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Copper pricing and the fibre transition – escaping a cul-de-sac

A report for **ETNO**

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About Plum

Plum Consulting offer strategy, policy and regulatory advice in the telecoms, media and online sectors; and on radio spectrum as a key sector input. We draw on economics, our knowledge of the sector and our clients understanding and perspective to shape and respond to convergence.

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Executive Summary

> *"The freedom and extent of human commerce depend entirely on a fidelity with regard to promises."* David Hume, 1739

The European Commission, in its questionnaire on costing methodologies published in October 2011, considers a range of options including a switch to historical cost accounting for parts of the access network to reduce the price of copper and a link between the price of copper and fibre investment.

Plum was asked by ETNO to carry out an impact assessment of these proposals and potential alternatives. Our analysis focuses on anticipated deployment of fibre to the home (FTTH) and fibre to the cabinet (FTTC) under alternative assumptions. In order to understand the investor perspective regarding fibre investment and the impact of European policy, we also interviewed a number of global equity investors who invest in the sector.

Qualitative analysis

Lowering the price of copper would reduce investment when account is taken of platform competition and capital market impacts for an existing network operator as well as reduce investment by entrants and platform competitors.

For an existing network operator lowering the price of copper would have the following effects on next generation access investment:

- Disregarding regulatory credibility and capital market impacts, changing the price of copper would have no impact on investment incentives for a copper network operator who does not face platform competition (assuming consumers are willing to pay a fixed price premium for fibre over copper).
- When a copper network operator faces platform competition, investment is partially motivated by a desire to reduce customer losses. Therefore lowering the price of copper would reduce incentives to invest to retain customers since customer retention is less valuable.
- When capital market impacts are taken into account reducing the price of copper would also:
  - Reduce free cash flow, which is likely to reduce discretionary capital expenditure in order to maintain investor returns, and potentially avoid a downgrade of the operator’s credit rating.
  - Undermine investor confidence in future investment because reducing the price of copper and changing established regulatory costing methods to support price reduction would undermine trust in regulation.

For an independent fibre entrant, or for a competing wireless or cable platform, lowering the price of copper would unambiguously harm investment since it would lower retail prices in the market for both current and next generation access and thus reduce demand and/or lower the price for fibre.

For a conditional change in the price of copper linked to fibre deployment, or a commitment to deploy fibre, the detailed rules will matter (assuming this option is administratively and legally feasible). Many questions remain unanswered in relation to this idea, for example:

- Does FTTH only qualify or other forms of fibre roll-out and cable?

- Must it be incumbent fibre or does investment by others contributing to meeting the Digital Agenda targets also qualify?
- Does existing fibre qualify?
- Would it be rational to lower the copper price where investment costs are high given the likely outcome would be a low price, no investment, cul-de-sac?

We would also expect the negative capital market impact to be felt in this scenario, depending on how these ambiguities play out.

Quantitative analysis

In addition to the qualitative analysis we also analysed the impact of a change in the copper price on investment in next generation access in quantitative terms. The Plum Access Investment Model (AIM) assumes that investment ceases at the level of coverage when the return from investing equals the cost at the margin, and that the incremental costs of investment rise with coverage.

We considered different investment cases including a copper network operator with limited competition (wireless only), a copper network operator with strong platform competition (wireless and cable) and the case of a fibre entrant investor. We also considered FTTH and FTTC investment decisions. For an incumbent investor with limited (wireless only) competition we assumed that take-up of grows to 45% of households over five years and that the investor is able to charge a premium of €5 per month for those who adopt FTTC and €10 per month for those who adopt FTTH. With these assumptions, and our assumed cost-coverage curve, equilibrium household coverage is 11% for FTTH and 67% for FTTC (considered separately as independent investment decisions).

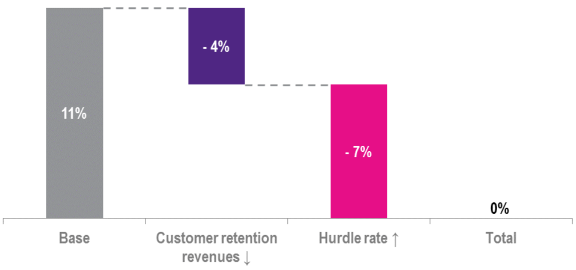
With a base case established we carried out sensitivity analysis in relation to the input assumptions and focussed on two inputs in terms of the potential impact of policy changes: the price of copper and fibre (assuming the two are partial substitutes and the prices will be linked); and the hurdle rate for investment which reflects the cost of capital, a premium related to investment stranding risk and a premium reflecting the value of the option to wait when investment is uncertain (a so called real option premium).

Unconditional change in the price of copper

We considered a reduction in the price of copper by a hypothetical one-third from €9 (our base case assumption) to €6 per month. This has two effects. First, it reduces the value of investing to hold on to customers who would otherwise migrate to wireless. Second, it is assumed to increase the hurdle rate via equal impacts in terms of stranding risk and real options premium, from 10% to 14%.

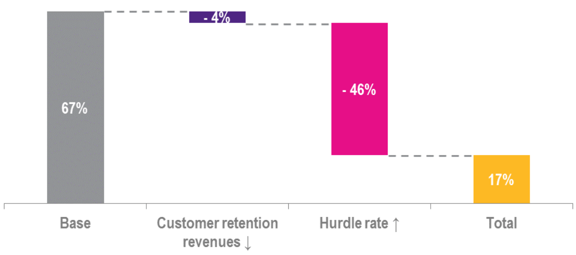
These effects reduce FTTH coverage from 11% by 4 and 7 percentage points respectively to zero (the combined effect may be greater but minimum coverage is zero) as shown in the left hand figure below. For FTTC coverage is reduced from 67% to 17% - as shown in the right hand figure below.

Impact of a reduction in the price of copper on FTTH coverage



Source: Plum Consulting AIM

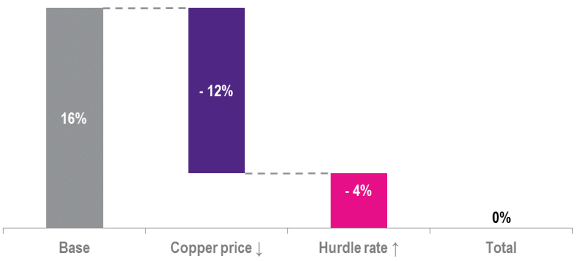
Impact of a reduction in the price of copper on FTTC coverage



Source: Plum Consulting AIM

For a fibre entrant the impact of a reduction in the price of copper is more pronounced since, as in the qualitative analysis, the price reduction is felt fully. The copper price reduction accounts for a greater coverage reduction than in the previous copper network operator case, with the hurdle rate increase eliminating residual investment – as shown below.

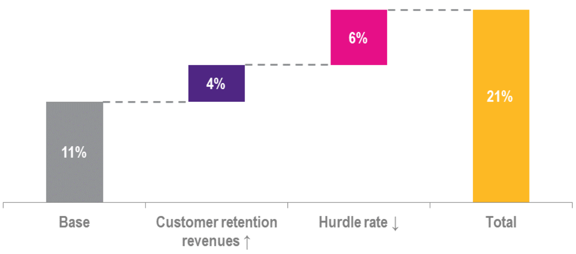
Impact of a reduction in the price of copper on an entrant's coverage



Source: Plum Consulting AIM

We also considered a copper price increase. This increase the incentive to invest directly via customer retention benefits associated with investment, and is also assumed to reduce the hurdle rate thereby increasing investment further. The impact for FTTH and FTTC investment are shown below.

Impact of an increase in the price of copper on FTTH coverage



Source: Plum Consulting AIM

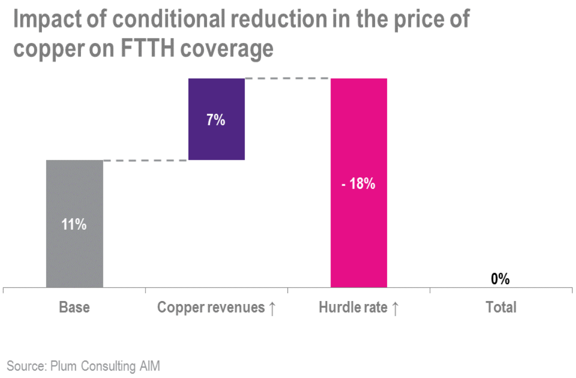
Impact of an increase in the price of copper on FTTC coverage

Source: Plum Consulting AIM

With strong platform competition the base case level of investment is higher than in the case considered above since the additional gains from customer retention accompanying investment outweigh the negative impact due to market sharing. However, the sensitivity analysis of the strong platform competition case produces similar results to those above. We note that with strong platform competition a prior question should be asked, namely is continued price regulation required?

Conditional change in the price of copper

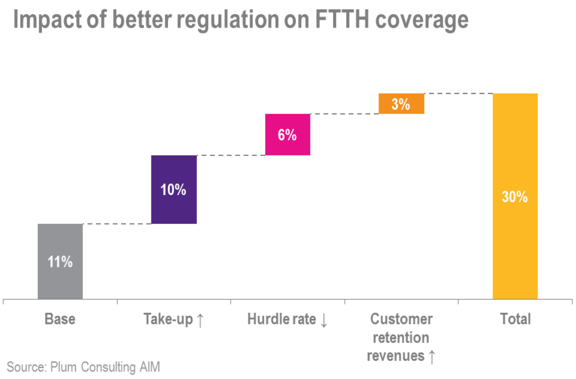
For a linkage between the copper price and FTTH investment, and leaving aside the questions raised in the qualitative analysis, conditionality may be considered to introduce a static incentive for FTTH investment. However, a threatened price reduction (which we assume harms expectations) and/or uncertainty regarding how conditionality might be applied or evolve can more than offset any static positive incentive effect and kill FTTH investment – as shown below.

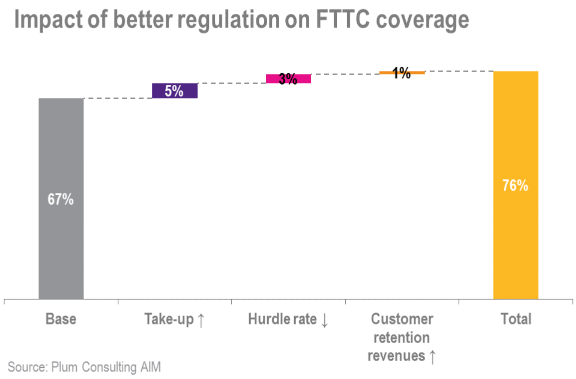


We note that FTTC may nevertheless be preferred in many locations – so the impact on FTTH indicated above may have little impact overall where FTTC is a feasible and attractive alternative. However, the hurdle rate impact would also be expected to depress FTTC investment.

Better regulation

Finally, we consider a favourable regulatory mix involving a rising copper price (and the signal of commitment this implies) combined with the pricing freedom to permit service-price differentiation and dynamic evolution of prices which we assume results in take-up increasing by ten percentage points. FTTH coverage increases to 30% whilst FTTC coverage increases to 76% - as shown below.





Escaping a cul-de-sac

The response to our discussion with equity investors indicated that having proposed that the price of copper might be lowered, positive action is now required to return to pre-questionnaire levels of investor confidence.

We were told that given the history of price declines in the sector, the risk premium required to justify investment without a clear change of direction in prices is likely to be large (and potentially in excess of consumer willingness to pay). It is therefore crucial to reduce the investor risk premium via credible signals of commitment to a better regulatory approach. We propose the following for consideration:

- Maintaining a technology neutral approach to maximise flexibility to find the least cost mix of technologies capable of achieving the Digital Agenda targets.
- Maintaining infrastructure competition and choice to help drive innovation, efficient investment and consumer and economic welfare gains over time. An approach to regulation during transition which supports, rather than harms, platform competition and choice should be pursued.
- Maintaining a replacement cost methodology for copper and, potentially moving to a "backstop" price cap with upward (RPI+) trajectory. This could offer stability, protect consumers and send a positive signal to investors during the transition from copper to fibre.
- Remedies for next generation access should be differentiated from those for copper given the need to foster innovation and investment and the limited pricing power in relation to fibre given current generation access substitutes. For fibre we propose (in addition to open access) that:
  - The anchor price provided by regulated copper access is sufficient constraint, and when and where copper is withdrawn by a virtual copper equivalent "anchor product"; or alternatively
  - A discounted cash flow (DCF) based price control applied with up-side potential built in for the investor via a WACC premium, appropriate volume assumptions and a long-term commitment. In deciding between an anchor product approach and the DCF approach the objectives of achieving investor trust and pricing flexibility should be key considerations.
- The opportunity for copper retirement should be supported by analysis and removal of barriers to transition. However, given the complexities involved and differences in investment strategies rapid copper retirement should not be assumed, nor be a policy objective.

1 Introduction and context

The Digital Agenda and the EU2020 strategy have set clear targets for Europe 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.

The EU Electronic Communications Framework focuses on the promotion of competition, investment and innovation and consumers interests. Under Art.13 of the Access Directive, national regulators are empowered to impose price controls, including the obligation for cost-orientation, as a remedy where there is significant market power. The 2009 Framework Directive also notes that:

> *"...it is necessary to give appropriate incentives for investment in new high-speed networks that will support innovation in content-rich Internet services and strengthen the international competitiveness of the European Union. Such networks have enormous potential to deliver benefits to consumers and businesses across the European Union. It is therefore vital to promote sustainable investment in the development of these new networks, while safeguarding competition and boosting consumer choice through regulatory predictability and consistency."*

The European Commission issued a questionnaire on costing methodology and the approach to regulation in October 2011. It is against this backdrop that this report was commissioned to consider the European Commission's proposals and alternatives and to analyse their expected impact on investment in next generation access networks.

