Future evolution of fibre regulation

A report for BT

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Executive Summary

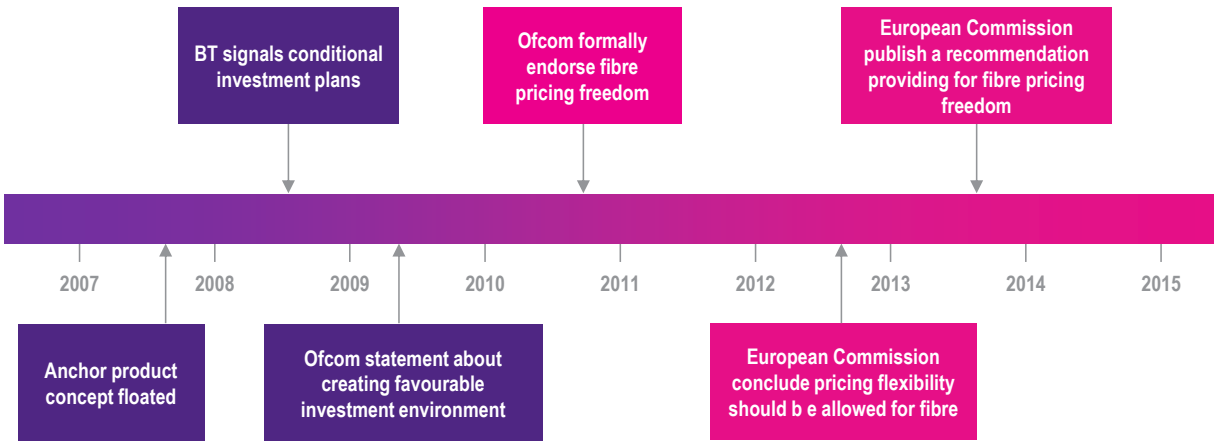
Ofcom consulted on access markets and regulation in July 2013. The possibility that fibre might in future be subject to a cost oriented price control, not during the current review period through to 2017 but potentially from 2017, is raised in the Ofcom consultation: *"…we consider it likely…that at some point in the future it will be appropriate to impose a form of price control on VULA*."

This report considers the development of the current approach to fibre regulation, market outcomes in the UK with fibre pricing flexibility subject to competitive constraints, how supply and demand conditions in the market for broadband access might evolve up to 2017 and beyond, and the choices and trade-offs in terms of future regulatory options.

We find that the decision not to apply a price control to fibre in the UK followed a long and deliberate examination of the costs and benefits of alternative approaches in the period 2007-2010. The decision not to apply a price control rested on a number of considerations including:

- Existing regulatory and market safeguards including an established framework to ensure non-discrimination in the wholesale supply of fibre; and competition from cable and from regulated copper ADSL.
- Recognition of the benefits of pricing flexibility in terms of investment incentives and demand for fibre, and in turn the consumer and competition benefits flowing from fibre investment. It was also recognised by Ofcom that a degree of commitment to the proposed approach was required in order to promote efficient and timely investment.
- Recognition of the complexity and potential unintended consequences of setting a price control for fibre in a new market subject to uncertainty.

In September 2013 the European Commission published new guidance on regulation which provides for fibre pricing freedom subject to non-discrimination requirements and competition from competing platforms and/or from a regulated copper ADSL anchor product. The development of the policy approach is summarised below.



Following the Ofcom decision not to apply a price control to fibre, which was clearly signalled in 2009 and formally decided in 2010, BT began a programme of fibre (mainly fibre to the cabinet) investment with retail products launched in 2010. The stated aim was of passing two thirds of homes by early 2014, making this one of the most rapid fibre investment programmes undertaken in the world.

Take-up has steadily climbed reaching around 10% of homes passed on average by 2013, and a growing number of competing retailers now market fibre services. Upgrades to the fibre product have also been introduced with up to speeds increased from 40 to 80 Mbps, and an "on demand" fibre to the premise extension product introduced. Trials of alternative vectoring technologies are underway which could raise speeds further.

Government funding has also been made available to extend fibre deployment beyond the commercial deployment, potentially to 95% of the UK by 2017. BT has entered into a number of contracts to deploy fibre beyond their planned commercial footprint assuming pricing flexibility remains in place. Were this not the case the extension of fibre would be more limited.

Our examination of supply side developments points to the possibility of an upgrade of cable to DOCSIS 3.1 offering higher speeds and capacity. We anticipate substantial improvements in the coverage, speed and capacity of mobile broadband with LTE and additional spectrum.

On the demand side the rapid and on-going shift to smart wireless devices is changing the market dynamic. It has encouraged development of more bandwidth-efficient services and the development of HEVC compression which is expected to halve the required speed and capacity for a given quality of video. Mobile data is becoming the default form of connectivity that almost all consumers will have, with fixed becoming the incremental add-on.

We conclude from our examination of supply and demand side developments that it is by no means clear cut that copper ADSL will cease to provide a constraint on fibre pricing over time; and that it is probable that mobile LTE will increasingly substitute for fixed, and thus provide an additional constraint.

Turning to future regulation any assessment should consider the costs and benefits of alternative options. The considerations that led Ofcom and the European Commission to adopt, subject to conditions, pricing freedom for fibre are likely to remain legitimate in future.

Further, having announced a policy of pricing freedom for fibre, a return to cost orientation by Ofcom once (some) investment has been made could be expected to harm investor expectations and discourage new investment including maintenance, upgrades and extensions. It would also impact negatively on investor expectations throughout Europe.

If, however, the existing anchor copper product and competing platforms are found to no longer provide a significant competitive constraint on fibre pricing, then an 'upgraded' anchor product on fibre could be adopted, leaving pricing freedom in relation to more advanced service offers.

Alternatively, if a comprehensive price control were adopted, it would reduce flexibility and scope for service-price differentiation, thereby reducing investment and fibre take-up. The analytical exercise involved in setting a future price control taking account of project risk at the time of investment could also be expected to be both complex and subjective.

Given existing checks and balances including non-discrimination, the anticipated development of competitive retailing of fibre and the reasonable expectation that substitution pressures will remain in the medium term, signalling the likelihood of a price control on fibre would not appear warranted.

Signalling that a price control is unlikely to be required and that alternatives exist if concern regarding possible abuse of market power grows would appear more prudent. The new Commission recommendation on costing and non-discrimination provides Ofcom with a basis for providing such clarity.

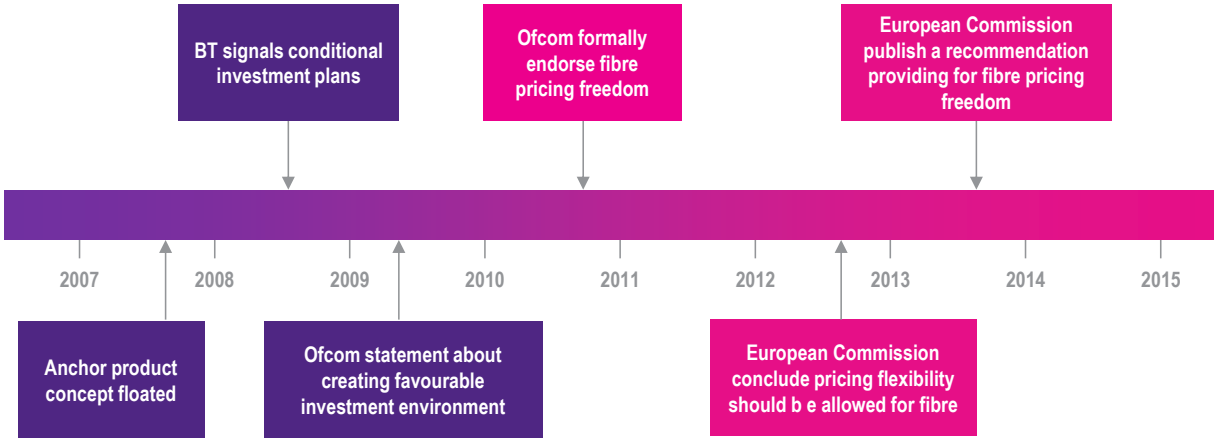
1 Development of fibre pricing freedom

Pricing flexibility in relation to fibre was adopted by Ofcom in 2010, alongside non-discrimination requirements. Adoption of the policy followed prolonged analysis and consultation from 2007-2010 on alternative approaches to regulating fibre.

Subsequently, and following extensive analysis and debate about the appropriate regulatory framework for fibre, the European Commission published a recommendation proposing pricing flexibility subject to non-discrimination and competitive pressure from legacy broadband and/or competing platforms.

