for fibre to be set early in its life and so facilitate an efficient network transition. In contrast, using a top down approach would require high prices initially reflecting low early penetration levels. This could jeopardise the success of fibre investment and undermine an efficient transition.

However, even with a constant real price for fibre under a DCF approach investment may be deterred. The initial price may need to be relatively low to encourage new users to switch to fibre and experience the service. If the regulated price is used as the basis for a margin squeeze test, then it may be necessary to either allow for a lower initial price and an increase over time i.e. a tilt rate or, preferably, to adapt the margin squeeze test to cover an appropriate longer timeframe commensurate to the initial investments made.

Whilst the DCF approach provides for recovery of cost when the market is best able to bear the cost the risk that anticipated demand does not eventuate remains. To offset this risk an adjustment to price to allow for asymmetric risk is required (discussed in Section 6). However, since operators may not be able to price up to an elevated price cap initially a tilt in the regulated price until high-speed broadband has become well established may be required.

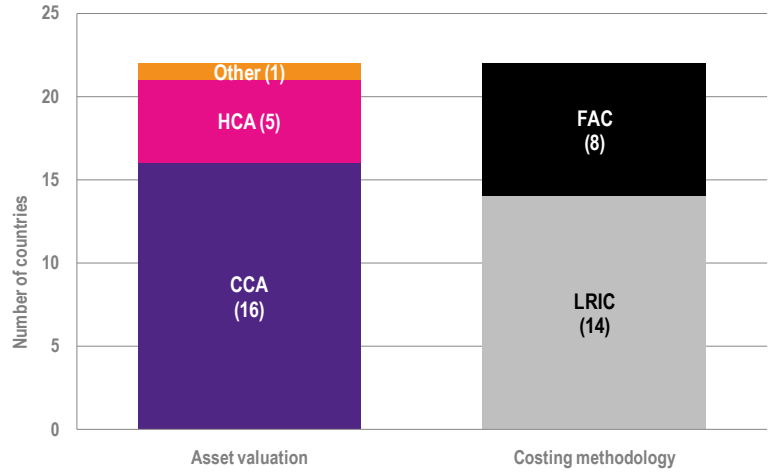
A DCF approach can provide a strong degree of transparency and commitment, as it provides a clear profile for the recovery of costs over time and effectively shifts the recovery of cost to later time periods when the volume of services are able to support the cost of the network. By making the transfer visible to all parties and the consequences of any change in approach visible, the transparency enhances the regulatory commitment.

3.7 Current approach to costing in Europe

Based on BEREC data the dominant approach to asset valuation for copper loops in Europe is CCA, while the most popular costing methodology is LRIC, as illustrated in Figure 3-5.[28] The BEREC analysis also data finds that the choice of costing and asset valuation has been stable over recent years, with a few countries switching away from HCA and FDC to CCA and LRIC in 2007.

[28] BEREC. October 2010. "Regulatory accounting in practice". BoR (10) 48. http://www.irg.eu/streaming/BoR%20(10)%2048%20BEREC%20RA%20report%20in%20Practice%202010_final.pdf?contentId=546971&field=ATTACHED_FILE

Figure 3-5: Costing and asset valuation for copper loops



Source: BEREC, Plum Consulting

We note that high level comparisons may not fully capture differences between regulators and that the detailed parameters assumed by each NRA, such as assumptions about expected efficiency gains, cost of capital or forecast volume may mean that the same high methodologies may produce very different results. Further, some regulators may use more than one methodology such as reconciliation of bottom up and top down results. This may mean that apparently different methodological choices could generate similar outcomes.

BEREC has not yet published data on approach to pricing fibre. Figure 3-6 summarises approaches we are aware of - adopted or planned – to costing/pricing fibre access in the EU.

Figure 3-6: Approaches in relation to next generation access

Country	Approach
Netherlands	DCF approach using economic depreciation and a bottom up model for operating costs.[29]
UK	Retail minus approach to setting price for virtual unbundled loop and no unbundled fibre product[30]
France	Duct sharing at cost oriented rates and access to terminating segment according to the principles of reasonableness, transparency, objectivity, non-discrimination, relevance and efficiency[31]
Germany	Ex post price regulation of fibre loops (includes prior scrutiny of prices by the NRA)[32]

[29] OPTA. May 2010. "Regulation, risk and investment incentives." Regulatory Policy Note 6. http://www.opta.nl/en/news/all-publications/publication/?id=3201

[30] Ofcom. October 2010. "Review of the wholesale local access market". http://stakeholders.ofcom.org.uk/consultations/wla/statement

[31] Arcep. 9 November 2010. Decision 2010-1211. http://www.arcep.fr/index.php?id=8571&L=1&tx_gsactualite_pi1[uid]=1331&tx_gsactualite_pi1[annee]=&tx_gsactualite_pi1[theme]=&tx_gsactualite_pi1[motscle]=&tx_gsactualite_pi1[backID]=26&cHash=4

[32] Federal Network Agency. 25 January 2011. "Bundesnetzagentur invites comments on new regulatory conditions for the last mile." http://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/EN/2011/110125LastMileREgulatoryConditions.html

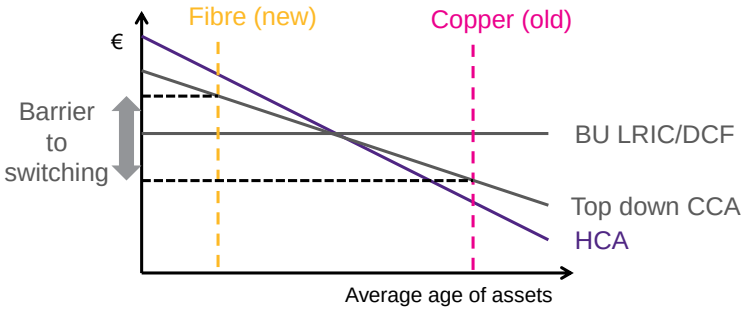
4 Assessment of methodologies

We first discuss the interaction between copper and fibre pricing methodologies and then assess the methodologies discussed in Section 3 against the principles outlined in Section 2.

4.1 Interaction between copper and fibre pricing methodologies

It is important to consider the interaction between the approach to pricing copper and fibre before making a decision about the appropriate methodologies. Figure 4-1 illustrates a stylised application of HCA, top-down CCA, bottom-up LRIC and DCF approaches to asset valuation and costing (leaving aside the impact of volumes).

Figure 4-1: Costing methodologies and age of assets



Both HCA and top-down CCA result in declining levels of cost over time, due to the declining balance of the value of the asset from depreciation and hence a lower return on capital.[33] A bottom up LRIC approach and a DCF approach will result in constant cost recovery in real terms.

In the early years of the roll out of fibre, the value of assets and regulatory prices will be high under HCA/ top-down CCA approach as the average age of the assets will be near new. [34] On the other hand, the value of assets of copper will be low (both due to the age of the assets and due to the fact that some assets are likely to be fully depreciated). This means that regulatory prices based on HCA/top-down CCA will produce low prices for copper and high prices for fibre, making the transition from copper to fibre difficult.

Whilst it could be argued that the regulatory price is a price ceiling and not a price floor, if an operator cannot charge the regulated price in the initial years, then they will not recover the full cost of the asset over its expected life (as in later years price will be restricted to cost and the deficit will never be recovered). Further, margin squeeze rules may mean that the regulated price is a floor price for other services and that the operator may not be able to charge prices lower than the regulated price.

If a regulator were to use a bottom up LRIC or DCF approach to the price of fibre and a HCA/CCA approach to copper, the problem will be partially addressed. This is because the price of fibre will be

[33] This assumes that straight line rather than economic depreciation or an annuity is used for CCA/HCA.

[34] In the case of HCA, this is true of both discounted and undiscounted cashflows. In the case of CCA, the comment is true for undiscounted costs as long as input prices are increasing by less than 5% and for discounted cashflows at much higher rates of input price increases.

stable over time rather than set at an initial high level.[35] However, the price of copper will be low and this may discourage efficient roll out of fibre. This suggests that it may be preferable to set copper prices on a bottom up LRIC basis and fibre on a DCF basis. Alternatively, regulators may wish to calibrate their copper loop prices with a bottom up model to ensure that CCA prices do not depart significantly from efficient price levels.

4.2 Copper assessment

Table 4-1: High level assessment of methodologies for setting copper prices

	Competition & Neutrality	Efficient network transition	Protecting consumers	Protecting investors	Commitment, consistency & transparency
Top Down FAC HCA	○	◔	◑	◔	◑
Top Down FAC CCA	◑	◑	◑	◕	◑
Top Down LRIC CCA	◑	◑	◑	◕	◑
Bottom Up LRIC CCA	●	●	◑	◑	◔

● supportive / ○ not supportive

Note: CCA is the most widely adopted approach so no change from this approach is consistent with harmonisation.

A historic cost approach is not appropriate, as it is likely to undermine the incentives for the efficient roll out of fibre – in essence copper access will undercut returns for fibre and result in reduced or delayed investment.[36] Further, a switch to HCA late in the life of copper may undermine prospects for full cost recovery by investors, due to the differences in profile of cost recovery over time between HCA and CAA, as discussed in section 4.1. Top down and bottom up CCA and LRIC approaches all have some merit for copper.

Bottom up LRIC is likely to provide a better signal for fibre investment, but top down approaches may also provide efficient signals, depending on the age of assets, approach to revaluation and treatment of fully depreciated assets. A bottom up LRIC approach provides little regulatory commitment and may be prone to revaluation and re-optimisation of assets without compensation. This may undermine expected returns over time. However, given that the level of new investment in copper is likely to be limited (although not zero) this may be less significant for pricing copper access.