Plum has developed the Access Investment Model (AIM) to provide a quantitative assessment of the impact of changes in the price of copper on the roll out of next generation access networks. In this paper we set out our underlying qualitative analysis of the investment decision and the relationship to policy and then consider the sensitivity of investment in quantitative terms to changes in input assumptions including the price of copper.

We consider the investment decision from an investor's perspective assuming that an investor has other opportunities for investment within and outside the communications sector. We consider the perspective of an investor in a copper network contemplating an upgrade to fibre and that of an investor in alternative platforms or contemplating market entry.

Whilst investment in cable, wireless and satellite access will all contribute to the achievement of the Digital Agenda we focus on fibre to the cabinet (with vectoring to deliver higher and more consistent speeds across lines) and fibre to the premise in our investment analysis. However, the approach to copper and fibre pricing will also impact on investment in other platforms and technologies.

2 The investment decision

The roll out of high-speed broadband networks will result primarily from commercial investment decisions across Europe. Public funding is also expected to play a role in areas where coverage is not considered commercially feasible. The approach to regulation will have an impact on both the extent of commercial investment and public subsidy required, and potentially on the achievement of the Digital Agenda goals and targets.

Investors will invest if they expect the return to exceed the cost, taking account of returns available from alternative (including outside – both geographically and outside the telecoms sector) investment opportunities and of the option value of waiting before investing. Investors can be expected to consider a wide range of investment options including the choice of technologies (a mix is likely) and the timing, pace and extent of investment including coverage.

In appraising the investment decision and the possible impact of policy on it we consider two perspectives:

- The perspective of an equity investor who will consider, alongside expected returns, the credibility of policy and the risk of expropriation, free cash flow and the health of a company's balance sheet.
- A cost benefit net present value (NPV) decision framework that abstracts from capital market considerations (aside from use of an assumed discount rate to calculate present values).

The heuristic rules applied by investors and the NPV rule may differ. Heuristic rules of thumb are not only a short hand for how investors themselves assess risk and allocate funds across a portfolio of investments, but may also capture aspects of the investment decision not well characterised by static cost benefit analysis.[1] Funds will not be forthcoming unless investors are satisfied that apparently NPV positive investment opportunities are not subject to asymmetric regulatory risk. Current conduct is an important signal of future conduct in assessing such risk.

Our analysis focuses on incremental revenues and incremental costs i.e. what is the balance of change from investing versus not investing. However, overall revenues can also come into play in incremental analysis. For example, for an existing operator facing the loss of customers to competing platforms the incremental revenue gain from investing (compared to doing nothing) includes total revenues for those customers retained via investment - in addition to the ability to up-sell to higher quality broadband access services. Current and next generation access are also partial substitutes. The price of current generation access is therefore a consideration in relation to the transition to next generation access. Uncertainty, in particular demand uncertainty (including competition and the level and growth of consumer willingness to pay), is also a key consideration.

The anticipated regulatory and policy environment affects expected revenues and costs, and may itself introduce uncertainty regarding future returns and therefore expected returns (and/or the timeframe over which returns are considered). We explore the channels through which policy choices might impact on investment decisions.

[1] For example, the use of hurdle rates of return above the cost of capital was once thought to involve bias by investors but has more recently been rationalised as approximating a dynamic "real options" approach to investment decision making. Dixit and Pindyck (1994) "Investment under uncertainty." Princeton University Press.

2.1 A mix of technologies and approaches is anticipated

A mix of technologies and approaches can be used to meet the Digital Agenda targets. Copper (VDSL), fibre to the premise, coaxial cable, advanced wireless and satellite can all be expected to contribute over the next decade. The technologies may also be deployed in different ways depending on local circumstances. For example VDSL may be deployed from the exchange (where line lengths are low) or from street cabinets, and with or without a home gateway that would allow voice services to be offered without continuation of a copper line from the exchange.

These technologies are also subject to change in terms of their expected costs and capabilities, for example, the commercial development of vectoring for VDSL (considered further in Appendix A), DOCSIS 3.0 for cable and LTE plus additional spectrum[2] all offer the prospect of greatly enhanced performance.

However, none of these technologies has reached a stable end point and there is therefore value in pursuing a policy framework and investment strategy that allows for adaptation. Options exist both in relation to the mix of technology, and to the timing, pace and extent of deployment. For example:

- BT recently announced that they were bringing forward their fibre to the cabinet deployment to two-thirds of UK premises by one year to the end of 2014.[3]
- Verizon in the US have announced that they do not intend to deploy further fibre to the home beyond existing investment unless operating costs can be reduced, including via improved in-home wireless distribution technology.[4]

2.2 Investor perspective

We spoke to a number of equity investors, with funds under management in excess of €2 trillion who take comparatively long-term market positions, to gain an insight into their views of the opportunity in relation to investment in telecommunications in Europe, particularly in relation to next generation access. We also asked them about their perception of the policy environment in Europe in relation to telecommunications investment. We found that:

- There are substantial funds available for investment - the question is whether to invest in telecommunications in Europe or to invest in other regions or sectors.
- Consideration of a potentially significant reduction in the price of copper has reduced investor confidence in long-term investment in the telecommunications sector in Europe.
- The business case for next generation access investment requires revenue upside, but history and signals of future intent point to a downward trend.
- The restoration of confidence in policy requires a credible signal and an increase, rather than decrease, in the price of copper could contribute to increased credibility.

[2] The target reallocation of 800 MHz and 2.6 GHz spectrum by 2013 and agreement to identify 1200 MHz of spectrum for mobile by 2015, alongside deployment of LTE, will greatly enhance the speed, capacity and coverage of wireless broadband.

[3] BT. 3 November 2011. Q2 2012 Results.
http://www.btplc.com/Sharesandperformance/Quarterlyresults/PDFdownloads/q211_slides.pdf

[4] Verizon. September 2011. "Verizon Communications Inc at Goldman Sachs Communicopia Conference – final transcript." Page 9.
http://www22.verizon.com/idc/groups/public/documents/adacct/goldman_conf_vz_transcript.pdf

- A decrease in revenue from a lowered price of copper would result in pressure to cut discretionary investment in order to maintain free cash flow and dividend yields, and/or a deterioration in the balance sheet which could see debt ratings reduced, thereby increasing the cost of capital. [5]

We also note that in addition to the above considerations, equity investors consider the anticipated NPV from investment, but seek upside opportunity commensurate with the risk they would be taking. There was a concern that regulation introduces an asymmetric risk by effectively capping any upside.

The investor perspective should be considered alongside the cost benefit (NPV) perspective below. The two perspectives are complementary to understanding the potential impact of policy on investment.

2.3 Cost benefit perspective

The cost benefit decision rule is simple to state: invest if the net present value of expected incremental revenue less the net present value of expected incremental cost exceeds the option value of waiting, taking account of outside investment opportunities (the opportunity cost of capital).

Invest when: NPV [E(ΔR) - E(ΔC)] > Option value of waiting;

Where E refers to expected and ΔR and ΔC refer to incremental revenues and costs respectively from investing compared to a base case or counterfactual.

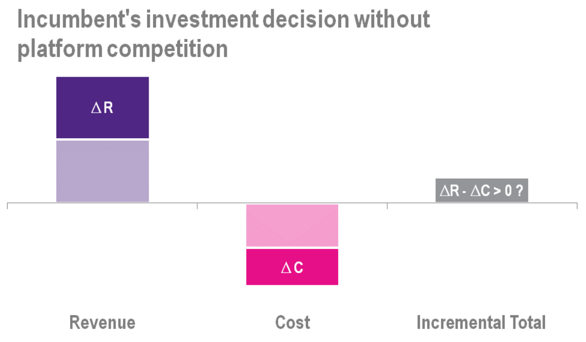
We consider three distinct idealised cases (and leave aside the option value of waiting):

i. An existing copper network operator with no platform competition.
ii. An existing copper network operator facing platform competition and customer losses.
iii. A fibre entrant.

2.3.1 Copper network operator with no platform competition

Figure 2-1 illustrates the case of an existing copper network operator with no platform competition.

Figure 2-1



[5] There is empirical evidence for the market as a whole of a relationship between free cash flow and investment. See Denis and Sibilkov. December 2011. “Financial Constraints, Investment, and the Value of Cash Holdings.” *The Review of Financial Studies, 23(1).*

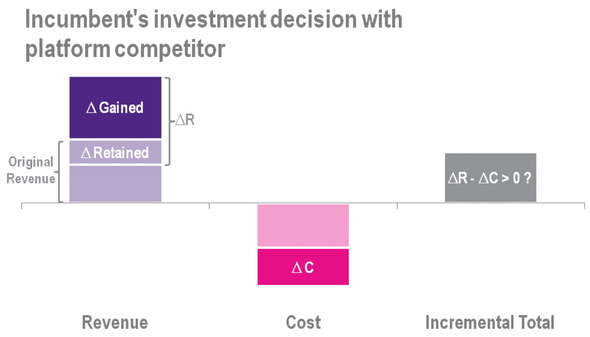
For this case what matters is the incremental revenue and cost compared to the provision of current generation broadband. Assuming that consumers are willing to pay a premium for next generation access compared to current generation access and that this is independent of the price of current generation access, all that matters is the anticipated increase in revenue (ΔR in the figure), not the existing revenue base which depends on the price of copper.

In other words, in this simple and restricted analysis and leaving aside capital market effects the price of copper has no impact on investment by an existing copper network operator. We note that a lower price of copper might lead to a decision not to re-invest in copper (were next generation access investment unprofitable), ultimately leading to the withdrawal of service.

2.3.2 Copper network operator with platform competition

For an incumbent facing customer losses due to competition a benefit of investment may be to stem customer losses to alternative platforms. The higher the price of copper the more there is to lose in terms of revenue from customer loss, and therefore there is more to gain from next generation access investment to the extent that this helps retain customers. This is illustrated in Figure 2-2.

Figure 2-2

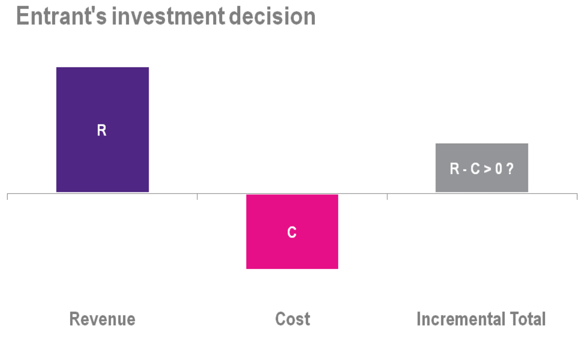


2.3.3 Entrant or competing platform

Figure 2-1 illustrates the case of an entrant or platform competitor (leaving aside the complexities of expectations and option values). As there is no network in place, the investment decision depends on the total revenue and cost rather than the change.

Incremental revenue is determined by anticipated demand, the price of existing generation access and the anticipated premium for next generation access. To the extent that existing copper DSL and next generation access are substitutes a lower price of copper would therefore directly harm the business case by reducing R (which is the incremental revenue in this case compared to not investing).

Figure 2-3



2.4 Dynamic considerations

The above analysis does not take account of dynamic considerations:

- The expectation of a reduction in copper prices after investment is made would lower expected returns from next generation access as demand would be lower due to reduced customer switching and/or prices would have be lower to attract customers.
- The expectation of a future reduction in fibre prices after investment is made would lower expected returns from next generation access.
- Uncertainty over policy and returns may increase the option value attached to waiting thereby raising the effective investment hurdle rate and reducing/delaying investment.

Considering the first two points above there is a potential contagion risk if the approach to copper pricing is changed in an apparently ad-hoc or opportunistic way since investors may factor in the risk of similar conduct once they have invested in next generation access (leaving aside any direct price or demand linkages).

It is for this reason that a policy and regulatory commitment to cost recovery and a reputation for consistent "rule based" behaviour is important.[6] This principle is enshrined in Article 5(a) of the 2009 Framework Directive:

> *"promoting regulatory predictability by ensuring a consistent regulatory approach over appropriate review periods"*

An abrupt change to the approach to pricing copper can be expected to raise investor doubts regarding future conduct and returns from next generation access investment. There is a body of literature that considers the issue of regulatory commitment and investment and the conclusions are clear. In a comparative study of telecommunications regulation Levy and Spiller found that:[7]

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[6] The circumstances are analogous to monetary policy where a commitment to low inflation (via policy targets and institutional mechanisms) is necessary to avoid the short run temptation to allow inflation to rise. The seminal paper on this issue was by Kydland, F. and E. Prescott (1977), "Rules rather than discretion: The inconsistency of optimal plans", *Journal of Political Economy* 85, pp. 473-490. For the parallel with regulation see Stern, Levine and Trillas. December 2002. "Independent Utility Regulators: Lessons from Monetary Policy." http://papers.ssrn.com/sol3/papers.cfm?abstract_id=371680&download=yes

[7] Brian Levy and Pablo Spiller. 1994. "The Institutional Foundations of Regulatory Commitment: A Comparative Analysis of Telecommunications Regulation." *Journal of Law, Economics and Organisation*, Volume 10(2).

> *"...performance can be satisfactory with a wide range of regulatory procedures, as long as arbitrary administrative action can be restrained. We find also that regulatory credibility can be developed in not very propitious environments, that without such commitment long-term investment will not take place...."*

A study of regulation and outcomes in deploying fixed voice networks across Europe from the 1870's onward also pointed to the benefits of credible commitment:[8]

> *"I find that countries with competition between telephone providers and whose governments did not threaten to expropriate firms' assets saw higher telephone penetration and lower prices, even in rural areas."*

2.5 Conclusion

Lowering the price of copper would tend to reduce investment for an incumbent facing platform competition and for an entrant/platform competitor. Further, capital market effects via reduced cash flows and dynamic impacts in terms of investor expectations reinforce this conclusion, including for the restrictive case of an incumbent facing no platform competition.