We first set out these historical roots, summarised in Figure 1-1, of the current approach as these should provide a touchstone against which any future change should be assessed.

Figure 1-1: UK and EC development of regulatory policy in relation to fibre pricing



1.1 Conceptual roots 2007-2010

1.1.1 Pricing flexibility and non-discrimination

The eventual decision to not apply cost orientation to fibre had two conceptual roots:

- Adoption of the equivalence principle and the creation of Openreach in 2006, which increased the credibility of a non-discrimination commitment.
- Recognition of the anchor product principle, whereby a basic regulated broadband product acts as a constraint on the pricing of more advanced products via a chain of substitution.[1]

Ofcom first set out the concept of anchor product regulation in September 2007 stating (Paragraph 1.10) that:[2]

[1] The anchor product concept was first floated in March 2007. Brian Williamson. March 2007. "Risk, reward and efficient investment in access networks." http://www.cullen-international.com/cullen/telecom/europe/flashet/2007/nga/risk_reward_and_efficient_investment_in_nga_march-2007.pdf

[2] Ofcom. September 2007. "Future broadband - Policy approach to next generation access." http://stakeholders.ofcom.org.uk/binaries/consultations/nga/summary/future_broadband_nga.pdf

"We are proposing to achieve the conditions for this investment by adapting the existing principles of contestability, innovation and equivalence that we have used for the regulation of current generation broadband. In addition we think that two further principles will be necessary as we move to next generation access, to reflect the commercial risks and different characteristics of these investments compared to existing access networks, which are largely sunk cost investments…

- *reflecting risk in returns: we recognise that anyone who makes investments in next generation access is likely to face significant commercial risks. Regulation should reflect these risks in order to provide appropriate incentives for investment in the first place. We are consulting on a range of approaches to reflect such risk such as anchor product regulation, and risk-adjusted returns; and*
- *regulatory certainty: It is also important that the regulatory regime we adopt is clear and in place for a reasonable period of time, to allow investors the clarity that they need to invest with confidence. We are publishing this consultation and establishing a program of seminars and meetings supporting it to provide this clarity."*

The importance of price flexibility to efficient investment was emphasised in paragraph A7.18 of the Ofcom consultation:

"Anchor products provide a high degree of flexibility for investors in new access networks, allowing the option to secure higher returns for new or higher performance services. This flexibility also provides operators with an ability to experiment with service offerings and tailor them to end customer needs. Such price differentiation is also welfare enhancing. Price differentiation…could in turn allow investments to take place that would, with a single price, not be possible. This is unlikely to be possible under a flat rate pricing system (such as cost based pricing)."

In a September 2008 consultation Ofcom noted the need for commitment over time, pricing flexibility and the risks inherent in imposing a fibre price control given the level of uncertainty involved (emphasis added):[3]

- *"Despite the likely change in risk over time, it is important for Ofcom to **commit** to consistent pricing approaches and indicate their likely duration in order to provide as much clarity as possible on our view of appropriate returns and hence ease of investment decisions." (Paragraph 7.12)*
- *"Where demand is **uncertain**, forecasting future revenues becomes more difficult and this increases the risk of setting prices too low or too high. If we were to set prices too low, we risk stifling efficient investment. Conversely, if we were to set prices too high, we risk stifling consumer demand." (Paragraph 7.13)*
- *"The **regulatory costs and risks** involved in setting prices under these conditions suggests that it is might not appropriate to set prices across all wholesale products. This suggests there can be benefits in approaches where the market sets prices, especially in the earlier stages of market development when there is substantial uncertainty on demand. This also allows a degree of flexibility in price setting." (Paragraph 7.14)*

In effect the decision over how to regulate fibre was assessed by weighing up the costs and benefits of alternative approaches, rather than relying on a mechanical application of a full set of *ex ante*

[3] Ofcom. September 2008. "Delivering super-fast broadband in the UK - Setting the right policy framework." http://stakeholders.ofcom.org.uk/binaries/consultations/nga_future_broadband/summary/main.pdf

remedies (all to be applied or not) based on an assessment of significant market power (SMP). The September 2008 consultation also set out Ofcom's preference for the anchor product approach (Figure 1-2, from Ofcom paragraph 71.8).

Figure 1-2: Ofcom preference for anchor product approach (2008)

"Anchor product pricing is an alternative approach to setting mandated prices or allowing the network operator complete freedom to set all prices. The approach involves specifying one or more wholesale products for which the price would be set by Ofcom – the anchor. Prices of other, non-anchor products could be set freely by the asset owner."

"Anchor product pricing has the advantage of creating incentives for efficient investment (by allowing higher prices on higher bandwidth products) while ensuring that consumers of products currently available today are not adversely affected."

"We consider that of the options outlined, the anchor product pricing approach has significant advantages. Where feasible, is likely to be the most efficient pricing approach for risky next generation access products. Its main advantages are:

- *it provides incentives to invest by allowing higher returns on new products (likely to be higher speed broadband);*
- *it minimises the risk of detriment by ensuring that products equivalent to those available today are offered at equivalent prices;*
- *the ability to charge excessive prices is limited because the anchor product's price constrains the prices of all other products offered;*
- *it allows flexibility in pricing, enabling investors to trial different price points and change price to maximise take-up; and*
- *it carries less regulatory cost and risk compared with the option where the regulator sets the absolute prices."*

1.1.2 BT signal fibre investment intent and Ofcom respond

In July 2008 BT announced plans to invest £1.5 billion bringing fibre (a mix of FTTH and FTTC) to 40% of UK households or 10 million homes by 2012, but conditional on Ofcom nurturing a "supportive and enduring regulatory environment".[4]

In Mach 2009 Ofcom issued a statement signalling their intent to create a regulatory framework favourable for investment.[5] In statements issued the same day Ed Richards (CEO Ofcom) and Ian Livingston (CEO BT) set out their positions: see Figure 1-3.[6]

[4] http://news.bbc.co.uk/1/hi/business/7506742.stm

[5] Ofcom. March 2009. "Delivering super-fast broadband in the UK - Promoting investment and competition." http://stakeholders.ofcom.org.uk/binaries/consultations/nga_future_broadband/statement/statement.pdf

[6] http://news.bbc.co.uk/1/hi/technology/7919904.stm

Figure 1-3: Reported comments by Ed Richards and Ian Livingston

Mr Richards said that the wholesale pricing would be considerably more flexible than current wholesale products and that its hands-off approach reflected that it was dealing with a new BT.

"This is not the BT of old milking a copper network put in years ago. This is a risky investment for it" he said.

BT chief executive Ian Livingston welcomed the move, saying it "set expectations for the whole UK industry as the market evolves into a fibre-based world".

"Today's announcement gives us the green light to push ahead with our £1.5bn superfast broadband investment plans to reach at least 40 per cent of UK households by 2012," Mr Livingston said in a statement.

The purpose of the Ofcom statement and statements by the respective CEOs was to set the scene for BT to invest in fibre ahead of a formal statement of the detailed regulatory position in 2010.

Ed Richards further set out the approach at the June 2009 ECTA regulatory conference, linking pricing freedom to assurance of non-discrimination and emphasising the need for a long-term framework:[7]

> *"One of the reasons we can contemplate certain forms of pricing freedom is precisely because functional separation gives us a guarantee of fair access to monopoly infrastructure."*
>
> *"Deployment of next generation technologies is a long-term strategy. It needs a regulatory system which is transparent, predictable, sustainable and fair for all categories of investor, in both the short and the long term."*

1.2 Formal fibre pricing flexibility in the UK (2010)

Following a consultation in March 2010 Ofcom issued a statement in September 2010 which formally endorsed fibre pricing freedom:[8]

> *"We have decided not to regulate the prices of the product(s) that BT provides under its VULA obligation. We consider that this approach will give BT the flexibility to price its VULA services according to emerging information on the demand for, and supply costs of, NGA services. At the same time, the prices of these services will be constrained by the availability of current generation broadband services and by competition from services provided over cable TV network infrastructure." (Paragraph 1.27)*

1.3 Fibre pricing flexibility in Europe (2013)

The European Commission engaged in extensive analysis and consultation, concluding that pricing flexibility (subject to conditions) should be allowed for fibre in July 2012:[9]

> *"When the right conditions are imposed by regulators (equivalence of input obligation, replicability test), and where there is a significant competitive constraint (from operators with*

[7] http://media.ofcom.org.uk/2009/06/25/ecta-conference-fibre-investment-for-europes-recovery/

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

[9] European Commission. 12 July 2012. "Enhancing the broadband investment environment – policy statement by Vice President Kroes." http://europa.eu/rapid/press-release_MEMO-12-554_en.htm

cost-oriented access to the copper network in accordance with Commission guidance; or from other infrastructure-based competitors such as cable or LTE."