As copper is likely to be partly phased out by 2020 (to meet digital agenda targets) and face stronger competition from wireless such as LTE, there is an argument for maintaining the current approach employed in each member state. This is because switching methodologies increases regulatory

[35] Indeed, it may be appropriate to allow an upward tilt in prices until high-speed broadband is well established.

[36] For example, even if only the duct associated with copper is priced on historic cost basis, this approach would undercut new fibre lines where this includes significant incremental fibre investment. A backward looking approach to pricing duct will therefore undermine and delay NGA investment. Further, a switch away from forward looking cost approaches (currently in use by most NRAs) would increase regulatory risk of opportunistic revaluation of fibre assets in future and deter fibre investments.

uncertainty and raises risk of cost over or under recovery. It may therefore be appropriate to continue to use any currently used top down CCA based approach and for harmonisation to focus on improving commonality in the application of methodologies.

We consider that three approaches: top down FAC CCA, top down LRIC CCA and bottom up LRIC CCA could be used to set prices for copper access. In the absence of regulatory precedents, bottom up LRIC would be preferred to provide the appropriate price signal for fibre rollout. However, given that copper services are currently regulated, it may be sensible to maintain current approaches.

4.3 Fibre assessment

Table 4-2: High level assessment of methodologies for setting fibre prices

	Competition & Neutrality	Efficient network transition	Protecting consumers	Protecting investors	Commitment consistency & transparency
Top Down FAC HCA	◔	◔	◑	◑	◑
Top Down FAC CCA	◑	◑	◑	◑	◑
Top Down LRIC CCA	◑	◑	◑	◑	◑
Bottom Up LRIC CCA	●	◑	◑	◔	◔
DCF	◕	◕	◑	◕	◕

Bottom up LRIC and DCF approaches provide better price signals for network competition and for efficient network transition, as they allow the smoothing of cost recovery between the initial time period when penetration is low and later time periods when penetration is increased. Some smoothing is also possible under a CCA approach in terms of asset prices, but this is not likely to be sufficient to address volume issues.

Historic cost is least likely to provide appropriate signals as it will not take account of expected penetration increase or asset price changes. All approaches have the potential to protect consumer long term interests by restricting any potential abuse of market power, although, in the short term there is likely to be little scope for raising prices above cost, given the need to move consumers from copper to fibre.

A bottom up LRIC approach is subject to re-optimisation and revaluation over time exposing the investor to risks of recovering less than the full value of their investment. This is likely to be of particular concern to fibre investors, given the high sunk cost of investment and long asset life. It may be possible to address this risk by allowing for shorter asset lives and so increasing prices; however, this in turn would make the transition to fibre more difficult. [37]

[37] The use of shorter asset lives may be most appropriate for VDSL cabinets, where FTTC is deployed initially. It seems less appropriate for additional duct deployed to accommodate fibre.

Top down CCA based approaches can potentially provide reasonable assurance of cost recovery, although both LRIC and FAC approaches can result in optimisation of costs, potentially undermining assurance as to cost recovery. Provided an appropriate approach to capital maintenance is followed, asset revaluations will be taken into account in setting prices.

Historic cost provides reasonable assurance of cost recovery, with no scope for asset revaluations. The failure to revalue may result in a profile of cost recovery over time which does not provide accurate price signals to other platforms and makes the transition to fibre more difficult. This means that the prices based on historic cost are likely to be high in the initial years and low in later years. A potential concern with both CCA and HCA approaches is that initial unit cost estimates are likely to be high due to initially low take-up. This could mean that wholesale charges need to be set below the cost estimate produced by the model. Unless operators are allowed to set wholesale charges in excess of modelled costs in later years they will not be able to fully recover their costs.

The DCF approach explicitly sets prices to recover the investment over a specified time period and any regulatory decision to adjust subsequent prices will be transparent. The approach provides a high level of regulatory commitment, although there still will be scope for regulatory opportunism in the way that actual costs are taken into account. Top down CCA approaches (with appropriate safeguards for CCA revaluations) can provide some commitment as regulators explicitly state how they address issues such as optimisation and revaluation of assets. However, we note that regulators have re-valued assets such as the Ofcom revaluation of copper, exposing operators to risk of loss.

Top down CCA (LRIC and FAC) would provide long term commitment, but would be difficult to set in the early years due to low volumes leading to high prices and due to the absence of accounting data. They could be applied to set a price ceiling. Bottom up LRIC could be used to set prices, but would provide investors with little assurance against regulatory opportunism.

We consider that the DCF approach combines both attractive levels of assurance about recovery of cost with a practical means of smoothing prices over time. It is also consistent with determining prices from a business plan rather accounting data, as is likely to be initially required. However, the DCF approach will require an adjustment to prices to allow for the asymmetric demand risk and will require visible regulatory commitment due to the long term nature of returns. This may be difficult in an environment of triennial market reviews.

A pragmatic approach to setting fibre prices would be to use both the DCF approach and top down CCA/LRIC approach and allow the operator to set the price at the maximum allowed under either approach.[38] The top down approach is an accepted methodology for setting regulated prices and is widely employed. The regulator would have assurance that prices were based on cost orientation, but the operator would have greater pricing flexibility, enabling a rapid response to new information about consumer preferences and demand. The publication of cost information based on the two models would increase the transparency of the impact of the DCF approach on pricing. However, there is risk that returns may be greater than cost over time.

[38] A variation would be to use the top down approach as a ceiling and the DCF approach as a floor. However, if the initial prices were lower than the ceiling (due to high prices from this model), there is a risk of under-recovery over time, as the top down price may fall below the DCF price.

4.4 VDSL assessment

We consider sub loop unbundling products are a form of copper access and therefore the discussion regarding the appropriate approach to copper applies to sub loop unbundling. Active VDSL wholesale products (bitstream) may best priced on a retail minus basis, to provide an appropriate balance of incentives for network roll out. However, if a cost orientated approach is required then the following needs to be taken into account.

While VDSL requires risky investment, it is not of the same magnitude as FTTH. There is also the potential to move from FTTC to FTTH and therefore some investments such as street cabinets and VDSL equipment may have a short economic life. This would suggest that a CCA based approach (top down FAC/LRIC and bottom up LRIC) would be relevant to VDSL bitstream pricing rather than a DCF type approach as not all investments are new. Bottom up LRIC is likely to be less appropriate, as it is not likely to accurately reflect the costs faced by the operator unless it is based on actual network topology and operating costs. If the LRIC model is based on a hypothetical optimised network, then the actual cost of rolling out VDSL may be greater and investment would be deterred.

Given the incremental nature of VDSL over copper access, there is a case for aligning the costing methodology with that of copper, either top down CCA or bottom up LRIC. This will minimise regulatory burden and facilitate recovery of joint and common costs, which will be considerable. However, it is important that the additional risk of VDSL compared to copper is taken into account in the setting of asset lives for VDSL equipment (which will have short economic lives) and an appropriate adjustment to the cost of capital.

4.5 Recommended approaches

Table 4-3 summarises our recommendations for the approach to pricing copper and fibre in the transition.

Table 4-3: Recommended methodologies[39]

	Copper	VDSL	Fibre	Conditions
Top Down FAC HCA	✗	✗	✗	n/a
Top Down FAC CCA	✓	✓	?	Network is not heavily depreciated/fully depreciated assets not excluded Consistent approach to capital maintenance Reasonable basis for efficiency adjustment
Top Down LRIC CCA	✓	✓	?	Network is not heavily depreciated/fully depreciated assets not excluded Consistent approach to capital maintenance Reasonable basis for efficiency adjustment

[39] These combinations are a simplified version of the available choices. Some countries have developed alternative methodologies such as the use of indexed historic cost with economic depreciation in France. Arcep, Décision number 05-0834, http://www.arcep.fr/uploads/tx_gsavis/05-0834.pdf

	Copper	VDSL	Fibre	Conditions
Bottom Up LRIC CCA	✓	?	?	Realistic network topology Based on actual operating costs Consistent approach to efficiency over time Asset lives adjusted to reflect stranding risk
DCF	✗	✗	✓	Regulatory commitment Risk adjustment to allow for demand risk Incorporate actual costs over time Offset any under-recovery due to margin squeeze rules

5 Common methodological issues

5.1 Joint and common costs of copper and fibre access

In the transition period while copper and fibre access networks co-exist, they will normally share common facilities such as ducts and poles. There will be a range of operating costs such as maintenance personal, buildings, corporate overheads which are shared between fibre, copper and other services. This raises the question of how to allocate joint and common costs between copper and fibre loops.[40] A complication to the problem of allocating joint and common costs is that demand for fibre is highly uncertain and likely to be elastic i.e. sensitive to price. This means that allocation of a significant share of joint and common costs to fibre at an early stage may dampen demand for fibre.

The Commission's recommendation on NGA does not consider the issue of common cost allocation between copper and fibre access in detail. It suggests that common ordering and provision, IT and wholesale product management costs should be allocated on a "proportionate basis" between all undertakings enjoying access.[41]

Economic theory suggests that the most efficient means of recovering common cost is Ramsey pricing.[42] Ramsey prices include a mark-up over marginal cost for each service that allows the recovery of common and fixed costs, where the mark-up is determined so as to limit the loss in economic efficiency introduced by the departure from marginal cost pricing. More specifically, the Ramsey pricing rule, in its simplest version, requires each mark-up over marginal cost to be inversely proportional to the market own-price elasticity of demand of the service.[43] This rule minimizes the impact on welfare as the reduction in the demand for each service generated by the increase in prices above the first-best level (i.e. above marginal cost) is smaller the more inelastic the demand for the service.