[8] Scott Wallsten. 2005. "Returning to Victorian Competition, Ownership, and Regulation: An empirical study of European Telecommunications at the Turn of the 20th Century". *The Journal of Economic History. Volume 65(3).*

3 Policy alternatives

To compare alternatives we require a base case and an alternative. Under both cases we assume that open access is required or permitted on commercial terms. In addition to the cases below we also consider a more favourable policy alternative in terms of investment with rising copper prices.

3.1 Base case or counterfactual

We assume for our base case that:

- The costing methodology for copper is stable and that common costs are transferred as customers migrate to next generation access.
- Next generation access prices are cost oriented but on terms that recognise that recovery over time may vary (via a net present value approach).
- Costs differences by location are allowed for in pricing (otherwise deployment in higher cost locations might not be commercially viable even where there was sufficient demand to justify deployment).
- The ability to segment the market and price differentiate and to adjust prices dynamically over time (learning) is restricted by access price regulation.
- There is an opportunity for copper retirement but not an obligation (conditional or otherwise). We assume a significant period of parallel running with FTTH and long-term use of copper under FTTC. Appendix B discusses the impact of copper retirement on the business case for investment and the policy issues associated with copper retirement.
- The scope and need for a premium on the WACC for next generation access is recognised.
- The practical effect in terms of the ability to realise higher returns from a WACC premium may be limited by willingness to pay and competition from other platforms including regulated copper.
- The European Commission questionnaire has not damaged policy credibility in terms of a reasonable assurance of a return on investment.

3.2 European Commission questionnaire based alternative

A number of possibilities are raised in the European Commission questionnaire. We consider these in two parts and reduce them to the following:

- Copper costing and pricing: the price of copper is reduced on average via a move to historical cost accounting.
- Fibre-investment copper-pricing linkage: copper prices are not reduced where there is some commitment to FTTH rollout.

In relation to the latter we note that there is significant degree of uncertainty over how the mechanism might work (were the broad approach feasible in administrative and legal terms).

4 Qualitative appraisal of policy alternatives

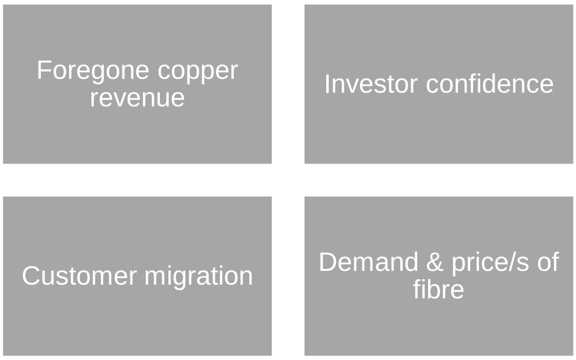
In this section we appraise the policy alternatives considered in Section 3 in qualitative terms based on the general investment decision framework discussed in Section 2.

4.1 Overview of previous analysis of transition

There is little published analysis of regulation during transition from current to next generation access which considers the interaction between regulation of both current and next generation access. A possible reason for this is that, to the extent that the old and new technologies are substitutes during transition, one would not normally subject both to *ex ante* price controls (alternative ideas including anchor product regulation have been proposed to avoid this).[9]

Policy papers by WIK, Plum and Cave *et al* consider copper fibre transition. There is also a recent academic paper by Bourreau, Cambini and Dogan (2011).[10] We comment on these papers prior to our appraisal of policy alternatives. We note that there are a number of channels through which the regulation of current and next generation access may interact and that no single analysis takes all of these into account fully. Figure 4-1 provides an overview of the broad range of considerations in relation to regulation and transition.

Figure 4-1: Issues considered in European studies



There does appear to be one unambiguous conclusion, namely lowering the price of copper would harm the investment case for entrants and competing platforms (wholesale and retail prices are linked and retail prices for one platform impact on others). The more complex question relates to incentives for investment in relation to the regulated existing generation broadband access network. The following provides a broad overview of the papers mentioned above:

- The WIK study[11] considers foregone copper revenues only, and focuses only on the case of a copper network operator who is also the fibre investor. The WIK modelling does not consider

[9] Brian Williamson. September 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

[10] Bourreau, Cambini and Dogan. July 2011. "Access pricing, competition, and incentives to migrate from "old" to "new" technology." Working paper, Harvard Kennedy School. http://web.hks.harvard.edu/publications/getFile.aspx?Id=711

[11] WIK. April 2011. "Wholesale pricing, NGA take-up and competition."

customer migration incentives but acknowledges that a lower copper price would discourage customer switching to next generation access. Dynamic issues in relation to investor confidence are not considered.

- The Plum study[12] is broader in scope than the WIK study. It discusses customer switching incentives and the linkage between copper and fibre pricing, and investor confidence under alternative approaches. It puts little weight on foregone copper revenues on grounds that they are irrelevant for entrants and platform competitors, and likely to come under pressure from wireless competition.
- Cave *et al*[13] suggest that the abatement in copper prices be applied to duct in order to provide incentives for fibre roll out. They also suggest that a tax could be applied to the copper price to remove over-recovery of the copper asset without distorting incentives to invest in fibre by alternative operators. The paper assumes that a key objective of the regulator is extract any historic over-recovery of cost on copper as this is assumed to enable incumbents to invest in fibre ahead of entrants. Dynamic issues in relation to investor confidence are not considered.
- In an earlier paper Cave argues that every opportunity should be taken to encourage competition between networks (including wireless) in the provision of high speed broadband services: "*If the European Commission were to adopt an approach to NGA networks that creates incentives against inter-modal competition...it would run the risk of leading the sector down a technology cul-de-sac*."[14]
- Bourreau *et al* consider customer migration and foregone revenue effects. Dynamic issues in relation to investor confidence are not considered. Whilst the various effects can result in ambiguous impacts Bourreau *et al* conclude that:
  - If the access price of the old generation network is low, in order to encourage customers to switch from the old legacy network to the new network operators should offer low prices for NGN services and that *"this effect reduces the profitability of the new technology infrastructure and the incentive to invest in it."* Page 33.
  - *"Extending regulation to the new technology negatively affects investments."* Page 33.

4.2 Impact of lowering the price of copper

The conclusion of the analysis in Section 2, supported by an examination of the literature and its limitations in this section, is that lowering the price of copper would tend to reduce investment for an incumbent facing platform competition and for an entrant/platform competitor. Further, capital market effects via reduced cash flows and dynamic impacts in terms of investor expectations reinforce this conclusion. The potential negative impact in terms of capital market linkages is highlighted by the

"Such a switch, however, can lead to conflicts with consumers, who would like to stay with the copper network under the low end-user prices resulting from low levels of aC [the price of copper]. This conflict is not directly addressed by our competition model." Page 129.

[12] Plum. March 2011. "Costing methodology and the transition to next generation access." http://www.plumconsulting.co.uk/pdfs/Plum_Costing_methodology_and_the_transition_to_next_generation_access_March_2011_Final.pdf

[13] Cave, Fournier and Shutova. 2011. "Which price level for copper access and transition to fibre."

[14] Cave. July 2011. "Europe should not sacrifice network competition as it rolls out next generation access networks."

following analysis by HSBC of the upside of telecommunications in terms of the scope to reduce capital expenditure (capex) in response to a revenue downturn:[15]

> *"...capex have the potential to more than offset such pressures: in our scenario analysis of a 'terrible trio' bear case, these headwinds entail a hit to cash flows that is similar to the savings available by setting capex at maintenance levels."*

Lowering the price of copper is therefore in tension with the Digital Agenda goals and objectives.

4.3 Impact of changing the copper pricing methodology

Proposals to lower the price of copper have been rationalised as consistent with a change in costing methodology, with a number of alternatives put forward which would involve lowering or eliminating the capital base on which returns are calculated:

- Moving to historical cost accounting
- Distinguishing replicable and non-replicable assets
- Applying a short run incremental cost methodology

Proposals to lower the value of copper have also been supported by arguments other than a (false) pro-investment argument. It has also been argued that lowering the of copper would support local loop unbundlers by improving their margins and/or improving the competitive position of copper versus alternative platforms; or that copper volumes declines may lead to excessive increases in prices for those consumers who remain on copper.

However, where platform competition is strong the first consideration should be whether competition is sufficient to allow a reduction in regulation. Reducing the price of copper would not in any case be expected to improve unbundler margins since retail competition would be expected to pass the copper price reduction onto consumers.

A decline in volumes may also have a smaller impact on prices than is perhaps anticipated since common costs should be reallocated from current to next generation access during transition, thereby reducing the impact of volume shifts. Were the price implications of volumes reductions considered excessive a more pragmatic and practical approach could be pursued potentially including a back-stop price cap and notice of termination of copper service at some point.

The proposed methodological changes are potentially harmful in their own right since doing so with the aim of lowering prices can be expected to harm investor confidence and credibility, and is inconsistent with the aim in the 2009 Framework Directive of *"promoting regulatory predictability by ensuring a consistent regulatory approach*." In relation to the specific propositions we make the following comments:

- A move from current cost accounting to historic cost accounting would represent a shift away from the method used in the European Commission Recommendation on accounting separation and cost accounting (2005/698/EC) and from the method adopted by the majority of national regulators and confirmed by the NGA recommendation adopted in September 2009.

[15] HSBC. Global Telecoms, Media & Technology – Equity. October 2011. "Cloudburst."

- Adopting a distinction between replicable and non-replicable assets opens up a definitional issue (what is non-replicable and is it stable over time?) and would undermine independent competing access platforms.
- Short run incremental cost is an inappropriate basis for recovery of infrastructure services since it would deny cost recovery and cast doubt on durability of any future implied commitments in relation to fibre.

Infrastructure renewals accounting – utilised in the UK water sector - has also been suggested as appropriate to the approach to valuation of duct in the telecom sector.[16] The approach has little relevance for the telecoms sector and was adopted in the water sector to manage the difficulty with valuing water sector assets at privatisation when water prices were well below that consistent with the replacement cost of the assets.

More generally we also note that utility approaches to regulation of next generation access have been proposed (including some co-investment models). The fundamental difficulty with these approaches is that they are suited to circumstances where there is limited innovation and little or no competition, consumer choice and little or no demand uncertainty.

Competition and choice are valuable in driving innovation, efficient investment and consumer and economic welfare over time. An approach to regulation during transition which supports, rather than harms, competition and choice should be pursued and need not be inconsistent with investment.

4.4 Impact of a fibre-investment copper-price linkage

It is also proposed that next generation access investment (or a commitment to it) might be linked directly to copper prices. In other words investment would then appear to have the added incentive of avoidance of a reduction in the price of copper. There are various problems with this line of reasoning:

- For a game involving rational players to form an equilibrium, the end game must be an equilibrium (otherwise the game unravels).[17] In this case the potential end game may be low copper prices and no investment. This would not appear to be an equilibrium of a game played by rational players (given the objective of achieving the Digital Agenda targets).
- Restricting the linkage to fibre to the premise (as has been suggested) would be inconsistent with technology neutrality and would raise the cost of delivering on the Digital Agenda targets substantially in some locations, thereby outweighing any apparent incentive effect. Further, to the extent that FTTC investment might still be preferred there would be no direct incremental incentive effect (though there is significant harm in terms of and cash flows and potentially investor expectations).
- Even if the incumbent does not invest others might, and it would be irrational to lower the price of copper thereby undermining their investments. Anticipating this it may neither make sense to lower the price of copper nor to threaten to do so.

[16] Frontier Economics. June 2011. "Access network costing."
http://www.vodafone.com/content/dam/vodafone/about/public_policy/policy_papers/nga_costing_proposals.pdf

[17] A strategy combination is a subgame perfect Nash equilibrium if it is a Nash equilibrium for the entire game; and its relevant actions rules are a Nash equilibrium for every subgame. Out of equilibrium behavior is irrational in a non-perfect equilibrium. See Rasmusen. 1989. "Games and Information – an introduction to game theory." Blackwell.

- Moving to historic cost accounting (as proposed in Part I for other reasons) would reduce the scope to link maintenance of copper prices to investment. The two aspects appear at least partially inconsistent.

4.5 Conclusion

We conclude, based on qualitative analysis, that lowering the price of copper on an unconditional or conditional basis (linked to fibre investment) and/or supporting a proposal to lower the price of copper via an ad-hoc change to costing methodology could be expected to harm investment incentives in relation to next generation access. We consider this issue further in the following quantitative analysis.

5 Quantitative appraisal of policy alternatives

In this section we apply the Plum Access Investment Model (AIM) to analyse the three basic investment cases considered in sections 3 and 4, namely a copper network operators facing limited wireless competition, a copper network operators with a cable competitor and a fibre entrant. We comment on business case versus economic welfare analysis, outline the model and input assumptions, examine the sensitivity to changes in assumptions and examine the impact of alternative policy approaches by mapping policy alternatives to changes in input assumptions.

5.1 Business case versus economic welfare analysis

The business case analysis is linked to, but is not the same as, an economic welfare analysis. The standard measure of economic welfare is the change in difference between willingness to pay and cost, i.e. the sum of consumer and producer surplus, and external value. Our analysis:

- Neglects benefits in terms of the difference between willingness to pay and cost, but utilises the fraction of consumer surplus that can be captured via a simple price premium and cost to drive investment. Investment incentives and consumer and societal interests would be better aligned with service-price differentiation and dynamic pricing.
- Neglects deployment-timing differences between FTTC and FTTH. FTTH has been deployed in practice at a rate of less than 10% of households per annum (Verizon) whereas FTTC deployments (BT) may be around twice this pace per annum. Earlier deployment could make a substantive difference to the net economic benefit and result in earlier gains to the application ecosystem and earlier gains in terms of any network externality effects.

