

Regulatory policy and the roll-out of fibre-to-the-home networks

A report for the FTTH Council Europe

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Executive Summary

This report looks at regulatory policies aimed at promoting the roll-out of fibre-to-the-home networks.

In this report, commissioned by the FTTH Council Europe, we look at ways in which regulatory policy could support investment in fibre access networks, both in terms of applying the existing regulatory framework in the most conducive manner and pursuing additional policy options that would promote such investment.

The European Commission's Digital Agenda sets out ambitious targets for broadband, which may only be met through widespread fibre deployment to the home ...

The European Commission's 'Digital Agenda' (DA) sets out ambitious targets for access to fast and take up of ultra-fast broadband, which are to be achieved between now and 2020. While there remains some ambiguity about the connection speeds that will be required in practice – and more clarity about the specific objectives in terms of greater symmetry between download and upload and consistency and reliability of services would be welcome – there are good reasons to believe that the only way of meeting the targets will be through an extensive, EU-wide roll-out of fibre networks to the home (FTTH). All other access technologies (wired and wireless) that have a fibre component which terminates outside the building are unlikely to fulfil – on the necessary large scale – the 100 Mbps DA target (or even the 30 Mbps target if high levels of symmetry, latency, consistency and reliability are required).

... but actual fibre deployment in Europe is limited, and widescale deployment is uncertain.

However, fibre deployment in Europe so far is rather limited and is lagging behind the level of roll-out (and take-up) of FTTH services in parts of Asia and North America. Where FTTH networks have been rolled out more widely (predominantly in Northern Europe and the Baltic states), non-incumbent operators have often been in the lead. Looking forward, projects funded or led by local authorities, lateral entry into fibre by utility companies and to some extent competing telecommunications operators, are expected to account for the majority of fibre build within Europe.

The business case for FTTH is challenging, not least because users at present do not appear to be willing to pay a premium for higher speeds.

The limited roll-out reflects the fact that the business case for FTTH is challenging. The required investment is large, most of the costs are sunk as investments cannot be undone if demand turns out to be insufficient, and there is considerable uncertainty about consumer interest in and willingness to pay for ultra-fast broadband. At present, end-users do not appear to be prepared to pay a premium for higher speeds or additional bandwidth.

However, willingness to pay for fibre may not be a true reflection of value owing to informational problems, co-ordination issues and the potential of wider social benefits.

Amongst other reasons, this may be because users are not fully informed about the differences in the quality of service that would be provided over fibre, or because the benefits from improved connectivity depend on the availability of services that fully exploit the greater speed and reliability, but which users have not yet experienced. The fact that services that would drive the take-up of fibre might not be developed quickly unless the infrastructure is in place and unless service providers and network operators can co-ordinate effectively means that the full value of FTTH networks may not readily be realised, delaying or suppressing investment. In addition, there may be wider societal benefits associated with widespread fibre deployment, which are not (fully) reflected in the willingness to pay of end-users.

This means that there may be a good public policy argument for promoting the roll-out of FTTH networks.

On this basis, there would seem to be a good public policy case for promoting faster roll-out of FTTH networks across Europe. The existing regulatory framework should be applied in a manner that is conducive to fibre investment, and additional policy measures might be needed to deal with the fact that the societal value of a fibre-based access infrastructure is not fully reflected in the business case for fibre investment.

Expectations about the likely obligation to provide wholesale access to fibre networks on regulated terms affect the fibre business case. More certainty about future regulation may help – but specifics matter.

What operators of fibre access networks expect in relation to having to provide access to third parties at regulated, cost-reflective rates clearly has an impact on anticipated returns and investment incentives. The European Commission's Next Generation Access (NGA) Recommendation provides national regulators with a framework for dealing with the specific challenges faced by investors in fibre networks by allowing them to include a sufficient risk premium when setting regulated access charges for fibre networks, and to take account of specific strategies for sharing and reducing the risk of fibre investments. However, Member States are only beginning to implement these recommendations, and there is consequently some uncertainty over how fibre access will be regulated in practice. Greater certainty about how the Recommendation will ultimately be reflected in regulatory controls might help promote fibre investment, but the specifics clearly matter.

De-regulating wholesale access in competitive areas can provide incentives for investment, while allowing risk premia in the calculation of access charges may not have much effect.

De-regulation of wholesale broadband access where competition is sufficiently strong appears to have a positive effect on investment, as suggested by the example of Portugal. There, the Portuguese telecommunications regulator (ANACOM) decided to de-regulate wholesale broadband access in competitive urban areas (i.e. Lisbon or Porto with three or more operators and a high number of households with cable access). In the view of the FTTH Council, this is one of the main reasons for Portugal Telecom's significant investment in the roll-out of its FTTH network in the country. By contrast, the prospect of being allowed higher returns might not be sufficient. For example, the initiative by the Dutch regulator (OPTA) to allow an as of yet unspecified premium over the 'normal copper weighted average cost of capital (WACC)' in addition to a premium reflecting asymmetric regulatory risk does not appear to have triggered any substantive increase in fibre investment.

Alternative pricing options that allow price differentiation in line with commitments by the access seeker could help with sharing risks, but so far these options have not gained much traction.

Alternative pricing options could help investment by allowing network operators and access seekers to share some of the risk by differentiating access charges according to the level of the access seeker's commitment: lower prices would be charged for long-term agreements with volume guarantees because the access seeker takes on some of the risks associated with uncertain demand and willingness to pay. Higher charges for short-term 'pay as you go' access services would then compensate the access provider for bearing greater levels of risk. However, such differentiated charging options so far do not seem to have been explored to any great extent.

Promoting infrastructure sharing and re-use could result in substantial cost savings and make investment more attractive.

Regulatory policies that actively promote infrastructure sharing and re-use could also help significantly to lower deployment costs. According to the FTTH Council's Costing Model tens of billions of Euros could be saved on a total estimated cost of €202bn to reach the DA targets through relatively modest levels of duct infrastructure sharing and re-use. The plans for developing a shared passive infrastructure for next generation networks in Italy are expected to minimise roll-out costs by re-using a significant proportion of existing or parallel conduits. The regulation of physical infrastructure access (PIA) plays a crucial role here as well.

Support for co-investment, in particular with local utilities, could also promote fibre roll-out.

Co-operation between municipalities can equally lead to significant cost savings, for example through and co-ordination of civil engineering works. Supporting co-investment strategies with utilities can help to lower costs and share risks. Telecoms operators might team up with power companies who may wish (or may be obliged to) make use of smart meters and require the appropriate ICT infrastructure to support their smart grids.

Looking only at the regulation of fibre may not be enough. In the transition from copper to fibre access networks, access charges for the legacy copper network matter as well.

However, looking purely at the likely regulation of fibre access charges is insufficient. Matters are substantially more complicated as new fibre access networks are expected eventually to replace existing copper infrastructure. The migration from one technology to another means that there will be a transition period where both are in use, and competing for (incremental) investment as well as users. This means that the approach used for setting charges for access to the legacy copper network will also affect the incentives for fibre investment.

The interaction between fibre and copper access charges is complex, with a number of effects working in opposite directions. There is little consensus on whether lower or higher access prices for copper (relative to fibre) would stimulate fibre investment, as both technologies not only compete for investment but also for end-users.

The setting of appropriate access charges for copper- and fibre-based wholesale services in order to ensure a smooth transition has attracted considerable attention. Their interaction is complex, and there are a number of effects working in opposite directions. Unsurprisingly, there is no general consensus on the most appropriate approach to access pricing during the transition from copper to fibre, as responses to the European Commission's 2011 consultation on costing methodologies¹ clearly show. There appears to be little agreement on whether high or low copper access charges are more likely to stimulate fibre investment. Because fibre and copper not only compete for incremental investment, but are also substitutes from the end-user perspective, attempts to increase access charges for fibre relative to copper to reward fibre investment are constrained by the extent to which differences in the final retail prices for the products can be sustained.

¹ See

http://ec.europa.eu/information_society/policy/ecomm/library/public_consult/cost_accounting/index_en.htm

Focusing on competition for investment, lower copper charges would seem to make fibre investment relatively more attractive for incumbents, but less attractive for entrants...

Looking purely at the pay-back on investment, a larger gap between copper and fibre access charges (if brought about in a manner that does not undermine trust in the regulatory process) would make fibre investment relatively more attractive for incumbents, whilst entrants would prefer to purchase cheaper copper access than to invest in their networks. Analysis undertaken by WIK Consult suggests that incumbent operators would only switch from investing in copper upgrades to investing in fibre for an access price differential in excess of €8/month. At current average monthly prices for unbundled local loops prices, this would mean fibre access would have to be priced at almost double the cost of the unbundled copper loop.

... but the required difference may not be sustainable in light of current customer willing to pay.

Such a difference would undoubtedly lead to a substantial retail price difference. At least at present, such a large differential is unlikely to be sustainable given that end-users seem to be prepared to pay at most a small premium for ultra-fast broadband over and above their willingness to pay for fast broadband services, and there seems to be little scope for arrangements where service providers exploiting higher bandwidth infrastructure could contribute to the bill.

In order to support an access price differential in the face of retail competition, it may be necessary to drive a wedge between copper access and retail prices, or allow incumbents to withdraw copper access where they make fibre access available.

This means that, at present, there is little scope for promoting fibre investment simply by allowing higher returns on fibre than on copper, unless mechanisms that prevent the difference in access prices feeding through to retail prices are in place. Options that might be considered in this regard are:

- an effective 'tax' on copper-based access, aimed at driving a wedge between access and retail prices and ensuring that large access price differentials do not lead to unsustainable retail price differentials (with the increased revenues potentially being made available to support fibre deployment); or
- allowing incumbents to withdraw copper-based access products as soon as they offer fibre-based access services in order to prevent a situation in which competition from 'cheap' copper undermines the fibre business case.

Alternatively, higher access charges may be set for both technologies, but made contingent on fibre investment taking place.

Instead of strongly differentiated access charges for copper and fibre, one might consider higher access charges for both technologies but make these conditional upon fibre investment (as proposed by European Commission Vice-President, Neelie Kroes). This could be implemented by averaging access charges across the two technologies, which would effectively permit incumbents to increase the access prices they can charge by rolling out fibre.

Reasons why the limited willingness to pay may not reflect the full value of fibre networks should be addressed in any case, by improving information and allowing service provider involvement to overcome co-ordination problems.

Regardless of what supporting measures might be taken to support an appropriate difference in access prices, there is a strong case for adopting measures that target distortions in the willingness to pay of end-users for higher speeds and greater bandwidth. The limited willingness to pay a premium for fibre-based access may be distorted because of insufficient information about the quality of the services received and the lack of services that would make use of the higher connection speeds. Making it easier for end-users to understand what service quality they can expect from copper and fibre could increase the premium that end-users are prepared to pay for fibre and put fibre investors in a better position to recoup their investment. Exploring how providers who benefit from better connectivity may contribute towards investment costs could likewise improve the business case for fibre investment.

It might be the case that none of these measures are sufficient to promote FTTH roll-out, and that more direct intervention is needed.

Even with all these measures in place, the business case for FTTH investment may not fully reflect the societal value of fibre access networks. In this case, public policies aimed explicitly at promoting fibre roll-out would be required. These could take various forms, ranging from charging regulators more explicitly with promoting investments (e.g. through allowing or disallowing certain investments), through more direct public sector involvement in pushing the roll-out of fibre access networks (e.g. through soft funding or public-private partnerships) to the adoption of a 'fibre switchover' policy.

The right policy choice depends on a number of factors, and 'one size fits all' is unlikely to work. Regulatory commitment is crucial, and clear policy choices are needed.

In practice, the most appropriate policy towards the promotion of fibre networks will depend on a host of factors. There is a clear case for removing anything that might artificially depress the willingness of end-users to pay for fibre, and to promote ways that allow service providers to contribute towards the cost of deploying fibre in the access network. Applying the established regulatory framework with a greater investment focus would seem to be appropriate, given that the issue at hand is not simply one of making sure that existing infrastructure is used as widely as possible, but rather that new infrastructure is put in place in the first instance. The regulatory commitment towards rewarding investment is crucial. A clearer acknowledgement of the need for appropriate reward of investors would seem to help in strengthening investment incentives – but to be effective this would have to be combined with a clear indication of the magnitude of the reward that successful investors should be allowed, and a commitment to protect such returns from being eroded through a process of frequent reviews.

Where the public sector needs to get involved, such involvement must be targeted and efficient, based on clear policy decisions and supported by effective implementation.

If the public policy case for fibre deployment is much stronger than the business case, the public sector will need to step in either through direct contributions or through getting actively involved in the deployment of fibre networks in order to realise the societal benefits from fibre roll-out. Where reliance is placed on the public sector to contribute to, or even drive the roll-out of fibre networks, it is important to ensure that maximum impact is achieved. Where funds are being made available, they need to be disbursed effectively and on those projects with the greatest benefits. This will require clear rules on what projects (and potentially what technologies) should be supported, and an effective administration for implementing such support. Issues such as the prescribed operating model would appear to be of lesser importance in driving fibre deployment.

1 Introduction and background

In this chapter, we set out the context for our analysis in this report, by looking at the targets for broadband roll-out and take-up contained in the Digital Agenda for Europe, assessing how these compare with similar targets that have been set in the United States and in Asia, and examining what kind of progress has been made to date in meeting the targets within the European Union.

We then go on to discuss why further upgrades to legacy copper-based access networks may be insufficient to enable the EU Member States to reach the Digital Agenda targets and, hence, why the widespread deployment of FTTH networks might be necessary.

The chapter concludes by noting the challenging business case within Europe for fibre investment, which, in turn, raises the key question as to how regulatory policy could promote incentives for fibre roll-out.

1. In this report, commissioned by the FTTH Council Europe, we look at how regulatory policy might be used to support investment in fibre access networks in terms of both applying the existing regulatory framework and adopting further policies to promote fibre. We identify how regulation affects the incentives for fibre investment, and consider potential responses in cases where the public policy case for fibre deployment is strong, but the business case may not be. Our starting point is that roll-out of fibre access networks will play a key role in meeting the ambitious targets for broadband roll-out and take-up set by the European Commission as part of its Digital Agenda (DA) for Europe², but that the business case for the deployment of fibre-to-the-home (FTTH) networks is challenging.

1.1 The Digital Agenda targets

2. In relation to broadband roll-out and take-up, the DA requires that basic broadband services should be available to all EU citizens by 2013, fast broadband services (i.e. broadband services providing connection speeds of 30 Mbps or higher) should be made available to all by 2020, and by this time at least 50% of the EU population should be using ultra-fast broadband (i.e. connections providing speeds of 100Mbps or higher), which implies ultra-fast broadband coverage of substantially more than half the EU population. These targets are not dissimilar from those set in other parts of the world (see box).

² See http://ec.europa.eu/europe2020/index_en.htm

Broadband targets in the US and Asia-Pacific

As part of the 'National Broadband Plan' the US have set a goal to ensure that by 2020, "[a]t least 100 million U.S. homes should have affordable access to actual download speeds of at least 100 megabits per second and actual upload speeds of at least 50 megabits per second."³ According to the latest available census figures, in 2010, there were around 117.5 million households⁴ in the US, thus the target roughly translates to ensuring over 85% of US households have access to ultra-fast broadband by 2020.

Japan has had a series of targets in place since 2001, persistently striving for faster speeds and greater coverage. In 2005, under the u-Japan policy, the Ministry of Internal Affairs and Communications (MIC) set a target for all municipalities in Japan to have broadband access by 2008, and over 90% of Japanese homes to have access to broadband networks with at least 30Mbps upload speeds by 2010. More recently, Japan has set targets to improve speeds available and the number of households actually using the service. By 2015, Japan hopes to provide access to broadband with download speeds of at least 100Mbps for 100% of households, and to increase broadband use from 30% to 100%, also by 2015.⁵

In 2004, Korea embarked on its Broadband Convergence Network Initiative (BcN) with the aim of providing fixed line connections achieving download speeds of 100Mbps to 10 million households by 2010. Following the BcN was the Ultra Broadband Convergence Network (UBcN) programme setting targets to be achieved between 2009 and 2013. This latest initiative, aims to connect 14.5 million households to 100Mbps broadband by 2013 in addition to a commercial 1Gbps service by 2012 and 200,000 1Gbps lines by 2013.⁶

3. Figure 1 shows how well Europe is performing against the (wider set of) DA targets. Targets in blue are to be achieved by 2013, orange by 2015 and violet, by 2020 with progress up to 2009 illustrated in these colours and progress between 2009 and 2011 presented in green, yellow and pink respectively. The target of 'broadband for all' seems to be well within reach and the target of 100% coverage of fast broadband is the DA goal with the largest improvements in 2011⁷. However, achieving 50% of house hold take-up of ultra-fast broadband by 2020 remains challenging with little progress made between 2009 and 2011.

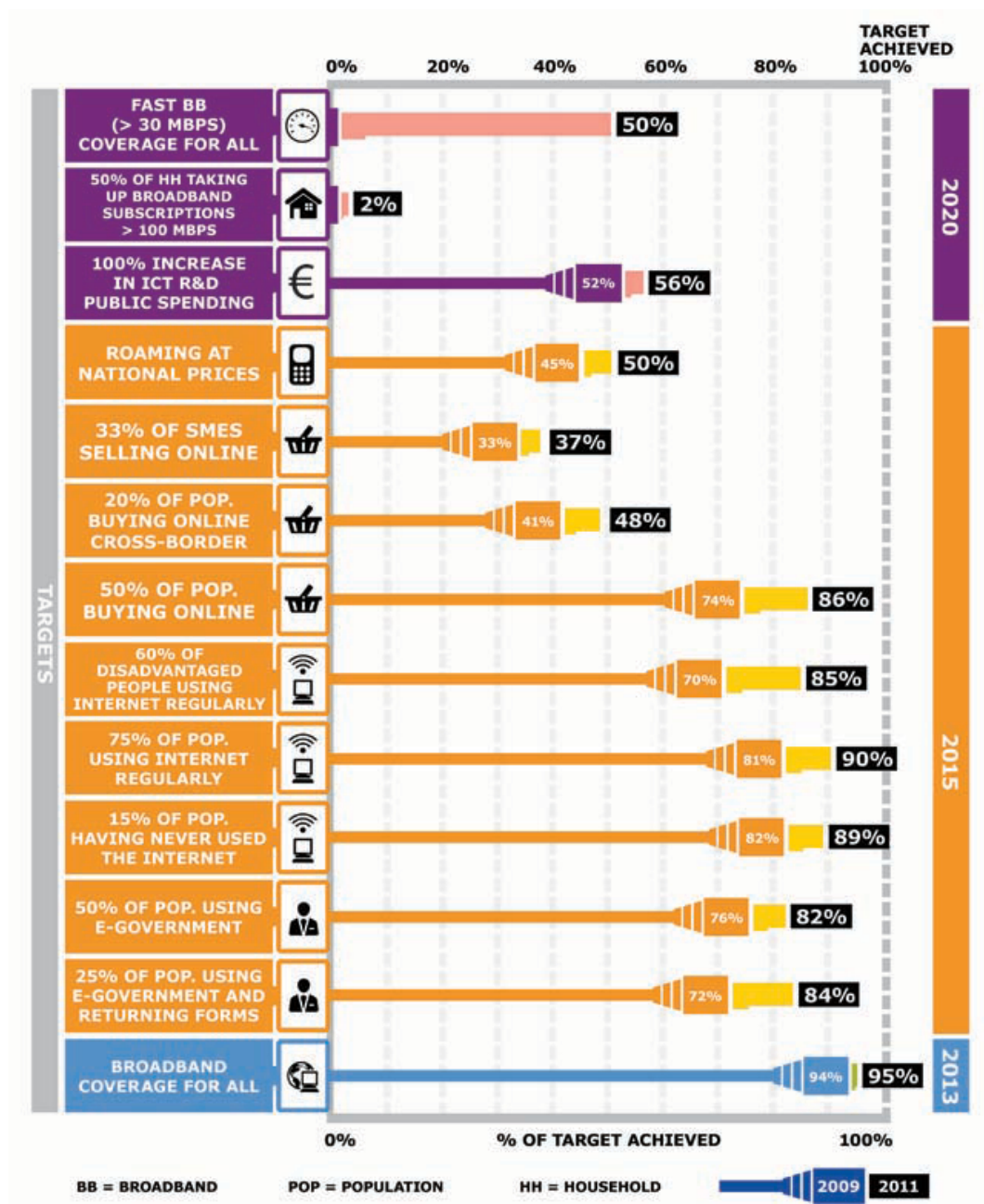
³ Federal Communications Commission, "Connecting America: The National Broadband Plan". Available to download at www.broadband.gov/plan

⁴ Actual figure quoted is 117,538 million households. Data on Households can be downloaded from the census website <http://www.census.gov/compendia/statab/cats/population.html>

⁵ Business Software Alliance, "Country Report: Japan", available at http://portal.bsa.org/cloudscorecard2012/assets/pdfs/country_reports/Country_Report_Japan.pdf

⁶ Ovum consulting, "Broadband Policy Development in the Republic of Korea – A Report for the Global Information and Communications Technologies Department of the World Bank", October 2009.