Subsequently, after further discussion of the proposals with stakeholders, the Commission published a recommendation on costing and non-discrimination on 11 September 2013. This recommendation provided for fibre pricing freedom subject to non-discrimination requirements and anchor product and/or platform competition.[10]

The accompanying communication on the Telecommunications Single Market stated that:[11]

"More consistent and predictable regulation and a more stable regulatory environment can be reached by (1) further harmonising the costs that incumbents may charge for giving others access to their copper networks; and (2) ensuring that "access seekers" have truly equivalent access to networks. Where such competitive constraints and non-discrimination are ensured, the prices for "next generation" products would be determined by the market rather than being regulated; while the prices for access to copper networks would remain broadly stable, and would not artificially undercut those for the networks of the future."

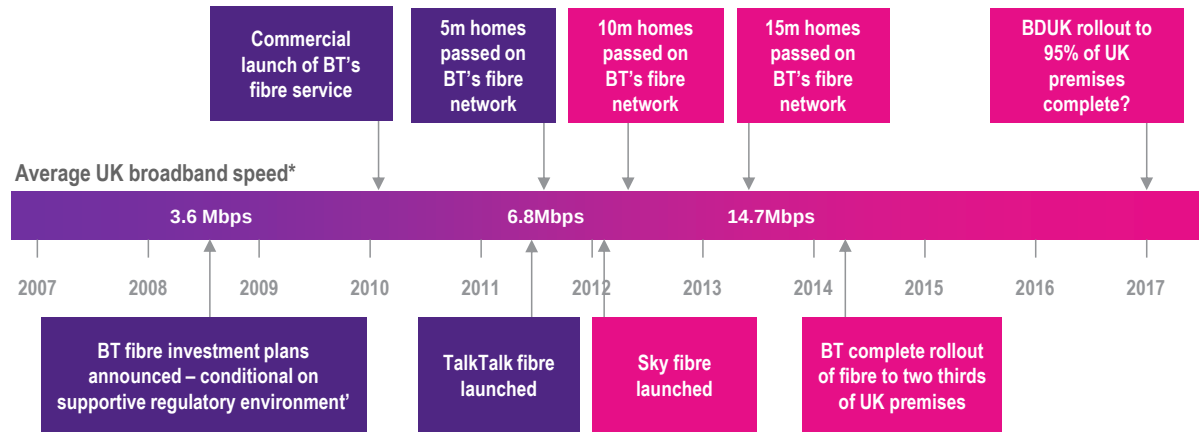
[10] European Commission. 11 September 2013. "Commission recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment - C(2013) 5761." https://ec.europa.eu/digital-agenda/en/news/commission-recommendation-consistent-non-discrimination-obligations-and-costing-methodologies

[11] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0634:FIN:EN:PDF

2 Pricing freedom has seen rapid fibre deployment and good market outcomes

Figure 2-1 summarises developments in the UK market following the decision by Ofcom to allow fibre pricing freedom.

Figure 2-1: Market development



*Average actual UK fixed-line residential broadband speeds, Ofcom 2013

The UK market has seen good outcome in terms of fibre investment following the announcement by Ofcom in 2009 to allow fibre pricing flexibility (confirmed formally in 2010):

- Fibre service was first offered in January 2010 with a target to reach two-thirds of homes (19 million) by the end of spring 2014. Take-up is growing and averages 10% of premises passed.
- On-going innovation, with VDSL peak speeds doubling from 40 to 80 Mbps and the availability of an on-demand fibre to the premise extension product from street cabinets.
- Competitive retailing - in February 2012, there were 53 CPs selling or trialling fibre services using Openreach's super-fast fibre access product to offer their own fibre services.
- Rising average connection speeds - doubling in the past two years across urban, sub-urban and rural areas.
- Internet use which exceeds the average in the EU across all age groups and is steadily rising.

2.1 Fibre investment and take-up

In July 2008 BT announced plans to invest £1.5 billion to bring a mix of FTTH and FTTC to 40% of UK households or 10 million homes by 2012 (later increased to £2.5 billion and two-thirds of households), but conditional on Ofcom nurturing a "supportive and enduring regulatory environment".[12]

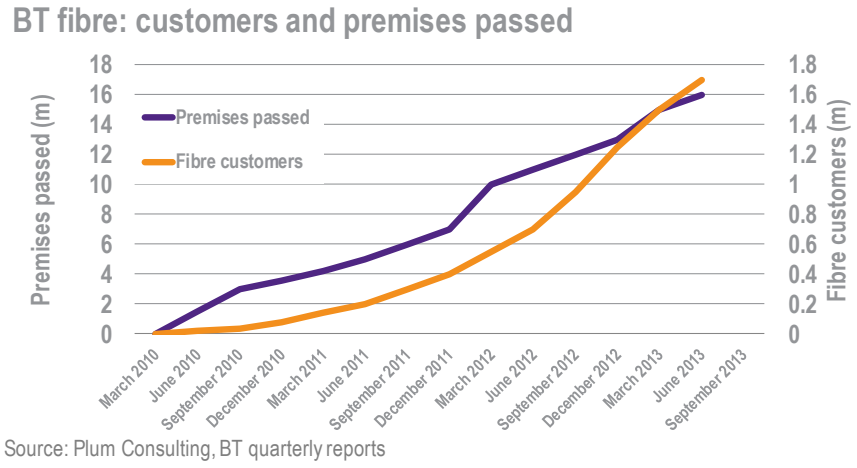
[12] http://news.bbc.co.uk/1/hi/business/7506742.stm

Ofcom released a statement in 2009 proposing "*wholesale pricing flexibility to enable returns appropriate to the considerable risks of building new networks, but constrained by the market in the interests of customers*"[13]

BT announced the commercial launch of its Infinity product (largely based on FTTC architecture) on 25 January 2010. In 2011, BT announced that rollout would be accelerated to reach two-thirds of households by the end of 2014, one year ahead of the original target.[14]

Network roll-out has been rapid, reaching 5 million premises by July 2011, 10 million premises by March 2012 and 15 million by March 2013 (see Figure 2-2, which also shows take-up).

Figure 2-2: BT fibre: premises passed and customers



Source: Plum Consulting, BT quarterly reports

2.2 Retail competition

The BT retail fibre product "Infinity" was the first to market in January 2010. Subsequently other key broadband retailers have launched fibre offerings:

- May 2011 - TalkTalk fibre launched
- January 2012 - Sky fibre launched
- April 2012 – TalkTalk & Sky launch 80 Mbps

As of August 2013 seven ISPs, in addition to BT retail, have launched fibre broadband packages using BT's network including Sky, TalkTalk, Plusnet, EE, John Lewis, Zen and Eclipse.

Sky actively promotes fibre through advertising campaigns and promotions, including bundled offers of fibre and TV. In May 2013 TalkTalk announced that they had added 43,000 fibre customers in H2 vs. 22,000 in H1, taking its fibre customer base to 73,000.[15] TalkTalk actively sell fibre to sub 3Mbps ADSL customers to support TV on demand. A competitive fibre retail market has developed.

[13] Ofcom, March 2009 http://stakeholders.ofcom.org.uk/consultations/nga_future_broadband/statement/

[14] BT. October 2011. http://www.btplc.com/News/Articles/ShowArticle.cfm?ArticleID=D228F2B4-25FC-4095-8EC4-BD17B903CC3B

[15] http://www.talktalkgroup.com/~/media/Files/T/TalkTalk/pdfs/presentations/2013/preliminary-results-presentation-2013.pdf

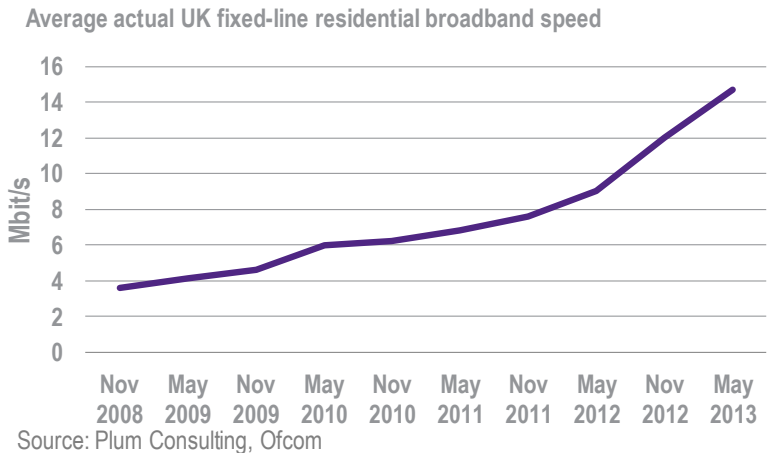
2.3 Broadband speeds

Following the launch of an up to 40 Mbps fibre to the cabinet service in 2010, Openreach announced the launch of a fibre to the premise product in October 2011[16] and doubled the speed of fibre to the cabinet to up to 80 Mbps in March 2012.[17]

From spring 2013, Openreach has started to make 330 Mbps FTTP available "on demand" in FTTC enabled areas. Alongside these developments basic broadband has been steadily upgraded to ADSL2+.