5.2 The Plum Access Investment Model (AIM)

The model analyses coverage at a continuous level with a range from 0% to 100%. We assume that both FTTC (with vectoring – see Appendix A for consideration of this) and FTTH can in principle substantially meet the Digital Agenda goals. However at least the final 5% of coverage (and potentially much more in some countries) will utilise a mix of technologies including wireless and satellite (not modelled). The model estimates the level of coverage at which incremental revenues from deploying fibre are equal to the incremental costs on a connected household basis.

- The incremental revenues of deploying fibre are the calculated as the NPV of cash flows over a 15 year period and are composed of:
  - The ability to capture a proportion of the willingness to pay premium for next generation broadband compared to current generation broadband (via take-up and price premium assumptions). The investor is assumed to be indifferent between their own demand from their retail arm and demand generated by others.
  - The revenues from existing copper customers who are retained if there is investment in fibre but lost if there is no investment.
  - Any change in copper revenues if the investment decision impacts on the copper price.
- Incremental costs of deploying fibre are assumed to occur in period zero and are composed of:

– The cost of passing a home - which is increasing as the level of coverage increases.
– The cost of connecting a home – which is constant.

- The FTTC and FTTH investment choices are analysed separately. In reality we expect there to be a technology mix.

As we are focussed on the difference between current and next generation access and the sensitivity of this to changes in assumptions, the model does not need to include aspects of the market which do not change between the base case and alternative scenarios.

5.3 Model input assumptions

5.3.1 FTTH and FTTC costs

Table 5-1 presents a summary of a range of cost estimates.

Table 5-1: Summary of a range of cost estimates

Study	Summary of cost estimates
Analysys Mason, 2008[18]	Study for the UK Broadband Stakeholder Group (BSG) examining the cost of deploying FTTH and FTTC in the UK. Cost estimates were calculated by geotype based on population density and distance from the exchange. Costs (up to 95% coverage) per premise passed for FTTH range from £250 - £2,500, and the cost of connecting a home is between £250 and £1,000. For FTTC costs range from £50 - £300 per household passed and costs of connecting a home are between £100 and £200.
Verizon[19]	Verizon estimated the cost of passing a home in 2006 was $873 and the cost of connecting a home was $933, this was estimated to fall to $700 and $650 respectively by 2010.
WIK, 2010[20]	Estimates FTTC and FTTH costs for Germany. FTTC costs range from €109 - €2,009 per house passed, FTTH costs range from €596 to €4,506 per house passed. Estimates assume a 50% take-up and do not include in-house wiring and CPE.
DBCDE, 2010[21]	Report estimates the marginal cost of connecting homes with FTTP in Australia, but do not include operating costs. Costs rise approximately linearly from about AUS$1,000 per household for 5% coverage to AUS$5,000 for 90% coverage, above 93% coverage costs rise rapidly.
OECD, 2008, "Development in fibre technologies and investment"	Estimates costs to connect a home to FTTH in the Netherlands. Costs are split into passive and active costs; passive costs range from between €549 - €1,021 depending on geo type, while active costs are fairly constant at an average of €767 per house connected.

[18] Analysys Mason. 2008. "The cost of deploying fibre-based next-generation broadband infrastructure." http://www.analysysmason.com/PageFiles/5766/Analysys-Mason-final-report-for-BSG-(Sept2008).pdf

[19] "Verizon provides FiOS update" http://www.networkworld.com/news/2006/092706-verizon-fios.html?page=2

[20] WIK. 2010. "Broadband deployment and its limits". http://www.wik.org/fileadmin/Konferenzbeitraege/2010/National_Strategies/PLUECKEBAUM_WIK_Ultrabroadband_Conference_2010.pdf

[21] DBCDE. 2010. "National Implementation study." http://www.dbcde.gov.au/broadband/national_broadband_network/national_broadband_network_implementation_study

We fitted curves to the discrete Analysys Mason geotype data as illustrated in Figure 5-1 for FTTH and Figure 5-2 for FTTC (allowing for take-up and the costs of passing and connecting a home).[22]

Figure 5-1: Incumbent

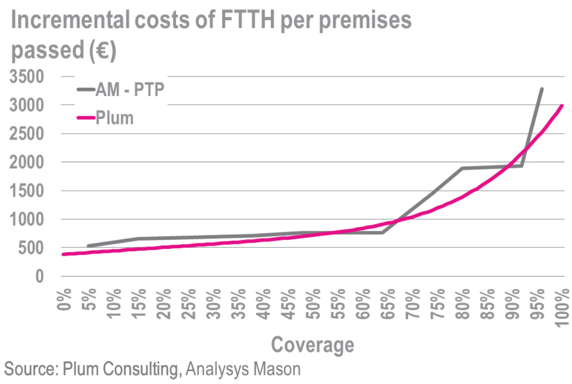
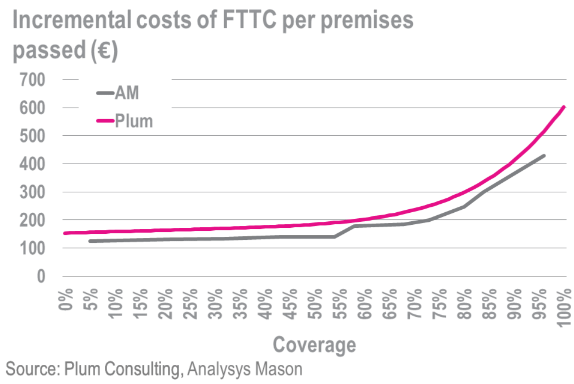


Figure 5-2: Incumbent



5.3.2 Other modelling assumptions

Table 5-2 gives the assumptions that are common across the baseline investment cases.

Table 5-2: Baseline Plum "AIM" parameters

Parameter	Assumption
NGA price premium	€5 for FTTC and €10 for FTTH per month, thereafter growing at 2% real per annum. The price for a fibre entrant is the copper price plus the premium above i.e. €19 per month.
Wholesale copper price	Baseline copper wholesale price of €9 per month.[23]
Change in operating costs	FTTC: assumed to be neutral on grounds that gains from reconditioning and installation checks offset any additional cabinet related maintenance costs. FTTH: saving of half of estimated maintenance per line (whether or not copper is retired) assumed to be 10% of €9 per month.[24] See also discussion in Appendix B. There are no operating cost savings for a fibre entrant.
Hurdle (discount) rate	10% - The rate at which future costs and revenues are discounted. Linked to, but not necessarily confined to, the WACC (can include real option effects and risk of stranding).

Note: the above assumptions in relation to take-up and the potential price premium were informed by a range of information including the experience of Verizon in the US considered in Appendix C.

[22] The fixed cost for passing a home, dependent on coverage, C: FTTC: 65 + 50C + 400C^6; FTTH: 250 + 600C + 2000C^6 FTTC includes an upward adjustment of €15 per premise to allow for vectoring (not included in the Analysys Mason study). The cost of connecting a home - which is constant by location: FTTC: €185 per connected household (includes additional cost of €35 per household for the additional cost of vectoring); FTTH: €300 per connected household.

[23] In 2010 the average full LLU monthly rental in the EU was €8.53; the monthly average total cost for full LLU (including a connection cost) was €9.63. Source: Digital Agenda Scoreboard, "Database on electronic communications market indicators", http://ec.europa.eu/information_society/digital-agenda/scoreboard/download/index_en.htm

[24] For the year ending March 2011, BT's revenue for "wholesale analogue exchange line services" was £1,708 million, while provision/maintenance opex costs were £157 million or 9%. http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2011/CurrentCostFinancialStatements2011.pdf

A number of assumptions also differ across the three cases as summarised in Table 5-3.

Table 5-3: Assumptions that vary across the scenarios

	Incumbent - limited competition	Incumbent - cable competitor[25]	Fibre entrant[26]
Broadband take-up	80%	90%	80%
Fibre take-up (over 5 years)	45%	30%	40%
Cable starting market share	-	30%	-
Annual loss to mobile if no investment[27]	2%	2%	-
Annual loss to cable if no investment	-	10%	-

5.4 Technology mix and modelling approach

In practice a range of technologies would be deployed and the appropriate mix will be highly dependent on local circumstance. For new fixed access deployment (greenfield and entrant) FTTH is likely to be preferred as there is no existing copper network to support FTTC deployment. FTTH may also be preferred in locations where there is an existing copper network if the density of premises and/or network topology makes FTTC an unattractive choice, where readily usable ducts and/or poles are available or where fibre can be buried directly (as in the Netherlands). Fibre to the basement also represents an intermediate case. Finally, in some locations wireless and satellite access are likely to be preferred.

In our modelling we restrict attention to FTTH and FTTC, and assume generic cost functions in relation to coverage (our focus is the sensitivity to changes in assumptions). In the modelling we examine FTTH and FTTC investment separately, assuming that one or the other takes place. It is then possible to determine the technology mix from the net revenue at each coverage level. However, given that FTTH is assumed to be around four-times more expensive than FTTC while incremental revenue over existing generation broadband is assumed to be around twice as great for FTTH than FTTC, in the base case (and the majority of modelling results) FTTH is not the preferred choice at any coverage level. However, we focus on the sensitivity of the investment case for both technologies to variations in assumptions, to illustrate how coverage varies for both FTTH and FTTC for the given generic cost functions we have assumed.

[25] With a cable competitor overall broadband take-up increases from 80% to 90% because some cable customer's take-up broadband services as part of a bundled TV package and fibre take-up is assumed to fall to 30% as the incumbent is now competing with an alternative provider.

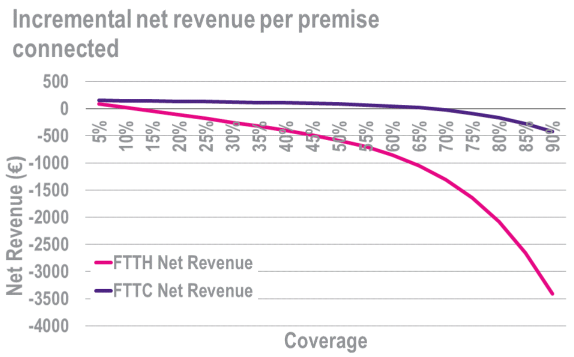
[26] For a fibre entrant take-up is 40% instead of 45% after 5-years, as they do not have an established customer base. In addition we assume that the fibre entrant's incremental costs are higher than the incumbents since they do not have existing infrastructure – revised fixed cost function: $400 + 600C + 2000C^6$.

[27] Customer losses to competing platforms represent the net impact of customer loss and win-back, and for modelling purposes are assumed to decline to zero with next generation access investment.

5.5 Baseline modelling results

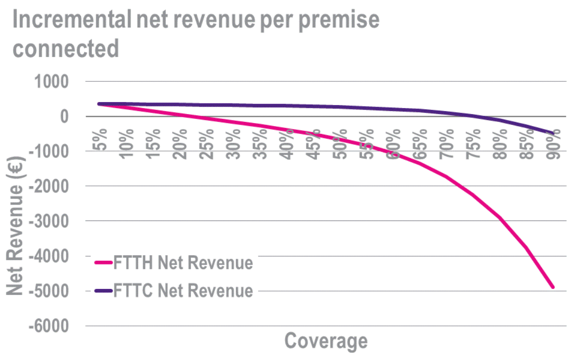
Investment will continue up to the point where the incremental net revenue (revenue minus cost) is zero. Figure 5-3 shows the discounted net revenue for FTTH and FTTC as a function of coverage for a copper incumbent with limited (wireless) competition, Figure 5-4 shows the same curves for the case when there is a copper incumbent facing platform competition from cable.

Figure 5-3: Incumbent - limited competition



Source: Plum Consulting AIM

Figure 5-4: Incumbent – cable competition



Source: Plum Consulting AIM

Table 5-4 shows a summary of the baseline coverage results for the different scenarios.

Table 5-4: Summary of baseline coverage results

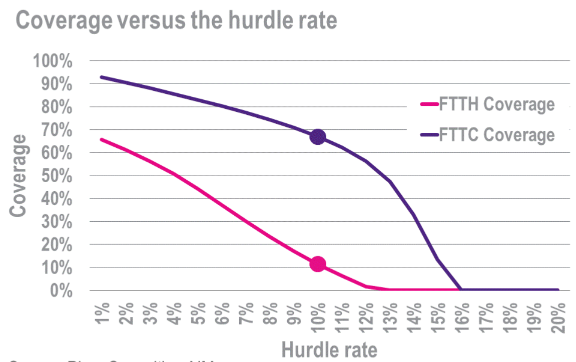
	FTTH Coverage	FTTC Coverage
Copper incumbent with no major platform competition	11%	67%
Copper incumbent with cable competitor	22%	75%
Fibre entrant	16%	-

The results show that coverage is higher when there is a cable competitor. This is because in the case with a cable competitor the benefits of greater revenues from customer retention outweigh the reduced take-up of fibre. In the case with a cable competitor, FTTH net revenues are higher than FTTC below 4% coverage, therefore the model predicts FTTH coverage of 4% and FTTC coverage from 4% to 75%. In the case with limited platform competition the net revenues from FTTC investment in our model are always higher than from FTTH investment; therefore the model predicts no FTTH investment and FTTC investment up to 67% coverage. However, in practice we expect there to be a mix of FTTH and FTTC deployment (in addition to cable, wireless and satellite access) depending specific circumstances as explained in 5.4.