However, there are practical difficulties in making reliable estimates of price elasticities.[44] Regulators have generally preferred to use equi-proportional mark up (EPMU) or simple rules such as zero or 100% mark up on services. Under EPMU, the mark up is a fixed proportion of incremental costs. The EC has recommended zero mark up for mobile termination rates (and hence recovery of common

[40] Economists distinguish between joint and common costs. Joint costs – those costs which arise when two or more goods, or services, are produced in fixed proportions. Joint costs cannot be uniquely associated with the production of any particular good, or service. Common costs – those costs which arise in the production of two or more goods, or services, that are not produced in fixed proportions, and which are not incremental to the production of any specific one of these goods, or services.

[41] In this context it is important that common costs are allocated between corresponding retail and wholesale products, i.e. those wholesale products that support competitive retail offers, on an equitable, non arbitrary basis, as otherwise competition risks being distorted.

[42] Jean-Jacques Laffont and Jean Tirole. 2001. *Competition in Telecommunications*, MIT Press.

[43] The own-price elasticity of a good or service is a measure of the sensitivity of the demand for that good or service to changes to its own price. If there are externality and cross-price effects the rule requires that each mark-up is inversely proportional to the super-elasticity of that service. The cross-price elasticity of one good or service is a measure of the effect on demand for that good or service of a change in the price of another good or service. The super-elasticity of one good or service measures the percentage change in the demand for that good or service in relation to a percentage change in the prices of the other goods or services. Formally the super-elasticity is the sum of the own price and cross-prices elasticities weighted by relative revenue shares.

[44] Ofcom. May 2009. "Wholesale Mobile Voice Call Termination." http://stakeholders.ofcom.org.uk/consultations/mobilecallterm/summary

costs from other mobile services such as voice origination, subscription and data)[45], while a number of regulators have recovered 100% of common costs on shared loops from narrowband services and 0% from broadband services.[46]

There are a number of potential rules of thumb which could be used to allocate common costs such as allocation on the basis of duct space occupied by fibre and copper lines, mark up on the incremental cost of fibre or a simple 100/0% split between copper/fibre (or vice versa).

A pragmatic means of recovering common costs between copper and fibre access would be to allocate common costs on the basis of the volume of end user lines.[47] This would have the effect that as a customer switched from copper to fibre, they would bear the same amount of common costs i.e. they would "carry" their share of common costs with them. It would help to ensure the appropriate build/buy signal for operators and ensure parity between areas which may require significant incremental duct expansion for fibre and those where existing assets are utilised. It would also avoid problems with other methodologies such as duct space allocations resulting in a high proportion of common costs being spread over a few lines at the initial stage of roll out and longer term discontinuities from 100/0% allocations (when the transition is complete, there would be a sudden increase in fibre prices).

Allocation on the basis of line numbers may also be roughly consistent with the Ramsey approach. When there are few fibre customers and many copper customers, most of the common costs will be borne by copper customers. Over time as fibre customers increase, then the proportion of common costs recovered from fibre increases. We therefore recommend that, as a pragmatic alternative to the economically efficient Ramsay pricing approach, the allocation of duct costs on the basis of the number of end user lines for FTTH should be considered in future guidance on this topic.

5.2 Actually versus hypothetically efficient operator

The NGA recommendation states that sub loop unbundling pricing is to be *"in line with current methodologies for pricing copper"* and regulated access prices *"should not be higher than the cost incurred by an efficient operator"*.[48] However, the recommendation does not provide guidance on the interpretation of cost orientation for the pricing of fibre loops. Access to civil engineering infrastructure should reflect the *"costs effectively borne by the SMP operator, including due consideration of risk"* and should take account of *"actual lifetimes of the relevant infrastructure"* and include depreciation.[49]

[45] EC. 7 May 2009. "Regulatory Treatment of Fixed and Mobile Termination Rates in the EU", 2009/396/EC. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:124:0067:0074:EN:PDF

[46] Oftel. December 2000. "Statement on the implementation of shared access to the local loop in the UK." http://www.ofcom.org.uk/static/archive/oftel/publications/broadband/llu/shac1200.htm

[47] Where multiple copper lines are replaced by one fibre connection, there may be a case for taking account of the number of end users itself.

[48] Commission Recommendation of 20/09/2010 on regulated access to Next Generation Access Networks (NGA). Preamble Para 32 and Annex 1 (5).

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0035:0048:EN:PDF

[49] Commission Recommendation of 20/09/2010 on regulated access to Next Generation Access Networks (NGA). Preamble Para 16 and Annex 1 (2).

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0035:0048:EN:PDF

5.2.1 Copper

In relation to copper networks, because of their history and scope to set prices above efficiently incurred costs where there is market power, various approaches are applied to estimate the scope for efficiency gains and to incentivise such gains. Bottom up LRIC approaches may base efficiency adjustments on a hypothetical network or benchmarking with other operators. Top down models may base efficiency targets on historic information, management projection, benchmarking and analysis of costs and cost trends.

Under either approach, if multi-year price caps are applied these provide an opportunity for operators to outperform the productivity growth assumed in setting the price control and therefore to profit from efficiency gains – at least until the price control reset. We note that the efficiency factor "X" in an RPI-X price cap should represent the expected gain in efficiency relative to the economy as a whole.[50]

In relation to hypothetical models, models should not be based on an assumption of an instantaneous and efficient network. In reality networks are built over time and demand shifts, and the costs of the network that results should be recoverable. In relation to cost benchmarks we note that there is a need to compare like with like taking account of material differences in circumstances and that a comprehensive rather than selective set of benchmarks should be considered. Differences in definitions of cost categories may also be important. For example, part of the operating costs of an unbundled loop is fault clearance and the costs for fault clearance might be included in the costs for the loop but might as also – at least partly and to different degrees – be included in other fees outside of the loop price. Finally, care is needed in summing cost components as there may be trade-offs between them, for example, the sum of lower operating costs and lowest capital costs observed across a set of benchmark companies is unlikely to be feasible as there is a trade-off between capital and operating costs.

Taken together these weaknesses of benchmarking imply that it may be more appropriate to utilise actual network configurations and accounting data alongside incentives for efficiency gains over time.

5.2.2 Fibre

Fibre differs from copper in two fundamental ways in terms of incentives for, and therefore whether there should be, a presumption that costs are incurred efficiently. First, uncertainty over demand and willingness to pay the incremental costs involved in fibre provision mean that operators may find it difficult to recover efficiently incurred costs let alone any inefficiency. Second, operators have an opportunity to optimise network architecture and operating costs as they build the network.

Given the strong incentives for fibre operators to roll out network efficiently and the uncertainty around cost recovery we consider that any assumed efficiency gains should be based on reasonable expectations of actual cost trends rather than on hypothetical cost models.

[50] Bernstein, J., & Sappington, D. 1999. "Setting the X factor in price-cap regulation plans". *Journal of Regulatory Economics*, 16(1).

5.3 Asset lives and depreciation

Depreciation is the recovery of the cost of investment in access networks and is therefore an important element of the charge for copper and fibre access. The transition from copper to fibre raises a number of questions regarding the approach to depreciation for both copper and fibre networks.

The Digital Agenda broadband targets imply that copper loops from the exchange to the customer premise are likely to be progressively phased out since DSL cannot deliver the speeds required to meet the targets. The economic life of copper may therefore be limited. In contrast, fibre loops and civil infrastructure have potentially long economic lives as technical progress is likely to focus on upgrades to electronics.

The Commission NGA recommendations suggest that NRAs should take account of the "actual lifetimes of the relevant infrastructure" and include depreciation.[51] We assume the reference to actual life is intended to mean the economic or useful life of an asset, that is the expected period that an asset will be in service as opposed to the physical life of an asset. The physical life of an asset may exceed the economic life where technology change means that an asset should be replaced. This is particularly relevant to telecommunications equipment where the pace of technical change is likely to result in the replacement of equipment prior to the end of its useful life.

The Commission may consider that it is undesirable that asset lives differ between member states. However, there are sound reasons for some differences in asset lives between member states when the economic rather than physical life of an asset is considered given differences in network competition and expected market development. The approach to asset lives will also depend on choices about accounting methodology. Approaches such as bottom up LRIC models which have a significant risk of revaluation of assets due to technology or market changes imply a higher risk of asset stranding and this may be reflected in decisions about asset life i.e. shorter lives. On the other hand top down CCA FCM will provide greater assurance that technical and market changes will be reflected in costs and taken into account in setting charges. This may enable a longer view to be taken of the economic life of an asset.

Further, any harmonisation of asset life is likely to have significant implications for existing charges and raise risks of under/over-recovery of asset values over time. However, it may be appropriate for NRAs to take account of the asset lives in other member states when setting or reviewing asset lives in their own jurisdiction and we observe that NRAs do take account of developments when reviewing asset lives and depreciation.[52] BEREC may be well placed to take forward any formal co-ordination required in this space.

The transition to fibre means that the price of regulated copper access becomes important in determining the viability of fibre build out. Under HCA or top-down CCA approaches, fully depreciated assets will be excluded from cost i.e. if a proportion of copper loops are fully depreciated then copper loop price will be lower. However, the price of fibre loops will reflect their cost, meaning that a significant proportion of fully depreciated loops could dis-incentivise investment in fibre. There is a case for basing charges on an assumption that assets are not fully depreciated i.e. reflecting these costs in the price. While this may raise concerns about over-recovery of copper costs, the trade off in terms of improved investment incentives may offer higher ultimate benefits to consumers.

[51] Commission recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA). Annex 1 (2). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0035:0048:EN:PDF

[52] Ofcom. March 2005. "Valuing copper access." http://stakeholders.ofcom.org.uk/binaries/consultations/copper/summary/copper2.pdf

In summary, we believe that NRAs should review the determination of asset lives for copper access infrastructure in light of the transition to fibre networks and Digital Agenda targets. Further, NRAs should reconsider exclusion of fully depreciated assets from regulatory price determinations, otherwise investment signals for the NGA will be distorted.