The combination of service upgrades and adoption of fibre has seen actual average broadband speeds in the UK rising at an accelerating rate, as shown in Figure 2-3.

Figure 2-3: Average actual UK fixed-line residential broadband speed



Source: Plum Consulting, Ofcom

The incrase in speeds has been almost uniform across the country with speeds having roughly doubled across urban, sub-urban and rural households over the past 2 years.[18]

2.4 Internet use

Internet use in the UK has steadily risen across all age groups, as illustrated in Figure 2-4. By 2012 80% of those aged 55-64 and 60% of those aged 65-74 used the internet.

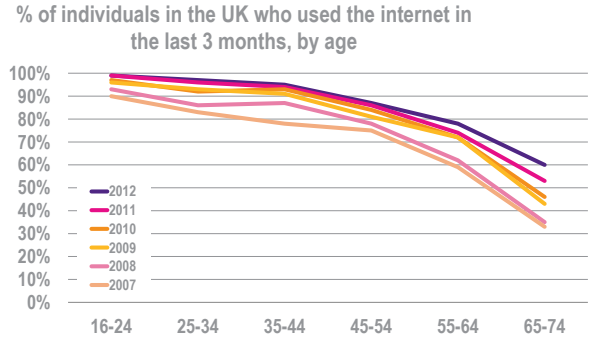
Internet use in the UK exceeds the EU average; with use amongst those 65-74 almost double the EU average, as illustrated in Figure 2-5.

[16] http://www.news-openreach.co.uk/news.aspx?newsid=46

[17] http://www.news-openreach.co.uk/news.aspx?newsid=47

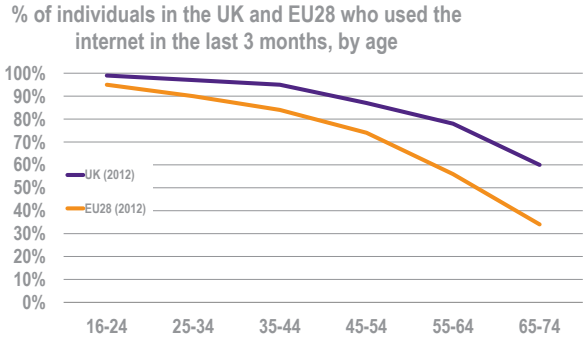
[18] Ofcom. August 2013. "UK fixed-line broadband performance, May 2013." Figure 2.5. http://stakeholders.ofcom.org.uk/binaries/research/broadband-research/may2013/Fixed_bb_speeds_May_2013.pdf

Figure 2-4



Source: Plum Consulting, Eurostat

Figure 2-5



Source: Plum Consulting, Eurostat

Rising internet use reflects a number of factors, including availability, affordability and competitive marketing of a range of broadband services. It is an indicator of a healthy market.

3 Future market development

ADSL, alongside cable in cable areas, is considered to impose sufficient constraints on fibre pricing to prevent excessive pricing. An important question is how the market will develop over the next 3-6 years (i.e. over the next two market review periods) and whether (and to what extent) the constraints on fibre pricing might weaken. A related question is whether wireless will in future exert greater constraints than at present.

3.1 Ofcom view

Ofcom state that they consider that during the current review period to 2017 wireless and fixed will remain in separate markets whilst current and next generation fixed broadband will remain the same market:

> *"Although uptake has been increasing and a move to 4G will increase the speeds available, following the latest round of spectrum auctions, we consider that this is unlikely to significantly affect the demand for broadband via fixed line access within the time horizon of this review because it is unclear when these services will be available to – and adopted by – a significant proportion of UK customers. Even if this were to occur within the period of this review, the expected continued deployment of superfast broadband means it is not clear that the material difference in broadband speeds between fixed and mobile would significantly narrow."* *Paragraph 3.34*[19]

> *"On balance, the evidence suggests that it is appropriate to define a single market for broadband services at all speeds. We acknowledge that there are factors pointing to a separate market emerging at the retail level for fibre-based products at some point in the future. However, we consider that there is not sufficient evidence to conclude that this is likely to occur during the three-year forward look period of this market review. Therefore, on balance, we are proposing to define a single retail product market including both fibre- and copper-based products. This is consistent with the NGA Recommendation, which states that WBA over VDSL should be considered a chain substitute to existing WBA over copper loops."* *Paragraph 3.52*[20]

3.2 Our assessment

In Appendix A we consider supply and demand side changes that may impact upon substitution between current and next generation broadband; and between mobile and fixed broadband.

- On the **supply side** we conclude that the move from 3G to 4G, coupled with additional spectrum, will increase the speed, capacity and coverage of mobile broadband and significantly reduce the unit costs of carrying data. This shift is likely to substantially change the competitive pressure of wireless on fixed broadband, and to shift the primary difference between mobile and fixed

[19] Ofcom. 3 July 2013. "Fixed access market reviews. http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/summary/fixed-access-markets.pdf

[20] Ofcom. 11 July 2013. "Review of the wholesale broadband access markets." http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/summary/WBA_July_2013.pdf

services from speed to capacity. We also conclude that the likely upgrade of cable to DOCSIS 3.1 will significantly increase the speed (particularly the upload speed) and capacity of cable.

- On the **demand side** we conclude that it is by no means inevitable that demand and willingness to pay for bandwidth (both speed and capacity) will increase. The global market is shifting decisively towards mobile devices - tablets and smartphones; and wireless broadband connections (from a negligible share of primary use broadband connections to over 80% by 2018). Accompanying this shift will be associated changes which reduce requirements for speed and/or capacity:
  - Increased use of smaller screens which require lower speeds/less capacity.
  - A step change in compression to HEVC which will halve video data/speed requirements.
  - Growth in streaming - which reduces demand for high speeds to minimise download times.
  - Smart devices will manage downloads making optimal use of available connectivity and scheduling them in anticipation of user needs, thereby minimising peak speed requirements.

The above demand side developments will increase substitution both between current and next generation fixed broadband (by reducing the incremental value of increased speed), and between mobile and fixed (by reducing the incremental value of increased capacity and speed).

Ofcom argue that substitution between mobile and fixed may not increase because *"…it is not clear that the material difference in broadband speeds between fixed and mobile would significantly narrow."* However even were the speed difference to remain as speeds for mobile and fixed rise, the incremental value of the difference will decrease if willingness to pay for speed increments is subject to diminishing returns.

The fact that mobile broadband access will be near universal in future (reflecting smartphone adoption), will be sharable (via Wi-Fi tethering and/or shared data plans) means that mobile will represent the baseline from which the need for fixed access will be assessed by consumers. Those taking fixed service will need to be convinced that the incremental benefits exceed the costs (considering both line and broadband charges).

3.3 Market review versus choice of regulation – burden of proof

Allowing fibre pricing freedom subject to an anchor product discipline and a non-discrimination requirement is in essence a cost benefit judgement. The approach was judged by Ofcom to be superior to full cost orientation or no *ex ante* regulation after weighing up the costs and benefits of the alternatives.[21]

The standard or burden of proof in deciding whether to continue with the status quo approach in future can, and arguably should, differ from that applied in deciding the scope of relevant markets. Current generation fixed broadband and mobile broadband may constrain fibre pricing sufficiently for pricing flexibility to be the preferred regulatory approach, once account is taken of other factors including the costs and risks involved in price regulation of fibre and commercial incentives to grow the fibre broadband market. In the next section we consider this broader assessment of future options.

[21] This approach, whereby the costs and benefits of different regulatory options are considered, is the formal position in relation to airport regulation where a test which combines the telecoms 'three criteria' test and adds a cost benefit criteria. Civil Aviation Act 2012. http://www.legislation.gov.uk/ukpga/2012/19/section/6/enacted

4 Future policy development

In this section we consider three questions:

- Should regulation change if market circumstances change?
- What costs and benefits should be assessed in deciding whether regulation should change?
- How might regulation change in response to a change in market circumstances?