5.6 Sensitivity of baseline coverage to assumptions

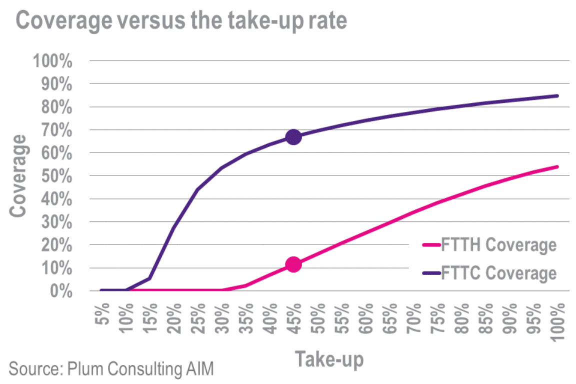
We modelled variations in assumptions solving for the breakeven level of coverage at the margin. Figure 5-5 through Figure 5-10 show the results. The circle on each curve marks the base case.

Figure 5-5: Incumbent – limited competition



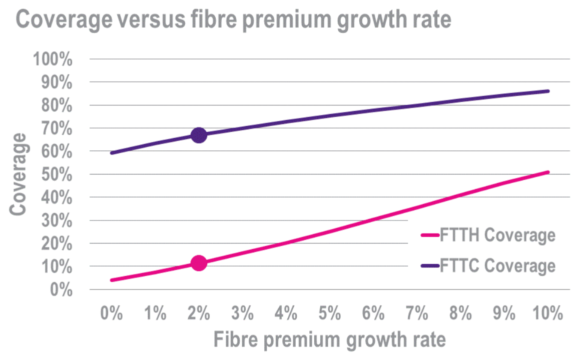
Source: Plum Consulting AIM

Figure 5-6: Incumbent – limited competition



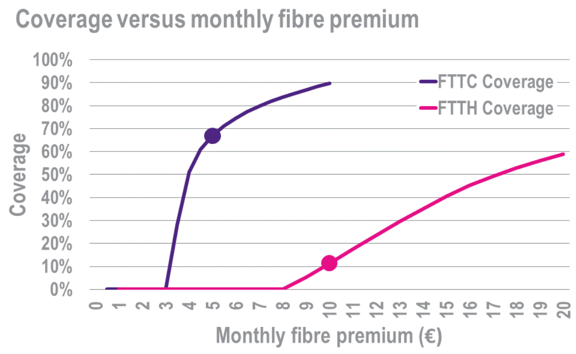
Source: Plum Consulting AIM

Figure 5-7: Incumbent – limited competition



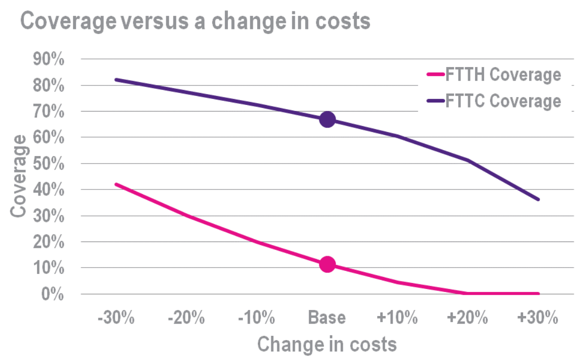
Source: Plum Consulting AIM

Figure 5-8: Incumbent – limited competition



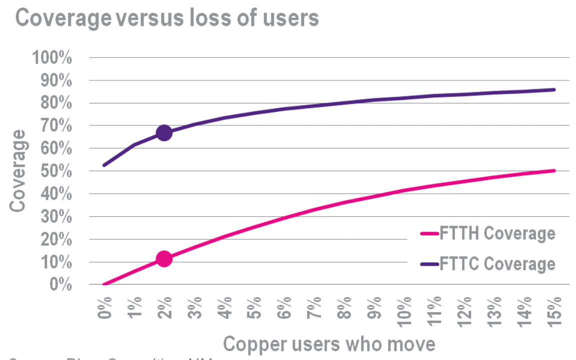
Source: Plum Consulting AIM

Figure 5-9: Incumbent – limited competition



Source: Plum Consulting AIM

Figure 5-10: Incumbent – limited competition



Source: Plum Consulting AIM

The above graphs show a range of scenarios – some of which are clearly unrealistic. However this was done to illustrate the sensitivity of coverage to a wide range of assumptions.

The graphs highlight that coverage results in the AIM are highly dependent on the underlying assumptions. For FTTH a small change in a single assumption can result in coverage falling to zero. FTTC coverage is less sensitive to changes in the assumptions; however there are still points at which investment falls to zero.

We performed the same sensitivity analysis for the case with a cable competitor and for a fibre entrant. The results were broadly similar so are not reported here, all the graphs had the same shape but were shifted up to reflect the higher coverage. The FTTC investment case is more robust, for example even when the FTTC premium falls to €1 a month, FTTC coverage is 26% when there is a cable competitor.

5.7 Analysis of policy alternatives

We consider different policy scenarios as set out in Section 2 and their potential impacts on investment by copper network operators and others (entrants or alternative platforms). We model the impact via assumptions regarding the impact on the inputs to our model. Table 5-5 sets out the cases we analyse. These are examined in more detail below.

Table 5-5: Policy impact scenarios

Policy	Case	Channel
Lower copper price	Fibre entrant (FTTH)	• Price of fibre lowered by same amount with no offsetting gain • Impact on expectation of future stranding risk and impact of uncertainty on option value of waiting
	Copper network operator (FTTH or FTTC)	• Price differential between copper and fibre unchanged • Changes opportunity cost of customer loss and therefore benefits of upgrade via retention effect • Impact on expectation of future stranding risk and impact of uncertainty on option value of waiting
Lower copper price conditional on no fibre investment	Copper network operator (FTTH)	• Decrease in copper customer revenues if there is no investment in fibre • Impact on expectation of future stranding risk and impact of uncertainty on option value of waiting
Higher copper price	Copper network operator (FTTC or FTTH)	• Changes opportunity cost of customer loss and incentivises investment via retention effect • Reduced expectation of future stranding

5.7.1 Policy impact for copper incumbent with limited platform competition

Impact of lower copper price

We analyse the impact of a hypothetical reduction in the copper price from €9 a month to €6 a month (following a five year linear glide path). The effect works through two channels:

- Reducing the price of copper reduces the benefit of retaining customers who would be lost to other platforms in the absence of investment, so the benefit of investing is less. The benefit of retained customers for FTTC investment is assumed to be half that of FTTH due to the lower premium and lower likelihood of retention with FTTC.
- Reducing the price of copper will have an impact on the hurdle rate due to two effects:
  - By reducing the price of copper the expectation of fibre being stranded in the future is increased, we assume the hurdle rate is increased by 2%.[28]
  - The decision to reduce the price increases uncertainty regarding future regulation. With greater uncertainty it may be best to wait before investing – equivalent to an increase in the hurdle rate. We assume the hurdle rate increases by 2%.[29]

Figure 5-11 and Figure 5-12 (previous Figure 5-5) show the sensitivity to these effects.

Figure 5-11: Incumbent – limited competition

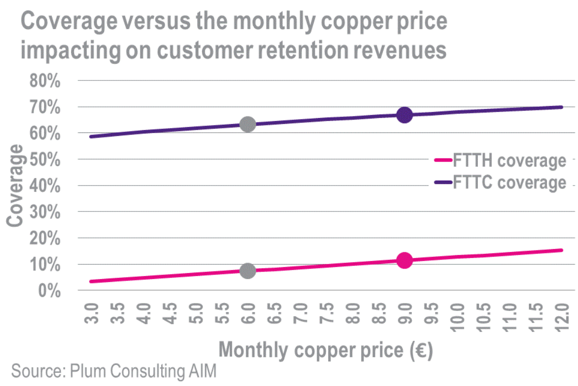
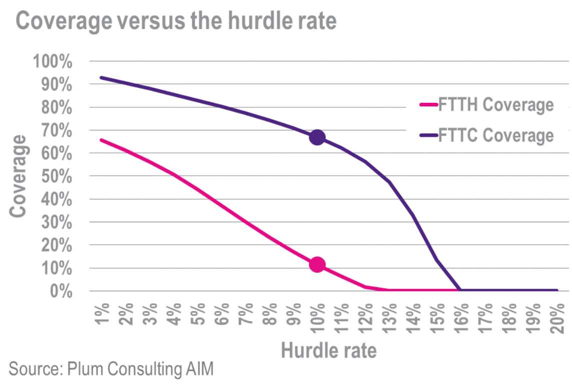


Figure 5-12: Incumbent – limited competition



The combined effect is to reduce coverage from 67% to 17% for FTTC and is more than sufficient to eliminate FTTH investment as shown in Figure 5-13 and Figure 5-14.

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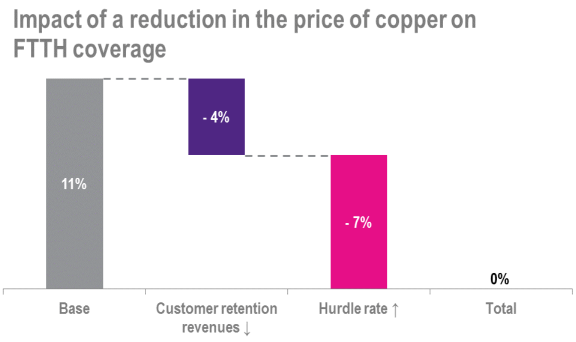
[28] The probability of stranding can be modelled via a Poisson distribution. The probability of no single stranding event is then given by e^{-pt} where p is the annual probability of stranding. Since the continuous time form of discounting is also an exponential the probability of stranding can be modelled as a straightforward addition to the hurdle rate.

[29] This is a judgement based on option value theory. For example, if the WACC is 8% then uncertainty of 9% (the expected variance of net revenue) gives a hurdle rate of 10%. If the variance increases to 17% the hurdle rate will increase by 2%.

Dixit. Winter 1992. "Investment and hysteresis." *Journal of Economic Perspectives*; Volume 6. The impact of uncertainty on investment hurdle rates with irreversibility and uncertainty can be modelled as a multiple of the cost of capital and can be calculated under a set of simplifying assumptions (investment is one off and volatility follows a geometric random walk with variance σ^2). The formula for the mark-up is:

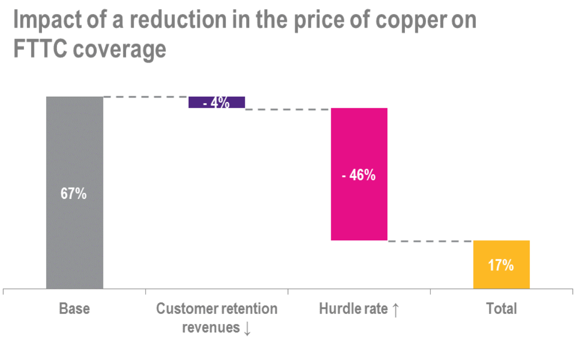
$$\rho^1 = \frac{\beta}{\beta-1}\rho \text{ where } \beta = \frac{1}{2}\left[1+\sqrt{1+\frac{8\rho}{\sigma^2}}\right]$$

Figure 5-13: Incumbent – limited competition



Source: Plum Consulting AIM

Figure 5-14: Incumbent – limited competition



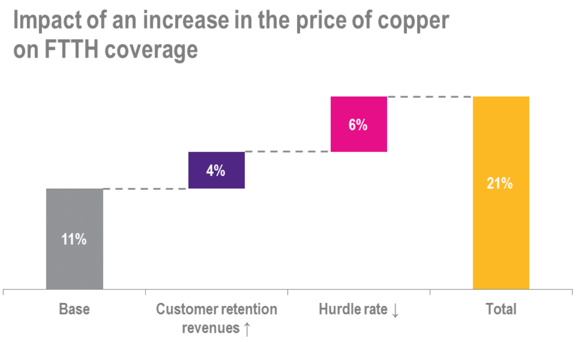
Source: Plum Consulting AIM

In practice, we would not expect FTTH coverage to necessarily fall to zero. There is likely to be considerable variation in next generation access technology deployed in different locations, depending on the nature of copper networks such as the length of lines and density of housing. This will alter the optimal balance between FTTC and FTTH.

Impact of a higher copper price

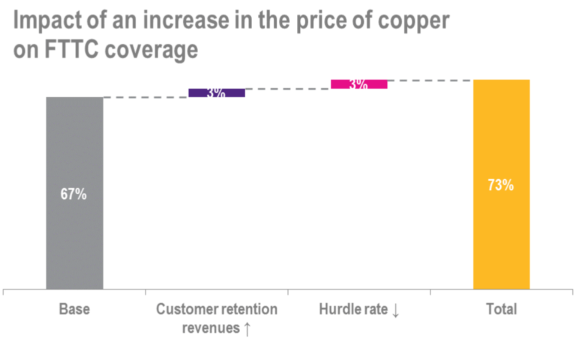
For a hypothetical increase in the price of copper (i.e. one-third to €12 a month over a 5-year linear glide path) the effect is similar but opposite to a reduction in the price of copper, in particular the decision to increase the price of copper is seen as a positive signal by prospective investors, thereby increasing confidence and reducing the hurdle rate by 1 percentage point. Figure 5-15 and Figure 5-16 show the impact.

Figure 5-15: Incumbent – limited competition



Source: Plum Consulting AIM

Figure 5-16: Incumbent – limited competition



Source: Plum Consulting AIM

The overall impact causes coverage to increase from 11% to 21% for FTTH and from 67% to 73% for FTTC.

Impact of conditional lower copper price

This scenario is the same as the first scenario; however the price of copper is only reduced if there is no investment in fibre. For a linkage between the copper price and FTTH investment, and leaving aside the questions raised in the qualitative analysis,[30] conditionality may be considered to introduce a static incentive for FTTH investment. However, a threatened price reduction (which we assume harms expectations) and/or uncertainty regarding how conditionality might be applied or evolve can more than offset any static positive incentive effect. For FTTC assuming the approach is unconditional the impacts are as set out above i.e. coverage falls from 67% to 17%.