5.4 Dual running costs during transition

A naïve regulatory response to the additional costs of transition might be to argue that these are the responsibility of the network operator and the unit prices should not be adjusted to take account of the increase in unit costs. However, such an approach would penalise the operator for rolling out fibre networks, as fibre roll out will result in loss of volume on the copper network and the higher the take up of fibre the larger the cost penalty from falling copper volumes would be. It would also be discriminatory, as an operator without a copper network who rolled out a fibre network would be at an advantage to a copper network operator, as they would not face higher per unit copper costs arising from successful roll out of fibre. Failing to allow for the increased unit costs of copper during the transition to fibre would therefore disincentivise fibre network investment and distort competition.

During the transition both copper and NGA networks will operate below capacity as customers will be shared between them. However, spare capacity does not represent inefficiency (a point which is true more generally when capacity increments are lumpy and demand is growing and/or uncertain).[53] What this points to is the need to minimise such costs where possible. The following approaches could help minimise such costs:

- Avoid regulatory barriers to the phase out of copper services such as obligations to provide LLU services when an operator has ceased to provide ADSL based services. The EC recommendation on regulation of NGA states that "*NRAs should ensure that alternative operators are informed no less than 5 years, where appropriate taking into account national circumstances...*"[54] This requirement could result in significant costs which will undermine the competitiveness of the network operator and access seekers' retail offers in the market and harm customers.
- Allow the price of copper to rise during the transition to encourage customers to switch. However, this approach is unlikely to be acceptable if it were to operate unchecked and on its own. Other mechanisms to promote transition that could be considered include:
  - Development of virtual wholesale products on fibre ("anchor products") that provide copper customers with a retail product equivalent to copper over fibre (lower bandwidth at an equivalent price). This would encourage those customers who do not wish to upgrade to fibre services (and corresponding higher prices) with an alternative to remaining on copper.
  - Developing a plan to "switch off" the copper network to avoid excessive costs from maintaining two access networks for an extended period. This may require co-operation between Government, the regulator and operators to determine an appropriate and acceptable approach. There may be parallels with agreed processes for analogue TV switch off developed and applied throughout Europe.

[53] For a general discussion of spare capacity and efficiency, see William Baumol and Gregory Sidak. 2002. "The pig in the python: is lumpy capacity used and useful?", *Energy Law Journal*, Vol. 23, pp. 383-399.

[54] Commission recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA). Paragraph 39. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0035:0048:EN:PDF

5.5 One or two models

The discussion above suggests that it may be best to have one model for copper and a second one for fibre. A potential concern with this suggestion is the treatment of joint costs straddling the two technologies, in particular - but not limited to - common duct. We believe that it is possible to address this concern in a satisfactory way, as follows. Firstly, identify the extent of common duct (note that duct installed to accommodate access fibre should be treated as being specific to fibre) both for the current period and for future periods (duct prices will change over time). Secondly, determine the annualised cost of this duct both for the current period and for the forecast period. Thirdly, split this annualised cost between the two technologies on the basis of an appropriate allocation basis.

We consider that it is likely to be desirable to have a common approach to copper and VDSL, given the strong element of sharing between the two services. Secondly, VDSL does not have the same specific issues as fibre with high levels of sunk costs (as a proportion of the total cost of the service).

5.6 Geographic segmentation

5.6.1 Fibre

Fibre roll out will be undertaken on a local or regional basis, even in countries with planned deployment to 100% of the country, the development will be staged. The regional roll out of fibre raises a question as to whether the price of fibre should be on a geographically segmented basis. There are a number of reasons for favouring geographic segmentation of fibre pricing:

- Costs of deployment will vary depending on the area. Setting a nationally averaged price will incentivise an operator to roll out in low cost areas and not roll out in higher cost areas. While prices could be reset, nationally averaged prices are likely to result in prices not reflecting costs in at least the short term.
- Geographic segmentation sends the appropriate price signals to wholesale and retail customers. This will mean that roll out in an area can take account of the willingness to pay of customers in that area. In most countries, 100% rollout of FTTH will not take place and it is important that roll out decisions are aligned with consumer willingness to pay.
- Cable competition may vary over the national territory based on historical presence and is frequently limited to low cost areas. Setting a nationally averaged price may make it more difficult for network operators to compete in cable areas. This distorts competition to the detriment of consumers.
- Cost data is more likely to be available on a regional basis, as operators will initially cost their target roll out areas. It would be appropriate to determine prices for the areas to which cost information is available.

In light of the above, there are sound reasons for considering geographic segmentation of pricing.

5.6.2 Copper

The reasons for geographic segmentation of pricing do not generally apply to copper pricing, as the network has already been rolled out and therefore, the economic benefit of geographic segmentation for copper are likely to be limited. Geographic segmentation will result in some prices increasing and some decreasing. Where prices are increased, the business plan of LLU operators will be undermined, requiring higher retail prices and likely to result in lower volumes. Price changes will eventually be passed through to customers, meaning that broadband prices are likely to increase in less densely populated areas. While such an increase may be justified, it is likely to be poorly understood and unpopular with consumers.

6 Risk and the cost of capital

The EC recommendation acknowledges that the cost of capital for fibre investment should reflect the higher risk of investment relative to copper and that this may require a premium to be added to the cost of capital. In Annex I to the recommendation, the Commission states that the NRA should take account of uncertainty relating to demand, costs, technological progress, market dynamics, competition and the macro-economy when estimating investment risk.[55]

The Commission notes that these factors may change over time, in particular due to the progressive increase of retail and wholesale demand. The Commission also states that regulators should take account of factors that potentially mitigate the risk of NGA investment by operators including economies of scale, high retail market shares, control of essential infrastructure, operating cost savings, proceeds from sale of real estate and "*privileged access to equity and debt markets*."

We first comment on the considerations identified by the Commission and then consider the extent to which an adjustment to the cost of capital can reflect and compensate for NGA investment risk. We conclude that separate provision is also required to fully address demand risk.

6.1 "Privileged access to equity and debt markets"

It is not clear that anyone has privileged access to equity and debt markets (perhaps with the exception of access to debt for government whose long term fiscal position is considered sustainable and who can therefore rely on future taxation to meet borrowing costs).

In relation to operators Figure 6-1 sets out three reasons why the notion of privileged access to equity and debt markets does not appear to offer useful guidance in considering the cost of capital.

Figure 6-1: Privileged access to capital markets?

Investors in capital markets have a wide range of options open to them beyond investment in telecommunications or NGA in particular. Investment options will be considered on their merits rather than "privileged" status – the investment itself must stack up relative to alternatives including holding on to cash or investing in other businesses or regions.

The cost of capital is strictly project specific – though it may be estimated for the firm as a whole or for copper versus other activities. The portfolio of investments of a particular operator is not therefore the relevant consideration.

Finally, we note that access seekers are often large telecommunications operators who may be access providers in one country and access seekers in another.

6.2 The weighted average cost of capital (WACC)

Given the large scale of investment required in NGA, the cost of capital is an important element in setting cost orientated prices. However, we note that even if an appropriate cost of capital were set, it does not follow that investment, and in particular efficient and timely investment, will take place. First,

[55] Commission Recommendation of 20/09/2010 on regulated access to Next Generation Access Networks (NGA). Annex 1 (6). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0035:0048:EN:PDF

because the implied prices (and assumed volumes) might not be met in practice if incremental consumer willingness to pay is insufficient and competing access technologies (including copper) are more attractive to consumers. Second, because setting a price control may both limit the scope for price differentiation and for prices to reflect consumer preferences across technology choices.

The weighted average cost of capital (WACC) consists of the cost of equity(Ce) and the cost of debt(Cd), weighted by the gearing (g or ratio of debt to the value of the firm):[56]

$$WACC = (1-g)Ce + g(Cd)$$

The cost of equity is composed of three factors: the risk free rate (Rf), the market risk premium (Rm-Rf) and the beta (b or variance of firm returns compared to the market returns):[57]

$$Ce = Rf + b(Rm - Rf)$$

The cost of debt is composed of the risk free rate (Rf) and a firm specific risk premium (Df):

$$Cd = Rf + Df$$

The concept of "beta" is important to the discussion that follows regarding non-diversifiable and diversifiable risk. The cost of capital is intended to compensate for non-diversifiable or systematic risk; risk that cannot be diversified by holding other investments. This is not the same as the variability or risk associated with an individual investment or share. Instead, what is important is the relationship between a project's earnings and earnings on all real assets. Cyclical firms (or projects), whose revenue and profits are more strongly dependent on the business cycle, tend to be higher beta firms (projects).

Diversifiable risks should be taken into account when assessing projects by adjustments to expected cash-flows rather the WACC. The finance literature explicitly warns against adding a "fudge factor" to the cost of capital to allow for diversifiable risk.[58]

6.3 Non-diversifiable or systemic risk

In considering the additional risk of fibre over copper investment, we see a number of reasons for believing that the cost of capital for fibre will be higher than that of copper (FTTC is intermediate – perhaps closer to copper).[59]

- Operating leverage – projects with high fixed cost relative to variable costs are said to have high operating leverage. Higher operating leverage means higher risk and NGA investments require high levels of capital (fixed costs) and lower levels of operating cost. NGA investment will therefore have higher operating leverage and higher risk relative to copper.
- Long time period for returns – investment in NGA requires investment in assets with long lives such as duct and fibre. The finance literature recognises that projects with long term cash-flows are more risky than projects with short term cash-flows.

