The copper fibre transition - a guide for the perplexed

A report for ETNO

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Executive Summary

Over the past year there has been an active debate in Europe over copper pricing and fibre transition. To be expected there have been conflicting claims, but surprisingly there have even been differences over whether lowering or raising the price of copper would promote or discourage investment. This guide for the perplexed focuses on this question and considers the key considerations that must be taken into account to reach a sound conclusion in relation to this question. It focusses in particular on the modelling approach and results of a report by WIK Consult in relation to copper-fibre transition.

In considering the extent to which commercial investment can contribute to achievement of the Digital Agenda goals and the relationship to policy choices it is important to capture the key elements of the commercial investment decision. Based on actual fibre investments and discussion with network operators and equity investors during 2011/12 the following key considerations are identified:

- A mix of technologies should be considered including FTTH and FTTC (developments including vectoring are expected to offer higher and more consistent speeds with FTTC).
- Existing network operator deployments and entrant deployments will in the majority of circumstances involve a sustained period of overlap between existing and next generation access. Rapid switchover is complex and costly and is not observed in the market.
- Existing and next generation access will therefore compete and the price and demand for next generation access will be related to the price of copper DSL.
- Infrastructure competition is a spur to investment since investment is expected to help retain customers who would otherwise have switched to rival platforms.
- Investor expectations regarding future regulation and the health of the balance sheet have a powerful impact on willingness to invest.

Analysis of the investment decision and the potential impact of policy on the investment decision should therefore have regard to the above considerations. Quantitative modelling should also be informed by the results of qualitative reasoning, which provides a guide to modelling and what might constitute reasonable outputs.

The above issues have been brought into sharp focus by the results of modelling by WIK Consult that claim to show that a reduction in the price of copper would promote fibre investment. On examination we find that the WIK Consult approach treats copper and fibre as independent (rationalised based on a view that instantaneous switchover is feasible and optimal) and neglects consideration of investor expectations. The following table contrasts the WIK consult approach with commercial reality.

WIK Consult modelling	Market reality
Consider FTTH only, not FTTC	Both FTTC and FTTH investment
Parallel running of copper & fibre ruled out	Sustained parallel running (selective copper 'retirement' with FTTH)
Therefore fibre price & demand independent of copper price	Copper price & fibre price/demand linkage
Platform competition has almost no impact on copper return ('over time' customer loss not modelled)	Platform competition impacts on copper – incentive to invest

WIK Consult modelling	Market reality
Impact of methodology change to lower copper price on investor expectations not considered	Investor expectations critical

In conclusion, a number of considerations that should be considered are not captured or reflected in the WIK Consult approach. Therefore the model is uninformative regarding the approach to copper pricing consistent with efficient investment and/or achievement of the Digital Agenda goals for high speed broadband.

1 What is required to reflect market reality?

A number of sources can provide information on the transition to next generation access; including observation of investment across and within countries, consideration of evolving technology choices and discussion with management of firms and with equity investors. All of these point to a number of factors that need to be reflected in the analysis/modelling of copper-fibre transition:

- A technology mix is optimal. In particular, fibre to the home (FTTH) and/or fibre to the cabinet (FTTC) investment may be appropriate in different circumstances. Existing line lengths, customer density, duct availability etc. determine the optimal mix.[1]
- Dual running of copper and fibre is to be expected for an extended period with FTTH and for the foreseeable future with FTTC. In the case of FTTH legacy copper switch off is far from straightforward given the range of services supported by copper and customer migration issues, and a sustained period of dual running should be anticipated.[2]
- Infrastructure competition is an important driver of investment since investment in next generation access may help stem a loss of customers to rival platforms.
- Policy and regulation is an important factor in the investment decision and operates via a number channels:
  - Investor confidence in future regulatory conduct (a function of legal certainty and experience). If there is an expectation of a risk of denial of cost recovery in future then investment in long lived assets will be deterred. Past conduct is an important signal in the formation of such expectations.
  - Anticipated free cash flow as well as the net present value of future returns may influence investment. The reason for this is that free cash flow relative to debt can impact on the cost of debt and the reduction/deferral of discretionary investment is a means of maintaining investor returns.
  - The anticipated volume and price of fibre is related to the price of legacy copper broadband access since current and next generation access are partial substitutes in the market (and the rapid phase out of legacy services would be too costly/risky).
  - Given demand uncertainty and a lack of good information regarding customer willingness to pay for next generation access the opportunity to experiment with price points and to differentiate service quality and prices is important to the business case.