Leaving to one side the credibility and practicality of this policy approach the static sensitivity analysis with respect to the copper price is shown in Figure 5-17 (if the incumbent does not invest the price of copper is reduced to €6 over a 5-year linear glide path,[31] whereas if the incumbent invests the price of copper remains at €9 a month). Figure 5-18 shows the overall impact of a conditional reduction in the copper price including the impact on copper customer revenues and the dynamic impact on the hurdle rate.

Figure 5-17: Incumbent – limited competition

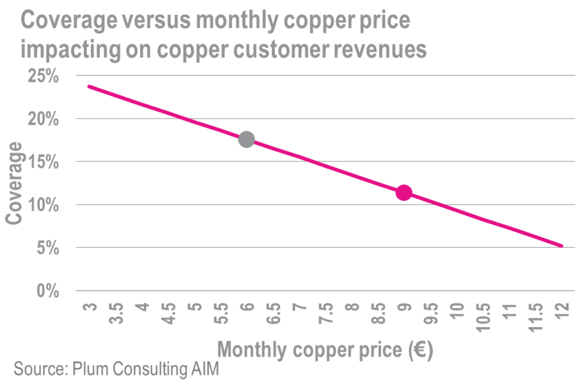


Figure 5-18: Incumbent – limited competition

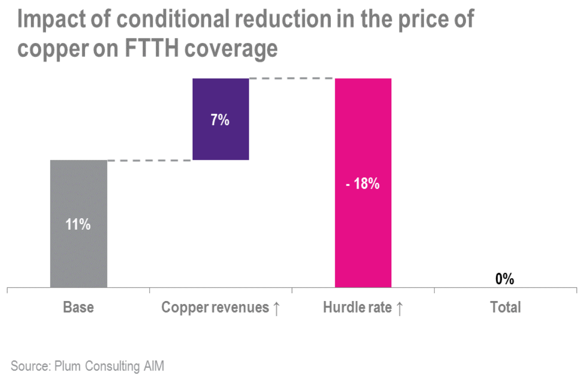


Figure 5-17 shows that via this channel a conditional reduction in the copper price by one-third would increase coverage by less than 10% - all other things been equal. This is because the operator earns incremental copper revenues by investing in fibre. However the anticipated negative dynamic impact on the hurdle rate is still expected to be present given the revealed willingness to pursue policy goals by ad hoc changes to regulatory prices. As shown in Figure 5-18 this reduces final coverage is zero.

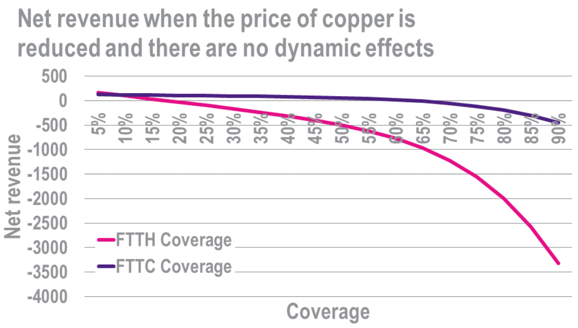
In practice it is unlikely that FTTH deployment will fall to zero and the optimal balance between FTTH and FTTC will vary depending on existing network architecture. We also note that if the conditionality is linked to FTTH investment only, and FTTC was preferred, the policy may harm the FTTC business case since the price of copper and therefore FTTC is lower.

[30] Note as discussed earlier that this may not be a credible or even rational game since the outcome of lowering prices in the no investment case is to discourage investment by the incumbent, other platforms and entrants alike.

[31] The questionnaire proposes a glide path but does not identify the period of time for the glide path, however, it suggests that the glide path is linked to fibre investment. This suggests that the glide path may cover a significant time period and we have assumed 5 years for the purpose of our analysis.

To examine this we put hurdle rate impacts to one side and consider a conditional (FTTH only) reduction in the price of copper which has a positive impact on FTTH coverage, and a negative impact on FTTC coverage via customer retention incentives as shown in Figure 5-19.

Figure 5-19: Incumbent – limited competition



Source: Plum Consulting AIM

This shows that in terms of the optimal mix of technologies it is optimal to deploy FTTH up to about 8% coverage, beyond this FTTC coverage will be more profitable and will reach coverage of 63%. Therefore the policy has caused FTTH coverage to increase from zero to 8% leaving aside dynamic effects whilst overall coverage falls with FTTC coverage reduced from 67% to 63% (there would also be negative impacts on potential entrants and an increased requirement for public funding in less dense areas).

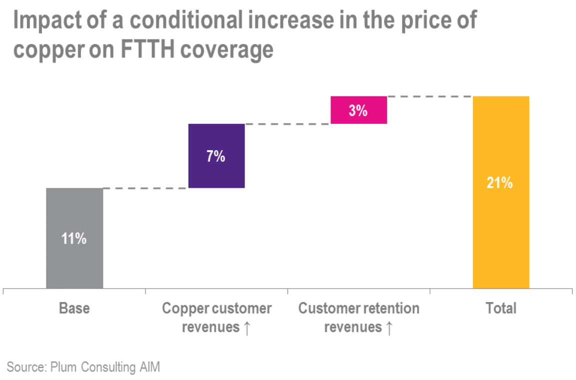
Impact of conditional higher copper price

In this scenario the copper price is increased if there is investment in FTTH. The base case is the same as outlined above where FTTH coverage is 11%. If the incumbent invests, the copper price rises to €12 a month over a 5-year linear glide path. The policy has a number of impacts on the investment decision:

- The increased price of copper means that the revenues from existing copper customers increases; if the copper prices increases to €12 a month, the investor gains an additional €3 a month per copper customer.
- The increased copper price also increases the revenues received from retained customers.
- There is no impact on the hurdle rate because although returns on copper are increased, conditionality reduces investor confidence in future decisions – as in the previous case.

The overall impact is shown in Figure 5-20 with FTTH coverage increasing from 11% to 21%. However, the same proviso applies as in the previous example, namely if FTTC investment was preferred, the policy may be thought of as either having no impact or potentially harming the FTTC business case if the hurdle rate is elevated as a result via harm to investor expectations.

Figure 5-20: Incumbent – limited competition



5.7.2 Policy impact for copper incumbent with cable competitor

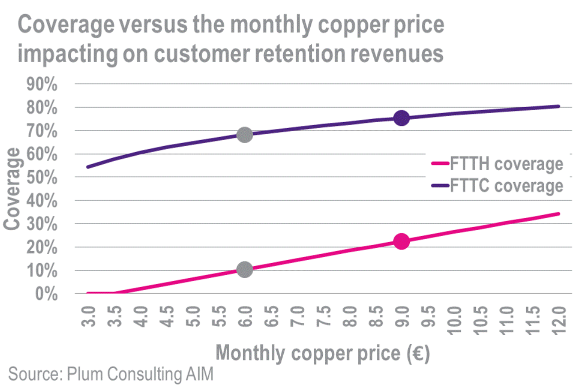
Here we look at the same policies as above but in the case of an incumbent with a cable competitor, the reasoning and the channels are the same as above. We note that with strong competition there is a question over whether wholesale price changes would be fully captured at the retail level due to competitive constraints (which we do not model since we assume 100% pass through).

However, cable competition will not be present in all locations of interest, in particular areas where the investment case is marginal (aside from those countries with near universal cable coverage). Further, where platform competition is strong a prior question should be asked, namely is continued price regulation required?

Impact of a lower copper price

The sensitivity of coverage to a change in the copper price impacting on customer retention revenues is shown in Figure 5-21. The result indicates that coverage is more sensitive to the copper price when there is a cable competitor; this is because one of the main reasons to invest when there is a cable competitor is to retain revenues, if the copper price falls the revenues from retained customers falls so there is less incentive to invest.

Figure 5-21: Incumbent – cable competition



The overall impact on coverage with a lower copper price is shown in Figure 5-22 and Figure 5-23, a fall in the price of copper from €9 to €6 causes FTTH coverage to fall to zero and FTTC coverage falls to 47%.

Figure 5-22: Incumbent – cable competition

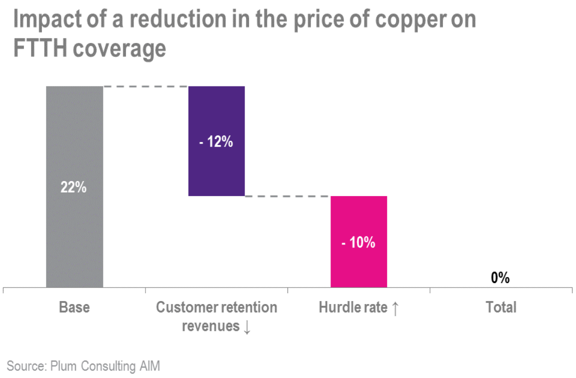
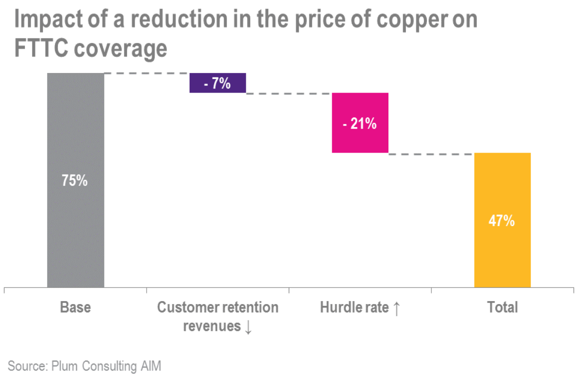


Figure 5-23: Incumbent – cable competition



Impact of a higher copper price

Figure 5-24 and Figure 5-25 show that an increase in the copper price to €12 a month causes FTTH coverage to increase to 40% and FTTC coverage to increase to 83% (with the proviso that pass through is likely to be less than the assumed 100% with a cable competitor).

Figure 5-24: Incumbent – cable competition

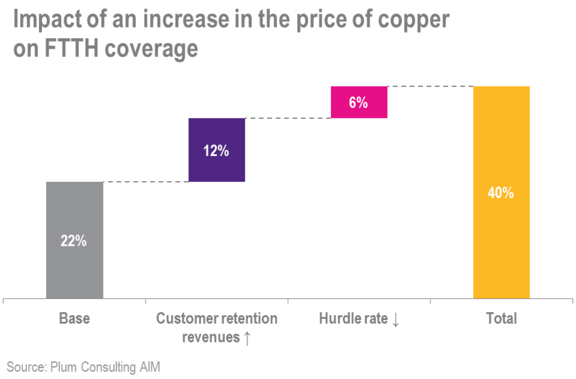
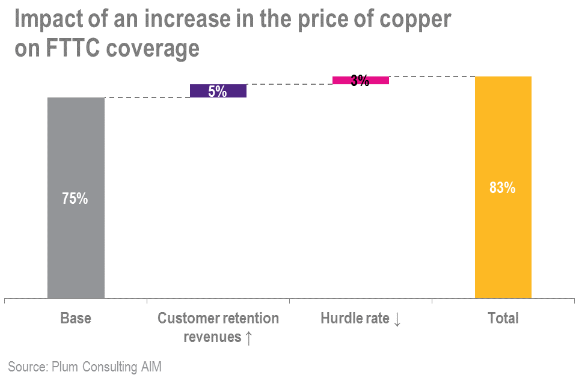


Figure 5-25: Incumbent – cable competition



Impact of a conditional lower copper price

The sensitivity of coverage versus a change in the copper price impacting on copper customer revenues is shown in Figure 5-26; the result is broadly similar to when there was no cable competitor. The overall impact of a conditional reduction in the price of copper is shown in Figure 5-27, FTTH coverage falls from 22% to 8%.

Figure 5-26: Incumbent – cable competition

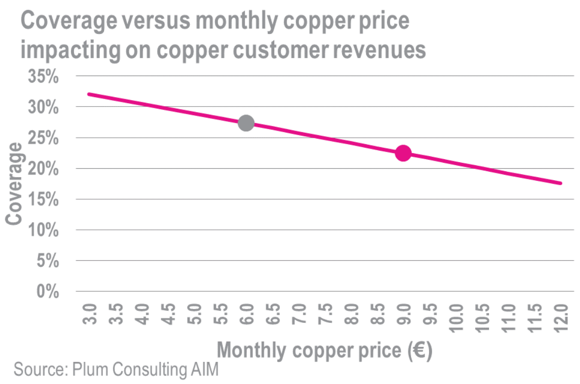
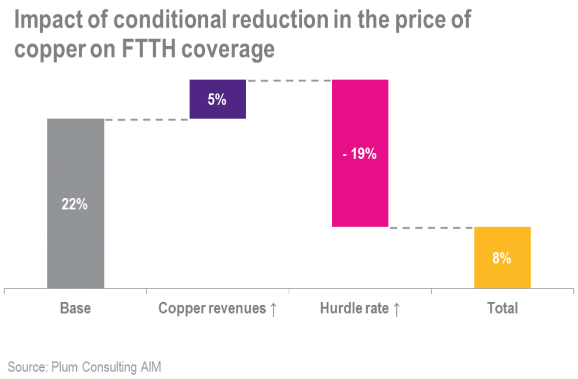


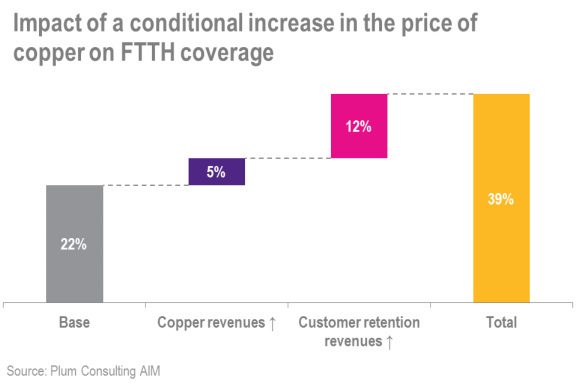
Figure 5-27: Incumbent – cable competition



Impact of a conditional higher copper price

Figure 5-28 shows the overall impact of a conditional increase in the price of copper, FTTH coverage increases from 22% to 39% (with the proviso that pass through is likely to be less than the assumed 100% with a cable competitor).