⁷ We note that in January 2012, only 8.5% of fixed lines across Europe were capable of providing speeds of 30 Mbps and above (see Figure 5). The rapid increase in high speed broadband coverage between 2009 and 2011 must therefore be a result of a rapid rise in coverage of other technologies such as mobile broadband, cable and fibre.

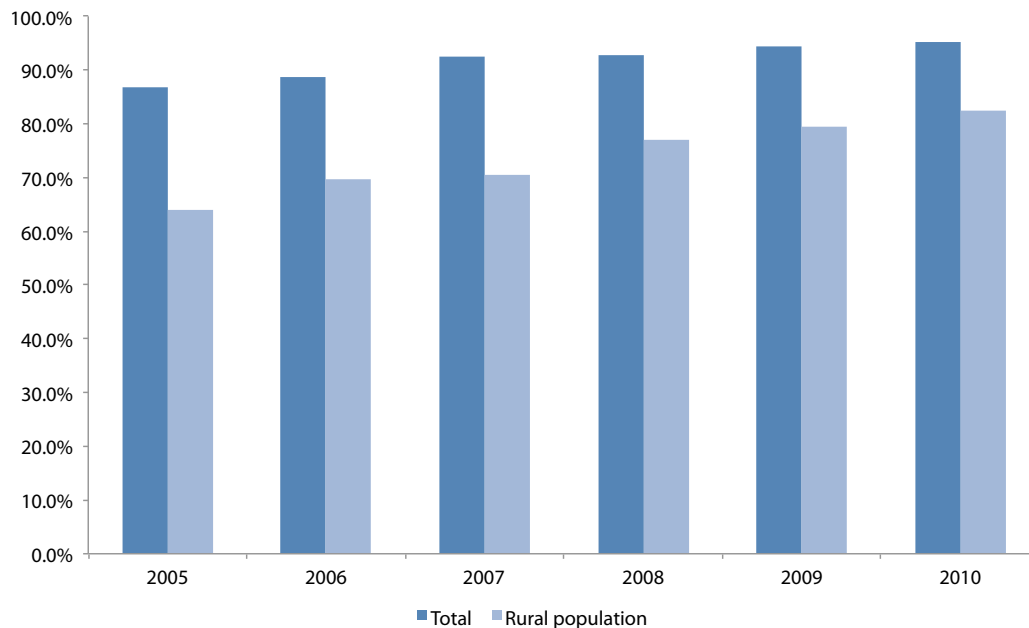
Figure 1: How the EU scores on the Digital Agenda targets

Source: European Commission, Digital Agenda Scoreboard, Commission Staff Working Paper SWD(2012) 180, 18 June 2012.

4. Good performance against the basic broadband target is not surprising. At present, broadband services across Europe are predominantly provided via legacy copper and cable networks. Fixed broadband coverage in Europe has been steadily increasing in the last five years and, using the DSL footprint as a metric, fixed broadband services were available to 95.3% of the population and 82.5% of the rural population by the end of 2010, with penetration in rural areas increasing more quickly (see Figure 2). Incumbent copper technologies such as Asymmetric DSL (ADSL) are capable of providing basic access speeds

of up to 8Mbps download and 1Mbps upload, with the more advanced ADSL2+⁸ capable of supporting speeds of up to 24Mbps download and 1Mbps upload, and VDSL2 and cable networks (utilising the DOCSIS 3.0 standard) providing still higher speeds.

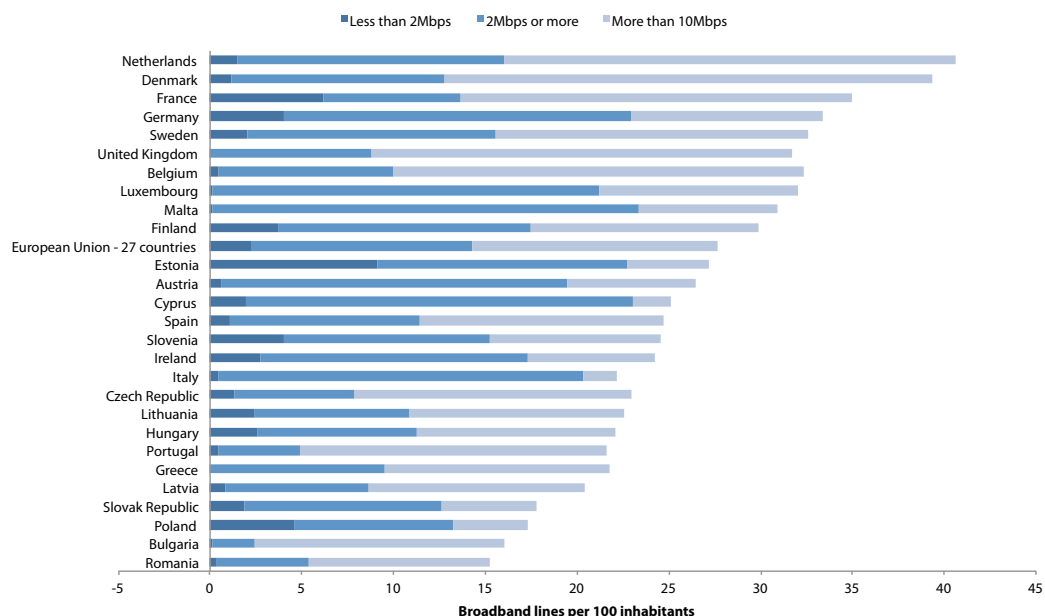
Figure 2: Fixed broadband coverage growth in the EU-27 – proportion of the population covered by fixed broadband



Source: Digital Agenda Scoreboard, <http://scoreboard.lod2.eu/index.php?page=export>

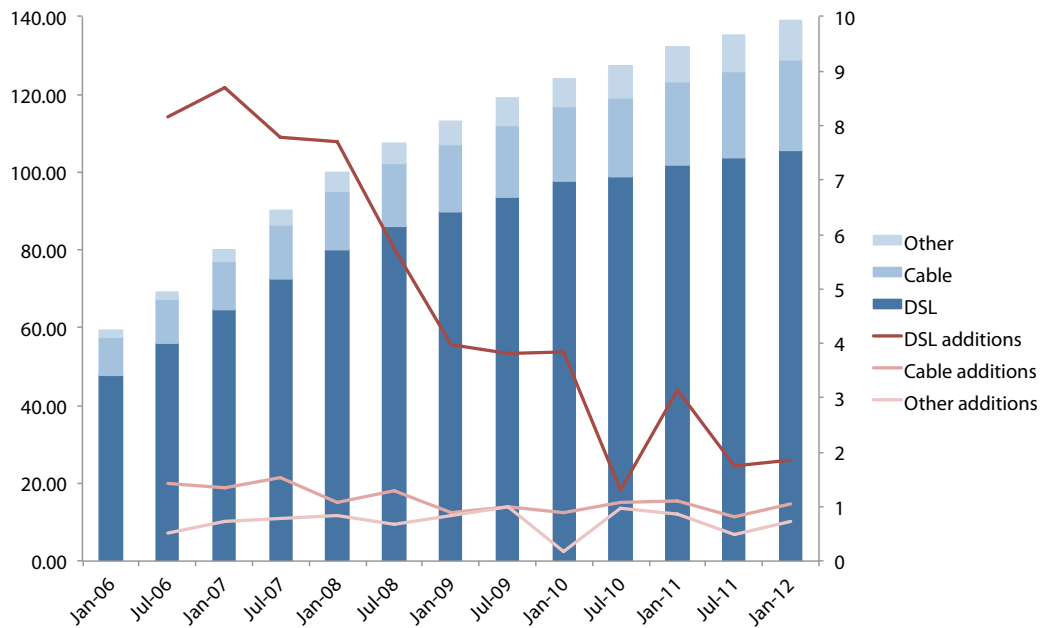
5. There are however substantial differences across Member States, both in terms of coverage (in particular in relation to broadband coverage in rural areas) and connection speeds. Figure 3 shows penetration measured in terms of broadband lines per 100 inhabitants, broken down by lines with a connection speed of less than 2Mbps, more than 2Mbps but less than 10Mbps, and greater than 10Mbps. This shows that higher penetration does not necessarily correspond to a greater share of connections with higher speeds.

⁸ "ADSL2 is also known as ITU G.992.3, which is an ITU (International Telecommunication Union) standard. ADSL2 and ADSL2+ extend the capability of regular ADSL by doubling the number of downstream bits. This can lead to connection speeds of up to 24 Mb downstream and 1Mb upstream, depending on the distance of the DSLAM (DSL Access Multiplexer) from the customer's home." See http://www.uswitch.com/broadband/guides/what_is_adsl2/

Figure 3: Fixed broadband coverage across Member States in 2011

Source: Digital Agenda Scoreboard, <http://scoreboard.lod2.eu/index.php?page=export>

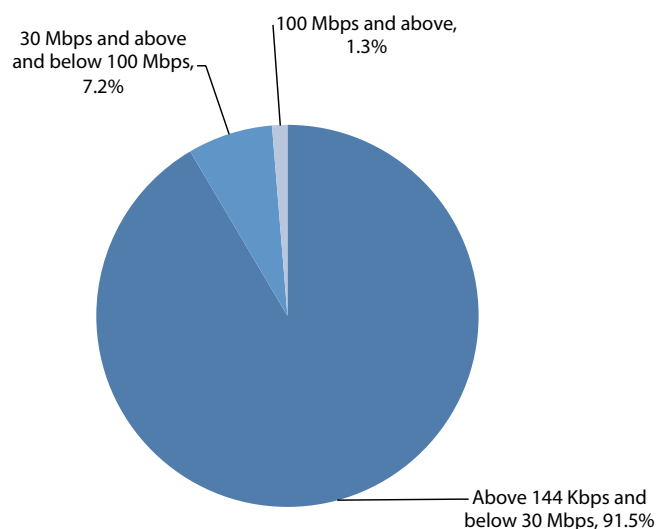
6. The introduction of technologies capable of providing fast and ultra-fast broadband has been slow. The majority of fixed broadband connections is based on DSL, and the reason the share of DSL connections in the overall mix of fixed broadband lines has fallen over the last few years is not because of a sudden surge in the take-up of alternative technologies (such as cable or even fibre), but rather because the growth in DSL lines is levelling off, as indicated by the falling number of net new additions in 2011 (see Figure 4).

Figure 4: Fixed broadband connections by technology (million lines)

Source: Digital Agenda Scoreboard (http://ec.europa.eu/information_society/digital-agenda/scoreboard/docs/download/broadband_lines_agreements.xls)

7. Given the dominance of DSL in the provision of fixed broadband, it is not surprising that in January 2012 only 7.2% of all fixed lines (without enhancements such as bonding and vectoring) in Europe were delivering connection speeds of 30Mbps or more, and just over 1% of lines were providing 100Mbps or more.

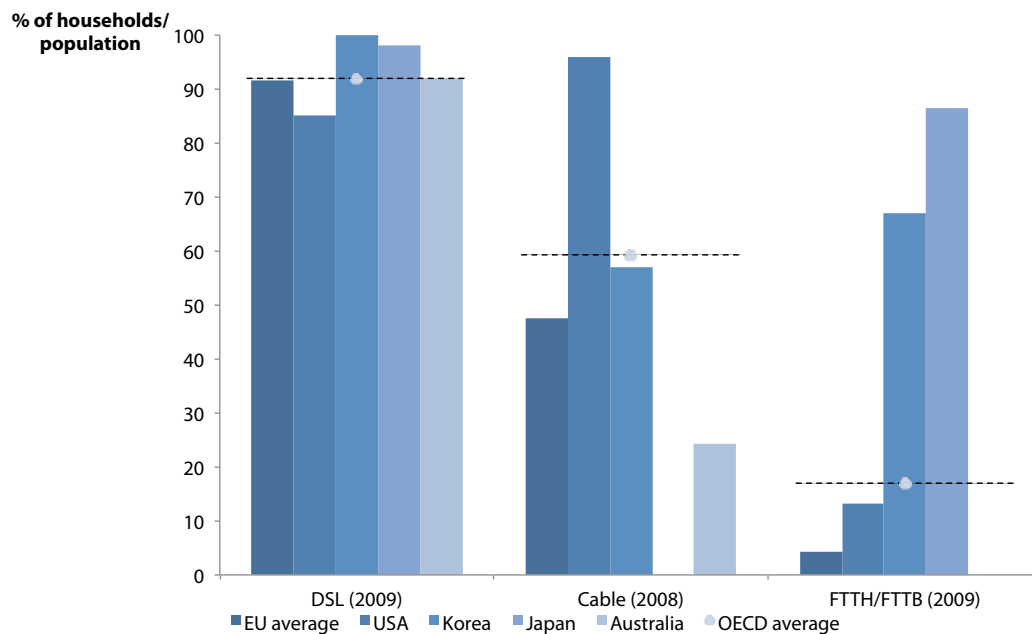
Figure 5: Breakdown of fixed broadband connections in Europe by speed (January 2012)



Source: Digital Agenda Scoreboard (http://ec.europa.eu/information_society/digital-agenda/scoreboard/docs/download/broadband_lines_agreements.xls)

8. Coverage of fibre access networks is very limited in Europe, and stood at less than 5% of the population in 2010,⁹ well below the OCED average (represented by the dotted line in the figure below). Cable coverage, although much higher than fibre coverage, is also trailing the OECD average with roughly the same gap in absolute terms (approximately 12 percentage points) as Figure 6 shows.

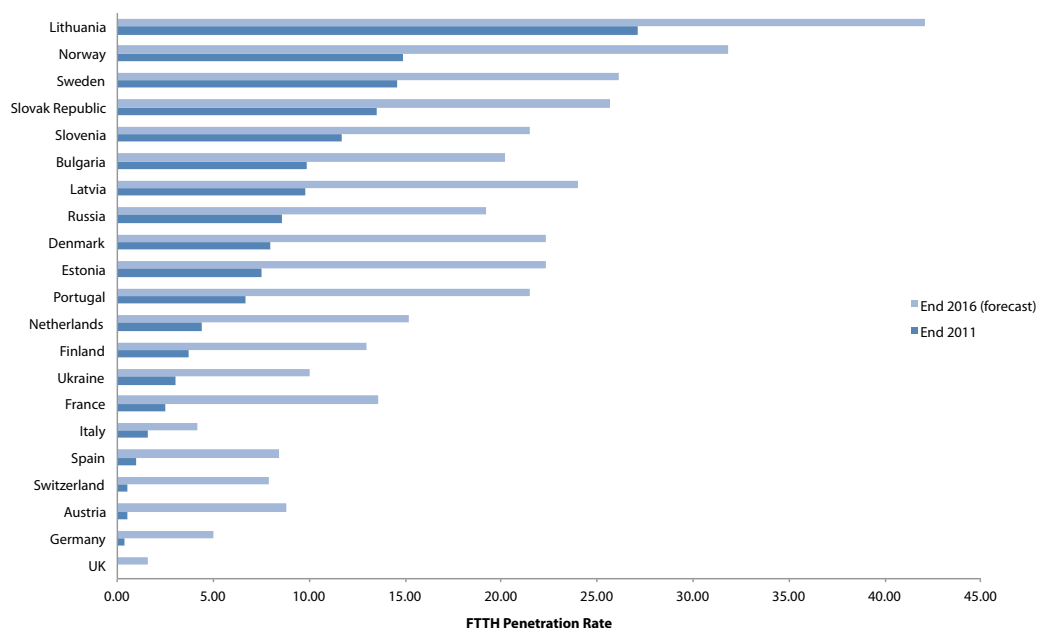
⁹ Jussi Hatönen, "The economic impact of fixed and mobile high speed networks", presentation at the EIB Conference in Economics and Finance, October 2011.

Figure 6: Coverage of broadband technologies

Source: OECD Broadband Portal,

http://www.oecd.org/document/54/0,3746,en_2649_34225_38690102_1_1_1_1,00.html#Coverage

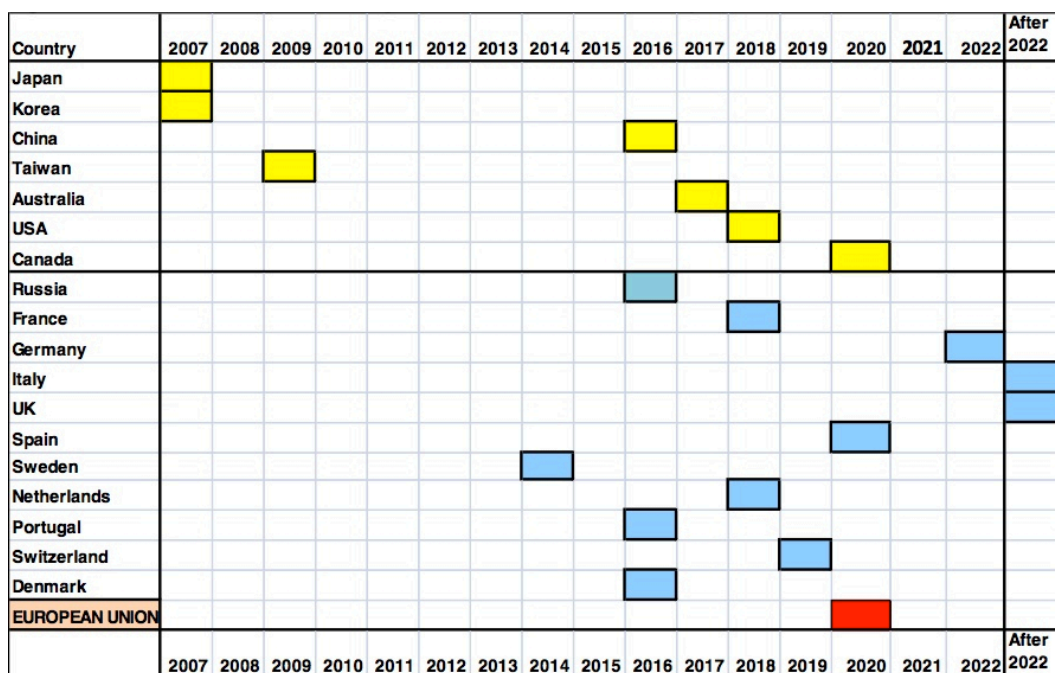
9. Fibre roll-out varies considerably across Europe, with Lithuania, Norway, Sweden, the Slovak Republic and Slovenia leading the way with the five highest fibre penetration rates (see Figure 7). The picture is not expected to change by the end of 2016, with those countries that are currently lagging not expected to catch up, and with the gap in penetration levels expected to widen further still.

Figure 7: Fibre penetration in Europe 2011/2016

Source: Heavy Reading, "FTTH in Europe: Forecast & Prognosis, 2011-2016", White Paper prepared for the FTTH Council

10. Overall, the FTTH Council predicts that fibre coverage will only reach 10.6% of households in the EU by the end of 2016,¹⁰ and that Europe will continue to lag behind the leading countries in the Asia-Pacific region as well as North America in terms of the time needed to reach 'fibre maturity' (defined as a 20% household penetration of FTTH or Fibre To The Building (FTTB)).

¹⁰ Heavy Reading, "FTTH in Europe: Forecast & Prognosis, 2011-2016", White Paper prepared for the FTTH Council.

Figure 8: Time of reaching fibre maturity within and outside Europe

Note: Yellow blocks represent countries outside Europe; blue blocks represent European countries; red block represents the EU as a whole.

Source: Heavy Reading, "FTTH in Europe: Forecast & Prognosis, 2011-2016", White Paper prepared for the FTTH Council.

11. Even where higher connection speeds are available, take-up is limited. Research undertaken by IDATE Consulting and Research - presented at the recent FTTH Council Europe Conference 2012 in Munich - showed that, at the end of December 2011, in the EU27 there were only 4.5 million FTTH/FTTB subscribers. However, there were 25.8 million homes 'passed' by the fibre, which suggests an average take-up rate of just 17.5%.¹¹ Whilst the take-up rates were high in Norway and Sweden, many countries experienced notably low take-up rates including France (<11%), Switzerland (<4%) and the UK (<2%).¹²

1.2 The case for fibre

12. Overall, both the availability and take-up of fast and ultra-fast broadband across Europe need to be improved substantially and in order to meet the DA targets.
13. Further upgrades to copper technologies, such as Very High Speed DSL (VDSL), can support download speeds of up to 50Mbps. However, whilst technologies

¹¹ Number of subscribers as a proportion of total Homes Passed.

¹² IDATE Consulting and Research, "FTTH/B Panorama", FTTH Council Europe Conference Munich, 15 February 2012 (http://www.ftthcouncil.eu/documents/Reports/Market_Data_December_2011.pdf)

such as DSL bonding (the combination of multiple DSL lines to provide higher bandwidth) or vectoring (the use of signal processing to remove noise from crosstalk) may be capable of supporting the provision of ultra-fast broadband (over 100Mbps) to some customers, whether these solutions will deliver such speeds in a commercial deployment and to the extent that would be needed for meeting the take-up target for ultra-fast broadband remains unclear.