[56] The formulas do not take account of tax. The correct treatment of tax is a complex issue will vary between member states. It is not specific to transition issues and we do not consider the matter further.

[57] Strictly beta is the covariance between a stock return and the market return over the variance of returns on the market.

[58] Richard Brealey, Stewart Meyers and Franklin Allen. 2008. *Principles of Corporate Finance*, 9th edition, McGraw Hill, page 247.

[59] Richard Brealey, Stewart Meyers and Franklin Allen. 2008. *Principles of Corporate Finance*, 9th edition, McGraw Hill, page 250.

- Option value – irreversible investments that have uncertain future returns and where an investor has some leeway to delay investment have an option value.[60] By investing operators forgo the option to delay investment and learn about demand, willingness to pay and costs. The option value raises the hurdle rate for investment.
- Income elasticity of demand – demand for NGA is likely to be more highly correlated with movements in incomes and GDP than demand for copper. This pro-cyclicality raises the beta factor.

Based on the above discussion, we believe that are sound reasons to expect that NGA investment will have a higher cost of capital than copper investment. We note that these factors will apply to some extent to both FTTC and FTTH investment.

6.4 Diversifiable or non-systemic risk

Much of the uncertainty described in the Commission recommendation will not be reflected in the allowed cost of capital, if determined based on the CAPM approach. This is particularly important in considering the Commission guidelines in Annex 1, sections 7 and 8. In section 7, the Commission states:

> "*Long-term access prices should only reflect the reduction of risk for the investor and therefore cannot be lower than the cost oriented price to which no higher risk premium reflecting the systematic risk of the investment is added*."

The calculated WACC premia will only partly compensate for volume uncertainty. The remaining element (diversifiable risk) is nevertheless real and needs to be considered in the context of cash flows rather than the cost of capital.

If demand turns out to be lower than anticipated in cost modelling, there may be no price that would recoup anticipated losses (since raising prices would further depress demand to the point where it is not profitable if demand turns out to be weak). The only way to compensate for this risk *ex ante* is to allow above average returns in the scenario where demand turns out to be high. There are a number of ways in which this might be achieved in practice:

- Defer *ex ante* price regulation, or set retail minus price regulation rather than setting cost orientated prices. This implies that demand does not need to be estimated by the regulator and that higher returns might (in a good outcome) be earned for a time by the investor. However, it leaves open the risk that should high demand eventuate *ex ante* price controls will be applied. In other words unless there is some commitment to defer *ex ante* regulation for a significant length of time asymmetric risk remains with the investor.
- Allow a price premium in an *ex ante* price control to compensate for demand risk. In terms of the anticipated impact on expected revenues this may be equivalent to a WACC premium. However, it differs in that a WACC premium for diversifiable risk may distort capital choices. However, we note that it may not be possible to charge the price premium and achieve assumed volumes.
- Allow a volume reward whereby the return on volumes, should they turn out to be higher than assumed, is retained by the investor. This leaves the investor with a valuable option to earn a higher return, whose value will depend on the baseline volume assumption used in setting the

[60] Avinash Dixit and Robert Pindyck. 1994. "Investment under uncertainty". Princeton University Press.

price control. This approach would appear to have positive incentive properties to grow the market for NGA, thereby encouraging partnerships with access seekers who have strong retail propositions.

We note that the volume premium approach is similar to the approach adopted in the Netherlands as described in Figure 6-2. Hybrid approaches might also be possible.

Figure 6-2: Netherlands approach to NGA premium

OPTA has dealt with the risk premia in the cost of capital for setting unbundled FTTH loop prices in the Netherlands.[61] OPTA regulate prices on the basis of a price cap calculated with a discounted cash flow (DCF) model that includes expected cash inflows and outflows over the life of the investment. The price cap is calculated by the setting the net present value of the investment at zero. The use of the DCF model is intended to provide pricing flexibility over time to the regulated operator, Reggefiber. OPTA has included two premia in the WACC for NGA pricing.

- The first premia is a compensation for systematic risk and takes account of the issue with higher risk of investment in fibre relative to copper. OPTA propose to recalculate this risk premia when NGA prices are determined every three years.
- The second premia is to allow asymmetrical regulatory risk. OPTA believe that this risk arises from the significant demand uncertainty associated with NGA investment combined with potential for regulators to set prices lower if outcomes turn out better than expected, while leaving risk with the firm if outcomes turn out worse than anticipated.

OPTA allows for the asymmetric risk by committing to allow Reggefiber the opportunity to earn a premium of 3.5% on the WACC i.e. if demand is higher than the central project, Reggefiber is allowed to retain the additional earnings up to 3.5% on the WACC. This means that Reggefiber face both the possibility of losses (if demand is lower than expected) and economic profits (if demand is higher than expected).

In relation to the level of demand that might be anticipated we note that Verizon in the US, in the absence of *ex ante* price controls and in the face of cable competition, has achieved penetration levels of around 32% for FTTH.[62] This illustrates that uncertainty regarding volumes, also due to platform competition, needs to be adequately reflected in price regulation.

6.5 Volume discounts

A long term contract with an access seeker increases the certainty of cashflows for an operator and therefore might be expected to result in a lower beta and lower cost of equity. Long term contracts may also impact on the optimal level of gearing, enabling higher levels of debt to equity thereby lowering the cost of capital. In section 8, the Commission states:

> "*The volume discount should only reflect the reduction of risk for the investor and therefore cannot result in access prices which are lower than the cost oriented price to which no higher risk premium reflecting the systematic risk of the investment is added.*"

[61] OPTA. May 2010, "Regulation, risk and investment incentives", Regulatory Policy Note 06. http://www.opta.nl/en/news/all-publications/publication/?id=3201

[62] Verizon. 25 January 2011. 4th Quarter Earnings. http://investor.verizon.com/news/20110125/

However, as the cost of capital will not reflect much of the additional volume risk borne by an operator and therefore, there is no reason to limit the price discount to the size of the risk premia in the cost of capital.

The NGA recommendation proposes that the risk premium form the basis for any risk sharing discounts for wholesale access. If a volume reward is used then, the discount would be based on the trade-off between the reduction in risk from commitment and expected gains from the volume premium. The calculation of a price premium is less clear cut. Option values may provide some guidance to the appropriate premium, but may not be conclusive. It may be possible to derive some understanding of the magnitude of the premium from the business case.

6.6 Assessment and proposed approach

To be effective in incentivising investment the approach adopted must reflect the level of non-diversifiable risk in the WACC and somehow address volume risk i.e. offer an upside reward that offsets downside risk. To be credible a transparent commitment to the proposed approach in advance will be required.

Our view is that a DCF approach which considers returns over the timeframe for business case analysis and which explicitly addresses volume risk is likely to be the most credible. Assumed volumes should be set such that there is a reasonable prospect of exceeding them and earning a higher return (volume reward) than the estimated WACC.

Once a price control profile is established there may also be merit in allowing under-recovery – should initial demand turn out to be lower than anticipated – to result in a credit which is carried forward and allows for the possibility of higher prices in future (on a net present value neutral basis).

7 Avoiding double jeopardy in the application of margin squeeze

Competition economics literature defines margin (or price) squeeze as "a strategy whereby a vertically integrated dominant firm can use its control of the input price and the retail price to 'squeeze' the profit margins of downstream rivals to whom it also supplies the input".[63] Margin squeeze abuses have been recognised as violations under Article 102 EC in a string of Commission's decisions.[64] [65]

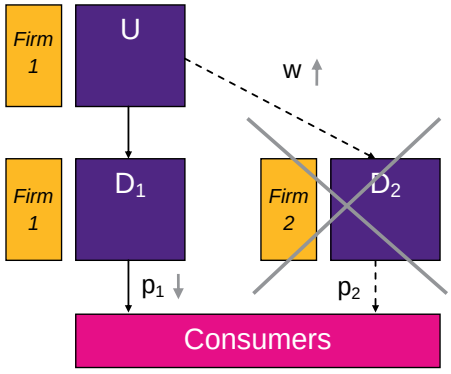
7.1 What is a margin squeeze?

A margin squeeze may occur in markets where a vertically integrated network operator sells an essential input to a number of downstream retailers and simultaneously supplies competing retail services. A margin squeeze takes place when, over a relevant time period, the difference between retail and wholesale prices is so small that a hypothetical, equally efficient downstream competitor would find it impossible to remain profitable. So, in consequence, a margin squeeze is said to prevail if the following condition is satisfied:

Downstream revenue – Upstream (input) price < Downstream unit cost [66]

This is depicted in Figure 7-1.

Figure 7-1: Margin squeeze illustration



The vertically integrated dominant firm:

- Typically raises the price (w) of inputs used in downstream markets to a level at which it is practically impossible for downstream competitors to make profit; or
- Pursues the strategy of keeping prices (p_1) below costs in the downstream market while being profitable overall through the upstream operations; or

[63] O'Donoghue, Robert, and A. Jorge Padilla. 2006. *The Law and Economics of Article 82 EC*. Oxford: Hart Publishing, p. 303.

[64] See e.g. EC Decision in Case COMP/38.784 of 4 July 2007 - Telefónica S.A, or ECJ. 14 October 2010. *Deutsche Telecom v Commission (Competition)*, C-280/08.

[65] Case law in the US appears to be developing in a different manner, as a recent US Supreme Court ruled that a price squeeze case may not be pursued in the absence of antitrust duty to deal. *Pacific Bell Tel. Co, dba AT&T California, et al v Linkline Communications, Inc*, et at 172 L. Ed. 2d 836 2009 US LEXIS 1635, 25 February 2009.

[66] The definition of the timeline over which the margin squeeze test is carried out is important. If the situation is present only at a point in time it does not constitute a margin squeeze. In an NGA context, the high initial costs required to deploy fibre and consequently the timeline for the profitability of such investments should be taken into account.