4.1 Should regulation change if market circumstances change?

Superficially the answer appears obvious – if market circumstances change in a way that alters the balance of costs and benefits of alternative regulatory approaches then regulation should change. However, adapting to changed circumstances is not always efficient, particularly when the scope for changes in future policy can impact expectations and investment decisions today.

Contracts and other commitments are made meaningful by agreement not to change course, or to only change course in agreed circumstances. An example is inflation targeting monetary policy regimes, where governments and central banks commit themselves to maintain low inflation even if it were in their interests to inflate the economy in future.

The value of commitment has long been recognised, as illustrated by the story of Odysseus and the Sirens. The essence of the problem is how to pre-commit so that expectations are not shaped by the anticipated response to future temptation (lowering prices in a regulatory context).

Formally, Kydland and Prescott showed in their classic 1977 paper that:[22]

> *"Even if there is an agreed-upon, fixed social objective function and policymakers know the timing and magnitude of the effects of their actions, discretionary policy, namely, the selection of that decision which is best, given the current situation and correct evaluation of the end-of-period position, does not result in the social objective function being maximized."*

In a commercial context commitment problems, where the return on an investment in physical, human or intellectual property depends on the actions of another party, may be addressed via common ownership or contract.

Whilst Ofcom (3 July 2013) may not be able to formally fetter their discretion they acknowledge the value of commitment in promoting investment (and commitment can only be meaningful if one chooses not to change one's mind if in future it becomes opportune to do so):

> *"…the majority of BT's commercial investment in its fibre network is likely to be complete by the start of the review period. Nonetheless…this investment was made in the light of the regulatory position previously set out by Ofcom. Adopting a consistent and predictable regulatory approach is important…" Paragraph 11.139*

Ofcom's Chief Economist Peter Culham introduced the concept of *"'Dynamically efficient value'"* which *"depends on what is required to avoid expropriation of assets"* in relation to access pricing – a concept

[22] Kydland and Prescott. "Rules rather than discretion: the inconsistency of optimal plans." *The Journal of Political Economy,* Volume 85(3). http://www.sfu.ca/~kkasa/prescott_77.pdf

that recognises the central importance of commitment.[23] Nonetheless Ofcom also say in the July 2013 consultation that:

> *"…we consider it likely…that at some point in the future it will be appropriate to impose a form of price control on VULA. We recognise that BT's expectations of any such future restrictions will affect its investment incentives today." Paragraph 11.144*

Finally we note that the EC regulation on costing and non-discrimination sets out a framework to promote copper price stability over the medium term (i.e. beyond the duration of a single review):[24]

> *"Once NRAs have finalised the recommended costing methodology, they should consider maintaining it, in application of Article 8 (5) (a) of Directive 2002/21/EC in order to promote regulatory predictability by ensuring stable access prices over at least two appropriate review periods, provided they maintain a price control obligation throughout this period."*

Given that the counterpart of copper price stability in promoting efficient investment is fibre pricing flexibility a similar commitment should apply.

We now consider whether it will be appropriate to impose a price control on fibre in the future and the costs and benefits that should be assessed in coming to a view on this in future.

4.2 What costs and benefits should be taken into account?

The question are seeking to answer is what considerations should be taken into account in deciding how to regulate fibre in future and what change in circumstance might trigger a price control.

4.2.1 Maintaining credible commitment

We first note that outcomes, and outcomes under alternative forms of regulation, should be assessed; and that a key outcome for consumers will be the availability of high speed broadband. As discussed above, credible commitment to not impose a price control on fibre is likely to be key to achieving this outcome – both in the UK and in the rest of Europe.

Investment can also be expected to be on-going with BT and others investing:

- Infilling existing coverage areas with additional cabinets where consumer demand for higher speeds justifies bringing fibre closer to the home either via additional cabinets, vectoring of VDSL, G.Fast (a more advanced form of vectoring) and the extension of fibre to the premise.
- Extending fibre beyond what is commercially attractive with funding support. The government through BDUK is seeking to extend fibre to 95% of the UK by 2017. Where BT has been successful in tendering for funds to extend fibre it has done so on contractual terms on the assumption that the regulatory status quo continues. Were this not the case the extension of fibre would be more limited.

[23] Peter Culham. 28 November 2012. "Pricing Access Networks in the Transition to NGA - Promoting Efficient Investment." ECTA Conference.

[24] European Commission. 12 September 2013. "Commission recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment - C(2013) 5761." Paragraph 46. https://ec.europa.eu/digital-agenda/en/news/commission-recommendation-consistent-non-discrimination-obligations-and-costing-methodologies

- Upgrading cable and wireless network capability.
- On-going investment in all networks to maintain service levels.

The Ofcom argument that "…*the majority of BT's commercial investment in its fibre network is likely to be complete by the start of the review period"* provides an overly narrow perspective on investment, but also points to an approach which undervalues commitment.

Not only might this deter investment in the UK, but from a European perspective investor expectations and sentiment might also be adversely impacted if Ofcom were to abandon fibre pricing flexibility partly on grounds that "*the majority of BT's commercial investment in its fibre network is likely to be complete…"* This could be particularly harmful in countries and regions where fibre investment is less advanced than in the UK.

Now that the EC recommendation on costing and non-discrimination has come into force Ofcom may have greater scope to commit to the existing policy approach and send a positive signal to the market.

4.2.2 Fostering a competitive high speed broadband marketplace

Initially BT was the only operator retailing fibre, but this situation has changed with many competitive retailers' trialling or selling fibre including two of the largest competing retailers TalkTalk and Sky. Ofcom note in relation to the development of a competitive retail market that:[25]

> *"…in the future other CPs may have had an opportunity to build up a reasonable base of superfast broadband subscribers on BT's network such that regulatory intervention may not be necessary."*

Further Ofcom note that:[26]

> *"…prices for SFBB [superfast broadband] are likely to remain low in order to make it attractive for the large number of consumers still on CGA to migrate to SFBB. To the extent that the prices for SFBB could increase because the premium some consumers are willing to pay for SFBB rises, it is not clear that this means we should define a separate market. Charging a premium for SFBB is consistent with a chain of substitution, even though historically some providers have not done so."*

Ofcom therefore recognise that market development may create a virtuous circle with competitive retailers and service-price differentiation maximising growth in the fibre market. Furthermore, a competitive market for provision of high speed broadband will spur investment by all broadband platforms including fibre, cable and wireless; and terrestrial and satellite TV broadcast platforms.

Moreover, the absence of a price control can be expected to encourage non-discrimination since it shifts the relative balance between the upstream and downstream profitability: "*the incentive to*

[25] Ofcom. 3 July 2013. "Fixed access market reviews". Paragraph 11.364.
http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/summary/fixed-access-markets.pdf

[26] Ofcom. 11 July 2013. "Review of the wholesale broadband access markets." Paragraph 3.51.
http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/summary/WBA_July_2013.pdf

discriminate is decreasing in the level of the access charge…"[27] Ofcom have also recognised that cost orientation can reduce incentives for voluntary non-discrimination:[28]

> *"With cost orientation at wholesale level, incentive to leverage is greater than if wholesale prices are unregulated"*

Whilst a non-discrimination requirement is part of the undertakings agreed by BT, outcomes where it is in the interests of the network investor to promote efficient retail competition can be expected to be superior.

4.2.3 Taking full account of competitive pressures in the market

As discussed in Section 3 and Appendix A supply side developments may strengthen the position of wireless relative to fixed, whilst demand side developments may strengthen wireless relative to fixed and current generation broadband relative to next generation broadband:

- Supply side developments include in particular the transition to higher mobile data coverage with sub 1 GHz spectrum and higher speeds and capacity with LTE and additional spectrum.
- Demand side developments include mass adoption of smart mobile devices and connectivity coupled with mobile-focussed applications development.

These developments could intensify competition, and should be comprehensively assessed in terms of the current and prospective impact on substitution:

- New measures and survey questions may be required to reflect new market developments in future assessments, for example, the possibility that smartphones (plus tethering) may substitute for fixed broadband.[29]
- The capacity and speed requirements of different applications should also be reassessed on an on-going basis to take account of shifts in consumer behaviour, for example if video consumption on tablets and smartphones were to become widespread (particularly alongside adoption of HEVC compression). Smart devices which manage "when and how" connectivity is used may also impact on consumer demand and willingness to pay for capacity and speed.

Finally, and crucially, substitution pressures should not be left aside if they do not meet the threshold for market analysis. Rather, the evolution of all competitive forces should be taken into account in deciding what form of intervention is appropriate.