14. This is because the performance of broadband services provided over copper networks tends to diminish (often sharply so) with distance – at a distance of 1.6km from the exchange, for instance, the performance of VDSL technologies can be reduced to the equivalent of the more commonly-deployed ADSL2+ technology. The ability of an operator to provide a consistent high-speed broadband service is also constrained by the quality of copper in the local access network.
15. As the Commission has noted in relation to its broadband vision, “[n]ot only download speeds are important in that context, but higher symmetry (much higher upload speeds) and lower latency may be required for innovative services and applications. There are already examples of services that depend on such connections: smart electrical grids that require low latency and can cut consumer expenditure and lower generating costs; real-time cloud computing services that require symmetrical upload and download speeds and can be used by small businesses to lower their costs; and intensive e-health services offered to remote hospitals and patients.”¹³ As shown above, both the US and Japan have set explicit upload targets in order to capture these effects. Fibre in the access network delivers the best performance to meet these conditions.
16. If the target speeds specified in the DA are interpreted as guaranteed (rather than ‘up to’) download speeds, and somewhat lower but still substantial upload speeds, then copper networks alone are unlikely to be sufficient to meet the DA objectives. Although fibre networks are also likely to be used to support broadband services featuring asymmetric upload and download speeds in the same way as copper networks already are, the key differentiator for fibre networks is that they can consistently support the provision of far higher upload and download speeds and can do so consistently, with in-built service guarantees that cannot be offered when the service is provided over copper. Moreover, unlike copper technology, the performance of a fibre network does not diminish with distance, allowing a more consistent quality of service.
17. As a result, while incumbent copper networks appear capable of meeting some of the basic DA targets, this report is premised on the assumption that the DA targets can be met fully only with a substantial amount of fibre deployment in the access network, and that fibre deployment provides the basis for any future growth in bandwidth demand or requirements.

¹³ “European Broadband: investing in digitally driven growth”, Communication from the European Commission, COM(2010) 472, September 2010, p 3.

18. Even if the policy case for fibre is strong, the business case for building FTTH networks is challenging. Rolling out such networks requires substantial investments¹⁴, which are predominantly sunk. The return is uncertain because it is unclear how much end-customers are likely to be prepared to pay for ultra-fast connections, and to what extent the requirement for providing wholesale access at regulated charges might curtail any upside in the case where take-up and willingness to pay turn out to lie more at the optimistic end of the spectrum of expectations. Uncertainty about future revenue streams is further increased by the fact that willingness to pay for ultra-fast connections is likely to be driven by the availability of services that make full use of the available bandwidth, once that infrastructure is made available to developers. The combination of uncertainty and sunk costs means that there is a substantive 'option' value associated with delaying the investment – and the fact that playing a 'wait-and-see' strategy is very attractive is clearly reflected in the rather slow roll-out of FTTH networks.
19. The problem is compounded by the fact that – at least in the short to medium term – incumbents and new entrants have a tempting alternative, namely to invest in upgrading the existing copper infrastructure, and using wholesale access to enhanced copper networks for providing services. Whilst the speed gains may be much smaller than what could be achieved by deploying fibre, and the service quality much more variable in terms of what bandwidth is actually delivered to each customer, the significantly lower investment cost makes such a strategy very attractive. The option also affords the ability to test end-customers' appetites for higher speeds, and service providers' inventiveness in coming up with new services that make use of the available bandwidth.
20. Last but not least, even under the most optimistic scenario in relation to take-up and willingness to pay, it may be the case that the value of an ultra-fast broadband infrastructure with wide reach is not fully represented by the user's willingness to pay. There may be wider societal benefits – positive externalities, in economic terms – that make the public policy case for fibre deployment stronger than even the best business case could be. As the Commission has stated, the *"target for fast and ultra-fast internet access was chosen because of the central role it will play in economic recovery and in providing a platform to support innovation throughout the economy, as electricity and transport did in the past. The roll-out of ultra-fast open and competitive networks will stimulate a virtuous cycle in the development of the digital economy, allowing new bandwidth-hungry services to take off and fuelling growing citizen demand, which in turn will stimulate further demand for bandwidth."*¹⁵

¹⁴ The European Investment Bank (EIB) estimates that meeting the DA broadband targets would require investment of between €143 billion (assuming prescribed target speeds are actual access but asymmetric speeds) and €221 billion (assuming prescribed target speeds are actual and symmetric access speeds).

¹⁵ European Commission, "European Broadband: investing in digitally driven growth", Commission Communication COM(2010) 472, September 2010.

21. This strongly links the broadband targets set out in the Digital Agenda to the grand infrastructure projects of the past (transport and electricity), which were often, but not exclusively, driven by commercial motives, and strongly supported by public policy.

1.3 The challenge for regulatory policy

22. Given the fact that the business case for fibre investment that is likely to be required to meet the targets set out in the Digital Agenda is challenging, a key question is how regulatory policy affects the incentives for fibre roll-out, and what might be done to promote investment in FTTH infrastructure.
23. It is this question that we address in the remainder of this report, looking first at how to regulate a fibre network whilst providing appropriate investment incentives for fibre in Section 2. In Section 3, we look at the incentives to invest in fibre during the period of transition from copper to fibre networks and consider how regulatory policy in relation to copper networks might affect fibre investment incentives. We also look at how to induce fibre investment in a period where fibre technology is in its infancy and while copper is gradually phased out. In Section 4, we move beyond the current regulatory framework of copper and Next Generation Access (NGA) and look at other options such as an augmented regulatory framework or public funding that could support fibre roll-out. Finally, in Section 5 we conclude on the combination of regulatory policy proposals that offer the prospect of being most effective in terms of incentivising fibre investment.

2 Regulated access charges and fibre investment

In this chapter, we examine in detail how regulated wholesale access charges are currently set and what this could mean for incentives to invest in the deployment of FTTH.

In doing so we look at existing regulatory policy within Europe in relation to Next Generation access networks, focusing in particular on the principles contained in the European Commission's NGA Recommendation and how these are likely to be implemented in practice by national regulators.

We discuss in depth the key choices facing regulators in the setting of cost-based wholesale access charges. In doing so we review the different approaches to costing methodologies that regulators are using to price access to existing copper-based services and what this means for pricing access to fibre-based wholesale services.

We examine the important issue of how regulators might best implement the Commission's recommendation that an appropriate risk premium should be included when setting wholesale fibre access charges. In this regard, we show why the inclusion of such a premium is only part of the issue and that a credible commitment on the part of the regulator to maintain this premium into the future is also key.

We go on to consider how risk in relation to fibre deployment might best be shared, through the use of different approaches to access pricing and via the adoption of co-investment strategies. In relation to the latter, we look at how IRU access is already emerging as an option for co-investment and we assess the possibilities and limitations of this approach.

We then turn our attention to the kinds of policies that national regulators need to consider in helping to promote more widespread roll-out of FTTH networks across Europe and how regulatory policy in this area needs to place more emphasis on promoting an environment that is conducive to investment in fibre networks and is less concerned about access to infrastructure that, in the main, has not yet been deployed.

2.1 Access regulation for NGAs

24. Expectations in relation to the way in which regulation will be applied to Next Generation Networks (NGNs) has a major impact on the business case for fibre deployment. As network operators who are designated by national regulators to hold positions of Significant Market Power (SMP) must provide wholesale access at charges set on the basis of cost orientation, regulatory policy affects the returns that a network investor can expect to earn (see box below discussing the effects of different regulatory policies in the context of a simple model). The impact is both direct through limiting the amount that a network operator can charge for wholesale access, and indirect through limiting the prices that can be charged to final users, given competition with other service providers operating on the basis of wholesale access to the operator's network. Uncertainty over the likely shape of future regulation will add to the risk facing an investor and have a detrimental impact on an investor's incentives.

25. Acknowledging the need for regulatory certainty, the European Commission in 2010 published its recommendation in relation to the regulation of access to Next Generation Access (NGA) networks (the 'NGA Recommendation'),¹⁶ which stipulates that SMP operators should be required to provide unbundled access to the fibre loop where deployed, and that exceptions can only be made in geographic areas where several infrastructures are present and competitive access offers that ensure effective downstream competition are in place. The principle of cost orientation should also apply to regulated wholesale charges for NGA access, but that *"to foster the deployment of NGA and to encourage market investment in open and competitive networks the Commission will adopt a NGA Recommendation based on the principles that investment risk should be duly taken into account when establishing cost-oriented access prices [...]"*.¹⁷

¹⁶ Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU).

¹⁷ BEREC, "Draft BEREC report on Co-investment and SMP in NGA networks", 8th December 2011, page 12.

Modelling the impact of regulation on investment incentives

Nitsche and Wiethaus (2011)¹⁸ developed a simple model to assess the incentives to invest in Next Generation Networks (NGN) under different regulatory regimes:

- access charges set at Long Run Incremental Costs (LRIC), which in the model entails an entitlement to recover investment costs from access seekers if the investment is efficient (i.e. if the NGN investment turns out to be justified by the willingness to pay of end-users);
- access charges set at Fully Distributed Cost (FDC), which means that investment costs are recoverable from access charges regardless of whether the investment turns out to be successful;
- risk sharing, where the incumbent and the new entrant jointly invest in the network (aiming to maximise industry profits), and then use it to compete downstream without making any payments; and
- a 'regulatory holiday', with the absence of any regulatory obligation to provide access, at least for a predefined period of time.

Investment incentives are measured by the extent of NGN deployment, and expected consumer welfare takes account of both NGN roll-out and end-user prices in the different cases.

The authors find that both a regulatory holiday and FDC-based access charges provide greater investment incentives than risk sharing and that the latter provides greater incentives than LRIC-based charging unless the probability that consumers have a higher willingness to pay for NGN access is sufficiently large.

Nitsche and Wiethaus also consider the application of a risk premium in order to mitigate the asymmetric curtailment of the upside under the LRIC approach. In other words, risk premia can allow an incumbent to charge above cost in the case of a positive demand development in order to compensate for the lack of contribution to investment costs through access charges when the higher willingness to pay for NGN services remains. However, the authors believe that the leverage of such an instrument would be limited because it would come into effect only when willingness to pay turns out to be high, and would in this case have a potentially large impact on competition.

As the authors highlight, the model is of course highly stylised, based on restrictive assumptions and focusing on very specific implementation of a limited range of regulatory policies. However, it effectively demonstrates the complex effects that regulatory policies have on investment, the role of risk and the asymmetric distribution of risk on investors and access seekers. The authors also highlight the importance of considering investment incentives and the intensity of competition on the basis of investments already undertaken when considering the consumer welfare effects of different regulatory options. The results *"suggest that regulators may dismiss regulatory holidays for good reason whilst they might consider risk-sharing arrangements a priori positively or even encourage them. One critical question open for future research is how to set access conditions (if any) for (late) entrants that do not participate in a risk-sharing agreement. In this context it seems pivotal that, first, a risk-sharing consortium allows all interested parties to get on board ex ante and, second, an overly favourable ex post access obligation does not jeopardise the very idea of risk-sharing."*¹⁹

¹⁸ R Nitsche and L Wiethaus, "Access Regulation and Investment in Next Generation Networks: A Ranking of Regulatory Regimes", ESMT Working Paper No 09-003, June 2009, later published in the International Journal of Industrial Organization, Vol. 9, 2011.

¹⁹ Nitsche and Wiethaus, op. cit., p 20.

26. Recognising that *"[t]he deployment of FTTH will normally entail considerable risks given its high deployment costs per household and the currently still limited number of retail services requiring enhanced characteristics (such as higher throughput) which can only be delivered via fibre"*, the NGA Recommendation states that *"[t]he costs of capital of the SMP operator for the purpose of setting access prices should reflect the higher risk of investment relative to investment into current networks based on copper."*²⁰ In addition, the Recommendation advocates that national regulators should consider other pricing arrangements for regulated access to the unbundled fibre loop such as long-term access prices or volume discounts that would allow an investor to diversify its risk, and includes provisions in relation to co-investment in fibre networks where such co-investment supports infrastructure competition between the co-investors.
27. What matters for investment incentives, however, is how access to NGA infrastructure and services will be regulated in practice. This is determined by how national regulators will implement the Recommendation within their own jurisdictions, and there are a number of uncertainties in relation to how regulators will account for risk and employ additional provisions in relation to differentiated access pricing schemes and co-investment above and beyond the question of how they will measure costs for new fibre deployment.
28. This is not just a matter of calculating correctly the premium that regulated firms should be allowed to earn above their cost of capital in order to account for the risk they are facing when deciding whether to invest. In order to promote investment, regulators would need to commit to not revising their views on the profits that a regulated firm will be allowed to make if demand turns out to be towards the upper end of the expectations. The larger the risks, the greater the premium would need to be – and the greater the likelihood that the need for such a premium is being questioned in case the investment pays off.

2.2 Measuring costs

29. Although cost-based access charges are an established instrument in the regulatory toolkit and have been used for more than a decade, the principle of cost-orientation leaves substantial latitude to regulatory authorities as to how this obligation is implemented in practice. Ofcom in the UK, for example, has only recently pointed out that there are considerable interpretative difficulties surrounding the requirement under the European regulatory framework that *"[e]ach and every charge offered, payable or proposed is reasonably derived from the costs of provision based on a forward looking long-run incremental cost approach and allowing an appropriate mark up for the recovery of common costs*

²⁰ Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU), paragraph 23.

including an appropriate return on capital employed", when imposing a cost-orientation obligation on an operator with SMP.²¹

30. This simply reflects the fact that establishing the costs associated with the provision of a particular access service is complicated because such services are normally provided using assets that have been constructed at some point in the past, have a long life span and support a range of services that can be provided concurrently. Calculating the cost of an access service involves some important choices (see separate box) and regulators have at their disposal a number of approaches for setting cost-based access charges.

²¹ Ofcom, "Review of cost orientation and regulatory financial reporting in telecoms, Call for inputs", November 2011, paragraph 1.10. These difficulties have most recently been brought to light by a dispute in the UK in relation to partial private circuits (PPC) (see UK Competition Appeal Tribunal PCC judgment of March 2011: <http://www.catribunal.co.uk/238-5136/1146-3-3-09-British-Telecommunications-Plc-.html>). Through its call for inputs, Ofcom sought to engage with stakeholders posing questions in respect of the circumstances in which it should impose cost orientation obligations on SMP providers, with what objectives and how those should be interpreted and, once imposed, how the obligations should apply. In particular, Ofcom posed questions around alternative remedies that might obviate the need for cost orientation, the manner in which the obligation might interact with others (such as non-discrimination) and the credibility, advantages and disadvantages of alternative cost standards that could be applied (ranging from LRIC+, DSAC/DLRIC ceiling/floors to FAC). It also asked questions in respect of the level of aggregation that should be used (e.g. product level or market level), the impact that changing technologies might have on the interpretation of cost orientation, and whether other factors, such as demand patterns or efficiency consideration, should be taken into consideration by Ofcom.

Key choices in establishing cost-based charges

Relevant asset base: In order to identify the assets that are used for the provision of a regulated service, one may look at the asset register and accounting output of the regulated firm (top-down), or an economic or engineering model of the regulated firm's operations (bottom-up). Top-down approaches give great weight to the existing configuration of an operator's network (which may not necessarily be efficient), whilst bottom-up approaches are more flexible in terms of establishing how an efficient operator could be structured, and what the efficient provision of services ought therefore to cost.

Asset valuation: this can be done on the basis of the cost historically incurred for an asset (historic cost), appropriately written down or establishing the replacement costs at any particular point in time (i.e. using modern equivalent assets at current cost). Whilst the top-down method with historic costs ensures that costs that have actually been incurred are recovered, it does not necessarily provide good price signals that reflect the cost of providing access. Charges calculated from an operator's books might include inefficiently incurred costs, which should not be recovered from access seekers. On the other hand, the book value of assets very rarely reflects their economic value, and it may be much lower (if assets have been depreciated in the book but are still in use to provide services) or higher (if technological developments have rendered historic assets obsolete). Therefore, access charges based on top down cost may not necessarily give appropriate build or buy signals.

Depreciation profile: with investment cost incurred at a specific point, but with assets utilised over a long period, the choice of annualisation or depreciation profile is a key factor in determining the annual costs of providing access as it spreads the investment costs over the perceived lifetime of the asset. From a cost recovery standpoint, each annualisation method results in a stream of permitted revenues that (ideally) matches the initial investment, but is associated with different 'price' paths. This means that switching approach during the lifetime of an asset without properly accounting for the costs recovered by the previous method may lead to the under- or over-recovery of costs. Economic depreciation approaches may be used, in which annualised investment costs are based on the expected evolution of demand, for example, or revenues that the operator could expect during the life of the asset. These methods would spread the costs of investment in such a way that stable unit costs are achieved, by adjusting annual capital charges based on a business plan and expected revenues of an operator. This is referred to as the discounted cash flow (DCF) approach, and has the great advantage of sharing the burden of recovering investment costs in line with the expected profile of demand, i.e. costs are recovered over the life of the asset based on expectations of demand.

Cost allocation: because many of the costs incurred by an access provider are common across a number of services, and fixed over a considerable range of output levels (i.e. change with output in a lumpy manner), it is necessary to determine what costs should be attributed to a particular service. A fully distributed (or allocated) cost (FDC/FAC) method allocates the whole set of costs which contribute to providing the service. Common and joint costs are allocated using rules determined by their direct or indirect causality to provide services. In this way, the method allocates all fixed and common costs (or a proportion thereof) to the cost of providing the service. Alternatively, a pure Long Run Incremental Costs (LRIC) method only includes costs that are incurred purely because of providing the service (or would be served as a result of not doing so). Access seekers make no contribution to shared and common costs. Whilst pure LRIC-based approaches ensure that an asset is efficiently used, they may not provide the proper investment incentives. LRIC+ approaches include a mark-up over pure LRIC in order to account for some of the fixed and common costs.

31. Even where the same methodologies are used, there are potentially large differences in regulated charges. A survey conducted by Body of Europe Regulators for Electronic Communications (BEREC)²² shows that since 2008,

²² BEREC, "Regulatory Accounting in Practice 2011", October 2011.

the majority of NRAs apply a combination of Current Cost Accounting (CCA) and Long Run Incremental Cost (LRIC)²³ to set cost-oriented wholesale access prices. Yet, access charges for unbundled copper loops in 2010 /2011 ranged from €5.98 in Poland to €13.98 in Finland.²⁴ Some of these differences may of course simply reflect country- and network-specific factors, such as differences in labour and civil engineering unit costs, topographic or demographic differences, or differences in financial parameters such as the cost of capital. It is however unclear whether such differences explain the entire variation in charges. Moreover, there are examples of dramatic changes even within a country, driven by adjustments made to key inputs (see box below).

Implications of asset re-valuations on cost²⁵

In the UK in 2010 there was a significant upward variation to the unit cost of wholesale access services reported by BT in its regulatory financial statements without any change having been made to the underlying methodology (top-down FDC using current cost accounting) or its implementation. The reason for the change was that as a result of a detailed review of how it purchased ducts, BT discovered that the discount it had been assuming in this calculation prior to 2010 should be revised from 45% to 14.5%. This is because the duct and its associated structures (manholes, joint boxes and cabinets) were valued at replacement cost – defined as the current contractual price which BT paid its suppliers for the construction of the assets in question after taking into account the discounts that would apply for bulk purchasing – the revision of the available discount led to an upward revision in the replacement cost of the ducts in a single year of the order of GBP1.9 billion. Although there was no direct impact on wholesale prices, which are set with reference to a price cap over a period of four or five years, there will be an indirect impact on the calculations underpinning the price cap to apply in the next control period because duct costs represent a significant proportion of the unit cost of unbundled local loops.

32. The choice of costing methodology provides regulators with some freedom in terms of trading off potentially conflicting regulatory objectives. What particular costing methodology should be applied is “*determined by two key factors: the prioritisation of the regulatory objectives, and prevailing market conditions*”, as BEREC noted in its recent response to the Commission’s consultation on costing methodologies.²⁶ A key consideration in this regard is the specific trade-off that needs to be struck between promoting intense retail competition in the pursuit of static efficiency (i.e. making sure that existing assets are used efficiently and that prices are driven towards marginal cost),

²³ Note here that the BEREC survey does not differentiate between pure LRIC and LRIC plus.

²⁴ Access charges are presented as monthly average total cost for full LLU and taken from the Digital Agenda Scoreboard

²⁵ See BT’s Regulatory Financial Statements 2010, “Current Cost Financial Statement for 2010 including Openreach Undertakings, Statement by Ofcom”, p 17f.

²⁶ BEREC, “BEREC’s answer to the Commission’s questionnaire on Costing methodologies for key wholesale access prices in electronic communications”, 9th December 2011, p 7.

and strengthening the incentives for investment in competing infrastructures and the deployment of new technologies (dynamic efficiency).