The above points should inform qualitative analysis, and to the extent possible be factored into quantitative analysis, of the linkage between policy and fibre investment. Any analysis cannot hope to capture the full complexity of commercial and regulatory factors influencing investment, but it needs to capture the key factors in a transparent way.

[1] The relative business case for FTTC has improved with the commercial availability of vectoring technology which supports higher speeds and greater consistency over copper lines. For example, Telekom Austria has announced plans to deploy vectoring. Further, the deployment of FTTC is compatible with offering fibre to the premise on an on demand basis (see BT, 3 February 2012, "BT holds successful trial of "FTTP on demand" and sets timeframe for doubling of FTTC broadband speeds." http://www.btplc.com/News/Articles/Showarticle.cfm?ArticleID=14863CF1-DD70-4D79-83F8-2CDA88B3E51B

[2] The experience of Verizon in the US who starting deploying FTTH in the US in 2006, and are free to retire copper, illustrates the range of opportunities for savings, but also the time required. Savings have been achieved by letting copper 'lie fallow' (i.e. not maintaining lines where FTTH is adopted), the closure of the first exchange in Texas in late 2011 (FTTH take-up was over 50%) and recent plans to selectively migrate customers whose copper line fault rates are high.

2 What does the literature tell us?

There is a large academic literature on investment and regulation in relation to telecommunications. However, there is only a limited and recent literature that addresses the problem of transition and the impact of regulation of existing and next generation access during a period of co-existence. The following provides an overview of published studies:

- A WIK study[3] considers copper and fibre (FTTH only) investment decisions as independent, for example examining the impact of varying the price of copper whilst holding the price of fibre constant. The modelling includes analysis of platform competition on the supply side but does not consider the interaction between current generation copper and next generation fibre prices. Dynamic issues in relation to investor confidence are not considered. A more recent WIK submission[4] to the European Commission draws on the previous study and responds to questions raised by the Commission.
- A Plum study[5] considers FTTH and FTTC investment decisions and includes a linkage between copper and fibre pricing. Investor expectations are considered via variations in the hurdle rate (WACC plus mark-up). The modelling allows for platform competition via assumptions regarding customer loss with and without next generation access investment and in the presence of weak or strong platform competition (it does not however model the interaction between copper-fibre pricing and alternative platform shares).
- Cave *et al*[6] 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*."[7]
- Frontier Economics[8] consider distinguishing replicable from non-replicable assets in setting access prices. Frontier Economics do not focus the impact of such a distinction on incentives to invest. However, Frontier note that:*"...setting prices to only reflect forward looking costs, if leading to an implicit writing off of the remaining value of past investments, would set a precedent*

[3] WIK Consult. April 2011. "Wholesale pricing, NGA take-up and competition." http://www.ectaportal.com/en/upload/WIK/WIK%202011%20-%20Wholesale%20pricing%20NGA%20take-up%20and%20competition%20-%20Final_Report_2011_04_07.pdf

[4] WIK Consult. December 2011. "Cost methodologies and pricing schemes to support the transition to NGA." http://ectaportal.com/en/upload/File/Reports/WIK_Cost_Methodologies_Final_Report.pdf

[5] Plum. December 2011. "Copper pricing and the fibre transition – escaping a cul-de-sac." http://www.plumconsulting.co.uk/pdfs/Plum_Dec2011_Copper_pricing_and_the_fibre_transition_-_escaping_a_cul-de-sac.pdf

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

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

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

which could discourage future investment." (Page 16). Further, BEREC[9] have questioned both the impact of the proposed approach on cross platform competition and investment and the practicality of the approach noting, in particular, that:

- *"Frontier does not consider the possible impact in terms of cross-platform competition and investment when writing down returns on some assets for fixed broadband access. In particular, overly aggressive reductions in legacy infrastructure asset valuations may harm the investment case for competing infrastructure operators. This would not go along well with the objective of the regulatory framework to promote infrastructure competition where feasible and to be technology neutral." Page 19.*
- *"...an asset class may be considered non-replicable in one case and replicable in another. This may raise difficulties for practical implementation." Page 20.*

- Bourreau *et al*[10] 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.