4.2.4 Avoiding the pitfalls of centralised price setting

The potential pitfalls of applying cost orientation to fibre in terms of information requirements and potential unintended consequences have been well recognised by Ofcom, for example:[30]

[27] Weisman and Kang. 2001. "Incentives for Discrimination When Upstream Monopolists Participate in Downstream Markets." *Journal of Regulatory Economics* 20(2): 125-139.

[28] Peter Culham. 28 November 2012. "Pricing Access Networks in the Transition to NGA - Promoting Efficient Investment." ECTA Conference.

[29] Surveys in the US have begun to assess these developments:

http://www.pewinternet.org/Reports/2013/Cell-Internet.aspx

http://www.pewinternet.org/Reports/2013/Broadband.aspx

> *"…there remains uncertainty about future demand for NGA services and the profile by which NGA investment should be recovered. As such, determining the level of charges remains difficult and carries a risk of setting inappropriate price levels that would particularly harm incentives for efficient investment (either expanding the network or improving technology) and BT's ability to experiment with pricing to encourage fibre take up." (para 1.35)*

Pricing flexibility is also important for fibre take-up and digital inclusion – objectives that will persist long after a given tranche of investment is complete. As Ofcom note:

> *"…limits on the structure of prices could also reduce BT's ability to experiment on price in order to increase take-up of NGA services." Ofcom, July 2013 (para 11.138)*

Given the long life of the assets, on-going uncertainty (for example regarding the impact of wireless) and the difficultly of applying cost orientation consistent with efficient service-price differentiation and dynamic pricing over time; the costs and risks associated with imposing a price control can be expected to persist. An assessment of risk at the time of investment would also be called for, consistent with the fair bet principle. The regulatory challenge in applying cost orientation will not necessarily get easier with time.

4.3 How might regulation change in response to a change in market circumstances?

We have argued above that a charge control for fibre may remain unnecessary (given market developments) and undesirable (given the value of commitment and the costs and risks involved in imposing a price control).

If, after carefully assessing the costs and benefits of alternatives to the status quo, it was decided that a more interventionist regulatory approach were required, then there are two basic options previously considered by Ofcom:

- To strengthen the anchor product by moving from reliance on ADSL alone to define an anchor product over fibre.
- To move to cost orientation, but on a basis as consistent as possible with the fair bet principle.

Both of these options have their pitfalls and both place greater reliance on regulatory as opposed to market decisions. The first consideration should therefore remain a proper assessment of the costs and benefits of alternative approaches against the status quo.

4.3.1 Consideration of sub-markets

In principle there may be sound arguments for differentiating regulation on the basis of geography and the presence of competing platforms.

A geographically segmented approach to regulation is familiar, and could apply in relation to any proposed increase in *ex ante* regulation of fibre. In particular, where cable is present this may provide

[30] Ofcom. 3 July 2013. "Fixed access market reviews". http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/summary/fixed-access-markets.pdf

a strong competitive constraint even were the constraint from regulated ADSL on fibre pricing to diminish over time.

The need for further regulation should therefore at a minimum be assessed within and outside cable areas (and whilst cable covers around 50% of households it will cover close to 75% of households where fibre is deployed commercially).

4.3.2 Virtual anchor product defined over fibre

Where cable is absent, and if the copper ADSL anchor product and LTE do not impose a sufficient constraint on fibre pricing, then an alternative to moving to full cost orientation for fibre would be to adopt a virtual anchor product over fibre. This would leave pricing freedom in relation to other service levels offered over fibre – in effect upgrading the anchor product in line with market developments.

The possibility of a virtual anchor product over fibre was explored early on by Ofcom, but the focus shifted to ADSL as the anchor product when it became clear that investment would primarily be in fibre to the cabinet and that copper and fibre service would be offered in parallel i.e. copper lines would not be retired in the near term.

The possibility of a virtual anchor product is also suggested by the European Commission:[31]

> *"If the product offered by the SMP operator on the legacy access network is no longer able to exercise a demonstrable retail price constraint on the NGA product (for example in the event of a copper switch-off), it could in principle be replaced by an NGA-based product that is tailored to have the same product features. However, it is not envisaged that such an NGA-based anchor will be required in the immediate future or before 2020."*

The timescale above also implies that the European Commission consider it likely that a copper anchor product is likely to provide demonstrable retail price constraint on fibre out to at least 2020.

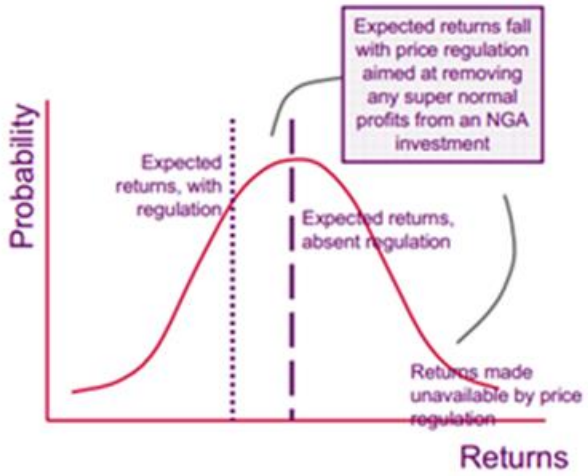
If a virtual anchor product were adopted it would be important to specify a price and service level which provided retail price constraint on fibre but also left scope for other service levels and price points.

4.3.3 Price control intended to respect fair bet principle

The principle of the fair bet has been set out clearly by Ofcom. The underlying problem is that, in advance, costs and revenues (which depend on demand and price) are uncertain. To offset this risk, regulated prices need to be high enough to generate expected returns equal to the weighted average cost of capital (WACC) i.e. "excess" returns in successful outcomes offset the risk of losses with less favourable outcomes. Ofcom have illustrated the problem, as shown in Figure 4-1.

[31] European Commission. 11 September 2013. Paragraph 56. https://ec.europa.eu/digital-agenda/en/news/commission-recommendation-consistent-non-discrimination-obligations-and-costing-methodologies

Figure 4-1: Illustration of fair bet problem



Ofcom analysis of the "fair bet" investment problem[32] – the risk that investors bear the downside but do not reap the upside of uncertain investment - also points to commitment not to apply price controls as one possible remedy:

> *"Another way of allowing a regulated firm a 'fair bet' on the investments that it makes is delaying the introduction on controls on its prices." Paragraph 11.145*

In relation to the fair bet problem the following apply:

- The calculated WACC does not include any allowance for the fair bet (a point which may be misunderstood as the WACC includes a risk related allowance). The reason for this is set out in Figure 4-2.[33]
- For an investment that is marginal (i.e. with expected returns only just above the WACC) there may be no regulated return *ex post* that would not deter investment – since any truncation of upside will reduce the expected return below the investment hurdle rate. A large investment project such as fibre deployment is really a portfolio of investment tranches, with a range of expected returns. An expectation that the returns profile will be truncated can therefore be expected to impact on the nature, pace and particularly the geographical extent of commercially attractive investment.[34]
- The fair bet problem is most unlikely to be a simple one-off with uncertainty resolved at some point in time. As existing uncertainties are resolved so new ones may arise, for example the potential impact of the on-going shift towards wireless smartphone and tablet use on the willingness to pay and hence demand for fibre.

[32] Ofcom. June 2013. "Cost orientation". http://stakeholders.ofcom.org.uk/consultations/cost-orientation/

[33] Reproduced from: Peter Culham. 28 November 2012. "Pricing Access Networks in the Transition to NGA - Promoting Efficient Investment." ECTA Conference.

[34] Where there are investment choices with different costs and different expected returns there may also be no regulated price, even in principle, consistent with efficient investment which requires that the projects which maximise the difference between revenues (reflecting willingness to pay) and costs. Brian Williamson. 2009. "The regulation of next generation access networks and the draft Commission Recommendation." http://www.nerec.es/wp-content/files/NEREC_report.pdf

Figure 4-2: The risk premium in the WACC does not include allowance for project failure

- "The WACC risk premium is the reward for bearing non diversifiable ("systematic") risk
  - More about volatility of returns than about project failure
  - And volatility could be greater for NGA services than current services
- The requirement for the fair bet does not arise from a need for a reward for bearing risk
  - it is to allow the investor to get his money back on average
  - a fair bet is one where the expected value of the outcome is equal to the stake
  - there is no reward element
- Even the risk neutral investor requires a fair bet: on average the upside return must compensate for the downside loss
- The risk averse investor also requires a fair bet: he diversifies among fair bets and so does not bear specific risk
  - he requires, in addition, compensation for bearing systematic risk
- Compensation for bearing the systematic risk of investing in equities is the basis for the risk premium in the WACC"

If it is decided that a comprehensive price control, as opposed to a virtual anchor product over fibre, be applied in future then, notwithstanding the above, an attempt should be made to compensate for the fair bet problem.