33. In light of the discretion that is available to NRAs within the principle of cost orientation, the European Commission has consulted on costing methods used for the setting of wholesale access prices and the implementation of cost orientation across Member States, *"with the objective of providing EU guidance to national regulatory authorities on how to set wholesale access prices in the transition period from copper to fibre-based networks, as announced in the Digital Agenda for Europe (DAE)"*.²⁷
34. Launched to stimulate an open and wide-ranging debate on the impact of different costing methodologies, the consultation notes that while price regulation based on cost orientation on the wholesale access market has in the past proven to be appropriate to remedy problems of market power, NRAs are applying divergent approaches, which may lead to a lack of predictability for investors. This may indicate an acknowledgment on the part of the Commission that regulatory policy over the past decade has been very successful in promoting competition on the basis of access to an existing network infrastructure, but that perhaps a stronger focus on investment incentives is required going forward.
35. The responses to the EC consultation show no clear consensus in relation to the most appropriate methodology for encouraging investment in fibre amongst operators. The summary in Table 1 below shows that:
 - there seems to be some agreement that different methods should be used for pricing access to fibre and copper networks, perhaps reflecting the fact that the scale of investment and the risk associated with fibre deployment are very different from those considered in relation to copper networks (although Telecom Italia, for instance, suggest that the same bottom-up LRIC approach based on CCA should be applied to both copper and fibre infrastructures *"as they belong to the same market on the national level"*²⁸);
 - the DCF method appears to be somewhat favoured for setting fibre access charges (largely because it seen to be most suited to dealing with

²⁷ Public Consultation On Costing Methodologies For Key Wholesale Access Prices in Electronic Communications, (http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/cost_accounting/costing_methods_questionnaire.pdf). The questionnaire focused on a number of features of access regulation, including cost models, modelling approaches and asset valuation methods and sought views on the choice of an appropriate cost model to calculate the cost of fibre based access. The consultation was also interested in respondents' views on the role of copper prices and a price differential to fibre access in increasing NGA investments including the effect of increasing or decreasing the copper access price – a topic that we will discuss in more detail below.

²⁸ All further references to responses to the EC consultation are to the publicly available versions of these responses, available at http://ec.europa.eu/information_society/policy/ecomm/library/public_consult/cost_accounting/index_en.htm

the uncertainties facing fibre investors and takes account of the interdependence between price and demand assumptions²⁹, though this adds complexity and limits transparency³⁰) – but FDC and LRIC approaches are also considered appropriate; and

- given that investments would be contemporaneous, there would seem to be little difference between using HCA and CCA for fibre networks. Indeed, some respondents proposed that either HCA or CCA could be used for the regulation of fibre. Fastweb, for example, considers that a Bottom-up LRIC model based on HCA would be a preferred method for fibre access charges during the transition, as the methodology involves actual costs and thus provides correct market signals for investors.

Table 1: Responses to EC consultation on costing methodologies

Respondent	Recommended methodology for pricing copper access	Recommended methodology for pricing fibre access
Bouygès Telecom	HCA with added depreciation mechanism	CCA DCF
BRECO	BU LRIC HCA	N/A
BT	TD FDC CCA	LRIC CCA <i>or</i> DCF
BUGLAS	HCA	N/A
Deutsche Telekom	BU LRIC	DCF
EWE TEL	LRIC HCA	LRIC HCA (or CCA)
Fastweb	SRIC	BU LRIC CCA <i>or</i> DCF
KPN	BU LRIC	DCF
Orange	CCA	DCF
S.E.C	TD FDC HCA	
Tele2	FDC HCA	FDC HCA (or CCA)
Telecom Italia	BU LRIC CCA	
Telefonica	TD CCA	
Telekom Austria	FDC	FDC CCA

Notes: HCA – Historic Cost Accounting, CCA – Current Cost Accounting, BU – Bottom Up, TD – Top Down, LRIC – Long Run Incremental Cost, SRIC – Short Run Incremental Cost, FDC – Fully Distributed Cost, DCF – Discounted Cash Flow.

²⁹ See, for example, the responses from Bouygès Telecom, KPN, Orange and Deutsche Telekom

³⁰ See response from EWE TEL.

36. If the responses show no clear consensus on the most appropriate methodology, however, they suggest that a common concern is the ability to recover costs³¹, and the uncertainty that some methods (in particular LRIC with CCA) might create in this regard.³² There also appears to be some common view that it would not be desirable to change costing methodologies in order to achieve harmonisation across Member States, which is echoed by BEREC arguing that a switch from say HCA to CCA, for example, in a country could reduce investor confidence, even if it improved the theoretical rigour of the costing policy. Instead, it would be less harmful to leave each country to continue with its current methodology in order to favour regulatory stability and predictability from one year to the next.

2.3 Accounting for risk

37. As noted above, in order to account for the specific risks associated with fibre investment, the NGA recommendation provides for the inclusion of an appropriate risk premium when setting wholesale access charges for fibre. The EC recommends that *“NRAs should, where justified, include over the pay-back period of the investment a supplement reflecting the risk of the investment in the WACC calculation currently performed for setting the price of access to the unbundled copper loop.”*³³ Such a premium should reflect *“additional and quantifiable investment risk incurred by the SMP operator”* and regulators must strike a balance between *“providing adequate incentives for undertakings to invest”* and *“promoting allocative efficiency, sustainable competition and maximum consumer benefits”*. This means that the return on capital allowed ought to be sufficiently high without being excessive.
38. In estimating the investment risk, the NGA Recommendation outlines a number of factors that should be considered, including³⁴:
- uncertainty relating to retail and wholesale demand;
 - uncertainty relating to the costs of deployment, civil engineering works and managerial execution;
 - uncertainty relating to technological progress;

³¹ BT for example asserts that costing methodologies should be assessed against two criteria, namely the extent to which cost recovery over the life of the assets is achieved, and the extent to which the methodology ensures prices are consistent with those of a competitive market. BT recognises however that no single costing methodology is able simultaneously to achieve both objectives, and therefore there are trade-offs that need to be considered.

³² See for example the responses from Deutsche Telecom or Telekom Austria, which favours FDC as this method ensures that actual rather than hypothetical costs are recovered.

³³ See Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU), Annex 1, Section 6.

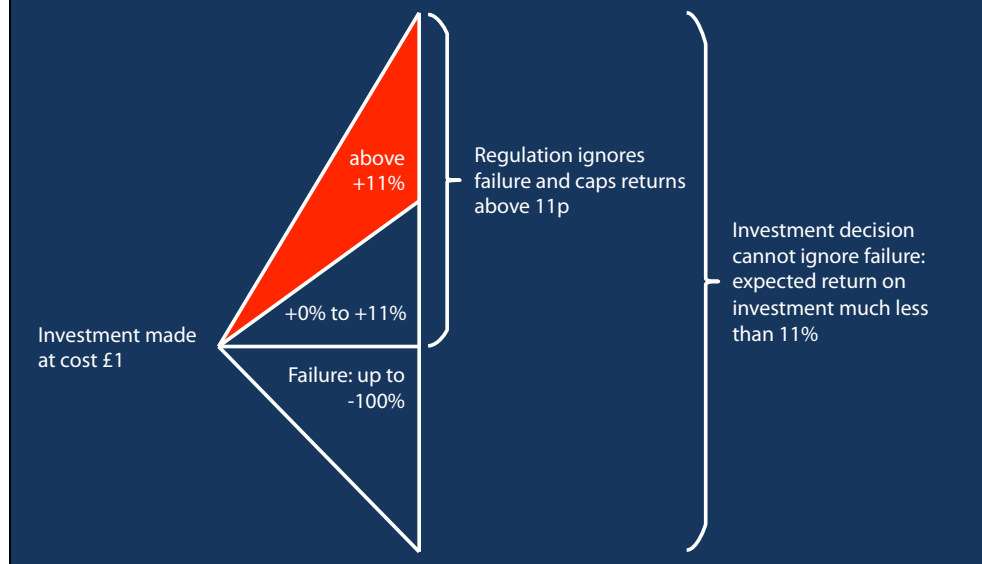
³⁴ Ibid.

- uncertainty relating to market dynamics and the evolving competitive situation, such as the degree of infrastructure-based and/or cable competition; and
 - macroeconomic uncertainty.
39. Allowing for the incorporation of a risk premium in the cost of capital addresses the regulatory hindsight bias that is inherent in the use of a firm's weighted average cost of capital for calculating the allowable return on an uncertain investment (see box below). However, as noted above, the key issue is not just one of correctly calculating what rate of return an investor would have to expect to make in the case where uncertain demand materialises, for example, in order to be compensated for the risk that it might not. In order to have the desired effect, the investor must also be able to rely on the regulator's commitment to allow this rate of return after the event. Although this may seem obvious, it is far from clear that the required premium will survive the pressure to bring down prices if demand turns out to be high, in particular where the premium has to be substantial in order to compensate for a high level of uncertainty. Put differently, the calculation of an appropriate premium is only one part of the equation – credible commitment to sticking with this premium in the face of pressure from competitors and customers is the other.

WACC and regulatory hindsight bias

Although regulatory hindsight bias might appear to be too obvious an error to occur in practice, the common use of a firm-specific Weighted Average Cost of Capital (WACC) in the calculation of cost-based access charges includes such a bias. Imagine, for example, a network operator with a Weighted Average Cost of Capital (WACC) of 11%, and a regulator setting access charges to limit the return of that firm from the provision of regulated access to 11%. This completely ignores that at the point at which an investment is made, future returns are uncertain, and may include cases in which the investment has to be written off completely, as well as cases in which the return might be well above 11%. The investment will only be undertaken if the net present value of future returns, calculated as the firm's WACC, is positive (though this is a necessary, but not a sufficient condition, as firms may apply project-specific hurdle rates for good reasons), but not otherwise. The regulatory constraint will 'bite' only in the case where the firm would otherwise earn a return in excess of 11%, but not in cases where for example the willingness to pay of customers or take-up turn out unfavourably.

In the case that the investment is a success, the firm would make an 11% return. However, if it is unsuccessful, the firm would lose the full sum of its investment. If the firm was only allowed a regulated rate of return of 11%, this firm would not invest as the expected rate of return on the investment given the counterfactual of failure cases would fall below its WACC of 11%, which would be loss making as illustrated below.



40. In addition to considering the cases of failure when setting an appropriate return on risky investments, allowing a risk premium on the WACC may not be sufficient. Further adjustments would be needed to account for the option value that an investor gives up as a result of committing resources – i.e. the value of delaying investments until some of the uncertainty over future returns has been resolved (see box below). The value of this option is commonly reflected in firms using hurdle rates that are well in excess of their cost of capital, and regulated returns that should promote investments have to take account of this. Put differently, expecting to be able to earn a regulated return that covers a firm's WACC is insufficient to trigger investment that is sunk and where returns are uncertain.

Sunk investments under uncertainty and the value of real options

The assumption that allowing an investor returns equal to the (properly measured) WACC is sufficient to provide an incentive to invest, fails to consider that investors typically have the option to delay their investment. Such an option is potentially very attractive if the investment is sunk and cannot be recovered if market developments turn out to be unfavourable. In the presence of uncertainty, delaying the investment is valuable because the investor retains the flexibility to invest only in some circumstances, but not others.

This means that in order to have an incentive to invest now rather than to wait and see, an investor needs to be compensated for the value of the option to invest later, which means that the required returns must be above the WACC. As Pindyck puts it, the “WACC *does not incorporate any adjustment for option value. To understand why, note that the WACC is simply the firm’s opportunity cost of capital. However, it is not the threshold expected return (or hurdle rate) needed to justify an investment. It would be the threshold expected return (or hurdle rate) if the investment in question was reversible, or if the firm had no option to delay investing and thereby wait for more information about market conditions. If, on the other hand, the investment in question is irreversible (as is usually the case in the telecom industry), the hurdle rate must exceed this opportunity cost of capital.*”³⁵

Whilst an investor in network infrastructure gives up the option to invest at a later stage, contingent on developments of demand, for example, its competitors purchasing wholesale access at regulated terms continue to benefit from substantial option values, as they essentially receive access on a ‘pay as you go’ basis without sinking any costs. This asymmetry in risk faced by an access seeker and the access provider also needs to be considered in looking at access prices in order to ensure that expected returns are sufficient to compensate the investor for undertaking the investment.

Calibrated estimates from the US suggest that, in order to address option values, an adjustment of up to 4.5 percentage points in the cost of capital used for setting Total Element Long Run Incremental Cost (TELRIC)³⁶ charges might be appropriate.³⁷

Hurdle rates in excess of the cost of capital are quite common in other industries, such as in electricity generation when looking at investments that are subject to uncertainty like investments in low carbon generation. For example, recent estimates³⁸ suggest that Vertically Integrated Utility (VIU) investors with a cost of capital at 6% face hurdle rates from 8% for investment in new generating capacity using mature technologies (e.g. onshore wind) up to 12% when deploying emerging technologies (e.g. Carbon Capture and Storage Coal). Elements of the recently published UK Energy Bill (2012) focus on removing uncertainty from the returns of investing in low carbon energy in order to develop the UK electricity network infrastructure and meet renewable energy obligations. Redpoint estimate that reducing uncertainty through fixed payments (per MWh of low carbon electricity) for example will lead to a reduction in the hurdle rate of up to 2% for an investor in new UK nuclear capacity compared with a 13.2% baseline.

³⁵ R S Pindyck, Mandatory Unbundling And Irreversible Investment In Telecom Networks, MIT Sloan School of Management Working Paper 4452, December 2003.

³⁶ “The total element long-run incremental cost (TELRIC) method was developed in the U.S. (by the FCC) as an approach to calculating prices based on the increment of the unbundled elements used to provide the service. In other words, it measures the incremental cost of adding or subtracting a network element from a hypothetical efficient system using current technologies. In addition, the method includes a reasonable allocation of forward-looking common costs, which allows the incumbent to recover a share of the fair value of their inputs in a competitive market over the long term.” See <http://www.regulationbodyofknowledge.org/faq/telMostCommonModels/>

³⁷ R S Pindyck, “Pricing Capital Under Mandatory Unbundling and Facilities Sharing”, NBER Working Paper 11225, March 2005.

41. The recent EC Questionnaire on costing methodologies³⁹ also sought views on how a risk premium to provide incentives for investment in NGA infrastructures should be calculated.⁴⁰ The majority of responses from those deploying fibre were in favour of incorporating a risk premium in the WACC in order to reward the investment risk, focusing on the non-systematic or specific⁴¹ nature of the investment risk that would need to be reflected in such a premium.
42. For example, BT noted that traditional WACC estimates account only for systematic risk and, although it is likely that the systematic risk of fibre is larger than that for copper (and hence it would be appropriate for a higher WACC for fibre), they considered the considerable degree of non-systematic risk, including volume and demand uncertainty, ought to be considered as well. In their opinion, the only way to capture this risk ex-ante is to allow larger returns than the actual WACC in situations where, for example, demand turns out to be high. In other words, *"the NRA should ensure the NGA investment represents a 'fair bet' from an ex ante basis, which means committing to allow above average returns in the good scenarios, in recognition of the fact that the investment was undertaken at a time when bad scenarios could have also materialised"*.⁴² Orange further emphasised this point, commenting that an FTTH WACC must be higher than a copper WACC in normal and positive cases such that, over the random distribution of demand, the investment is at least recovered at the end of the period by the investor.
43. Whilst supporting the use of including a risk premium in WACCs, some respondents noted that additional changes might be needed alongside an

³⁸ "Electricity Market Reform Analysis of policy options- A report by Redpoint Energy in association with Trilemma UK," December 2010 in response to DECC consultation on energy market reform

³⁹ European Commission, Questionnaire for the public consultation on costing methodologies for key wholesale access prices in electronic communications, 3 October 2011.

⁴⁰ Question 18: How do you consider that the incorporation of a risk premium in the WACC should be calculated to adequately and effectively reward the investment risk and provide the necessary incentives for investment in NGA infrastructures? – EC 2011 Questionnaire on costing methodologies.

⁴¹ Non-systematic or specific risk is risk that can in principle be eliminated through holding a diversified portfolio, in contrast to systematic or market risk, which cannot be diversified. The calculation of WACC is usually based on the so-called Capital Asset Pricing Model (CAPM), which considers the opportunity cost of providing funding for a particular project, ignoring any of the specific risk and only looking at the systematic risk of the project in terms of the correlation between expected returns and market returns. Effectively, this only considers the returns that would be required in order to include the project in a well-balanced portfolio, with projects whose returns vary in line with market returns, but with larger variance, requiring a return above the risk-free rate (the rate of return on the investment assuming zero risk), and projects with counter-cyclic returns requiring a smaller return (as these projects will perform counter-cyclical to the market trend, cushioning the downsides when the market falls).

⁴² See British Telecom's response to Question 18 of European Commission, Questionnaire for the public consultation on costing methodologies for key wholesale access prices in electronic communications.

increased WACC. For example, Telecom Italia noted that the WACC to which the premium is applied should be updated more frequently than is currently the case with copper in order to ensure consistency with the reality of financial markets and the company's risk profile. Telefónica stated that simply increasing the risk factor to calculate WACC was not the most appropriate method given that it is considered the underlying Capital Asset Pricing Model (see footnote 41) to be flawed.

44. Obviously, the level at which the adjusted WACC should be set requires detailed analysis and may differ slightly from country to country based on market circumstances. A few countries have already adopted measures pursuant to the NGA Recommendation and in doing so have announced their intention to include a risk premium in the calculation of allowable returns. For example:

- The Dutch regulator OPTA was an 'early adopter' of the NGA Recommendation, deciding that it would allow a limited premium (currently undisclosed) over 'normal copper WACC' to reflect the assumed fibre project specific risk in addition to a premium to account for asymmetric regulatory risk (currently set at 3.5%), and operator returns would be checked against the resulting normative rate of return every three years.
- Although it has yet to take an official stance in line with the NGA Recommendation, the German NRA, BNetzA, published a study on the calculation of the appropriate WACC for broadband access in November 2010. The study considered the relevant risk for copper-based fixed networks and also for a fibre network, concluding that, against a baseline WACC of 7.11%, there should be a risk premium for fibre networks of around 2.59%.⁴³ It is noteworthy that this figure is lower than the 4.5% premium above WACC that has been estimated to be required in order to compensate incumbent local exchange carriers in the US for the presence of option values in the setting of TELRIC charges.⁴⁴

2.4 Risk-sharing through access pricing and co-investment

45. In addition, to providing for NRAs to include a risk premium for fibre investments, the NGA Recommendation also states that they should assess pricing schemes that are aimed at diversifying investment risks. Such pricing schemes would see a differentiation between 'pay-as-you-go' access prices and lower prices that an access seeker might obtain for entering into a long-term agreement with a certain volume commitment, as this would shift some of the investment risk from the network operator to the access seeker. Obviously, such agreements would work only with short-term pay-as-you-go

⁴³ See "Wissenschaftliches Gutachten zur Ermittlung des kalkulatorischen Zinssatzes, der den spezifischen Risiken des Breitbandausbaus Rechnung trägt" 24 November 2010.

⁴⁴ R S Pindyck, "Pricing Capital Under Mandatory Unbundling and Facilities Sharing", NBER Working Paper 11225, March 2005.

charges that include a substantial risk premium, but would offer additional flexibility for investors and access seekers to allocate risk efficiently. So far, this option does not appear to have been explored in any detail, although OPTA has considered various risk-sharing options (e.g. in the form of limited investment contributions by access seekers and volume discounts that reflect total penetration).⁴⁵

46. Going beyond differentiation in the contractual terms upon which access is provided, another option for access providers and seekers to share risk is to invest jointly in the infrastructure, and then share it to provide downstream services. The NGA Recommendation does not actively encourage such co-investment, but provide some indirect support through enabling NRAs to suspend the obligation to provide access where there are competing access infrastructures in place, and to stipulate that joint investments in networks with multiple fibre lines could provide such competing access infrastructures.
47. The NGA Recommendation states that, in order to decide whether the markets in areas covered by jointly deployed FTTH networks are sufficiently competitive, NRAs should ensure that the terms of access faced by each investor allows for these players to compete on equal footing: *"in the light of the level of infrastructure competition resulting from the co- investment, a finding of SMP is warranted with regard to that market ... NRAs should in particular examine whether each co-investor enjoys strictly equivalent and cost-oriented access to the joint infrastructure and whether the co-investors are effectively competing on the downstream market."*⁴⁶
48. Risk-sharing or co-investment models in the area of NGA network deployment can involve arrangements that have been commonplace for years in relation to the deployment of, and the sale of capacity on international submarine cables. Instead of purchasing international bandwidth via leased lines, operators have long had the option of securing access to capacity on international submarine cable on the basis of what is known as an Indefeasible Right of Use (IRU). In return for such access – with the 'indefeasible' term meaning that it is not liable to be annulled or forfeited⁴⁷ – operators can secure bandwidth capacity at far lower costs than using leased lines and can also have the option of securing access to dark fibre.
49. IRU access to optical fibre networks is no longer restricted to submarine cable access, with such access also now available on metropolitan rings, intra-city trunk networks and local loop network, including FTTH networks. IRU access is typically of far longer duration than that for leased lines (with the latter having

⁴⁵ OPTA, "Access pricing: a key element in effective NGA Access Regulation. Balancing efficient investment and effective competition", presentation by Remko Bos (Director of the Department of Markets) at the FTTH Conference 2009.

⁴⁶ Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU), Article 28.