- ‘Squeezes’ the margin of downstream competitors by raising the price of upstream inputs and at the same time decreasing the prices of the respective downstream retail products.

The Commission has addressed the issue of margin squeeze in its recent Guidance on its enforcement priorities in applying Article 82 to abusive exclusionary conduct by dominant undertakings (‘the Guidance’).[67] The Guidance states that:

> *“...instead of refusing to supply, a dominant undertaking may charge a price for the product on the upstream market which, compared to the price it charges on the downstream market, does not allow even an equally efficient competitor to trade profitably in the downstream market on a lasting basis (a so-called “margin squeeze”).*[68]

7.2 Regulation and competition law

Margin squeeze tests have long been applied by NRAs as a form of *ex ante* regulation as well as by competition authorities as *ex post* enforcement of competition law.

When NRAs find that an operator has SMP in a market, they can impose regulatory remedies such as a requirement to supply a wholesale product and not to discriminate between their downstream business and other operators. The NRA may require the SMP operator to provide the product at a cost orientated price and could determine this price and set a price control over a multi-year period. In essence, the NRA can choose between a requirement to avoid a margin squeeze and the determination of a cost orientated price. Retail minus pricing obligations are a form of *ex ante* margin squeeze test requirement. Ofcom’s regulation of VULA (Virtual Unbundled Local Access) is an example. Ofcom require the provision of VULA on fair and reasonable (but not cost orientated) terms and have indicated that a margin squeeze would breach this requirement.[69]

Competition authorities may take action to enforce competition law, where an abuse of dominance is suspected. In a number of cases, the Commission has initiated action against a margin squeeze for products with a regulated cost orientated price. Under Article 102 and national competition laws, a margin squeeze may constitute an abuse of dominant position.

In a limited number of member states, the NRA is also the competition authority (NCA) for the telecommunications sector. This enables the authority to take action to prevent margin squeeze by regulation and action to punish margin squeeze under competition law. However, there is potential for conflict between margin squeeze action by regulators and competition authorities, due to having two sets of rules and the risk of contradictory decisions or the imposition of inconsistent remedies. The Commission has taken action in a number of cases in the telecommunications sector, against operators whose prices have been regulated by their NRA.[70] These have been documented in the

[67] European Commission. 2009. “Guidance on the Commission's enforcement priorities in applying Article 82 of the EC Treaty to abusive exclusionary conduct by dominant undertakings.” Para. 80. http://ec.europa.eu/competition/antitrust/art82/guidance_en.pdf.

[68] European Commission. 2009. Guidance on Article 82., para. 80.

[69] Ofcom 7 October 2010. “Review of the Wholesale Access Market”, page 145. http://stakeholders.ofcom.org.uk/consultations/wla/statement

[70] Such as Deutsche Telecom and Telefonica cases cite above.

literature and we do not propose to discuss them further in this paper, as our focus is on the use of both *ex ante* margin squeeze and price regulation by NRAs.[71]

There are a number of potential problems arising from the joint use of margin squeeze and price controls:

- *Ex ante* regulation may continue where there is competition but an SMP designation still applies.
- Application of lower threshold of margin squeeze or cost oriented price will undermine cost recovery by the operator.
- An overly complex or poorly designed margin squeeze test may limit pricing flexibility at the retail level and undermine price differentiation required to facilitate efficient investment and to respond to competition.

The first of these problems is likely to affect the pricing of copper loops in a market with wireless competition and the latter two issues are likely to impact on fibre loop and VDSL pricing. We now discuss these in more detail.

7.3 The use of margin squeeze to regulate copper prices

In most member states, LLU prices have been regulated on a cost orientated basis either on the basis of LRIC or FAC CCA cost of a loop.[72] However, in Austria, the NRA has also applied an *ex ante* margin squeeze test and has required loop prices to be reduced below the cost orientated price, due to reductions in the retail price of broadband due to competitive pressure. However, if an operator is reducing retail prices to meet competition and this price reduction is sufficient to require consequent reductions in the LLU price below the cost orientated price, then regulation of the loop is no longer required (the European Framework requires the removal of regulation once a market becomes competitive).[73]

The continued development of wireless and cable broadband is likely to increase the competitive constraints on copper broadband prices. The competitive constraint of wireless and cable will vary between member states and therefore it is difficult to generalise about the nature of competition in individual states, however, where the development of competition in the retail market is sufficient to drive retail prices below that required to allow a sufficient margin between retail and wholesale prices, then an NRA should review their market analysis to determine whether the operator still has SMP. Operators will be subject to competition law, however, in the absence of dominance, an operator will no longer be obliged to comply with margin squeeze requirements.

[71] Damien Geradin and Robert O'Donoghue, 2005. "The concurrent application of competition law and regulation: the case of margin squeeze abuses in the telecommunications sector", *Journal of Competition Law & Economics*, Volume1, Issue, page 355-425.

[72] BEREC. October 2010. *Regulatory accounting in practice*, BoR (10) 48. http://www.irg.eu/streaming/BoR%20(10)%2048%20BEREC%20RA%20report%20in%20Practice%202010_final.pdf?contentId=546971&field=ATTACHED_FILE

[73] 2009/140/EC, para 5. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF

7.4 NGA Recommendation

The Commission's recommendation suggests that NRAs need to ensure that pricing arrangements such as discounts for long term or volume commitments do not result in a margin squeeze over an appropriate timeframe.[74] It recommends that NRAs adopt a reasonably efficient competitor test, where the margin squeeze test is applied to check whether a reasonably efficient competitor could compete in the downstream market if it purchased access at the wholesale price. This is in contrast to an equally efficient competitor test, where the assessment is based on whether the operator's own downstream operations could trade profitably on the basis of the upstream price charged to competitors.

The Commission recommends that NRAs specify in advance the methodology and the parameters for the test and remedial mechanisms where a margin squeeze is detected. The Commission also recommends the use of a margin squeeze test for a wholesale broadband service where a cost orientated price is not determined.

7.5 Fibre and margin squeeze

The combination of margin squeeze and cost orientated price controls raises a question over prospects for cost recovery. At an early stage of fibre investment it may not be possible to charge cost reflective retail prices and grow the market. In order to attract customers, an operator may have to offer attractive retail prices including discounting and other promotional offers.[75] There is a risk that this may result in retail prices which could breach a traditional margin squeeze test.

The application of margin squeeze tests to the early stage of a product life is difficult and complex as illustrated by the difficulties encountered by NRAs and NCAs with low speed broadband. Given the potential impact on investment in NGA, it is vital that NRAs apply margin squeeze tests in a pragmatic and sensitive fashion. Difficulties (excluding market analysis issues) in applying margin squeeze tests to high speed broadband include:

- Determining incremental costs relating to wholesale broadband products may be difficult given the extent of shared and common costs.
- Historic accounting information will overstate costs in an immature market, as initial volumes will be low and many costs will be incurred upfront (e.g. advertising and marketing). Unit costs may also decrease over time as firms learn by doing.
- Discounted cashflows over time are likely to be more appropriate than historic cost as they will take account of declining costs and future volumes but also raise difficult issues such as determination of the appropriate time period for recovery of cost, forecast volumes and costs.
- Likely need for penetration pricing i.e. use of low prices to attract customers to use a service.
- Estimation of appropriate customer life and churn rates.
- Significant up-front costs of home gateways internal distribution, and set-top boxes.
- Valuation of intangible assets such as the termination value of consumers.

[74] S. also EC Decision in Case COMP/38.784 of 4 July 2007 - Telefónica S.A, § 342

[75] Rosston, Savage and Waldman. 2010. "Household demand for broadband internet in 2010." *The B.E. Journal of Economic Analysis and Policy*. http://www.bepress.com/bejeap/vol10/iss1/art79/

NRAs will need to give careful thought to the development of appropriate margin squeeze tests, while some of the experience with early broadband will be relevant, the challenges and consequences of margin squeeze tests for high speed broadband are likely to be even greater. We now discuss three issues discussed in the Commission's NGA recommendation: equally efficient versus reasonably efficient competitor, commitment discounts and volume discounts.

7.6 Equally efficient versus reasonably efficient competitor

In the preamble to the recommendation, the Commission states a preference for "reasonably efficient competitor" test in place of an "equally efficient competitor" test.

Following the Commission's recommendation, the ECJ released its ruling on the Deutsche Telecom case. In its ruling, the Court made it clear that the appropriate test for margin squeeze is the equally efficient competitor test, consistent with case law precedent and previous court rulings in this case.[76] The equally efficient competitor test is widely used by competition authorities and NRAs.[77] This conflicts with Commission's recommendation, and would also oblige operators to speculate about the cost levels of a reasonably efficient competitor rather than refer to their own cost levels. Further, it is not necessarily in consumers' interests for higher cost entrants to be protected, as they will face higher prices than that of an equally efficient competitor. There is a strong case for using the equally efficient competitor test.

The choice of test is also relevant to the issue of volume and commitment discounts and to the scope of the margin squeeze test i.e. whether the test should be applied to the market as whole, customer segments, groups of products or individual products.

7.7 Scope of the test

The use of the equally efficient competitor test suggests that the starting point for the analysis should be the product range within a defined market that is sold by the SMP operator rather than specific products. This is particularly relevant to price differentiation and the likely need to offer low margin entry level retail products to attract customers onto the network. Ofcom noted in its recent broadband margin squeeze decision that it may make sense to incur losses on lower price services, if customers are migrating up the value chain to higher margin services.[78] The margin squeeze analysis should focus on returns across the product range rather than individual products. The application of the margin squeeze test at a detailed product level avoids the difficulties with determining incremental costs for individual products. The narrower the scope of the test, the greater the likely difficulty with determining the relevant incremental costs for the product. This is particularly true for NGA where operators are providing services in competition to other platforms and face demand uncertainty.