[99] BEREC. December 2011. "BEREC response to the Commission's Questionnaire on costing methodologies for key wholesale access prices in electronic communications." http://erg.eu.int/doc/berec/bor/bor11_65_costingmeth.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

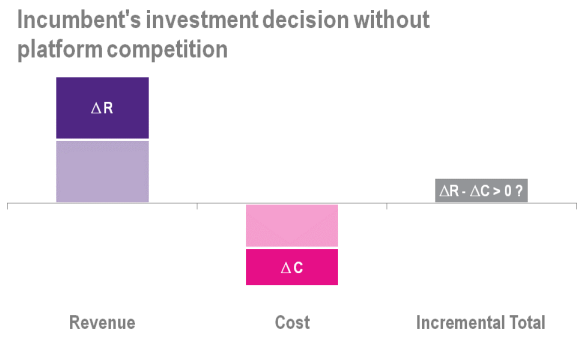
3 What does a simple qualitative assessment tell us?

The advantage of a simple qualitative analysis is that it is transparent and helps establish an intuitive basis on which to build and assess quantitative models that may incorporate multiple effects and feedbacks. A simple qualitative analysis, outlined by Ofcom, is to view consumer willingness to pay for fibre as incremental in relation to copper – or in other words that a chain of substitution exists between current and next generation access.[11]

3.1 Existing copper network operator leaving aside platform competition and investor expectations

In practice platform competition (which will be increasingly intense everywhere as wireless is enhanced) and investor expectations will have a material impact on incentives to invest. However, leaving these considerations to one side in order to set out a hypothetical base case analysis, the price of copper would have no impact on the investment decision of an existing copper network operator since the incremental revenue (and incremental cost of investing) are independent of the copper price. Figure 3-1 illustrates this case of an existing copper network operator with no platform competition.

Figure 3-1



All that matters in this simplified case is the anticipated increase in revenue (ΔR in the figure), not the existing revenue base that 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.

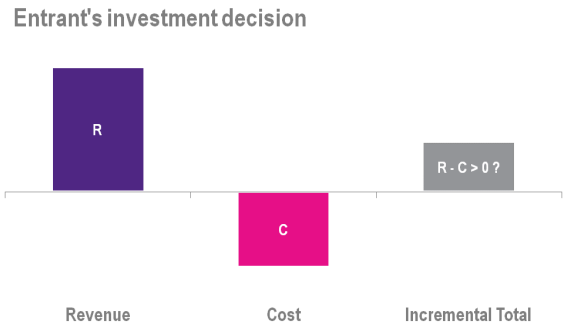
Other cases can also be considered in qualitative terms, in particular the case of an entrant to the market and the case of an incumbent operator facing platform competition (note that the analysis of both of these cases also neglects any potential impact of changes in the price of copper on investor expectations).

[11] Ofcom. March 2009. "Delivering super-fast broadbnand in the UK. "Paragraph A 1.66.
http://stakeholders.ofcom.org.uk/binaries/consultations/nga_future_broadband/statement/statement.pdf

3.2 Entrant or competing platform

The entrant or competing platform case differs from that of an existing network operator as incremental revenue in this case is the copper price plus the next generation access premium i.e. revenue is strongly dependent on the price of copper. Figure 3-2 illustrates this case (with overall revenue R representing incremental revenue since there are no prior revenues to consider).

Figure 3-2

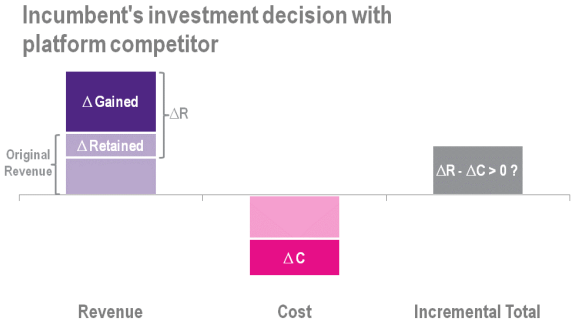


A higher copper price would therefore promote investment by entrants and other platforms, and one would expect to see this in a quantitative model.