⁴⁷ See note on IRUs by HM Revenue & Customs at: <http://www.hmrc.gov.uk/manuals/cirdmanual/cird70340.htm>

the option of rental terms of a year or even less) and can often run for 20 years or more.⁴⁸ In some cases, IRU access applies for as long as the lifetime of the asset.⁴⁹

50. IRU access in the case of FTTH has already emerged as a popular option in France, in the context of co-investment in FTTH by the four main broadband providers (France Télécom, SFR, Free Infrastructure and Bouygues). The arrangement that these players have agreed is that where one of them constructs the local FTTH connection to a building it then offers passive access to the others in the form of an IRU that runs for a period of 24 to 30 years (which is then renewable two times).⁵⁰
51. Of the various ways in which such co-investment could be organised, reliance on IRUs seems to be the one that is most likely to find favour with NRAs. As suggested by BEREC, “[f]rom a technical point of view, IRU access to a (fully spliced) multi-fibre infrastructure is likely to provide near equivalent access with respect to an own network, providing SLAs and access to collocation nodes are well-specified in the agreement. ... As a result, complementary rollout with access warranted though IRUs on layer 1 to the partners is unlikely to significantly limit competition in a multi-fibre complementary roll-out scenario with respect to a fully parallel roll-out. NRA should however ensure that mutual access allows sufficient independence in all areas or on all network levels.”⁵¹
52. Whilst IRUs are a well-established method of supporting infrastructure sharing in the telecommunications sector, it is not clear however, that they are suitable for all (or indeed most) potential co-investment settings. For example, IRUs might work well in a reciprocal setting (e.g. in cases where two network operators extend their footprint and decide to offer IRUs to each other in newly covered areas), but may prove to be less attractive for potential co-investors bringing rather different strengths to the table (e.g. utilities and telecommunications operators).

2.5 Regulatory policy to promote fibre roll-out

53. Imposing an obligation to provide access has substantial implications for investment incentives, and the terms that will apply to such access matter. Regulatory policy has of course always been aware of this, and the ability of investors to recoup efficiently incurred costs as well as sending the correct

⁴⁸ See, for example, the IRU Agreement between AT&T and At Home Corp. in relation to fibre optic capacity provision in the United States, which runs from 1/7/2001 to 1/4/2020: <http://contracts.corporate.findlaw.com/operations/services/1105.html>

⁴⁹ IRU access to capacity on the SE-ME-WE 3 international submarine cable continues for as long as the cable remains operable. See: [http://www.smw3.com/smw3/SignIn/Download/IRU/Standard%20Agreement/AG-IRU-Final%20\(Mar03\).pdf](http://www.smw3.com/smw3/SignIn/Download/IRU/Standard%20Agreement/AG-IRU-Final%20(Mar03).pdf)

⁵⁰ See Draft BEREC report on Co-investment and SMP in NGA networks, BoR (11) 69, December 2011, Section 2.1 Case Study No.1 at: http://erg.eu.int/doc/berec/bor/bor11_69_coinvestmentnga.pdf

⁵¹ Ibid., p 40.

price signals for efficient new investment has been a key regulatory objective besides the encouragement of competition on the basis of wholesale access to network infrastructure. These objectives are, however, not necessarily well aligned, and regulators have always had to think about the right trade-off between static efficiency (preventing inefficient use of existing assets through the exploitation of market power) and dynamic efficiency (encouraging new investment and innovation). As both regulators and operators have pointed out, the specific implementation of a cost-based charging regime needs to be based on both specific market conditions and the relative importance of the conflicting regulatory objectives.

54. When looking at fibre networks, the investment impact of regulatory policy acquires a new dimension. The issue at hand is not simply one of allowing a fair return on assets that have been in the ground for a long time or sending the right signals for efficient bypass of existing network infrastructure. Network operators do not just need to undertake incremental investment to maintain or improve the existing infrastructure and enable the provision of access services that would not otherwise be available (such as unbundled local loops or bitstream access), but rather consider large sunk investments that will eventually replace the existing network infrastructure. Put succinctly, the balance between ensuring a competitive downstream market (while allowing existing operators to recover efficiently incurred costs) and providing incentives to invest in competing infrastructure (where such competition was economically viable) that has been struck in the regulation of access to legacy copper networks may need to change to provide strong incentives for the investment in new fibre access networks. More emphasis may need to be given to creating the right environment for investment in new infrastructure relative to promoting the most widespread use of infrastructure that might hypothetically exist.

2.5.1 Costing methodology

55. The specific costing methodologies that are being used to set access prices appear to be of relatively limited relevance, provided that cost recovery is not jeopardised. There appears to be a weak consensus for using a DCF methodology in relation to setting fibre access charges because it is seen to deal more effectively with the uncertainties involved in fibre investment and to capture better the link between price and take-up, but FDC and LRIC approaches should work as well.
56. Whilst regulatory certainty is clearly valuable, and regulators should refrain from changing their approach to setting access charges without good reasons, this would not seem to preclude using a different approach for fibre.
57. The fact that there is no strong preference for any particular costing methodology may simply reflect the fact that what matters more than the specific approach used is the judgment that regulators exercise when establishing cost-based charges. The responses to the Commission's consultation seem to suggest more or less that the particular flavour of costing methodology does not matter provided NRAs are cognisant of the need to assure investors that they will be able to recover their costs and not have their upside curtailed whilst being exposed to the full downside risk. Both the theoretical literature and the views expressed by operators make clear that it is

the threat of regulatory hindsight bias that strongly undermines investment incentives.

2.5.2 Risk premia for fibre investment

58. Although avoiding hindsight bias might seem to be straightforward, it is worth pointing out that traces of it are present in limiting the allowed rate of return of a regulated firm to the firm's WACC – an approach that is well established in regulatory practice. Whilst this might not matter much if the risk facing an investor is small, it can have a large chilling effect on investment if future demand or willingness to pay and commercial success is uncertain.
59. To correct for this, as well as to compensate investors for the option value they give up when rolling out fibre networks (and the corresponding option value they are providing to access seekers who obtain wholesale access on a pay-as-you-go basis), the allowed return must be above the normal WACC. The Commission's NGA Recommendation enables NRAs to include appropriate premia – but so far there is little clarity on whether regulators will make use of this flexibility and at what level these premia will be set. So far, only OPTA has decided to include a risk premium, but has not specified at what level this might be set. The indication from work commissioned by the BNetzA is that it could be around 3 percentage points, and whether this is sufficient to provide appropriate investment incentives remains to be seen. It is worth noting, however, that this figure is lower than the adjustment suggested for the setting of TELRIC charges for access to unbundled network elements in the US, where the underlying investments are unlikely to have involved the substantial investment risks associated with fibre networks.
60. An open question is how the periodic review of allowable premia fits in with the need for regulatory commitment. If a promised higher rate of return can easily be reduced upon the next review, it will have a limited impact on investment incentives. This means that one would also need safeguards that protect investors from being exposed to the risk of excessive downward pressure on prices in the cases where demand turns out to be high – after all, it is easy to forget in these cases that the world could have developed entirely differently.
61. In any case, even if NRAs were able to commit to adjusting the allowed rate of return for fibre investments by including a material premium over the WACC, the investment impact of such a measure is far from clear. This is because the positive effect of higher returns only materialises in the case of positive market developments, which means that the adjustment that would be required could be substantive and ultimately not sustainable in the market. As we discuss in more detail in the following section, competition on the basis of alternative access products may limit the amount that the investor can expect to realise unless the premium that end-users are prepared to pay for fibre access is limited. Although no more than anecdotal evidence (and noting that there are many other reasons that might render the roll-out of fibre networks unattractive). OPTA's proposed allowance of a (so far unspecified) premium to reflect the risk of fibre deployment has not been followed by increased fibre deployment in the country. FTTH penetration in the Netherlands at the end of 2011 stood at just 4.4%, projected to rise to 15.2% by the end of 2016, with no

improvement in its ranking compared to elsewhere in Europe, as illustrated in Figure 7.

2.5.3 De-regulating fibre access

62. The NGA Recommendation enables NRAs to suspend the obligation to provide wholesale access on regulated terms where competing access networks are in operation where access offers supporting downstream competition are in place.⁵² In order to maximise investment incentives, NRAs might have to make use of this provision in a forward-looking manner, i.e. committing not to impose access obligations in areas where the deployment of fibre networks will result in competition in the access market (rather than limiting it to cases where such competition already exists). This should in principle cover competition between fibre infrastructure rolled out by a new entrant and the legacy copper network operated by the incumbent, which would impose constraints whilst the copper network is still in operation.
63. The NGA Recommendation acknowledges the possibility of effective downstream competition in areas where there are several alternative infrastructures.⁵³ The prospect of suspending regulation for the transition period could potentially provide a good incentive for alternative network operators, although new entrants investing in fibre access networks would need to form expectations about the level of competition they will face from the incumbent after having sunk their network investments. A decision to de-regulate may however indicate a stronger commitment than a decision to allow a risk premium, subject to periodic review, and should therefore have a bigger impact.
64. Such a policy would in some ways correspond to offering a 'regulatory holiday', albeit one where the impact on the returns the investor can expect to earn would be limited by the presence of competitive access infrastructure (e.g. cable networks). This would remove one of the biggest concerns associated with offering a regulatory holiday, namely the restricted consumer benefits that arise from affording market power to the successful investor, but would also limit the impact on investment incentives.
65. Again, anecdotal evidence suggests that suspending access regulation for fibre networks in competitive areas does provide an incentive for rolling out FTTH. Portugal Telecom cites the Portuguese NRA, ANACOM's, early adoption of measures pursuant to the NGA Recommendation – and specifically its decision

⁵² Recital (20) of the NGA Recommendation states that, "...in exceptional circumstances, NRAs could refrain from imposing unbundled access to the fibre loop in geographic areas where the presence of several alternative infrastructures, such as FTTH networks and/or cable, in combination with competitive access offers on the basis of unbundling, is likely to result in effective competition on the downstream, level."

⁵³ In relation to the principle whereby NRAs should mandate unbundled access to the fibre loop, recommendation 22 of the NRA Recommendation states, "Any exception could be justified only in geographic areas where the presence of several alternative infrastructures, such as FTTH networks and/or cable, in combination with competitive access offers is likely to result in effective competition on the downstream level."

to de-regulate wholesale broadband access in competitive urban areas (i.e. Lisbon or Porto with three or more operators and a high number of households with cable access) – as one of the reasons for its significant investment in the roll-out of FTTH.⁵⁴ Of course, the decision to de-regulate wholesale fibre access may have been facilitated by the fact that Portugal enforces regulated access to the physical infrastructure (poles and ducts), which provides another safeguard as operators could deploy alternative networks utilising the ducts and poles of the incumbent (see paragraph 132 below).

2.5.4 Differentiated access prices

66. Allowing differentiated access prices to reflect the extent to which the access seeker would share some of the investment risk, e.g. through long-term volume commitments is an option that so far has not been explored in any detail. Such pricing would seem to be a natural way of compensating the access provider for the option value that the access seeker enjoys if it purchases access on a pay-as-you go basis. It would complement the inclusion of a substantial risk premium in short-term access charges and could provide a flexible way of encouraging efficient risk-sharing between network operators and access seekers.
67. Perhaps one of the main reasons why this option has had limited traction so far is that establishing whether different access terms are justified with reference to the risk taken on by the access seeker or are an attempt to engage in anti-competitive discriminatory behaviour, is potentially difficult. In particular, allowing lower prices for long-term commitments might be used by a vertically integrated network operator to favour its own downstream operation to the detriment of third party access seekers.
68. The NGA Recommendation emphasises that in assessing such alternative access pricing proposed by the SMP operator NRAs need to be *“satisfied that the SMP operator has provided all relevant information related to the investment, and [that] such schemes do not have a discriminatory or exclusionary effect.”*⁵⁵ This involves making sure that long-term access prices are not lower than a cost-based charge that has been calculated without any risk premium, and

⁵⁴ See FTTH Council Europe Case Study on Portugal Telecom: http://www.ftthcouncil.eu/documents/CaseStudies/PORTUGAL_TELECOM.pdf. Specifically, Anacom has replaced national access regulation with regulation at the subnational level, removing certain access obligations in areas where there is “at least one co-installed operator and one operator of cable distribution networks where the percentage of cabled households by the dominant player in the municipality is more than 60%” (see Anacom, “Markets for the Supply of Wholesale (Physical) Network Infrastructure Access at a Fixed Location and Wholesale Broadband Access”, 2009). These areas account for around 55% of broadband access in Portugal. The obligations that have been removed in these areas (access, transparency, non-discrimination, accounting separation, price control, cost accounting, and financial reporting obligations), were previously nationally applied to the dominant operator Portugal Telecom and remain in force in those areas that do not meet the above characteristics (see section 8.4 of Anacom’s determination for a detailed explanation of obligations removed).

⁵⁵ Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU), Article 26.

that there is a sufficient margin between (short-term) wholesale and retail prices to allow for market entry by efficient downstream competitors. The second condition may be unduly restrictive if it were to require that market entry on the basis of short-term access agreements should be possible as such market entry may not be efficient compared with risk-sharing arrangements.

69. Greater clarity about the potential for using such arrangements, and about the way in which NRAs would go about establishing whether a proposed scheme will pass muster, would seem to be helpful and could encourage commitment from access seekers that would lower the investment risk for fibre deployment.

2.5.5 Co-investment and infrastructure sharing

70. The co-investment provisions in the NGA Recommendation appear to be limited to the promise that no access obligation may be imposed where co-investors are engaging in infrastructure competition – such as in cases where networks with multiple fibre strands have been deployed, and co-investors control these individually. This may be overly restrictive and limit incentives for co-investment to very specific instances and configurations (e.g. those where IRUs provide an appropriate way of structuring the co-investment).
71. Because the requirements specified in the recommendation appear to limit the potential benefit from co-investment to cases where the firms that get together to share investment risks are actually competing in the same retail market, the prospect of limited (or even suspended) access obligations would not apply to cases where co-investors come from different areas and are expected to benefit from the jointly constructed networks in different ways. Yet, such cases are relatively common in driving fibre roll-out, and might still constrain market power because each of the investors could provide access to third parties on a commercial basis.
72. Indeed, one area where substantial cost savings through co-investment can be achieved is via joining forces with utilities or municipalities in order to save on civil engineering cost associated with digging trenches. The FTTH Council Costing Model estimates that on a total estimated cost of €202bn to reach the DA targets tens of billions of Euros could be saved through modest levels of duct infrastructure sharing and re-use. Therefore, a regulatory policy towards the promotion of infrastructure sharing and re-use could help significantly to lower deployment costs.
73. For instance, in Italy, a Memorandum of Understanding (MoU) has been signed between telecommunications operators and the Minister of Economic Development to develop a shared passive infrastructure for the development of next generation networks with both private and public funding. Signatories of the MoU will become part of a new company that will be responsible for the roll-out of this infrastructure, co-ordinating with municipalities, local utilities and other stakeholders to minimise roll-out cost by re-using a significant proportion of existing or parallel conduits.⁵⁶ In Austria, the cooperative ARGE

⁵⁶ Ministry for Economic Development Italy, Memorandum of Understanding, Italia Digitale, Sviluppo dell'infrastruttura per Reti a Banda Ultra Larga.

Glasfaser Waldviertel brings together three municipalities with the aim of exploiting economies of scale and sharing knowledge and experience in rolling out a regional fibre network. The co-operative aims to take advantage of planned works on the sewage system in the area to install ducts, which would result in significant cost savings in the roll-out of fibre.⁵⁷ Going beyond co-ordination of works, in Germany, regional operator Inexio has teamed up with power companies RWE and Energieversorgung Mittelrhein (EVM) and the local councils to roll out fibre in the district of Cochem-Zell. Power companies in Germany have an obligation to provide smart meters in all newly built housing and require ICT infrastructure to support their smart grid. It is therefore cost efficient for power companies to lay down fibre in cooperation with telecommunications providers.

⁵⁷ FTTH Council Europe, Austria Case Study: www.ftthcouncil.eu/documents/CaseStudies/AUSTRIA.pdf

3 Regulation and transition to fibre

In this chapter, we expand further on the role of regulation in relation to fibre investment by focusing on the key regulatory challenge of providing incentives for an efficient migration from copper-based access networks to fibre equivalents. In this respect, we make the point that the regulation of fibre access cannot be considered in isolation but instead that access terms for copper-based services have to be taken into account at the same time.

To illustrate this point, we examine the impact of copper access charges on the incentives for fibre investment from the perspectives of incumbents, as well as from entrants and access seekers, drawing on a number of recent studies in this area.

We then address the important point about how competition for retail broadband customers will inevitably impact on whatever wholesale fibre premium the regulator allows and in particular the role that lower copper charges can play in this respect. We survey a number of findings in this area from the academic literature, recent economic studies and regulatory decisions where we find that there is little evidence to suggest that retail customers are willing to pay over and above the existing cost of copper-based services in order to avail of services provided over fibre-based networks.

We conclude this chapter with a discussion on the implications this has for regulatory policy, focusing on reducing returns from copper networks, raising the premium on fibre and the ways in which the fibre deployment and the development of advanced services provided over this infrastructure might be better co-ordinated.

74. In the previous section, we looked at the impact of regulatory policy on the incentives to invest in fibre networks, (implicitly) assuming that the potential investor only could decide whether to make this investment – and possibly to delay it until some of the uncertainty surrounding future demand resolved. In practice, the issue at hand is more complex: The question is not simply whether to invest in fibre or continuing with the existing copper infrastructure ‘as is’ (i.e. decide not to invest), but whether to serve potential demand for higher bandwidth connections by upgrading existing copper networks rather than investing in fibre. Such upgrades would not deliver the speed, quality and consistency of service available from fibre networks, but would cost less. Moreover, they could be undertaken in a piecemeal fashion and would thus retain some option value.
75. Even if fibre access networks might eventually replace much of the existing copper infrastructure, there will be a period during which both are in operation and are competing for both investments and customers. As a result, the regulatory challenge is therefore one of providing incentives for an efficient migration from copper to fibre. Thus, one cannot look at the regulatory policy towards fibre networks in isolation - the terms and conditions for copper access matter as well. These terms affect the relative attractiveness of investing in fibre compared with upgrading copper, and the competition from copper-based access products that fibre-based access services face in the retail market.

3.1 The impact of copper access charges on fibre investment: competition for investment and competition for users

76. A recent paper by Bourreau et al.⁵⁸ provides a theoretical analysis of the impact of copper and fibre access charges on the incentives of incumbents and entrants to migrate from copper to fibre. Starting from a situation in which a regulatory obligation to provide access exists only for the legacy network, but not for the next-generation access network, the authors identify the following effects:
- a 'wholesale revenue' effect, which captures the impact of the new entrant's decision to roll out its own infrastructure on the wholesale revenues obtained by the incumbent. Because a higher level of investment by the incumbent in its fibre network triggers more investment by the entrant, this will lead to a loss in wholesale revenues. The higher the regulated charge for access to the legacy network, the larger the wholesale revenue loss, which means that higher copper access charges discourage fibre investment by the incumbent.
 - a 'replacement' effect: low access prices for legacy infrastructures increase the opportunity cost of an entrant's investment, and therefore low access prices for copper make fibre investment less attractive for a new entrant; and
 - a 'business migration' effect: low prices for the legacy network mean that in order to encourage customers to move from the old to the new technology, prices for the new technology must be sufficiently low as well. This potentially constrains prices that are sustainable for fibre, reduces the profitability of new infrastructure and therefore reduces the incentives to invest in it for both entrants and incumbents.
77. For the incumbent, the business migration effect and the wholesale revenue effect work in opposite directions. Given this, the impact of higher copper access charges on the incumbent's investment incentives is ambiguous. For the new entrant, both effects work in the same direction, and higher wholesale charges for access to the legacy network promote fibre investment by the new entrant.
78. Considering regulated access to the new fibre networks in those areas without competing infrastructures (where both the incumbent and the new entrant have invested in fibre)⁵⁹ coverage will be lower than in the case where only copper access is regulated. The 'business migration effect' is replaced by a

⁵⁸ Bourreau, M., Cambini, C., Dogan, P. "Access Pricing, Competition, and Incentives to Migrate From "Old" to "New" Technology", Harvard Kenedy School Faculty Research Working Paper Series, July 2011

⁵⁹ Note that this implies that the regulatory authority will define different geographic markets for areas with multiple next generation infrastructures, and those where only a single next generation infrastructure is present, which would be subject to access obligations even in the case where it was constructed by a new entrant and could be said to compete with the legacy copper network of the incumbent.

migration effect at the wholesale level – the incumbent needs to offer attractive terms on the new network infrastructure in order to provide an incentive for access seekers to move from the legacy network to the new network. A key question for the regulator is whether the incumbent or the new entrant will end up with a greater footprint and thus be subject to access obligations in those areas where they alone have rolled out fibre. If it is the incumbent, then optimal access prices are positively correlated – if it is the new entrant, then this might be reversed (i.e. a lower copper access charge might imply a higher fibre access charge).

79. Whilst of course subject to restrictive assumptions, the theoretical model highlights that the effects of setting access charges for copper and fibre on the incentives to invest in fibre are complex, and that competition between infrastructures during the transition period needs to be considered. It should therefore not be surprising that different studies have come to very different results in terms of the relationship between copper and fibre access prices that would promote fibre investment.