Figure 5-28: Incumbent – cable competition



5.7.3 Policy impact for fibre entrant

There are two channels through which regulation lowering the price of copper will affect the investment decision of the entrant:

- A lower price of copper will reduce the price the incumbent can charge. If the copper price is reduced it will follow a 5-year linear glide path.
- The entrant's expectation of future asset stranding will increase (either direct or indirect via the impact of stranding on the incumbent on market prices), and alongside uncertainty and the real option effect this will increase the hurdle rate.

Figure 5-29 and Figure 5-30 show how the entrant’s coverage decision will change as the magnitude of the policy change and impact varies. We assume that the price of copper is reduced from €9 to €6 a month and the increased chance of stranding raises the hurdle rate 4%.

Figure 5-29: Fibre entrant

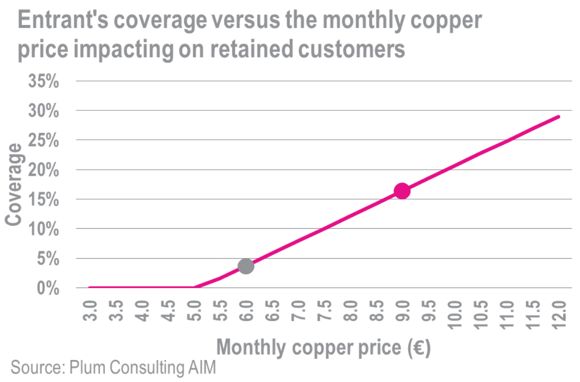


Figure 5-30: Fibre entrant

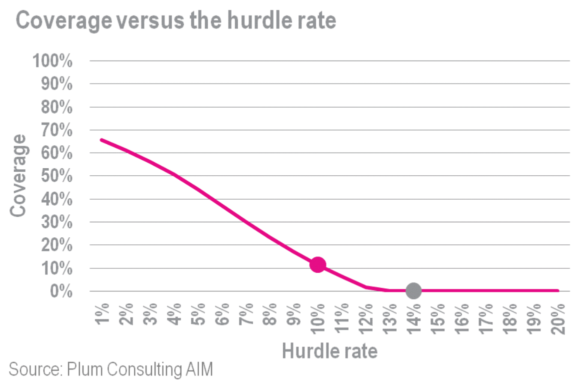
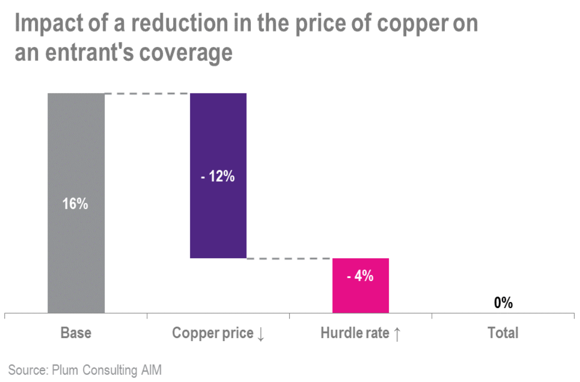


Figure 5-31 shows the overall policy impact on the entrant’s coverage decision based on the assumptions outlined above. The decrease in the copper price reduces coverage to 4%, with the additional impact on the hurdle rate resulting in no investment.

Figure 5-31: Fibre entrant



5.8 Escaping a cul-de-sac of price decline and lack of investor confidence

The response to our discussion with equity investors indicated that having proposed that the price of copper might be lowered that positive action is now required to return to pre-questionnaire levels of investor confidence. We were told that given the history of price declines in the sector, the risk premium required to justify investment without a clear change of direction is likely to be large (and potentially in excess of consumer willingness to pay). It is therefore crucial to reduce the investor risk premium via credible signals of commitment to a better regulatory approach. We propose the following for consideration:

- Maintaining a technology neutral approach to maximise flexibility to find the least cost mix of technologies capable of achieving the Digital Agenda targets.
- Maintaining infrastructure competition and choice to help drive innovation, efficient investment and consumer and economic welfare gains over time. An approach to regulation during transition which supports, rather than harms, platform competition and choice should be pursued.
- Maintaining a replacement cost methodology for copper and, potentially moving to a "backstop" price cap with upward (RPI+) trajectory. This could offer stability, protect consumers and send a positive signal to investors during the transition from copper to fibre.
- Remedies for next generation access should be differentiated from those for copper given the need to foster innovation and investment and the limited pricing power in relation to fibre given current generation access substitutes. For fibre we propose (in addition to open access) that:
  - The anchor price provided by regulated copper access is sufficient constraint, and when and where copper is withdrawn by a virtual copper equivalent "anchor product"; or alternatively
  - A discounted cash flow (DCF) based price control applied with up-side potential built in for the investor via a WACC premium, appropriate volume assumptions and a long-term commitment. In deciding between an anchor product approach and the DCF approach the objectives of achieving investor trust and pricing flexibility should be key considerations.
- The opportunity for copper retirement should be supported by analysis and removal of barriers to transition. However, given the complexities involved and differences in investment strategies rapid copper retirement should not be assumed, nor be a policy objective.

In order to model the above we consider a scenario in which there is return to credible commitment (assumed in our base case) and in addition:

- Service-price differentiation is feasible, allowing operators to target different segments of the market. Take-up is assumed to increase by 10 percentage points to 55%.[32]
- Revenues from customer retention increase because the copper price grows at the same rate as the fibre premium i.e. 2% per annum.
- Regulatory consistency and allowance for the copper price to rise reduces uncertainty and increases confidence in regulation. This is assumed to reduce the hurdle rate by 1%.

The overall impact of these changes is that coverage increases to 30% for FTTH and 76% for FTTC, as shown in Figure 5-32 and Figure 5-33.

[32] A single price point with a linear demand curve allows up to half of consumer surplus – the excess of willingness to pay over cost to be captured as revenue. With differentiation that is possible to increase this, but only partially (due to information constraints and limits on practical opportunities for market segmentation).

Figure 5-32: Incumbent – limited competition

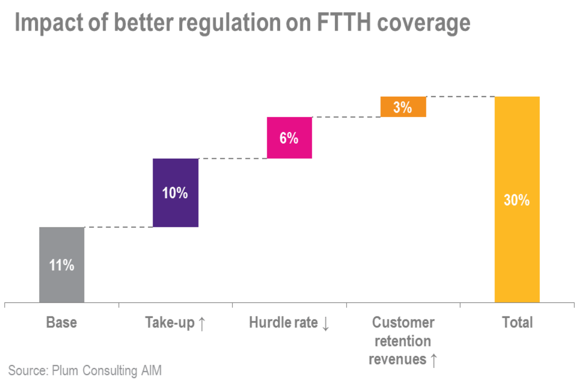
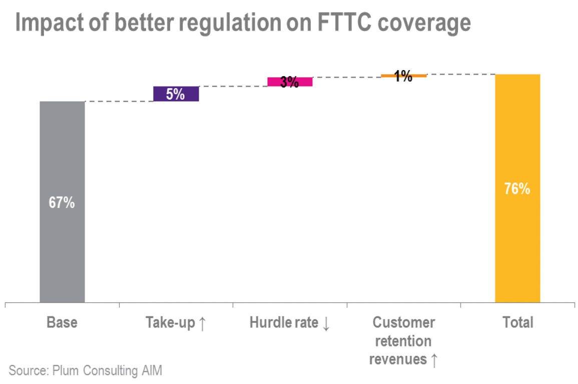


Figure 5-33: Incumbent – limited competition



We note that the above applies only to limited platform competition areas. However, cable competition will not be present in all locations of interest, namely those areas where investment is marginal. Further, where platform competition is strong a prior question should be asked, namely is continued price regulation required?

5.9 Conclusion

We conclude that lowering the copper price would reduce commercial investment by incumbent operators, and entrants and platform competitors in particular. This would impede progress towards the Digital Agenda goals, and/or require more substantial public funding to make-up the shortfall.

Appendix A: Potential of fibre to the cabinet with vectoring

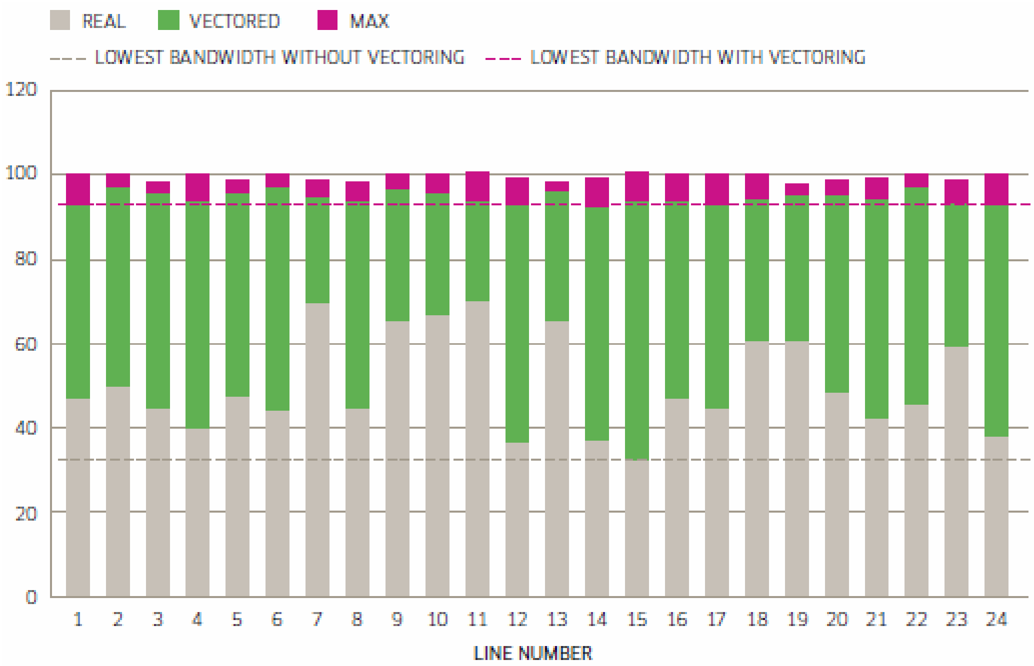
We comment here on the changing expectation regarding the capability of copper because:

- Of the potential contribution to achieving the Digital Agenda targets at reduced cost (thereby increasing the commercial contribution and reducing any public funding required).
- It relates to some of the assumptions underpinning proposals regarding copper pricing and copper retirement.
- FTTC can be deployed more quickly than FTTH so the associated economic benefits will begin to accrue earlier.

A.1 Impact of vectoring on download speed

The first phase of improvements to give higher speeds with VDSL was pair bonding, which was introduced last year and multiplies the speeds achieved by the number of pairs used for a given subscriber, or increases the distance that can be served at the same speed. Vectoring is the second phase of improvements. Alcatel will launch commercial equipment in December this year. Prototypes were developed first in 2009 and there is a year of practical experience from testing with 15 different operators in Europe, North America and the Far East. The potential performance gains, and gains in terms of consistency of performance on a line length of 400m for VDSL from the cabinet are illustrated in Figure A-1.[33]

Figure A-1: Impact of vectoring on broadband speed



Source: Alcatel-Lucent

[33] Alcatel-Lucent. "Get to fast, faster. Accelerate the existing copper plant with VDSL2 vectoring and bonding." Strategic White Paper. http://www.alcatel-lucent.com/vdsl2-vectoring/
See also (October 2011): http://spectrum.ieee.org/telecom/internet/copper-at-the-speed-of-fiber

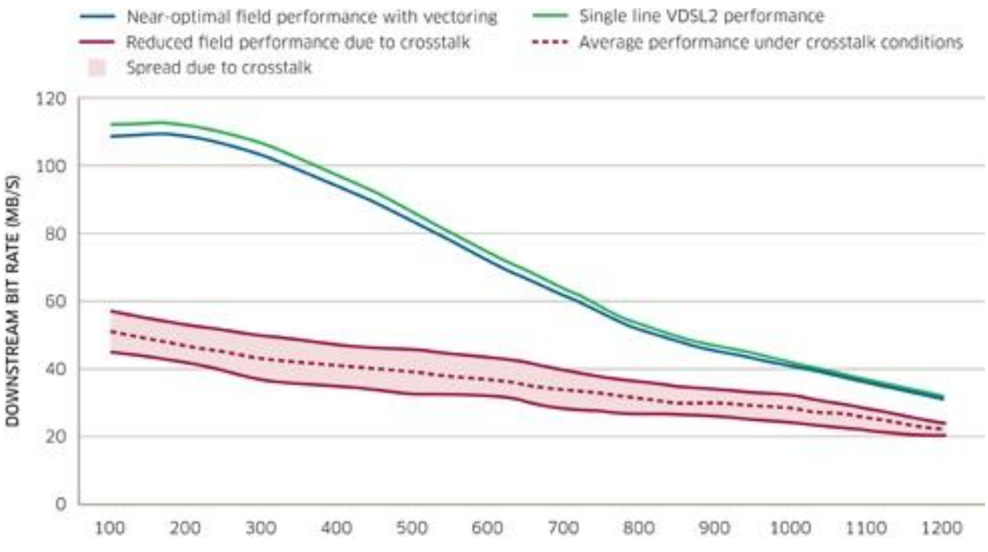
The grey bars show the bit rates in each of 24 copper pairs in a 400-metre binder without VDSL2 vectoring. Downstream, the lowest bit rates in this example are in the low- to mid-30s in Mbps. This low downstream bit rate sets the marketable bit rate to an equally low level. With VDSL2 Vectoring, bit rates increase considerably, as represented by the green bars in Figure A-1. The lowest bit rate available in this example is in the low- to mid-90s in Mbps.