3.3 Copper network operator with platform competition

For an existing network operator facing platform competition and the loss of customers to rival platforms a key motivation for investment is to improve service quality (or at least offer the option of higher service quality) in order to retain customers. The value of a retained customer is the entire revenue associated with that customer. Figure 3-3 illustrates the case of an existing copper network operator with platform competition.

Figure 3-3



In this case ΔR also includes the impact of investment on customer retention, which increases the incentive to invest if customers are more valuable i.e. if market prices for copper and fibre are higher.

A partial counterargument is that if prices for current and next generation access were pushed too high that would encourage customer migration to rival platforms. However, the network operator has the option of pricing below any price cap if this was the case and the associated losses outweighed the benefits.

This case has parallels with the entrant or platform competitor case considered previously since incremental revenue from customer retention corresponds to the overall revenue associated with the customer. A higher price of copper would therefore promote investment in this case as retaining a customer is more valuable, making investment to retain the customer more attractive.

4 Appraising the WIK consult quantitative modelling

In this section we take the overall lessons in terms of market investment decision-making, the literature and simple qualitative analysis and use it to appraise the WIK Consult analysis that concluded that significantly lowering the price of copper would promote fibre investment.

4.1 Transparency

In places the WIK Consult modelling analysis is explicit about the assumptions, but a number of the key assumptions and investment channels are not spelt out. Our evaluation is accordingly limited to those areas where the analysis is explicit.

4.2 Technology choice and parallel running of copper and fibre

The WIK analysis focuses solely on the point-to-point FTTH investment. Overall commercially viable investment can therefore be expected to be substantially lower given a choice of FTTH only (as both GPON and FTTC would otherwise have been the most cost effective choice in some circumstances). Further, inclusion of the possibility of FTTC investment would have called into question the underlying assumption that investment involves an either/or between fibre and copper.

4.3 Dynamic considerations

In reality, the copper fibre transition takes place against a counterfactual or base case that is dynamic in terms of the shares of different platforms, involves an extended transition and customer migration and involves a payoff to investment over an extended period of time. In other words it is a dynamic rather than a static decision problem and investor expectations regarding market development and regulatory conduct will play a critical role. It is therefore crucial that the key dynamic considerations are reflected in any analysis used to inform policy.

Whilst the WIK Consult modelling utilises a multi-stage model it does not consider the fact that all of the key variables including willingness to pay, demand for copper and demand for fibre can be expected to change over time both with and without investment. As discussed in the previous sections these dynamic considerations are crucial to investment incentives and to understanding observed investment behaviour.

The dynamics of demand and pricing and the timing of costs and revenues over the life of the investment are critical factors in real world investment decisions. Investor expectations are also critical since at the time of investment it is expected future demand and pricing that determine the commercial viability of any investment. The WIK Consult approach abstracts from these considerations. Focussing on a number of specific aspects the analysis:

- WIK Consult assumes that demand for fibre instantaneously reaches a long-run assumed level of 70%. This results in fibre cost estimates that are significantly lower than they would be if a customer transition to fibre and the discounted value of future versus current revenues were considered.

- WIK Consult assumes that the number of broadband subscribers on copper is static at 70% prior to the investment decision. This neglects consideration of potential customer loss to other platforms over time as a motive for fibre investment to retain customers.
- Copper and fibre do not in general co-exist so the interaction between prices and demand between the two are not considered.
- The impact of changing the price of copper on investor expectations in relation to future fibre pricing is not considered.

We now consider some of the above points in greater detail. However the broader point is that dynamics over time are crucially important.