3.2 Incentives for fibre investment

80. Focusing on competition for investment, copper charges matter because they determine the incremental return that an incumbent will get from replacing copper with fibre relative to not investing at all, or the return from investing in fibre compared with upgrading the copper access network. By contrast, new entrants should be expected to have a greater incentive to bypass the existing access network if copper access charges are higher. Assuming that any investment undertaken by new entrants would be in fibre rather than copper, this would suggest that the incentives for new entrants to invest in fibre are higher if copper access charges are higher (always provided that the regulated charges for fibre access are sufficiently high to allow recovery of efficiently incurred costs).

3.2.1 The incumbent's perspective

81. Looking purely at the relative attractiveness of copper and fibre investments, a larger gap between fibre and copper access charges would seem to make fibre investment relatively more attractive for incumbents.⁶⁰ All other things being equal (and notwithstanding possible constraints on fibre retail prices) higher copper prices can be expected to reduce incentives to invest in fibre because investing in upgrades and maintenance of the copper infrastructure becomes more attractive.
82. This view was expressed by a number of respondents to the recent EC consultation on costing methodologies. For example, EWE TEL considered that a high wholesale price for copper access would not provide incentives for SMP operators to invest in NGA networks and would simply lead to

⁶⁰ This is provided that the gap is brought about in a manner that does not undermine trust in the regulatory process, as this would have a chilling effect on the incentive to make any sunk investment.

overcompensation of the copper network, thus encouraging the incumbent to maintain its current position. BT further commented that if the price of copper-based services were to be set at a level that generates economic profits, these profits would become part of the opportunity cost of fibre provision.

83. In a recent study for ECTA, WIK-Consult (WIK)⁶¹ investigated the impact of changes in the copper access charge on fibre investment by an incumbent operator. More specifically, WIK considered a firm that owns and invests in a copper or FTTH access network ('incumbent'), to which other firms ('entrants') must obtain access in order to provide services to end-users. Based on assumptions about the difference in revenues that may be generated from copper-based and NGA-based services, the WIK study looks at various combinations of wholesale charges for copper and fibre access at which investing in fibre becomes profitable.
84. WIK considers that in the case of an integrated incumbent the decision to switch to fibre is driven primarily by the access charge differences between copper and fibre relative to their respective costs. For a given fibre access charge WIK considers that incumbent copper profits are increasing with the copper access charge, while fibre profits remain constant. This means that a switch from copper to fibre will occur if copper access charges are set at a level at which total profits are lower with copper than with fibre. With a fibre access charge at the level of brownfield LRIC (€11.65), WIK find that fibre is more profitable for all copper access charges below €3.42.⁶²
85. Based on an average LLU charge in the EU at the time the WIK study was undertaken was around €8.55, it is clear that setting the fibre access charge at the brownfield LRIC level would not give any incentive to incumbents to switch to fibre. At these copper access charges in Europe it would take a fibre access charge of €19.49 to induce fibre investment from the incumbent.⁶³ At this fibre access charge, profits would obviously be substantially higher (around four times the profits earned at a brownfield LRIC charge for fibre, and a correspondingly low copper access charge).
86. WIK also considers the impact of an alternative operator (cable) on their results, arguing that the presence of a cable network leaves copper profits virtually unchanged, but shows that fibre profits would be lower.⁶⁴ This would limit the extent to which an increase in the fibre access charge would feed through into increased fibre profits, potentially strengthening the argument for lower copper charges.
87. Based on these calculations WIK propose that copper access prices be based on the basis of an 'opportunity cost approach' rather than on an established

⁶¹ WIK-Consult, "Wholesale pricing, NGA take-up and competition", prepared for ECTA, 7 April 2011.

⁶² See Figure 6-2 and accompanying text of the WIK study. Figures given are for monthly charges.

⁶³ See Figure 6-3 and accompanying text of the WIK study.

⁶⁴ See Figure 6-15 and accompanying text of the WIK study.

cost-based approach such as bottom-up LRIC on a CCA basis. This would be justified in promoting the transition to fibre because forward-looking LRIC is unsuitable for a shrinking market and would lead to increased charges as demand for copper-based services falls and costs would have to be recovered from a smaller number of lines. Moreover, the CCA approach would require the regulator to establish replacement costs based on a modern equivalent asset, which is difficult in practice: copper would not be deployed, and fibre capabilities go beyond what copper can deliver. High and increasing copper access charges that would result from the use of such a methodology would foster further declines in volume, unnecessary overcapacities and allocative inefficiencies in the copper network.

88. The opportunity cost method proposed by WIK would lead to copper access charges in a range bounded by the copper LRIC before the market began to decline, and the short run incremental costs ("SRIC") of operating the copper network (which should include the rental value of assets that could be sold in a second hand market, but ignore all fixed and sunk investments in network assets). This means that copper prices should not go up, but should equally not fall below a level at which access services would be loss-making and would be abandoned.
89. While WIK considers that a lower copper access charge will encourage the switch to FTTH by the incumbent, Plum Consulting⁶⁵ take a different view, based on a different assumption in relation to platform competition. More specifically, where WIK assumes that platform competition will result in lower prices and thus potentially reduce the returns on, and the incentives to invest in fibre, Plum argues that platform competition drives the incentive to upgrade to fibre in order to stem customer losses and that the incentives to retain customers are affected by copper access charges.
90. More specifically, Plum argues that the incumbent's decision to invest in fibre will be affected by the price of copper only because the incumbent faces the prospect of losing customers to other networks (e.g. cable or wireless) and because investing in fibre will allow the incumbent to retain customers. Reducing the wholesale price of copper access will undermine the profitability of customers and thus the incentives to retain them: *"The higher the price of copper the more there is to lose in terms of revenue from customer loss, and therefore there is more to gain from next generation access investment to the extent that this helps retain customers."*⁶⁶

⁶⁵ Plum Consulting, "Copper pricing and the fibre transition – escaping a cul-de-sac", prepared for ETNO, December 2011.

⁶⁶ See page 10 of the Plum report. It is worth noting that the analysis presented by Plum appears to be based on the assumption that investing in fibre leads to the retention of customers regardless of whether or not these customers will be served via fibre (in particular FTTH). The assumption that customers who would otherwise leave will be retained, and will continue to receive a copper-based service, if the operator invests in fibre is somewhat peculiar, but appears to be crucial for making the link between copper access charges and the value of customers retained by fibre investments.

91. Plum attempts to quantify the effect of reducing copper access charges by using their proprietary Plum Access Investment Model. The authors start by estimating the level of coverage at which incremental revenues from deploying fibre (calculated as the NPV of cash flows over a 15-year period) are equal to the incremental costs of a connected household⁶⁷. This produces a baseline result indicating that incumbents would invest to reach FTTH coverage of 11% in the case of weak competition⁶⁸ and 22% in the case of strong competition.⁶⁹ FTTC coverage would be 67% and 75% respectively.
92. Compared with the weak competition base case, Plum finds that a reduction in copper access prices by one third (from €9 a month to €6 a month) using a linear glide path over a five-year period would reduce FTTH coverage by four percentage points owing to reduced incentives to invest to retain customers. Moreover, Plum argues that such a reduction would undermine trust in the regulatory process and increase the fear that fibre assets may become stranded in the future. This would have a further chilling effect on fibre investment, reflected in a higher hurdle rate. Plum consider that this additional effect could completely wipe out the incentives to invest in FTTH in the weak competition case.⁷⁰ FTTC coverage would fall from 67% to 17%, with 46 percentage points of the 50 percentage point reduction being attributable to the increase in the hurdle rate.
93. Conversely, increasing copper access charges by one third from €9 per month to €12 per month over a five year period would increase FTTH coverage by four percentage points because of greater incentives to retain customers. Plum also consider that in this case there would be a positive impact on the hurdle rate⁷¹, which would almost double the level of FTTH coverage from 11% to 21%.
94. In the presence of stronger competition (e.g. from cable), the impact of a proportional reduction (increase) in the price of copper access on customer retention revenues and thus FTTH coverage are even greater. A decrease in the copper price by one third would again completely wipe out FTTH

⁶⁷ Incremental revenues take into account any premium in the willingness to pay for NGA-based services compared to current broadband services that the incumbent will be able to extract, revenues for existing copper customers who would be retained if there were fibre investment but lost otherwise, and any changes in copper revenues if copper prices are affected as a result of the NGA investment. Incremental cost consists of a fixed cost of connecting a household and a variable cost of passing homes, which increases with coverage.

⁶⁸ This case captures a modest annual loss of 2% customers to alternative infrastructures (e.g. wireless) in the absence of fibre investment. The pricing of incumbent services appears not to impact on the level of customer loss.

⁶⁹ Strong competition captures the case where 12% of customers would be lost per annum (e.g. to a cable operator) without any fibre investment. The higher coverage in the case of strong competition implies that the benefits of greater revenues from customer retention outweigh the reduced take-up of fibre.

⁷⁰ See Figure 5-13 and accompanying text in the Plum report.

⁷¹ "[T]he decision to increase the price of copper is seen as a positive signal by prospective investors, thereby increasing confidence and reducing the hurdle rate by 1 percentage point", p 27 of the Plum report.

investment (leading to a reduction in penetration by 12 percentage points owing to the weaker retention incentives, and a further 10% because of the increase in the hurdle rate), and an increase in the copper price would push FTTH penetration from 22% to 40% (12 percentage points because of stronger retention incentives, and 6 percentage points owing to a lower hurdle rate). Table 2 summarises the results of Plum's quantitative analysis.

Table 2: Results of Plum's quantitative analysis of the impact of changing copper charges on fibre investment

	Base case	Retention effect*	Hurdle rate effect*	Resulting penetration*
Weak competition – FTTH	11%	-4%	-7%	0%
		+4%	+6%	21%
Weak competition – FTTC	67%	-4%	-46%	17%
		+3%	+3%	73%
Strong competition – FTTH	22%	-12%	-10%	0%
		+12%	+6%	40%
Strong competition – FTTC	75%	-7%	-21%	47%
		+5%	+3%	83%

* Figures shown are for a decrease/increase of copper access charges by one third from a base level of €9/month

Source: Plum Consulting, *Copper pricing and the fibre transition – escaping a cul-de-sac*, prepared for ETNO, December 2011, Figures 5-13 – 5-16 and 5-22 – 5-25

95. The view that higher copper access charges incentivise the incumbent to invest in fibre may be seen as providing further support for the earlier recommendations by Plum in favour of higher copper access charges. In an earlier report prepared for ETNO, Plum principally recommends a bottom-up LRIC approach using CCA valuation for setting copper access charges (with the caveat that maintaining whatever costing methodology a regulator currently uses may be preferable in order to avoid the risk of cost under-recovery that is associated with switching costing methodology).⁷² This approach would ensure that such charges are not depressed by historic cost being below replacement costs, and by leaving out copper network assets that are fully depreciated as might happen using a top-down approach.
96. In addition to the argument that reducing copper charges by pricing copper on a legacy basis would increase regulatory risk, this recommendation was driven by concerns about migration incentives. Low copper prices and a

⁷² Plum Consulting, "Costing methodology and the transition to next generation access – A report for ETNO", March 2011. Plum also notes, however, that. Given established regulatory practice, it would be most appropriate for every Member State to continue using its current costing methodology for consistency reasons; this is because switching methodologies increases regulatory uncertainty and raises the risk of cost under-recovery.

correspondingly large gap between copper and fibre access charges might discourage the take-up of fibre. The arguments that higher access charges directly promote fibre investment through incentives to retain customers seem to be specific to the second Plum report.⁷³

97. A further consideration that has been brought into play is that access charges for legacy network services may affect the ability of incumbents to finance fibre investment. Respondents to the EC consultation on costing methodologies noted that falling copper access prices would have a negative impact on NGA investment due to their impact on the incumbent's finances. For example, Telecom Italia noted that the copper access network is still a viable economic resource and needs the proper remuneration. It considered that a reduction of copper access charges would undermine the ability of the operator to raise funds for investments in new technologies. Telekom Austria also commented that lower wholesale copper access prices would reduce the income of the incumbent causing a decrease in fibre investments.
98. The argument that changes to the regulatory regime that put the recovery of investment costs at risk, or that look like opportunistic attempts to expropriate investors who have sunk costs, has clear merits. The potential impact of changes to the pricing of access on the cost of funds and the hurdle rates required needs to be considered.
99. By contrast, arguments that lower access charges undermine the ability of firms to finance investments presume that there are substantial capital market imperfections and should not be taken at face value. The implicit claim is that investment that could and would be funded from retained profits will not be undertaken if it has to be financed by issuing new equity or raising debt. Given that the investment in FTTH roll-out needs to be sufficiently attractive to ensure that any 'extra margins' earned by the incumbent will flow in this direction rather than being used to reduce other financial liabilities or increase share dividends, it is not obvious why such investments can only be funded from retained earnings. Even though capital markets in Europe have been less liquid over recent years, particularly during the recession, investments that are sufficiently attractive to plough back retained earnings should also be capable of attracting funding from other sources.

3.2.2 The entrant's/access seeker's perspective

100. For an access seeker, the decision to invest in fibre will be driven by a comparison of profits from using wholesale access to the incumbent's network and the profits from investing in its own infrastructure. Everything else being equal, higher access charges to legacy copper should make investment by the entrant more attractive.

⁷³ Plum Consulting, "Copper pricing and the fibre transition – escaping a cul-de-sac", prepared for ETNO, December 2011.

101. A study undertaken by LECG for ETNO⁷⁴ provides some empirical evidence for this link. LECG considers the impact of access regulation on investment in access infrastructure and shows that reducing the price of the legacy network through more intense access regulation (i.e. lower LLU prices) would reduce incentives to invest in an alternative network such as fibre. Econometric analysis shows that, all else being equal, a 10% reduction of copper access prices would cause an 18% fall in the subscriber share of alternative infrastructure (which is considered to encompass both investment in new fibre-based networks by incumbents and entrants, and investment in cable networks). The fall in subscriber levels is the consequence of reduced investment in alternative platforms.
102. In their responses to the EC consultation on costing methodologies a number of respondents commented on the effect of a change in copper prices on the incentives of 'alternative operators' or 'access seekers' to invest in fibre networks. Orange considered that a decrease in the price of copper access would provide a strong incentive for access seekers to stay on the copper network and reduce any incentives to switch to fibre. EWE TEL argued that an alternative operator would take into account the wholesale cost of copper networks as a cost saved by investing in a fibre network, and therefore a high copper access price would create incentives for NGA investment by access seekers.
103. On the other hand, an access seeker enjoying lower access charges may also have greater financing options for fibre investment. FastWeb raised this point in its response to the Commission's consultation, arguing that in cases where the decrease of copper wholesale prices was not passed on to customers, alternative operators (existing access seekers) could use the extra margin to invest in their own fibre infrastructure. However, as in the case of incumbents, this argument requires that there are strong capital market imperfections. In addition, it relies on retail prices for services based on copper access not falling in line with lower access charges. If access regulation succeeds in promoting retail competition, it is unlikely that lower copper access charges could simply be taken in the form of higher retained profits.

3.2.3 Copper assets versus poles and ducts

104. A separate, but highly relevant point, is the question of regulated access to physical infrastructure (poles and ducts). Obviously, the cost of poles and ducts forms part of the regulated access charge for unbundled copper loops and any wholesale products that might be used by access seekers for the provision of broadband services. Unlike the copper assets, poles and ducts will continue to be used in the provision of next generation access services. Also,

⁷⁴ LECG with the support of ETNO, "Access Regulation and Infrastructure Investment in the Telecommunications Sector: An Empirical Investigation", September 2007

the question of where (and to what extent) physical infrastructure needs to be upgraded to accommodate new network assets is important.⁷⁵

105. To the extent that existing poles and ducts can be used in the construction of new fibre networks, their pricing *"is neutral with respect to the transition from fibre to the copper because ducts are used by both technologies."*⁷⁶ This would suggest that considerations about the potential impact on fibre investment should not play a role in establishing the cost of physical infrastructure, and potentially setting the prices for physical infrastructure assets. Although new entrants might find it easier to roll out their networks if they could get access to the incumbent's physical infrastructure at lower prices, this would not send the right price signals for upgrades to ducts, and would also feed into the cost of regulated wholesale charges for fibre access.
106. A complication arises from the fact that the costs of duct and poles are perhaps are largely joint across all networks that use the physical infrastructure (and any wholesale services that will be provided over these networks). This suggests that the costs of ducts could in principle be allocated to copper or fibre, and thus be used to differentiate between fibre and copper prices.

3.3 Competition for users and the fibre premium

107. The fact that the gap between fibre and copper access charges affects the incentive to migrate from copper to fibre – which is ultimately driven by the extent to which end-users are willing to substitute one for the other – plays an important role in the theoretical analysis and has come up in the studies cited. The fundamental point is that the difference between wholesale charges for copper and fibre access will be reflected in a difference in retail prices, which in turn affects demand for copper and fibre-based access products. Regulatory policy can do nothing to increase the gap between regulated access charges for copper and for fibre beyond what is sustainable in the face of competition for users. Given a regulated access charge for copper, setting high fibre access charges is like pushing a string. Regulated access charges may ultimately not be 'binding' in the sense that, given competition at the retail level, pricing access at the maximum allowed level would not attract sufficient demand – and retail prices may be constrained at a level that does not guarantee sufficient returns.

⁷⁵ WIK notes, however that there may be an over-supply of ducts if fibre needs less capacity than is being released by the declining copper network. (WIK-Consult, "Wholesale pricing, NGA take-up and competition", prepared for ECTA, 7 April 2011, p 34) This view appears to be predicated on a simple relationship between the capacity of the network, and the capacity of the physical infrastructure that is carrying the wires or fibre strands. Matters are likely to be more complicated in practice. Even if some ducts and poles may become obsolete with the migration to fibre access networks, the capacity of others may still be insufficient to accommodate new network build, and there may be choke points. Also, price signals should provide the right incentives for efficient use of infrastructure. The view that more efficient fibre means overcapacity of ducts and poles is thus overly simplistic.

⁷⁶ M Cave, A Fournier and N Shutova, "Which Price Level for Copper Access in the Transition to Fibre?" 2011, p 5

108. In terms of the competitive pressure copper places on fibre, copper access charges may impact fibre investment incentives by constraining both the wholesale and retail prices of fibre. If changes in the copper access price feed through to retail prices and consumers see services provided over copper and fibre as substitutes, copper access prices will affect fibre take-up and in turn fibre retail profits and incentives to invest. As Cave et al. note, "*[t]he access price of copper has an impact on the fibre investment incentives through the retail price. A lower wholesale copper price leads to a lower retail copper price and, consequently, because copper and fibre connections are substitutes, to a lower retail fibre price.*"⁷⁷
109. This was an issue raised by both Deutsche Telekom and Orange in their responses to the EC costing questionnaire. They considered that increasing the price for copper access products will reduce the competitive pressure on fibre and allow fibre prices to rise to levels that will allow for a faster payback period for fibre investments and allow for a positive business case in more areas than would otherwise be possible. They also argued that higher copper prices would more likely result in widespread roll-out of fibre networks than would be achieved if copper prices remained stable or were reduced. Further, Telefónica considered that being able to obtain sufficient revenue streams from fibre investment is one of the main drivers of investment. With a higher price for copper, operators would be able to price their retail fibre products at higher levels and this would improve the business case for fibre for both the incumbent and access seekers.
110. Plum⁷⁸ emphasises the constraint that lower copper charges would place on fibre returns in deriving its recommendation for the most appropriate costing methodology for copper access. Although lower copper prices may stimulate broadband take-up and therefore increase the customer base that could eventually be migrated to fibre, the authors argue that any such effect would be dwarfed by the fact that a low copper price would encourage customers to stay on the copper network and thus discourage fibre investment.
111. Plum⁷⁹ also argues that the reduction in retail prices that flow from lower copper prices would undermine the investment incentives for new entrants. Using its Access Investment Model, it finds that a reduction in copper prices by one third would reduce an entrant's fibre coverage from a base line of 16% by 12 percentage points as a result of reduced retail prices lowering returns, with

⁷⁷ M Cave, A Fournier and N Shutova, "Which Price Level for Copper Access in the Transition to Fibre?" 2011, p 4f. Jeanjean and Liang analyse the impact of copper and fibre access charges on migration incentives in a simple model that captures both inter-platform and intra-platform competition (see F Jeanjean and J Liang, "Role of access charges in the migration from copper to FTTH", May 2011, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1829453).