[76] *Deutsche Telecom v Commission (Competition)*, ECJ, C-280/08, 14 October 2010.

[77] For example, Ofcom's investigation of BT's residential broadband pricing (2 November 2010), Court of Appeal, *Dŵr Cymru Cyfyngedig v Albion Water Limited* [2008] EWCA Civ 53.
http://www.catribunal.org.uk/files/Judgment_on_unfair_pricing_1046_Albion_071108.pdf

[78] Ofcom. November 2010. "Investigation of BT's residential broadband pricing."
http://stakeholders.ofcom.org.uk/enforcement/competition-bulletins/closed-cases/all-closed-cases/cw_00613/

7.8 Commitment discounts

The Commission's NGA recommendation allows for operators to charge lower prices for long term commitment and for volume discounts for pricing of fibre loops, however, it does so on the basis that there is sufficient margin between wholesale and retail prices to allow for market entry by an efficient competitor in the downstream market.

The application of the margin squeeze to long term contract prices raises a question about the appropriate focus of the test – should the test focus on the long term contract price and retail prices or should it also test the short term contract price? The answer to this question will depend on the extent of competition from the availability of long term contract prices. The Commission clearly contemplates that in the case of wholesale broadband, regulation may be relaxed where physical access remedies create sufficient competition.[79] Clearly, a similar outcome is possible for long term contracts, if a sufficient number of parties take up the contracts then the downstream market for short term contracts and the retail market will be competitive. In such a case, the margin squeeze test would be unnecessary for the short term contract price.

A difficulty for the infrastructure owner and potential co-investors (or buyers of long term contracts) is that the threat of a margin squeeze test on short term contract prices may undermine the rationale for a long term risk sharing contract. This is because the margin squeeze test places a potential ceiling on returns in the event that investment is more successful than initially projected i.e. some of the upside is passed onto buyers of short term contracts. However, in the event that the investment is unsuccessful i.e. take up or prices are below business case, the short term contract buyer can choose not to purchase or purchase at a price that guarantees a return.

This suggests that there is a case for NRAs to restrict the application of the margin squeeze test to the long term contract price. A concern under such an approach may be that the infrastructure owner does not offer long-term contracts on a commercial basis i.e. deters entry. This may raise concerns about sufficient competition in the downstream market. However, this problem could potentially be addressed by the provision of NRA guidelines on the offer of long term contracts to ensure that all players in the market have the opportunity to purchase these contracts.

We recommend that NRAs focus the margin squeeze test on the long term contract price and seek to avoid application of the margin squeeze test to the short term price by ensuring a competitive and transparent process for the purchase of long term contracts. Failure by a network operator to comply with the guidelines could result in the application of the margin squeeze to short term contract prices.

7.9 Volume discounts

The application of the margin squeeze test should be to the discounted price, provided that the network operator can meet the volume requirement i.e. consistent with equally efficient competitor test. There does not appear to be any reasonable basis for applying the margin squeeze price to the undiscounted price, unless the volume discount has been set for anti-competitive reasons. We discuss the appropriate approach to allowing volume discounts, but provided the discount is offered on a reasonable basis, then the margin squeeze test should be applied to the undiscounted price.

[79] EC, NGA Recommendation, preamble para 38.

7.10 Conclusions

The application of margin squeeze test in the transition to fibre raises a number of challenges. In regard to copper pricing, where a margin squeeze test implies a reduction in the regulated price below cost orientated levels, this should trigger a review of the market and whether an operator still has SMP. Where possible regulators should avoid applying margin squeeze tests and cost orientation regulation to the same product.

The application of margin squeezes to fibre wholesale and retail pricing raise many issues with applying the test in new and emerging markets. The use of parallel margin squeeze and cost orientation requirements requires careful application to ensure that regulation does not undermine the reasonable expectation of cost recovery. We consider that NRAs should use an equally efficient competitor approach, consistent with case law and regulatory practice. This will also help promote certainty in the application of the test. Commitment discounts require a careful balance between desire to promote competition with providing sensible *ex ante* incentives to share risk. One potential solution is to place greater weight on *ex ante* involvement of regulators in process to make risk sharing opportunities available to access seekers. Provided a fair process is followed, then there will be less concern about the use of commitment discounts to limit competition.

Appendix A: Cost orientation

A long standing remedy of European telecommunications regulation is a requirement on an operator with significant market power (SMP) to set prices on the basis of cost orientation.[80] This requirement has been maintained in successive EU reforms of telecommunication regulation, including the directive 2009/140/EC of 25 November 2009. The EC recommendation on NGA pricing proposes that NRAs should determine NGA wholesale prices on this basis.[81]

In simple terms, the requirement for cost orientation means that prices must be related to cost in some way. The underlying logic behind this requirement is that in the long run, in an effectively competitive market, prices will tend to cost (including a reasonable return or economic profit on capital invested). Otherwise, new firms would enter the market and drive prices to cost.

In applying cost orientation a regulator must consider how best to recover costs over time (given the long lived nature of assets involved) and, for common and shared costs including capital assets such as duct as well as ongoing operating costs such as maintenance staff, how to recover such costs across different services. There is no simple accounting answer to the right way in which to allocate such costs over time and across services. However both market conduct and the economics of efficient pricing offer some guidance.

In a competitive market firms take account of demand in setting prices and in many markets, firms set prices based on demand as well as cost resulting in price differentiation where different customers pay different prices for the same service or similar prices for different products e.g. airline seats. Further, a price above cost may be necessary to align the firms decisions with customers interests (where there are multiple investment options which customers value by different amounts).

Regulatory and judicial precedent suggests that cost orientation is a broad definition and allows a range of prices between LRIC and stand alone cost (SAC) to be determined for services and that a range of costing methodologies including current and historic cost and top down and bottom up models may be employed to determine cost. The requirement for cost orientation would appear to rule out pricing based purely on demand (as this would not take account of cost), but would allow the recovery of common costs on the basis of demand. The term cost orientation has been long established in EU telecommunications regulation, but has not been defined in legislation.

Cost orientation was a feature of early Commission telecommunications regulation and the Commission's 1997 recommendation on the Interconnection Directive explained cost orientation as follows:[82]

> "*The principle of cost orientation implies that the price charged for provision of a service should reflect the underlying costs incurred in providing that service*."

It does not define "underlying costs" or prescribe approaches to estimating cost, noting that the directive did not specify a form of cost methodology, only transparency about the approach used. The 1997 Interconnection Directive defined cost orientation for interconnection pricing as between a floor of LRIC and ceiling of stand alone cost.

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[80] Interconnection Directive (97/33/EC) and in the preamble and annex of the ONP Directive (97/51/EC). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0033:EN:HTML

[81] Commission Recommendation of 20/09/2010 on regulated access to Next Generation Access Networks (NGA). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:251:0035:0048:EN:PDF

[82] EC. 15 October 1997. "Commission Recommendation on Interconnection in a liberalised telecommunications market", C(97) 3148.

"…*whereas the level of charges should promote productivity and encourage efficient and sustainable market entry, and should not be below a limit calculated by the use of long-run incremental cost and cost allocation and attribution methods based on actual cost causation, nor above a limit set by the stand-alone cost of providing the interconnection in question*;"[83]

The remedy of cost orientation has remained a feature of regulation since this time, but there has been limited further elaboration of the meaning of the term. The 2002 Access and Interconnection Directive and the 2009 revision to the framework both prescribed cost orientation as a remedy without defining the term, although, the Access Directive does note that cost includes a reasonable rate of return on capital and that assets should be valued at current value.[84]

The ERG (now BEREC) has developed guidance on the meaning of the term cost orientation. The 2005 ERG guidance on accounting separation identifies fully allocated cost (FAC) and LRIC as the main costing methodologies for the purpose of demonstrating the cost orientation of charges. The ERG guidance states that the first test of cost orientation is whether prices are between a LRIC floor (the incremental cost of providing a service) and ceiling of Stand Alone Cost (SAC or the cost of providing an increment or service without providing any other service). FAC and LRIC plus common costs will lie somewhere between these two price levels. A further test is required for a group of products, a combinatorial test, whereby the aggregate revenue of services straddling the common costs is compared to the LRIC and SAC of these services measured as a single increment.[85]

The price floor of LRIC and price ceiling of stand alone cost is consistent with economic theory. Baumol and Sidak show that no firm in a perfectly contestable market would charge a price below incremental cost (otherwise it would lose income) or above stand alone cost (otherwise a competitor would enter the market).[86]

The European Court of Justice (ECJ) considered the issue of cost orientation in its recent *Arcor* decision, which involved an appeal against LLU pricing decision by the German regulator in 2001.[87] The Court noted that Community law lays down the principle of cost orientation for a number of telecommunication services, but does not specify what cost orientation means. The Court confirmed that depreciation and a return on capital were among the costs that need to be taken into account. The ECJ confirmed that the NRA has to take account of actual costs incurred by the operator and forward looking costs, however, the Court suggested that neither current or historic cost should be relied on alone to set prices. The justification for the Court's view is that historic costs might result in prices that were too low and current costs in prices that were too high. The ECJ concluded that NRAs could set charges on the basis of bottom up or top down cost models in the absence of complete and comprehensible accounting documents. We note that the ECJ's decision concerned pricing of copper loops prior 2002 and therefore may not be directly applicable to setting the price of copper or fibre loops today.