4.4 Copper-fibre price linkage and customer switching

The WIK Consult analysis considers a number of scenarios in which the access price of fibre is fixed and the price of copper is varied – in other words there is no linkage between the two. For example this is clear from the following that includes a crucial qualification in brackets:

> *"Summing up, what triggers the incumbent's decision to switch from copper to fibre is that fibre becomes more profitable for the incumbent than copper. Since higher copper access charges increase profits from copper but leave fibre profits unaffected (as long as the two services are not offered side by side)." Page 108.*

For a fibre entrant this is clearly unrealistic (other than in areas where there is no pre-existing copper). For the copper network operator under realistic commercial fibre deployments scenarios it is also unrealistic.

The WIK Consult analysis is also clear regarding customer migration incentives, namely that the impact of the access price of copper (aC) versus the price of fibre (aF) is not accounted for in the modelling. The following is clear on this (note that the first part of the quote is referring to switching the network from copper to fibre):

> *"…relatively low levels of aC vs. aF provide incentives for switching from copper to fibre. 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. This conflict is not directly addressed by our competition model." Page 129.*

Taken together the above assumptions naturally lead to a conclusion that a lower price of copper would promote investment. However, this result is a function of the assumptions only, which are unrealistic. More realistic assumptions involving price linkage and considering customer migration incentives could be expected to lead to result showing that a lower price of copper was harmful, or at best neutral under restrictive assumptions, for fibre investment.

4.5 Impact of platform competition

A stated motivation for fibre investment, and one that is consistent in terms of the locations where fibre investment has occurred, is that investment is in part a response (and effort to escape from) platform competition. This is most apparent where cable has been upgraded to offer high speed broadband

and marketed effectively. However, in future wireless LTE with additional spectrum may also substitute for copper DSL and motivate fibre upgrades (either FTTC or FTTH).

The WIK Consult model does not model the evolution of the market over time i.e. it does not consider how shares of different platforms might evolve with and without fibre investment. Instead different "static" equilibriums are modelled. These seem at odds with what one might expect, in particular WIK Consult state that:

> *"…we show that the introduction of cable can have quite asymmetric effects on copper and fibre profits. In this example the profits for copper at an assumed aC = 8.55€ are virtually identical with and without cable. In contrast, profits for fibre are distinctly lower in the presence of cable and increase less sharply in aF." Page 117.*
>
> *"cable only seems to discipline fibre. The reason is that at aC = 8.55€ copper's market share in the model with cable is almost exactly equal to the 70% penetration assumed in the model without cable. As a result profits have to be identical."*

These results should have motivated modification of the model structure and assumptions as they are out of line with reasonable prior assumptions and market evidence.[12]

4.6 Impact on investor expectations

WIK Consult conclude that substantially lowering the price of copper (3.42€ per line per month is one tipping point identified) would motivate fibre investment. Whilst this result is itself flawed given the assumptions of the model, the harmful impact on the investors balance sheet and on investor expectations regarding future fibre prices is not considered.

WIK do however analyse the critical market shares for fibre investment to be viable under different assumptions regarding the weighted average cost of capital (WACC) in Table 5-13 (page 81). Unsurprisingly this analysis shows that an increase in the WACC can make fibre investment unprofitable in higher cost locations (even with the unrealistic immediate fibre penetration assumption of 70%). The linkage between changes in the copper price and investor expectations should have been considered.

4.7 Appraisal of application of the WIK consult model to investment decision making

The modelling approach WIK Consult adopts is based on the literature and modelling in relation to competition assessments involving changes in market share. It has not been applied in a manner fit-for-purpose in relation to the question of how copper and fibre prices might impact on commercial investment decisions. Table 4-1 summarises our conclusions.

[12] The results suggest that the specification in the WIK Consult model of customer preferences in relation to service quality and price between different offers are unrealistic.

Table 4-1: WIK Consult modelling versus market reality

WIK Consult modelling	Market reality
Consider FTTH only, not FTTC	Both FTTC and FTTH investment
Parallel running of copper & fibre ruled out	Sustained parallel running (selective copper 'retirement' with FTTH)
Therefore fibre price & demand independent of copper price	Copper price & fibre price/demand linkage
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In conclusion, a number of considerations that should be considered are not captured or reflected in the WIK Consult approach. Therefore the model is uninformative regarding the approach to copper pricing consistent with efficient investment and/or achievement of the Digital Agenda goals for high speed broadband.