⁷⁸ Plum Consulting, "Costing methodology and the transition to next generation access – A report for ETNO", March 2011

⁷⁹ Plum Consulting, "Copper pricing and the fibre transition – escaping a cul-de-sac", prepared for ETNO, December 2011.

the hurdle rate impact completely wiping out the incentives for fibre investment by a new entrant.⁸⁰

112. The strength of this 'business migration' effect (or the corresponding migration at the wholesale level) identified by Bourreau et al. depends on the effectiveness of retail competition, and the degree of substitution between copper and fibre. It is stronger where retail competition is more effective and the more closely substitutable copper-based access services are for fibre-based ones. What ultimately matters is the 'fibre premium' that end-users are prepared to pay. Ignoring the somewhat peculiar logic of Plum's customer retention argument, it is the link between fibre and copper prices that comes from end-user substitution that is responsible for the negative impact of lower copper charges on fibre investment incentives and the overall ambiguous effect of copper prices on fibre investment for incumbents identified by Bourreau et al.
113. WIK, by contrast, looked at the impact that a higher willingness to pay for fibre relative to copper has on the gap between copper and fibre access charges at which fibre becomes more profitable. Considering the relative valuation of copper against fibre, WIK showed that, at a fibre access charge set to 'greenfield' LRIC of €13.92 and an 'intermediate' valuation for copper,⁸¹ the switch from copper to fibre occurs at a copper access charge of €6.06 – i.e. at a gap of €7.86. However, at a low valuation for copper (or, conversely, a high valuation of fibre), the switch occurs at a copper access charge of €8.55, i.e. a gap of only around €5.37, while at a high valuation (or a low fibre premium) of copper the switch occurs at a copper charge of €5.13 (i.e. a gap of almost €8.79). . Therefore the greater the distance between the valuation of copper and fibre, the smaller is the *required* difference between copper and fibre access charges that would induce fibre investment.⁸²
114. This leaves us in the difficult situation that a lower willingness to pay for fibre over copper means that a higher access price differential would be required in order to promote the migration from fibre to copper – but that at the same time sustaining such a higher access price differential will not be possible. Table 3 summarises WIK's findings, which suggest that in the case where access price differentials are reflected in retail price differentials, an access charge gap that provides an incentive for fibre investment is only sustainable if the fibre premium is above around €8/month. A smaller fibre premium would require a difference in access prices that is greater than the retail price

⁸⁰ See Figure 5-31 and accompanying text in the Plum report; we note that the detrimental investment impact of lower retail prices does not appear to be reflected in the modelling for the incumbent.

⁸¹ Based on assumptions surrounding ARPUs and considering the relative valuation of copper against fibre, in the intermediate valuation of copper, the incumbent earns a fibre ARPU €7.97 greater than that on copper. In the low valuation of copper case, the incumbent earns a fibre ARPU €11.95 greater than that on copper; and in the high valuation of copper case, the incumbent earns a fibre ARPU €3.99 greater than that on copper (see WIK-Consult, "Wholesale pricing, NGA take-up and competition", prepared for ECTA, 7 April 2011).

⁸² See Figure 6-9 and accompanying text in the WIK report

difference that end-users would be prepared to pay. Therefore, the extent to which retail prices are reflective of access prices, the fibre premium that customers are prepared to pay, and the determinants of that premium are important.

Table 3: Fibre premium and access charge gap

	Difference in ARPU (fibre ARPU above copper ARPU)	Difference in access charges required to make fibre investment profitable
High copper (low fibre premium)	3.99	8.79
Medium copper (medium fibre premium)	7.97	7.86
Low copper (high fibre premium)	11.95	5.37

Source: WIK-Consult, "Wholesale pricing, NGA take-up and competition", prepared for ECTA, 7 April 2011.

3.3.1 Pass-through of access charges

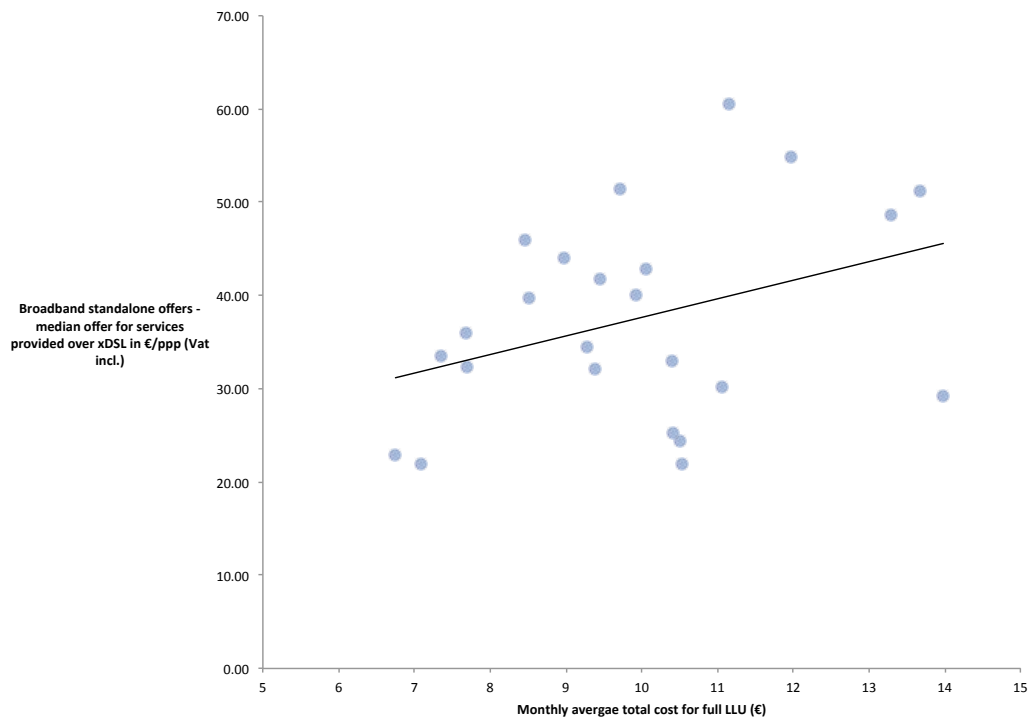
115. One should expect access charges to affect retail prices if access regulation is effective. Such an effect is apparent across Member States, even though retail prices are affected by a wide variety of country-specific factors: using data on copper access prices⁸³ and copper retail prices⁸⁴ across 24 EU Member States, Figure 9 shows a positive relationship between copper access charges and copper retail prices using 2010/2011.⁸⁵

⁸³ Copper Access Charge figures are for monthly average cost for full LLU as at October 2010 and are taken from the Digital Agenda Scoreboard Telecom Database (http://ec.europa.eu/information_society/digital-agenda/scoreboard/)

⁸⁴ Retail prices for copper are calculated using data from Van Dijk, "Broadband Internet Access Cost (BIAC)", report for the European Commission, information Society and Media Directorate General, August 2011 (prices as at 1-15 Feb 2011). For each country, we take the median offer per technology (xDSL) per basket in €/ppp (VAT incl.), for unbundled, broadband standalone offers and calculate the mean across the baskets.

⁸⁵ We present findings from those countries for which we had both sets of data, and omit Poland as an outlier.

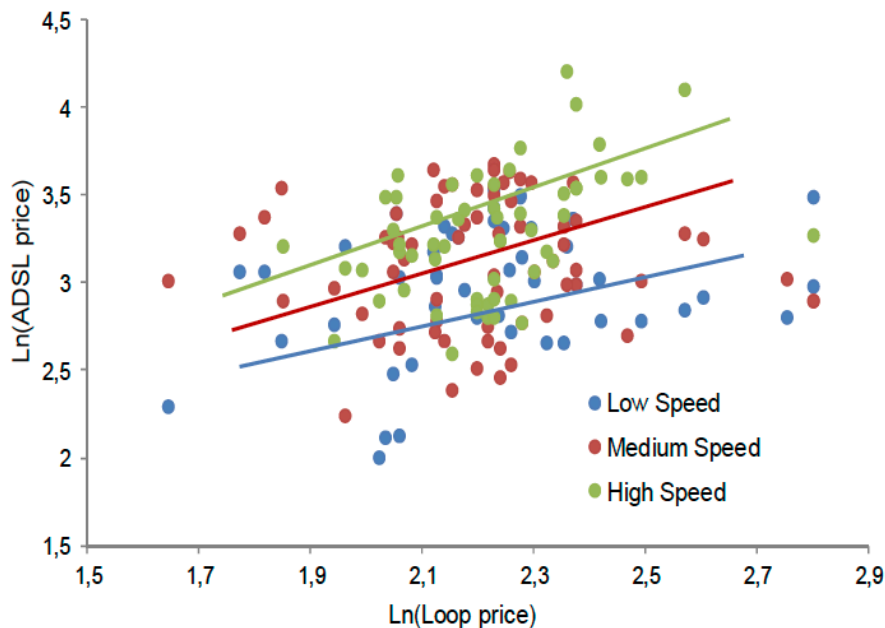
Figure 9: The relationship between copper access charges and retail prices across the EU



116. As part of its response to the EC questionnaire on costing methodologies, Telefónica submitted a report investigating the effect of a reduction in wholesale prices on retail prices for ADSL.⁸⁶ The study used wholesale and retail price data to estimate the “pass-on-elasticity” of a change in the wholesale price of loop access with respect to the price of broadband, considering the different ADSL connection speeds. Using a simple ordinary least squares regression, the study shows that pass-on elasticity is positive, and that it is greater for higher broadband connection speeds. Pass-on elasticity is 0.45 for low-speed connections (144kb – 1.99MB), 0.60 for medium-speed (2MB – 9.99MB) and 0.91 for high-speed connections (10MB or more). This evidence suggests that between 45 and 91% of any decrease in the access price for copper networks would be passed through to consumers, and that in particular for high-speed connections – which would be the closest competitor for FTTH services – changes in access prices will feed through almost fully into changes in retail prices.

⁸⁶ Solchage Recio & Asocioas (Strategic & Economic Consulting) Nov 2011, “Analysis of the relationship between wholesale and retail internet access prices”. Submitted as Annex 3 of Telefónica’s response to the EC Costing Methodologies Questionnaire.

Figure 10: Relationship between the logarithm of the loop access price and the retail price



Source: See Annex 3 of Telefónica's response to European Commission, Questionnaire for the public consultation on costing methodologies for key wholesale access prices in electronic communications

3.3.2 Retail price differences and fibre take-up

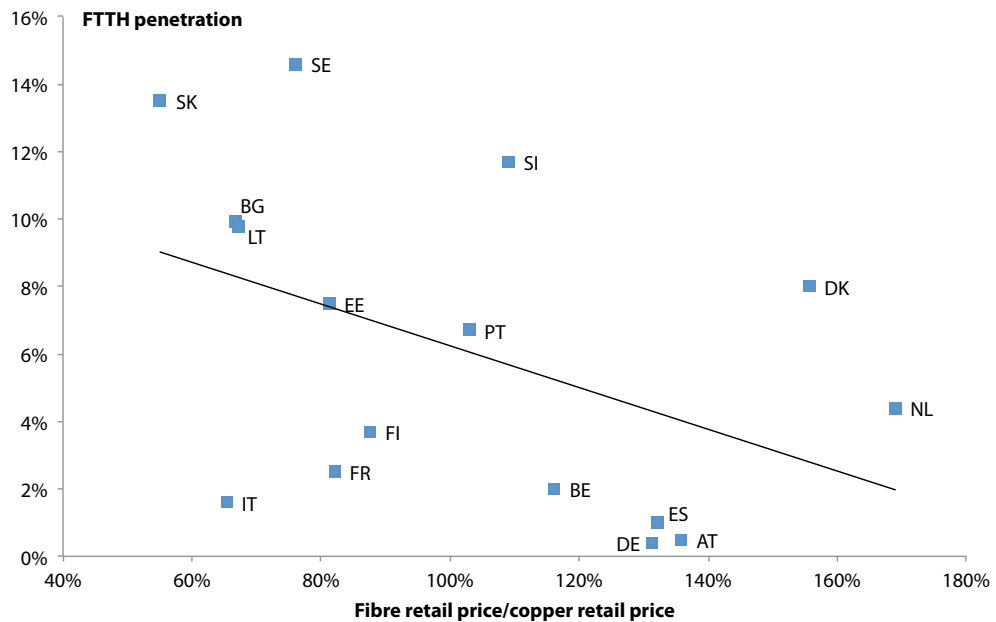
117. Whether copper and fibre based access are substitutes, and if so, how closely they are substitutable from the end-user perspective, is an empirical matter, but is likely to depend primarily on whether there are services that cannot be provided over (improved) copper access networks, or for which there is a discernable difference in service quality. If all services to which end-users can get access can be provided over copper without a discernable loss of quality, the willingness to pay for fibre-based access is limited by the price of copper-based access. In other words, the fibre premium is small or non-existent.
118. The current evidence suggests that the fibre premium that customers are prepared to pay is small indeed. A recent Ofcom report⁸⁷ notes that there is significant variation in the take-up of ultra-fast services across different countries. While in countries such as Sweden, Russia and Japan more than a third of households covered by ultra-fast services subscribe to the service, in other cases only a small proportion of consumers subscribe to ultra-fast services where they are available. Ofcom considered that one of the key factors that appears to drive take-up of 'ultra-fast' services as opposed to

⁸⁷ Ofcom, 14 December 2011, "International Communication Market Report 2011" (<http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr11/icmr/ICMR2011.pdf>).

'basic' services was the relative cost of ultra-fast services compared to basic broadband services. Ofcom specifically noted that research among UK ultra-fast broadband users, found that 'value for money' was the key consideration in taking up ultra-fast broadband services. Ofcom noted that, *"Virgin Media's 'up to' 50Mbit/s cable service (£25 per month in November 2011, excluding line rental) is nearly double the price of its basic 'up to' 10Mbit/s service (£13.50 per month), and only around 5% of Virgin Media's customer base took its 'up to' 50Mbit/s service by the end of June 2011."*⁸⁸ Ofcom noted that this was in contrast to those countries, for example Sweden and Russia, where take-up has been more successful and where broadband provided over fibre is often the least expensive fixed service available to customers.

119. Figure 11 plots the relative retail price of fibre-based to copper-based access products (i.e. the retail price of fibre divided by the retail price of copper) against the level of FTTH penetration for a number of European countries for which both sets of data were available. Despite there being a host of country-specific factors that affect the roll-out and take-up of fibre networks, this shows a clear negative relationship: higher fibre prices (relative to copper prices) tend to go with lower levels of penetration.

⁸⁸ See page 232 of Ofcom's report

Figure 11: Relative price of fibre and FTTH penetration

Source: Retail price data compiled from Van Dijk for the European Commission, "Broadband Internet Access Cost" reports (2008, 2010, 2011). FTTH penetration data from Heavy Reading for FTTH Council Europe, "FTTH in Europe: Forecast and Prognosis" February 2011 (with the exception of Belgium, for which only the 2010 penetration figure was available), and FTTH Council Europe website. Retail prices for copper and fibre are reported for the period from 1-15 Feb 2011. For each country, we take the median offer per technology (xDSL, FTTHx, cable) per basket in purchasing power adjusted € (incl. VAT), for unbundled, broadband standalone offers and calculate the unweighted average across baskets, which tends to lead to an over-representation of the more expensive products within each technology. However, lacking information on take up, using weighted average figures was not possible.

120. For example, Sweden has one of the highest rates of FTTH penetration in Europe, and retail prices for fibre-based access products that are below those of copper.⁸⁹ Whilst the lowering of fibre retail prices may have the positive effect of driving fibre take-up, it will of course also reduce returns on fibre investment. It is far from clear whether such a pricing structure is sustainable in the long run. The EC's 15th Implementation Report commented that average revenue per user for fibre in Sweden has declined to its lowest in years and the prospect for the roll-out of fibre was becoming less clear.⁹⁰ However, given that approximately 45% of the fibre infrastructure is publicly owned in

⁸⁹ 14.6% at the end of 2011, see Heavy Reading, "FTTH in Europe: Forecast and Prognosis 2011-2016", White paper prepared for the FTTH Council Europe, 2012

⁹⁰ Commission staff working document "Progress Report on the Single European Electronic Communications Market 2009 (15th Report)" SEC (2010) 630/1, p 393 of Annex 1; available at (http://ec.europa.eu/information_society/policy/ecomm/library/communications_reports/annualreports/15th/index_en.htm).

Sweden⁹¹, the lack of profitability in the fibre business does not seem to have deterred its roll-out in Sweden so far.

121. There is additional evidence to suggest that consumers are not willing to pay a significant premium for services provided over fibre despite the difference in the quality of service:

- Rosston et al. use data from a nationwide US survey administered during late 2009/early 2010 to estimate a random utility model of household preferences for broadband Internet services, offering essentially three grades of speed: slow (described as dial-up), fast (described as 'much faster downloads and uploads, great for music, photo sharing and watching some videos') and very fast (described as 'blazing fast downloads and uploads, great for gaming, watch HD, and instantly transferring large files'). Results suggest that the representative household has a high marginal willingness to pay (WTP) for a high speed internet service, but a low marginal WTP for a very high speed service: *"The representative household is willing to pay \$20 per month for more reliable service, \$45 for an improvement in speed from SLOW to FAST, and \$48 for an improvement in speed from SLOW to VERY FAST."*⁹² That is, the majority of the premium a representative household is willing to pay for an upgrade of broadband speed from a "slow" service is associated with an upgrade to a "fast" broadband service, and only a small additional premium of USD3 per month is associated with the incremental increase in speed to a 'very fast' service.
- A recent conjoint study⁹³ based on data from a web-based survey of 3600 respondents in the Netherlands showed that pricing played the biggest role in determining customer choice. The survey was designed around a number of attributes that would make up a typical dual or triple-play proposition, including download and upload speeds, number of TV channels and the price of broadband. Symmetric upload and download speeds (which would be more representative of FTTH services than copper-based access) appear to have limited appeal given current bandwidth demand, and enjoy only a limited price premium of around 8%-15%, or around €5 in absolute terms. In addition, projected increases to bandwidth demand seems to have little impact on relative consumer

⁹¹ Ibid.

⁹² See Gregory L. Rosston, Scott J. Savage, and Donald M. Waldman (2010) "Household Demand for Broadband Internet in 2010," The B.E. Journal of Economic Analysis & Policy: Vol. 10: Issue 1 (Advances), Article 79, p 35; available at: <http://www.bepress.com/bejeap/vol10/iss1/art79>.

⁹³ See Frans van Camp: *"FTTH Moves The Market"*, XS Insight presentation at FTTH Conference 2012, Munich, February 15. The analysis links participants' willingness to pay to nine attributes of dual and triple play packages including: the television provider, number of channels available, number of HD channels available, price of television package, broadband provider, download and upload access speeds, broadband package pricing and telephony. A conjoint analysis looks at the participants' willingness to pay for packages containing various combinations of these attributes and measures the participant's valuation of each attribute in money terms based on the participant's choices between these packages. The study was undertaken in September/October 2010.

preferences of FTTH and cable with FTTH gaining only a 0.8% increase in share (relative to current) when average download/upload bandwidth demand grows to 10Mbps/1Mbps and an additional 3.5% share (relative to current) when average download/upload bandwidth demand grows to 30Mbps/3Mbps.

122. Thus, evidence suggests that there is insufficient willingness to pay (at present) for services provided over fibre over and above the cost of services provided via copper-based access. This means that the gap that might be required to encourage fibre deployment by incumbent operators is very likely to be unsustainable in the short to medium term.

3.4 Implications for regulatory policy

123. Given that fibre and copper compete for both investment and users, investment incentives and migration incentives need to be considered together, and the regulatory policy towards both fibre and copper matters. The effects of policy changes are complex, often work in opposite directions, and may affect incumbents and entrants differently. As a result, *“the net effect of changes in copper access rates is unpredictable. On the one hand, reducing copper access rates would lower incumbent profits on copper and perhaps make fiber investments appear relatively more attractive to incumbents. At the same time, lower copper rates would reduce retail prices for DSL, thereby reducing expectations for fiber uptake and making fiber investments less attractive for incumbents and entrants alike. It is unclear which effect would predominate in practice, though, as noted above, recent research suggests more aggressive copper unbundling policies have, on net, reduced NGA investments.”*⁹⁴
124. This recent research uses a panel of EU Member States to estimate the impact of various competition, regulatory and demand-and cost related variables on fibre penetration.⁹⁵ Their measure of regulation is the proportion of total broadband lines that are being provided on the basis of regulated wholesale access, and the authors *“expect a negative sign ... since tight access regulation of existing broadband services creates corresponding expectations on future NGA access regulation on the part of infrastructure operators.”*⁹⁶ The econometric estimates confirm such a negative impact, which the authors link to the expectations of future NGA-related regulation (although their framework does not allow one to draw any distinction between a negative impact of lowering

⁹⁴ R Crandall, J Eisenach and A Ingraham, “The Long-Run Effects of Copper Unbundling and the Implications for Fiber”, March 2010, available at SSRN: <http://ssrn.com/abstract=2018929> or <http://dx.doi.org/10.2139/ssrn.2018929>, p 52 f.

⁹⁵ W Briglauer, G Ecker and K Kugler, “Regulation and Investment in Next Generation Access Networks: Recent Evidence from the European Member States”, Working Papers / Research Institute for Regulatory Economics, 2011,4. Forschungsinstitut für Regulierungsökonomie, WU Vienna University of Economics and Business, Vienna, available at <http://epub.wu.ac.at/3291/>

⁹⁶ Ibid., p 11.

copper prices because of it creating an expectation of tough NGA regulation, and the pressure it would put on the pricing of fibre access).

125. The impact of competition is non-linear, following the traditional inverse U-shape that one would expect from the interplay between the investment-enhancing effect flowing from the attempt to invest in order to gain a temporary advantage over competitors and the negative impact on profits that would reduce the attractiveness of investment:⁹⁷ Competition from cable networks would appear to have a negative impact, whereas competition from wireless services would seem to have a positive effect.