However, this is likely to prove both complex and subjective, since the impact of project risk on possible outcomes would need to be modelled and subjective judgements about the risk at the time investment was undertaken would be required. The potential reduction in demand and revenue if a price control reduced or eliminated service price-differentiation would also need to be considered.

Appendix A: Impact of demand and supply side changes on substitution

In judging the future strength of the copper ADSL anchor product in constraining fibre prices, alongside platform competition from cable and LTE, one needs to consider possible demand and supply side changes. It is also important to consider possible areas of uncertainty.

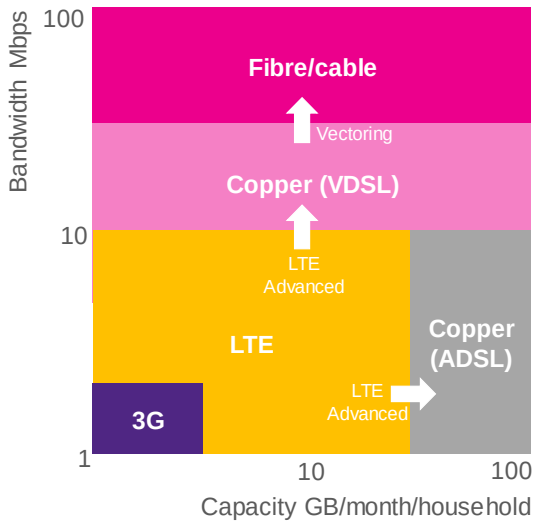
We note also that in the following discussion we do not assess whether or not mobile and fixed broadband services are in the same or separate markets. Rather we assess demand and supply side developments that may weaken or strengthen substitution across the market.

The aim is to inform thinking about the appropriate remedy for fibre, not whether SMP and therefore any *ex ante* remedy should apply.

A.1 Supply side changes

Figure A-1 illustrates broadband supply side developments in terms of capacity (horizontal axis) and speed (vertical axis).

Figure A-1: Characteristics of competing technologies (with arrows indicating evolution)



Supply side developments out to 2017 and beyond can be estimated based on technology roadmaps:

- VDSL will be available over a wider footprint with commercial deployment to two-thirds by 2014 and 90% by 2017. Fibre to the premise, vectoring, and/or further cabinets may be deployed over time. These upgrades offer higher speeds but not capacity compared to ADSL.
- Cable may be upgraded to DOCSIS 3.1 which would significantly increase the speed and capacity of cable, particularly the up-stream potential.[35] Vendors anticipate product in the

[35] http://blogs.cisco.com/sp/catching-up-with-ciscos-john-chapman-at-cable-congress-2013-this-week/#more-104374

marketplace by 2015, and operators are considering the potential of the shift in technology with Telenet noting in an investor call *"So that's [DOCSIS 3.1] going to be a huge leap forward"*.[36]

- Mobile is undergoing a rapid transition to LTE with additional spectrum at 800 MHz and 2.6 GHz now available. Coverage, speed and capacity will all increase significantly, and higher capacity will drive down unit costs. The anticipated reduction in unit costs with more spectrum and higher spectrum efficiency is significant and should ultimately be reflected in higher data tiers and/or lower tariffs for a given data bundle.

Verizon in the US have noted that *"…the 4G network is a less costly network to operate, at least 5 times less costly than the 3G network."*[37] Early indications in the UK suggest that LTE will deliver a substantially more competitive service versus fixed, as illustrated in Figure A-2 and Figure A-3).

Figure A-2: LTE speed

Figure A-3: LTE price

Modelling by Plum[38] and Ericsson[39] and projections by NSN[40] all suggest that the incremental costs of mobile networks will fall substantially – to less than £1/GB and potentially to around 20 pence/GB. If mobile unit data prices fall below £1/GB then re-directing fixed line and broadband expenditure of around £30 per month to mobile would buy a very significant amount of data – an amount that should be sufficient for the needs of at least a segment of the fixed broadband market.

Additional capacity will continue to become available over mobile networks at decreasing incremental cost as more advanced LTE is deployed[41], as lower cost base station architectures including small

[36] Telenet. February 2013. Q4, 2012 Results – Transcript. http://investors.telenet.be/phoenix.zhtml?c=241896&p=irol-resultcenter

[37] Verizon. 25 February 2013. http://www22.verizon.com/investor/DocServlet?doc=vz_morganstanley_transcript.pdf

[38] Plum. January 2012. "Mobile data growth – too much of a good thing?" http://www.plumconsulting.co.uk/pdfs/Plum_Insight_Jan2012_Mobile_data_growth_-_too_much_of_a_good_thing.pdf

[39] Ericsson. 2011. "In search of the sweet spot." http://www.ericsson.com/ericsson/corpinfo/publications/ericsson_business_review/pdf/111/111_in_search_of_the_sweet_spot.pdf

[40] NSN. 2013. "Technology Vision for the Gigabit Experience." http://nsn.com/sites/default/files/document/vision2020_whitepaper_final.pdf

[41] See for example: http://www.qualcomm.com/solutions/wireless-networks/technologies/lte-advanced

cells become common[42] and through availability of additional spectrum (potentially including 1.4 GHz, 2.3 GHz and 3.4 GHz). Whilst small cells will require back-haul they will not require fixed connectivity at every premise or to every small cell, with wireless back-haul likely to play an important role.[43]

In addition to broadband access platforms terrestrial and satellite free-to-air and pay TV offer alternative means of video delivery. They are less flexible in terms of on-demand, though coupled with large hard drives they can offer popular content on an on-demand-basis. LTE technology (eMBMS) may also support broadcast video delivery in future.[44]

All of these broadcast technologies, either offered as bundles or adopted by consumers, can reduce the value difference between copper ADSL and fibre and wireless and fixed by reducing the speed and/or data capacity required to meet consumers' needs over broadband (depending how strong consumer preferences are for genuine on demand video). For example, LTE broadband and satellite TV together might together provide a stronger competitive constraint on fibre than LTE alone.

In considering the strength of competition from copper ADSL and LTE on fibre the additional competitive pressure from broadcast TV should be taken into account.

A.2 Impact of supply side changes given today's behaviour

The supply side changes discussed above can be set alongside today's behaviour.

In June 2012 average fixed broadband data consumption was 23 GB, an increase of 35% over March 2011.[45] However, data consumption is non-uniform across households with 50% of households accounting for 90% of data consumption. This implies relatively low levels of data consumption for the other 50% of households, well within the scope of affordable mobile broadband packages.

In terms of broadband speed many ADSL connections offer speeds below around 10 Mbps, and lower speed connections are correlated with lower data consumption. This also points to the possibility of wireless substitution for this customer segment.

Whilst both demand for data and speed will change over time and might be expected to grow, there are competing forces at work, with some contributing to reduced demand (for example more efficient HEVC compression, which is expected to come to market over the next 2-3 years). These factors are considered further in A.6 after looking first at existing evidence of substitution.

A.3 Demand side changes

The demand side is arguably more uncertain than the supply side since consumer preferences across speed and capacity (and price), particularly as we move into a world of fibre and LTE, are not well known.

[42] For example: http://www2.alcatel-lucent.com/techzine/lightradio-network-a-new-wireless-experience/

[43] See for example: http://www.cisco.com/en/US/solutions/collateral/ns341/ns523/ns941/brochure_c02-728436.html

[44] http://www.ericsson.com/ourportfolio/telecom-operators/lte-broadcast

[45] Ofcom. November 2012. "Infrastructure report." http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/broadband-speeds/infrastructure-report-2012/

Further, developments in services and applications may increase or decrease demand for network speed and capacity, thereby either increasing or decreasing substitution between fibre and copper ADSL; and between fixed and wireless (including mobile and fixed wireless access).

What is clear is that whilst there are developments that could increase demand for capacity and speed and reduce substitution, there are also developments which are likely to have the opposite effect, as set out in Table A-1.