[83] 97/33/EC, 26 July 1997. Recital 10. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997L0033:EN:HTML

[84] Recital 20, 2002/19/EC. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0019:EN:HTML

[85] ERG, "Guidelines for implementing the Commission Recommendation C(2005) 3480 on Accounting Separation and Cost Accounting Systems under the regulatory framework for electronic communications, ERG (05) 29. http://www.erg.eu.int/doc/publications/consult_accounting_sep/erg_05_29_erg_cp_rec_as_and_cas_final.pdf

[86] William Baumol and Gregory Sidak (1994). *Towards competition in local telephony*, MIT Press, Cambridge, MA.

[87] *Arcor AG & Co v Bundesrupublik Deutschland*, Case C-55/06, 24 April 2008. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:62006J0055:EN:HTML

Appendix B: Capital maintenance

The use of CCA raises a question about how to ensure that the capital or equity of a company is maintained over time as assets are re-valued. There are two approaches to capital maintenance. Capital can either be viewed in operational terms (i.e. as the company's capacity to produce goods and services) or in financial terms (i.e. as the value of shareholder's equity). These concepts are known respectively as operating capital maintenance ("OCM") and financial capital maintenance ("FCM").[88]

CCA can be based on either the OCM or FCM approach. Under the OCM approach the focus is on ensuring that the firm sets aside enough money to ensure that equipment can be maintained[89] whereas under the FCM approach the focus is on the return received by shareholders.

Both OCM and FCM value assets on the same basis. However, they differ in the choice of depreciation methodology.[90] Under OCM the depreciation charge consists of the historic charge plus a supplementary charge where than charge is defined as the Gross Replacement Cost/Asset Life less Historic Depreciation. Where asset prices are increasing supplementary depreciation will be positive; where asset prices are decreasing supplementary depreciation will be negative.

Under FCM the depreciation consists of historic depreciation, supplementary depreciation and unrealised holding gains.[91] The unrealised holding gain takes into account price changes made in the course of a particular year and can be defined as Closing NRC less Opening NRC less Other Movements in the Account during the course of the year. Where asset prices are rising unrealised holding gains will be positive resulting in a reduction in the depreciation charge. Correspondingly, where asset prices are falling unrealised holding gains will be negative resulting in an increase in the depreciation charge. The sum of FCM depreciation for a given investment will always equal historic cost depreciation and in turn the original investment itself.

The discounted sum of annualisation charges under FCM and historic depreciation will be the same and will, in principle, equal the original investment. However, the profile of the annualisation charge differs with the FCM charge being lower in early years and higher in later years where asset prices are falling and higher in early years and lower in later years where asset prices are rising. A falling (rising) annualisation profile where asset prices are falling (rising) ensures competitive parity with operators entering the market at a later date.

The OCM methodology will generate a higher annualisation charge than the FCM methodology where asset prices are rising and a lower charge where asset prices are falling. In consequence, setting charges using an OCM methodology will result in the over-recovery of costs where prices are rising and under-recovery of costs where prices are falling. To provide investors with a reasonable

[88] ERG, "Summary of the annex of the Opinion (ERG (04) 15rev1) on a revision of the Commission's Recommendation on Accounting separation and cost accounting", ERG (04) 60. http://www.erg.eu.int/documents/erg/index_en.htm

[89] However, OCM may not achieve this goal since the sum of historic and supplementary depreciation over an asset's lifetime will not equate to the replacement cost of the asset, unless backlog depreciation is also taken into account. This is because supplementary depreciation in period t + n for an investment made in time period t only takes account of cumulated price inflation between t and t + n and, in doing so, does not consider price inflation between t +n and the retirement date of an asset. In consequence the sum of supplementary depreciation will be less than the difference between the purchase price at retirement date and the original purchase price.

[90] In addition, various other adjustments have been suggested to the P&L although many of these are based on a misunderstanding of the role of CCA.

[91] Unrealised holding gains can be shown in either nominal or real terms. In our experience it is usual to show nominal unrealised holding gains.

assurance of a return on their investment the FCM methodology should be preferred to the OCM methodology.

A possible counter-argument is that where asset prices are rising more money is required to replace assets at the end of their lifetime and therefore OCM is preferable to FCM. However, this argument can be criticised on at least three grounds:

- OCM, as normally defined, will not provide sufficient funds to replace assets where prices are increasing.
- It may well be the case that the assets in question would be replaced by another technology.
- FCM, by ensuring investors earn a satisfactory rate of return, will ensure that the company can attract finance for future investments.

For these reasons we prefer the FCM methodology to the OCM methodology.

Finally, it should be noted that the discussion above relates to the top-down methodology. In a bottom-up methodology, annualisation methodologies typically provide an FCM measure of annualised costs. For example, the tilted annuity methodology is an FCM measure. However, in practice, bottom-up models tend to estimate neither true OCM nor true FCM because no account is taken of holding gains and losses when the model is updated. This is a significant limitation of these models.

Appendix C: Annualisation

C.1 Annualisation in top down models

The most commonly used methodology in top-down models is straight line depreciation in conjunction with a separate capital charge. Where CCA is used tilted straight line depreciation, which takes account of anticipated equipment price changes, is sometimes used. Where asset prices are rising (falling) tilted straight line depreciation results in a lower (higher) depreciation charge than simple straight line depreciation in the early years of an investment and a higher (lower) charge in later years.

Top-down models generally estimate the annualisation charge i.e. the sum of depreciation and the capital charge, on the basis of straight line depreciation or tilted straight line depreciation. Charges set using this annualisation methodology will, in principle, ensure that the firm achieves a satisfactory rate of return on its investments. Whether it does so in practice depends on a range of factors including:

- The precise timing of the payments made for investments and the receipt of revenues. In addition, the precise mechanics of the calculation of the annualisation charge (e.g. whether capital employed is based on a start of year or mid-year values) will also have an impact.
- Regulatory adjustments made for “inefficiencies”, exclusions and other factors.
- Changes in valuation methodologies either between HCA and CCA or between different valuation methodologies within CCA.
- Whether market circumstances allow pricing up to *ex ante* price control levels consistent with assumed demand.

The annualisation charge will generally decline as the asset ages, even before account is taken of discounting. This is because the depreciation charge, before tilting, is constant while capital employed is decreasing. There is no particular reason to believe that the annualisation profile will correspond to economic depreciation. Where there is a mix of asset vintages this may not be a real problem since the over and under estimates will largely cancel each other out. However, where on average assets are either relatively new or old problems may arise. For example, in many countries the annualisation charge for circuit switches is very low because these assets are heavily depreciated.

A further problem may arise where there are fully depreciated assets – assets which are still in operation but have reached the end of their book lifetimes. In a top-down model these assets will normally be assigned zero value despite the fact they have a real economic value. In principle, the problem would not have arisen had asset lives been assigned correctly. Given the variation in asset lives between different countries it is certainly hard to believe that the extent of fully depreciated assets in some countries could not have been reduced had more appropriate book lives been used. On the other hand true asset lives tend to be determined by technological and economic factors rather than by purely physical factors. Hence, it is almost impossible to avoid some level of fully depreciated assets and asset write-downs (where book lifetimes exceed economic lifetimes).

The simplest approach to dealing with fully depreciated assets is to ignore them i.e. ensure that once assets have reached the end of their book lives no costs are attributed to these assets. Such an approach would support cost recovery but would mean that charges would not necessarily provide the correct economic signals. This is an important limitation where stakeholders need to be provided with

the correct signals to ensure that the appropriate level of investment in fibre and other technologies takes place.

C.2 Annualisation in bottom up models

Short period models often use some form of annuities to annualise costs, although other methodologies such as tilted straight line depreciation are also sometimes used. The following shows the tilted annuities formula:

$(r - p)/[1 + \left[\frac{1+p}{(1+r)^t}\right]$ Where: r = cost of capital, p = rate of change of input prices, t = asset lifetime.

A number of comments can be made about this formula:

- The formula assumes a one year delay between the investment being paid for and for the initial set of revenues to be achieved. Given that revenues are likely to be reasonably well spread out through the year one would expect an average delay of approximately 6 months. However, it is often the case that payment is made for the investment before it goes into service so the one year assumption may not be unreasonable[92]:
- The formula is likely to produce inaccurate results in a variety of circumstances. For example, if operating costs are growing or falling at a different rate to the price trend for capital costs then the price tilt in the annuities formula will be incorrect (a similar comment applies to tilted straight line depreciation);
  - The formula, like the tilted straight line depreciation, takes no explicit account of the price at which output can be sold. If the market price were increasing over time the annuities formula overestimates economic depreciation in early years and underestimates it in later years;
  - Although the tilted annuity approach is an FCM approach, in practice bottom-up models are not really based on an FCM methodology. This is because when models are updated models are re-dimensioned with no account being taken of dimensioning decisions made in the past. In consequence, any holding losses or gains arising from changes in technologies, prices or in relation to dimensioning issues are ignored;
  - In a bottom-up model where modelled asset lives are shorter than operational asset lives the annualisation charge will tend to be too high. This is because the model incorporates all assets required to produce a given increment of output and assumes that these are replaced at the end of their modelled asset lives, whether or not this is the case in practice. This contrasts with the situation in top-down models, which was described earlier. While top-down models may therefore understate costs where there are significant fully depreciated assets bottom-up models may tend to overstate costs in these circumstances.

The annuities formula might also be used in a longer period model. However, in practice, an alternative approach is often used. Under this approach the annual charge is determined as the Net Present Value of Investments (and operating costs)/Net Present Value of Output. The approach can be modified to allow for asset price changes.

[92] According to Comreg document 0939 some regulators have modified the formula to reduce the delay period to 6 months (Belgium and Ireland) and to zero (France). The reduction to 6 months appears superficially plausible but may be inappropriate if capital expenditure is paid for before going into service. A reduction to zero months appears to be simply wrong.