VDSL2 performance on a copper pair in real life scenarios is affected primarily by crosstalk from VDSL on other pairs in the same cable. The extent of the crosstalk varies depending on the strength of the signals on the other pairs and on their relative position to each other in the cable. Consequently performance in practice is unpredictable, and this makes it difficult for operators to offer specific service levels to customers.

Vectoring reduces the crosstalk on VDSL pairs that is caused by other VDSL pairs. It works by computing and applying a signal that cancels the crosstalk signal. This signal is specific to a given pair, and separate cancellation signals have to be calculated for each VDSL pair that is to be improved by vectoring. VDSL performance in not significantly affected by other pairs in the same cable that use ADSL because VDSL has little overlap with the spectrum used by ADSL. Equally VDSL does not significantly affect ADSL performance.

Vectoring applies to both the downstream and the upstream signals. In both cases the cancellation signal is computed and applied at the DSLAM end, so the cancellation is applied pre-crosstalk for downstream and post-crosstalk for upstream. The benefit of vectoring is that the performance of VDSL2 is restored to almost what it would be in a cable with no other pairs in use. This produces an improvement in practice depending on pair length ranging from 30% at around 1km to up to 150% at 200m, as shown in Figure A-2.[34]

Figure A-2: Effect of pair length of vectoring performance



This improvement gives either:

- Higher usable speeds at the same distance, so the operator can offer better services

[34] Spruty and Vanhastel. September 2011. "Boosting VDSL with Vectoring." http://www2.alcatel-lucent.com/blogs/techzine/2011/boosting-vdsl2-bit-rates-with-vectoring/

- Greater reach for the same usable speed, so the operator can offer services to more subscribers.

A further advantage is that the main network-based source of unpredictability in performance is largely removed and so an operator can quote service levels with higher confidence that they can be achieved. For example, Swisscom found that a system that delivered 75 Mbit/s in the laboratory without crosstalk performed in practice at speeds in the range 30-50 Mbit/s on different pairs due to crosstalk. With vectoring, all these pairs achieved around 72 Mbit/s. In relation to an actual investment case Belgacom expects to achieve availability of 30+ Mbit/s for 78 % of the population within 4 years using FTTC with vectoring.

Vectoring does not, however, remove the effects of incorrectly configured wiring at the subscriber premises, which are unpredictable and not wholly within the control of the operator. Vectoring also enables operators to turn off the power control (back-off) on the upstream signals and this increases upstream performance for the shorter pairs.

Local cabling depends on the local scenario but typically with VDSL there would be:

- DSLAMs at the MDF site serving subscribers close to that site
- DSLAMs in street cabinets serving subscribers further from the MDF site

200 pairs is a common cable size for a large cable from cross connect cabinet to subscriber. An Alcatel DSLAM card serves 48 lines and so 4 cards would be needed for 192 pairs within a 200 pair cable. Because of the loading on the processor, the maximum number of pairs that can benefit from vectoring at present is about 200 but this figure should double in 1-2 years time.

A.2 Migration issues and sub-loop unbundling

Vectoring is integrated into the DSLAM card and not added as separate equipment. Thus a VDSL card would need to be replaced by one with vectoring capability. Where a cable needs more than one DSLAM card with vectoring, there is a proprietary very high speed interface between the cards over which information on the crosstalk signals is exchanged so that the cancellation signal can take account of crosstalk from VDSL signals on all the other pairs even ones served by different cards. There are no plans to standardise this interface. This is why it is not possible to obtain the full benefits of vectoring when more than one operator uses VDSL in the same cable as a result of sub-loop unbundling or LLU with short loops.

In order to compute the crosstalk matrix, the CPE must be “vectoring friendly” and respond to test signals. Many installed CPE are capable of being upgraded remotely to make them vectoring friendly but a few would need replacing. If vectoring is used but there is VSDL with non-friendly CPE on other pairs in the same cable (or VDSL run by another operator) the performance gain will reduce by an unpredictable amount – since the effect depends on the electromagnetic linkage between the pairs in question. In order to support vectoring in a specific pair, the pair must have CPE that supports vectoring (= full support, more than just supporting computation of the crosstalk matrix).

Appendix B: Copper retirement

We note that copper retirement is predominantly relevant as a consideration in relation to FTTH and not FTTC investment. Copper retirement has been proposed as a way of lowering costs (from dual running) and potentially increasing demand for next generation broadband (by reducing the alternatives available to customers) thereby improving the business case for investment.

Whilst copper retirement does present an opportunity to reduce costs there are a number of complexities, including differences in circumstances that need to be taken into account. Potential cost savings may also not be that large.[35]

Further there are costs involved in relation to transition. We conclude that copper retirement should be available as an option to investors, should be facilitated via the removal or reformulation of existing regulatory constraints; but should not be assumed to be simple and rapid or mandated or linked in terms of conditionality with other elements of policy.

B.1 Impact on the business case for investment

The eventual savings from copper retirement would be greater for FTTH than for FTTC since FTTC (at a minimum) requires continued provision of copper from the street cabinet or exchange to the customer. Potential withdrawal of copper to the cabinet with FTTC is also dependent on availability of a suitable home gateway to maintain telephony service (a standard element of existing deployment in some countries but not others).

The precise magnitude of potential savings is not known, though we do know that Verizon in the US have stated that fault related maintenance per line switched from copper to FTTH is approximately halved (see Appendix C). However, it is important to note that this savings accrues whether or not the line is retired – it can simply be left fallow.

Further savings may accrue if copper service is ceased to all customers in an area served by an exchange since the exchange building itself may then be able to be closed and sold (though fibre aggregation points would remain). Commercial fibre rollout strategies do not always target entire exchanges though, as profitability may vary between different areas in the exchange and some operators chose a gradual roll-out in these areas. This can improve the business case and help in bringing fibre to more households overall. The opportunity to make savings through the closure of exchanges will also vary with some operators leasing exchange buildings for a fixed term and with a requirement to maintain other services, for example, leased lines or other services located at exchange buildings.

There will also be costs associated with copper retirement including the effort and cost involved in migrating those customers who do not voluntary adopt fibre and who use other services provided over analogue lines including burglar, personal safety alarms, fax machines, traffic lights, lift emergency telephones, bank card readers etc. These costs will fall on both operators and consumers and too rapid a transition is likely to increase them overall.

[35] For the year ending March 2011, BT's revenue for "wholesale analogue exchange line services" was £1,708 million, while provision/maintenance opex costs were £157 million or 9%. Source, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2011/CurrentCostFinancialStatements2011.pdf

There is a technical engineering task in developing a comprehensive view of existing services dependent on analogue lines and an engineering-economic-policy question around migration and who bears the cost. It seems reasonable to anticipate that too rapid a transition would raise rather than lower overall costs when migration costs are considered.

There may also be revenue impacts associated with copper retirement. In particular too rapid a migration without sufficient planning and support could well prove disruptive for customers and drive some off the network (copper or fibre) to alternative platforms. Too rapid a transition could therefore reduce expected revenues from fibre investment.

B.2 Potential policy issues

Regulatory barriers to copper retirement may include:

- The practical problems of providing back up power for voice services (since copper lines are powered from the exchange and fibre lines are not) so that users can make calls during a power outage (a requirement in most countries).
- Constraints on termination of service provision to unbundled local loop operators.
- Technology specific universal service requirements, for example for fixed line voice provision.

A number of these issues have been discussed in Finland in relation to the shift from fixed to mobile voice access,[36] though we are not aware of a comprehensive analysis of the issues involved.

B.3 Experience

There is very limited experience in relation to full copper retirement. Verizon in the US have retired one exchange five-years after first deploying FTTH. There are also trials of fibre only service provision planned in the UK and elsewhere. There is an opportunity to learn from experience over time. A number of fixed line operators have informed us that they are not expecting to retire copper in the near-to-mid term.

[36] Ministry of Transport and Communications. 2008. A phone for everyone – from fixed to mobile services. http://www.lvm.fi/fileserver/a%20phone%20for%20everyone%20%E2%80%93%20from%20fixed%20to%20mobile%20services.pdf

plum

Appendix C: Lessons from Verizon fibre deployment

The deployment by Verizon in the US of FTTH (marketed as "FiOS") provides an interesting case study because it is well advanced and therefore provides an indication of take-up as the market matures, and also provides some evidence in relation to copper retirement. Average revenue per FiOS customer is over $146 per month (the majority of FiOS customers take a TV package).

C.1 Deployment and take-up

Verizon first deployed FTTH ("FiOS") in 2006 in response to competitive pressure from cable and following the removal by the FCC in 2005 of mandated network access requirements in relation to fibre and limited unbundling options in relation to copper.[37]

Fibre was first deployed in suburban areas where overhead fibre was deployed. More recently, with more bendable fibre technology to enable fibre to be readily deployed within buildings, deployment has been extended to higher density areas with multi-dwelling units.

The requirement for a term contract was also dropped in locations with multi-dwelling units as occupancy turn-over is around 6-7 months and Verizon have found that take-up has risen without the term commitment requirement (and new landlords/new tenants are encouraged to take fibre when the tenant changes).

Verizon have passed 16 million homes with FiOS by mid-2011 and plan to pass 18 million homes. This compares to total voice connections of 24.5 million (Verizon have sold parts of their rural network so deployment is a smaller share of the pre-sale base). Verizon announced in March 2010 they were winding down their FiOS expansion, concentrating on completing their network in areas that already had FiOS franchises but were not deploying to new areas. In September 2011 Verizon stated in relation to FiOS that "...*the way things are today, I don't think that the financial model is such that I'm ready to expand over what we've committed to*."[38] However, Verizon do see an opportunity for further deployment if they can reduce labour and installation costs, in particular via improved in-house wireless to avoid cabling.

In non-FiOS areas Verizon have trialled and are planning the deployment of LTE and satellite TV bundles with an external antenna for the LTE broadband service to improve spectral efficiency. They envisage this bundle competing for copper line DSL customers in non-Verizon fixed line service areas.

FiOS internet subscribers were 35% and FiOS TV subscribers were 31% of homes passed with FiOS available for sale respectively in October 2011.[39] Commenting on take-up Verizon noted that:[40]

> *"We actually exceeded 40% penetration in Potomac. In Keller, Texas, which was one of our first markets, we're actually in excess of 50% penetration. ...So we're really starting to see some steam here that says we see 40% penetration overall in the next few years."*

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[37] Bauer. March 2005. "Unbundling policy in the united states - players, outcomes and effects." http://papers.ssrn.com/sol3/papers.cfm?abstract_id=976885

[38] http://www22.verizon.com/idc/groups/public/documents/adacct/goldman_conf_vz_transcript.pdf

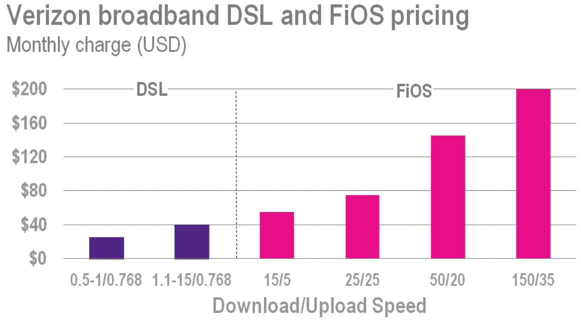
[39] http://www22.verizon.com/idc/groups/public/documents/adacct/2011_q3_qb.pdf

[40] http://www22.verizon.com/idc/groups/public/documents/adacct/vz-transcript-2011-11-09.pdf

C.2 Pricing of fibre and copper

Fibre prices are above copper DSL prices – as shown in Figure C-1. Fibre prices are differentiated with higher prices for higher speed tiers. Over time the tiers and price points have changed. Price differentiation increases the opportunity for fibre adoption and up-selling.

Figure C-1



Source: Plum Consulting. Pricing for one-year contract with phone service.

C.3 Copper retirement

Verizon have focussed on the fault rate reduction and operating cost savings when a customer switches from copper to fibre, rather than on copper retirement *per se*:[41]

> *"As we move people to FiOS our operating cost structure gets benefited by almost two times because the amount of truck rolls that I have on copper versus FiOS is about two times."*

In other words savings accrue when copper lies fallow, as opposed to requiring complete retirement. Copper retirement is however permitted,[42] and five years after Verizon began offering fibre to the home to customers Verizon gave notice in April 2011 of the first proposed retirement of copper at an exchange in Texas on or after August 2011.[43] Commenting on the trial Verizon noted that:[44]

> *"...we have done an experiment in Texas in Bartonsville where we have actually shut down the copper network and moved everybody into FiOS... It was a neighborhood that had more than 50% penetration. So it made financial sense to connect the ONT to the home and delete the copper network. We are doing a trial in Florida in another community doing the same thing."*

The introduction of a low price point 3 Mbps FiOS product (only available to existing fixed line customers) is seen as promoting fibre migration and retention which will produce immediate savings and which would eventually support retirement, with Verizon's Bob Elek quoted as saying:

> *"We're using the 3 Mbps FiOS Internet offer principally to migrate our 1 mbps High Speed Internet (DSL) customers and as a retention offer."*[45]

[41] http://www22.verizon.com/idc/groups/public/documents/adacct/2011_q3_trans.pdf

[42] There was an unsuccessful effort to reverse this policy. See Verizon response: http://fjallfoss.fcc.gov/ecfs/document/view?id=7020393147

[43] http://www22.verizon.com/regulatory/pdf/Bartonville-TX.pdf

[44] http://www22.verizon.com/idc/groups/public/documents/adacct/event_ucm_5_trans.pdf

[45] http://fastnetnews.com/fiber-news/175-d/4517-20-for-verizon-3-meg-fiber-with-catches