Table A-1: Impact out to 2020 of developments on speed & capacity demand

		Speed (fibre vs. copper ADSL)	Capacity (fixed vs. LTE)
Increase	Growth in video on demand & content sharing	↑	↑
	Growth of HD video	↑	↑
	Growth in multiple device use	↑	↑
	3D TV	Unlikely to impact significantly[46]	Unlikely to impact significantly
	Ultra HD (4K)	Limited development anticipated[47]	Limited development anticipated
Decrease	Growth of video & music streaming vs. download	↓ (buffer time only, peak speed matters less)	Neutral
	Smart background downloads e.g. Apple Newsstand & iOS 7	↓	Neutral
	HEVC (H.265) compression[48]	↓	↓
	Shift to small screen consumption i.e. tablets[49]	↓	↓
	Device-to-device wireless file transfer e.g. Apple Airdrop	Zero: no network required	Zero: no network required

An important driver of bandwidth-economising innovations is the global shift to mobile broadband relative to fixed, with Ericsson forecasting 7 billion mobile broadband connections by 2018, but less than 1 billion fixed broadband connections.[50] This shift has seen a wide number of application

[46] 3D has not gained traction in the TV market with the BBC putting 3D 'on hold' indefinitely in July 2013. http://www.bbc.co.uk/news/entertainment-arts-23195479

[47] 4K unlikely to be feasible over terrestrial broadcasting before 2020 due to spectrum constraints and requirement for user equipment change to shift to HEVC compression (which is likely to involve a separate transition from a shift to DVB-T2 with MPEG-4). This will limit the market development of 4K in the UK. In addition, ultra HD (4K) would offer limited benefit in many settings (depending on screen size and distance from screen): http://arstechnica.com/gadgets/2012/06/4k-tvs-are-coming-but-they-face-an-uphill-battle-in-the-home/

[48] Once in a decade change in compression standard agreed in January 2013 which will approximately halve speed and capacity required for given video quality. http://www.ericsson.com/res/thecompany/docs/publications/ericsson_review/2013/er-hevc-h265.pdf

[49] Tablet ownership in the UK more than doubled to 24% by Q1 2013, with one-third of tablet owners saying a tablet is their main means of connecting to the internet. http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr13/2013_UK_CMR.pdf

[50] Ericsson. June 2013. "Mobility report." Figure 3. http://www.ericsson.com/res/docs/2013/ericsson-mobility-report-june-2013.pdf

providers including Google and Facebook adopt “mobile first” development strategies, which puts an emphasis on improvements to compression and smart connectivity management.

A.4 Impact of demand side changes

To the extent that these developments reduce speed and capacity requirements they will:

- Help copper ADSL “compete” against fibre (dependent on willingness to pay for incremental speed).
- Support substitution of wireless for fixed (dependent on demand for capacity and the incremental cost of wireless capacity).

Other factors will impact on wireless-fixed substitution include:

- The improvement in in-building mobile data coverage from around 85% (informal industry estimates) to 98% (agreed plans and targets) with LTE at 800 MHz.
- Changes in the voice market with unlimited voice bundled with LTE plans, the shift to HD voice and the shift to VoIP over LTE (VoLTE).[51] This should reduce or remove differences in voice cost and quality as a barrier to adoption of mobile only.
- The rapid rise in smartphone ownership currently around 60% in the UK and increasing at a rate of around 10 percentage points per annum. This will transform smartphone data into a near ubiquitous default by 2017, with fixed broadband being perceived by consumers as the incremental add on (depending on capacity needs at home).
- Adoption of devices and price plans that enable shared use of mobile including Mi-Fi, smartphone Wi-Fi tethering and shared data plans.[52]
- The ability to carry smartphones and tablets from place to place allows large downloads (e.g. content or software updates) to be managed without a home broadband connection and outside of mobile data caps via public Wi-Fi or at work.

A.5 Evidence of mobile substitution

Whilst it experience with LTE in the UK is limited, in particular with LTE utilising sub-1 GHz spectrum, early indications point to the prospect of increased substitution from fixed services. [53]

Qualitative indications from a survey of 4G customers by EE suggest that substitution may increase:[54]

> *“Because 4G is proving to offer consistency as well as fast speeds, customers are increasingly using it to replace public Wi-Fi and home broadband. As the nationwide rollout of 4G has moved into less urban areas that have less public Wi-Fi, and relatively poor home broadband speeds, this trend has accelerated.”*

In Japan, NTT has cut its fibre prices 34% in response to competition from LTE:[55]

[51] Verizon in the US are pursuing this approach and plan to launch an all-VoIP LTE-only phone.

[52] For example: http://shop.ee.co.uk/sharer-offers-deals/offer-sharer-acquisition/pay-monthly/

[53] Ofcom report a fall in dongle use between 2011 and 2013

[54] EE. August 2013. “4GEE Mobile Living Index”. https://explore-orange-live-orangedigital.s3.amazonaws.com/2013/08/19/4GEEMobileLivingIndexFINALFINAL.pdf

"Sources at NTT East and NTT West are unequivocal in their views that the biggest, single reason for the slowdown in FTTH subscriber growth is the fact that many young subscribers now prefer to have their own 'personalised' LTE broadband services rather than paying for a household-based FTTH service – in addition to which they would be paying for a Smartphone LTE data plan anyway."

Service providers are also offering LTE services as a substitute for fixed, for example Verizon "HomeFusion" in the US (which utilises an external antenna to improve efficiency and range), AT&T "Home Base"[56] and Vodafone "Real LTE" in Germany.[57]

There is also already evidence of a significant number of smartphone-only households in the US- smartphone penetration is around 50% with perhaps one-third of these on LTE (with both fractions growing rapidly).

A Pew Internet survey summarised in Table A-2 found significant adoption of smartphone-only without home broadband (the difference column) - suggesting some combination of substitution and increased digital inclusion due to smartphones.[58] We note that these differences are already significant, although smartphone adoption at the time was around 56% and LTE adoption of less than one-third.[59]

Table A-2: US smartphone only adoption

	Broadband at home (%)	Home broadband or smartphone (%)	Difference (%)
All adults	70	80	+10
Ethnicity			
• White	74	80	+6
• Black	64	79	+15
• Hispanic	53	75	+22
Age			
• 18-29	80	95	+15
• 30-49	78	89	+11
• 50-64	69	77	+8
• 65+	43	46	+3
No high school diploma	37	52	+15
Household income < $30k	54	67	+13

Note: Pew Internet includes a larger set of categories than summarised above.

[55] http://delimiter.com.au/2012/11/21/customers-dumping-fibre-for-4g-in-japan/

[56] http://www.att.com/shop/wireless/devices/internethomephone.html#fbid=r5v0l5QoGL8

[57] http://www.vodafone.de/privat/mobiles-internet-dsl/was-ist-lte.html

[58] Pew Internet. August 2013. "Home broadband 2013." http://www.pewinternet.org/Reports/2013/Broadband.aspx

[59] One-third of Verizon contract customers have adopted LTE. This overstates the market total given that Verizon have led in LTE deployment.

In relation to substitution Ofcom state that:[60]

> *"…only 5% of households rely solely on mobile broadband. Instead, most households rely solely on a fixed broadband connection (84% of those with broadband). Although uptake has been increasing and a move to 4G will increase the speeds available, following the latest round of spectrum auctions, we consider that this is unlikely to significantly affect the demand for broadband via fixed line access within the time horizon of this review because it is unclear when these services will be available to – and adopted by – a significant proportion of UK customers. Even if this were to occur within the period of this review, the expected continued deployment of superfast broadband means it is not clear that the material difference in broadband speeds between fixed and mobile would significantly narrow."*

We first note that the measure of mobile only reported by Ofcom excludes smartphones.[61] Adoption of smartphones only or smartphones with tethering of other devices should in future be assessed alongside other forms of wireless access in assessing substitution.

We conclude, taking into account the range of existing evidence, the Ofcom conclusion above appears unlikely to hold within and beyond the current review period i.e. 2016/17. The capability of LTE, the evolution of compression and applications to enable lower bandwidth services, early qualitative indications from 4G adopters in the UK, and indications of substitution from international evidence all point to significant (but uncertain) potential substitution of mobile for fixed.

A.6 Uncertainty will remain

Supply side, and particularly demand side, developments are predictable to some extent, but significant uncertainty will remain.

The extent to which fixed telecoms and cable networks are upgraded over time will remain uncertain, whilst future spectrum release and the capability and cost of LTE-Advanced networks are also uncertain. In particular, the way in which mobile pricing strategy develops is uncertain – will operators pursue "high growth, low unit price" or "low growth, higher price" strategies?

On the demand side there is significant uncertainty over demand and willingness to pay for incremental improvements in speed and capacity. This is compounded by uncertainty over what demands different applications will place on networks, and consumers' preferences and willingness to pay for nomadic availability of connectivity.

[60] Ofcom. Paragraph 3.34. http://stakeholders.ofcom.org.uk/binaries/consultations/fixed-access-market-reviews/summary/fixed-access-markets.pdf

[61] Footnote 114. http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr13/UK_5.pdf