3.4.1 Reduction in copper charges and regulatory trust

126. Overall, this discussion would suggest that when setting regulated access charges for copper it is important to ensure that trust in the regulatory process is maintained. Reductions in copper charges – to the extent that they would be desirable to provide incentives for fibre investment and potentially steer incremental investment towards fibre rather than copper upgrades – must not create the expectation that access charges for fibre may also be lowered once fibre investment is sunk, which would expose investors to the risk of not being able to recoup their costs and facing expropriation through regulation. This strongly corresponds with the need to avoid regulatory hindsight bias as discussed above, and the importance of ensuring that regulation does not lead to an under-recovery of costs in the way we have established in the previous section.
127. This does not rule out pricing copper on a legacy basis, provided that the decision to do so does not undermine the principle that new investments should recover costs. Changes in regulatory policy towards copper should not lead to cost under-recovery, and might have to be explicitly justified with reference to a desire to speed up the transition from copper to fibre. This would of course go against the grain of technological neutrality, which has so far been one of the fundamental principles of the European regulatory framework for electronic communications services and networks. Whether such a change from established practice is appropriate and justified is a question that will undoubtedly be subject to considerable debate. However, the very fact that any explicit regulatory decision to reduce the return on copper networks to promote fibre would have to be subject to such a debate should in itself provide some confidence to investors that such a change would be exceptional and that they would be protected from any regulatory opportunism.
128. As noted above, one issue that needs to be addressed is how the costs of physical infrastructure that is used to support both copper and fibre networks ought to be measured and allocated towards the different services, which

⁹⁷ At moderate levels of competition an increase in competitive pressure spurs investment because operators have a greater incentive to gain advantage relative to their competitors, but if competition is strong than a further increase in competitive pressure has negative effects because the profits that would be required to recover investments will be eroded

needs to be consistent with the pricing of physical infrastructure access that might have to be provided on regulated terms.

129. Cave et al. argue that *"the pricing of duct access is neutral with respect to the transition from fibre to the copper because ducts are used by both technologies. Hence, the recovery of cost incurred is the main pricing objective for this type of asset. So, in the case of ducts, the useful lives of which are threatened neither by foreseeable technological obsolescence, nor by competition, it is possible simply to use HCA (historic cost accounting), which will ensure full recovery of costs (but no more) on an ex ante basis in the normal way."*⁹⁸ This means that different pricing policies might be applied to the physical infrastructure and the copper assets that are currently used in the access network.⁹⁹
130. In relation to the apportionment of physical infrastructure costs to copper and fibre-based wholesale products, Plum recommends that *"[j]oint and common costs such as duct and overheads are migrated to fibre as customers switch to fibre. A simple approach would be to reassign each customer's share of joint and common costs from copper to fibre as and when customers migrate."*¹⁰⁰ This means that fibre would carry an increasingly larger share of the costs of physical infrastructure, which in turn would lead to a situation in which wholesale copper access becomes cheaper not only relative to wholesale fibre access as take-up of fibre increases, but that the prices of wholesale products change in a similar manner relative to the (regulated) price of physical infrastructure access.
131. This may create problems with investment incentives, pointing towards the more general problem that having multiple tiers of intervention (e.g. physical infrastructure access plus wholesale products whose regulated price includes physical infrastructure costs, plus wholesale services that include one or more of these wholesale products) greatly compounds the risk as access seekers will pick and choose from amongst the different tiers of access to use the most advantageous mode of provision.¹⁰¹ As a result, there should be a general bias against overcomplicated access regimes with multiple substitutable tiers of access, and it might be appropriate to de-regulate wholesale access products where regulated access to physical infrastructure has to be provided.
132. Only a few EU countries have taken steps to ensure that the incumbent telecoms operator makes its physical infrastructure available for access by

⁹⁸ M Cave, A Fournier and N Shutova, "Which Price Level for Copper Access in the Transition to Fibre?" 2011, p 5

⁹⁹ Ibid., p 17

¹⁰⁰ Plum Consulting, "Costing methodology and the transition to next generation access – A report for ETNO", March 2011, p 7

¹⁰¹ In this case, only *one* access service being priced too low could encourage inefficient entry and undermine the ability of the access provider to recoup its investment. Conversely, *all* access services would need to be priced too high to choke off access based entry. We might call this the "extreme value problem" – that only the most economically advantageous mode of access matters where there are overlapping, substitutable modes of entry, so risks mount rapidly.

other operators. For example, a regulatory obligation is imposed on the incumbent telecom operators in Portugal and France, under which Portugal Telecom and France Télécom are obliged to share their physical infrastructure.¹⁰² Portugal Telecom's ducts became available for sharing following the enforcement of the Reference Conduit Access Offer (ORAC) in 2006. The ORAC specifies key pricing and operational aspects and also applies equally to new buildings, requiring Portugal Telecom to notify interested parties of its plans to invest and offer them the opportunity to share the cost of the new ducts and the associated benefits.¹⁰³ In France, the duct access offer is aimed at operators deploying public fibre-optic connections mainly to residential buildings and the offer specifies pricing in addition to well defined engineering principles for allocating space in ducts and the associated prices for such access.¹⁰⁴

3.4.2 Raising the fibre premium

133. Perhaps more importantly, there seems to be a strong constraint on the scope for regulatory policy to create a gap between access charges for copper and fibre even if such a gap would provide an incentive for incumbents to invest in fibre rather than upgrading their copper networks. This is because the effective fibre return is capped by the prices that can be sustained in competition with copper-based access products. Even if regulation were to permit higher access charges, these are irrelevant for fibre returns.
134. What matters in this regard is the 'fibre premium' that would be sustainable in the retail market. On all available evidence, this premium is very small – at least at present, based on the current mix of services enabled by fibre.
135. This might of course simply suggest that the value of fibre relative to (upgraded) copper is small, which would cast doubt on the net benefits from upgrading to fibre not only for operators, but for the economy as a whole, and suggest that the DA targets are possibly over-ambitious. In this view, if at a given retail price of copper-based access customers are not prepared to pay a premium for fibre-based access, then the main justification of pushing for fibre would have to come from wider social benefits (i.e. benefits that are not reflected in customer willingness to pay). In order to capture such wider benefits, it may be necessary to pursue a strategy of actively promoting fibre build, which we discuss in the next section.
136. However, this argument ignores two important points:

¹⁰² See page 100 of Ofcom, "Review of the wholesale local access market, statement on market definition, market power determination's and remedies" 7 October 2010. Available to download at http://stakeholders.ofcom.org.uk/binaries/consultations/wla/statement/WLA_statement.pdf

¹⁰³ See page 37 of Analysis Mason, "Operational models for shared duct access" 1 April 2010

¹⁰⁴ See page 42 of Analysis Mason, "Operational models for shared duct access" 1 April 2010. Available to download at http://stakeholders.ofcom.org.uk/binaries/consultations/wla/annexes/operational_models.pdf

- First, end-user choices may be based on incomplete and incorrect information. The fact that customers are not prepared to pay a premium for fibre may simply be because they are unable to establish the difference in quality of service that is available over fibre access networks.
 - Second, and related, the value of connectivity is driven by the value of the services to which the customer gains access. If there are no services that make full use of the capability of fibre in the local loop, there is no benefit to users from fibre-based access. However, this gives rise to co-ordination problems because the development of such services in turn depends on there being a sufficiently large number of customers who already have fibre connections, or can be expected to be willing to upgrade, as the addressable market is limited to such customers.
137. Both of these reasons suggest that copper and fibre-based access products may be regarded as being close substitutes because the value of fibre is not fully reflected in the (current) willingness of customers to pay, even though they might be in the longer term. This will not only limit the scope for regulatory policy to flex the ratio between regulated access charges for copper and fibre, but will also make the business case for fibre more challenging in general. WIK for example notes that its *“model suggests that at copper access charges which would be conducive to fibre investment, there could be a gap of about 11 – 15€ between the resulting copper retail price and fibre retail price.”*¹⁰⁵
138. If there are distortions in valuation, or if valuations for fibre are depressed because of co-ordination problems that delay or jeopardise the development of new services, then an obvious question is what can be done to correct for such distortions.
139. Advertising of broadband speeds has been a contentious issue around the globe, and it is quite conceivable that users are not fully informed about the services they receive, or are likely to receive when signing up for a broadband connection. The US Federal Communications Commission (“FCC”) found that in the United States actual speeds for both downloads and uploads were much lower than the advertised speeds. The average actual download in 2009 speed was found to be only 40–50% of the advertised “up to” speed for which households signed up.¹⁰⁶ Additionally, a survey by the FCC on the consumer

¹⁰⁵ WIK’s model does not assume that customers simply switch and pay €15 more for fibre. WIK compare equilibrium situations before and after a fibre build out and includes a dynamic interpretation, according to which the relative valuation of fibre against copper increases with time due to new applications for fibre only, thus consumers will have had a period of getting used to the value fibre provides (see WIK-Consult Wholesale pricing, NGA take-up and competition, Study for ECTA, May 2011, p 139). This means that the implied fibre premium should be regarded as a difference that might be sustainable in the longer term, even though it is not at present. Plum’s analysis is based on the assumption of a premium of €5 for FTTC and €10 for FTTH, increasing by 2% in real terms per annum

¹⁰⁶ Federal Communications Commission, “Connecting America – The National Broadband Plan”, 2010 (<http://www.broadband.gov/download-plan/>) - Exhibit 3.G and accompanying text

broadband experience found that 80% of broadband users in 2010 did not know the speed of their broadband connection.¹⁰⁷

140. Similar results have been obtained in the UK, where Ofcom found that *"DSL-based connections continued to deliver average download speeds that were much lower than the headline 'up to' speeds which are frequently used to advertise broadband services. 'Up to' 8Mbit/s and 'up to' 20/24Mbit/s ADSL connections delivered just 41% and 31% of headline speeds during the period, in line with results from previous research while cable and FTTC-based services on average delivered between 90% and 103% of headline speeds."*¹⁰⁸ Interestingly, the gap between promise and reality is greater for higher-speed DSL services, whilst cable and services with fibre to the cabinet tend to deliver what they promise.
141. Such large differences between what is being promised and what is being delivered could actively suppress the demand for fibre as copper-based access may be wrongly perceived to provide similar services. Combined with the fact that many customers may not be able to establish the speeds they are actually obtaining, and even if they might not be in a position to identify their connection as the main source of poor service quality (which may for example also be the result of congestion at the server end when downloading popular content), such advertising could artificially depress the fibre premium.
142. The Committee on Advertising Practice – a self-regulatory industry body in the UK – issued guidance last year on what can be included in advertising, but the restrictions (largely to do with avoiding terms such as 'superfast' and 'unlimited', and requiring the provision of information about technical speeds) have generally been regarded as insufficient and disappointing.¹⁰⁹ In Australia, Optus has been fined AUS\$ 5.26 million (reduced to AUS\$3.61 million following an appeal) for misleading advertising in relation to its broadband offers, failing to declare that speeds would be limited once customers had reached their download quotas.¹¹⁰
143. Improving the information provided to customers is an obvious way of removing distortions in valuation. This would entail, for example, provisions that stipulate what information has to be provided to customers, and in what form. Information about maximum available speed, for example, might be misleading, and operators could be required, for example, to inform customers about the speed they should be expecting to get most of the time, taking account of the quality of the line, distance from the exchange, contention ratio

¹⁰⁷ J Horrigan and E Satterwhite, "Americans' Perspectives on Online Connection Speeds for Home and Mobile Devices" 2010 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-298516A1.doc)

¹⁰⁸ Ofcom, "UK fixed-line broadband performance November 2011" Published 2 February 2012, available at http://stakeholders.ofcom.org.uk/binaries/research/broadband-research/Fixed_bb_speeds_Nov_2011.pdf

¹⁰⁹ <http://www.telegraph.co.uk/technology/broadband/8797632/Broadband-advertising-proposals-a-green-light-to-mislead-customers.html>;

¹¹⁰ <http://www.itwire.com/it-policy-news/regulation/53326-optus-broadband-ads-penalty-reduced-to-361-million-after-appeal>

used by the operator etc. Alternatively (or in addition), there might be information about minimum guaranteed speed, and a clearer identification of available upload speeds. For further clarification, it might be necessary to stipulate what the connection speed is in terms of the services that a user can expect to access rather than through technical parameters such as the bit-rate.

144. Research undertaken by Rosston et al. suggest that the valuation of internet connectivity is dependent on experience.¹¹¹ Quoting results from the Pew Internet and American Life Project (2010) and their own survey data, they report that roughly a third of inexperienced households would take up an internet service once they have experience the benefits of the service. In relation to higher speed services, the study found that subscribers' valuation of speed increases with experience, defined in terms of their existing connection speed, the period for which they have been connected, and experience with 'internet-related devices and applications'.
145. In particular, the study found that the premium that subscribers would be willing to pay for improved reliability increases with their existing connection speeds with existing households with a "slow", "fast" and "very fast" connection willing to pay USD11, USD19 and USD25 per month more for an improvement in reliability of service.¹¹² Users who own a smartphone, a webcam, or pay a fee to view or download videos. place a premium of USD1, USD 1.50, USD8 per month on "very fast" relative to "fast" services respectively, comparatively, users who do not have such "Internet-related device and applications" experience are not willing to pay a premium of very fast speeds. In addition, users of a smartphone, webcam and who pay a fee to download videos, and are prepared to pay USD4, USD6, USD8 per month more for a more reliable service relative to users who do not use these devices and services.¹¹³ This implies that broadband access has the characteristics of an experience good, whose quality is difficult to establish prior to purchase, but can be verified when it is being used.
146. If customers are uncertain about the value they might obtain from higher speed connections and are therefore reluctant to pay a premium for fibre access, a way of overcoming this problem might be through some form of penetration pricing: customers could in this instance be offered a brief trial period for a low price, after which they would have to sign up for a longer term and pay whatever premium is required to cover the cost of the trial period. Regulatory constraints may prevent operators from engaging in such a strategy if they set an unduly short maximum contract period in the interest of

¹¹¹ Gregory L. Rosston, Scott J. Savage, and Donald M. Waldman (2010) "Household Demand for Broadband Internet in 2010," The B.E. Journal of Economic Analysis & Policy: Vol. 10: Issue 1 (Advances), Article 79; available at: <http://www.bepress.com/bejeap/vol10/iss1/art79>

¹¹² The study used two levels - 'less reliable' and 'very reliable', which are defined as: "*Very reliable Internet service is rarely disrupted by service outages, that is, your service may go down once or twice a year due to severe weather. With less reliable Internet service you will experience more outages, perhaps once or twice a month for no particular reason.*" (see Table 1 of Rosston et al.)

¹¹³ See Section 5 of Rosston et al (2010)

facilitating customer switching. For example, Ofcom in the UK has in 2011 imposed a maximum contract duration of two years on broadband contracts, and also required operators to offer also shorter contract durations. This is in line with the European Telecommunications Framework as amended in 2009, which limited initial sign-on contracts for consumers to a maximum of 24 months.¹¹⁴ Whether this limit would prevent operators from engaging in penetration pricing strategies is an empirical matter, but the potential impact that a limitation on permissible contract durations might have on the available pricing strategies and the resultant ability to promote a new technology should clearly be taken into account.¹¹⁵

147. Providers of FTTH may also benefit from engaging in free trials to allow customers to gain first hand experience of the ultra-fast network, engaging with potential consumers to sign up to the service over the trial period. Such an approach was taken in the small town of Nuenen in the Netherlands as part of an experiment subsidised by the government. Most of the 8000 households took up the offer of free FTTH rolled out in 2004 (representing around 96% take up). Once the free trial period was over, prices for these services rose to between €60 and €75 per month and despite the significantly higher charges, 80% of Nuenen residents remained on the FTTH connection and paid these prices.¹¹⁶

3.4.3 Assisting in the co-ordination of service and infrastructure development

148. Matters are more complicated, however, because it is not simply an issue of the network operator (or a third party using wholesale access) offering an upfront discount to convince customers of the benefit of faster connection speeds. As noted above, the value that an end-user derives from a broadband connection is determined by the services to which they can obtain access, and without services that make full use of the technical capabilities of a network infrastructure, the value of this infrastructure to end-users will always be limited. This gives rise to a co-ordination problem, as customers will be reluctant to sign up without being able to access attractive high-bandwidth services, and investment in the development of such services will be limited as long as there is no sufficiently large customer base (or a sufficiently strong expectation that such a customer base will emerge).
149. This is not an uncommon challenge for 'platform businesses' – i.e. firms that provide a platform for two distinct customer groups to interact with each

¹¹⁴ Directive 2009/136/EC of The European Parliament and of The Council, of 25 November 2009, amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0011:0036:En:PDF>).

¹¹⁵ See <http://stakeholders.ofcom.org.uk/consultations/gc-usc/statement>

¹¹⁶ Trevor Barr, "Broadband: Towards Understanding Users", 25 September 2007 (<http://researchbank.swinburne.edu.au/vital/access/services/Download/swin:6414/SOURCE2>)

other.¹¹⁷ Platform businesses account for much of the ICT sector, and network businesses are a prime example.

150. There are different ways of overcoming this challenge, and most of these revolve around the appropriate sharing of costs. Because the platform essentially serves two distinct customer groups – the network allows service providers to reach their customers, and enables those who are connected to access services – many of the costs incurred are common across the two customer groups. The platform operator tries to make the platform attractive for both customer groups by recovering the cost in the way that provides the most attractive balance of costs and benefits to both sides, taking account of the fact that attracting more customers on one side generally helps to attract more customers on the other. This often leads to pricing structures that are very skewed (e.g. in the case of advertising-funded media, it is the advertisers who pick up the full cost of operating the platform that allows them to reach their target audience, with viewers, listeners or readers receiving valuable content ‘for free’).¹¹⁸
151. The flexibility of network operators to pursue different pricing strategies is, however, limited by regulatory constraints:
 - For example, it would not seem to be possible at present to charge service providers for access to end-users and thus ‘subsidise’¹¹⁹ connections, even if this were the most effective way of funding investment in fibre networks.
 - Similarly, whilst network operators may in principle enter into exclusive agreements with service providers in order to increase the attractiveness of their product to end-users (e.g. by ensuring that certain highly valued content is only available on a particular network)¹²⁰, it would not seem to be possible for network providers to limit access to end-users to certain service providers, or afford preferential treatment to certain traffic, as this would obviously go against the principle of net neutrality.
 - For the same reason, potential co-investment arrangements involving service providers and network operators in which the service provider contributes to the investment cost in exchange for preferential access to the end-user would seem to be infeasible.

¹¹⁷ For an extensive discussion of the economics of platform businesses see D Evans, ‘Platform Economics: Essays on Multi-Sided Businesses’, Competition Policy International, 2011

¹¹⁸ See J-C Rochet and J Tirole, Two-sided markets: a progress report. The RAND Journal of Economics, Vol. 37, 2006

¹¹⁹ Please note that this would not be a subsidy in the strict sense as costs are incurred in providing network connectivity to service providers and end-users jointly.

¹²⁰ Such exclusive supply agreements would of course be subject to competition rules and might not be permissible if both the service provider and the network operator are deemed to enjoy market power.

152. It is however worth noting that there appears to be some flexibility in this regard, with the EC Vice-President Neelie Kroes stating in a news article that she would not be opposed to flexible commercial agreements between network and content providers (such as Google and Facebook), saying: *"If operators can reach a commercial agreement with content and service providers, that's up to them, I'm not going to stand in their way," she says. Different business models can then compete.*"¹²¹ Of course, there are strong arguments in support of net neutrality, and one might need to consider supportive measures that ensure that customers are fully informed about any restrictions they might face in terms of access to content, and give them the option to avoid these restrictions in exchange for paying a price for access that covers the contribution that would otherwise come from the content provider (essentially a way of 'buying out' of any restrictions that might otherwise be imposed).
153. Alternatively, perhaps the only option for overcoming the problem that service development and take-up of high bandwidth connection are closely connected would be for the network operator itself to take charge of ensuring that attractive services are available to promote end-user take-up. This of course adds to the risk facing the network investor, and will not work if customers are enticed more by the range of services to which they will get access than one particular 'killer' application.
154. It may therefore be appropriate to consider whether some of the regulatory constraints that limit the flexibility of designing attractive offers in light of the platform nature of high-speed broadband connections should be relaxed. Although the principle of net neutrality might seem beyond reproach, there is nothing obviously wrong with service providers contributing to the cost of connections in exchange for preferential access to the end-user, provided of course that the restrictions that the end-user will face as a result are transparent and known in advance.

¹²¹ See FT article: <http://www.ft.com/cms/s/0/762c9402-eac7-11e0-ac18-00144feab49a.html#axzz1pxknEcFK>.

4 Active promotion of fibre roll-out

In this chapter, we move beyond the options for promoting fibre investment which are available to national regulators under the current regulatory framework to consider other types of measures that would actively promote more widespread deployment of fibre within Europe.

We look at the case for government intervention to promote fibre investment, on the basis that the positive spill-over effects from FTTH are such that there is a strong public policy case for fibre roll-out even if the business case for doing so is not sufficiently strong. In considering this point, we draw on a number of studies which have examined the societal and wider economic benefits arising from increased broadband availability. We also observe the clear statements in the Commission's Digital Agenda favouring increased public intervention to drive the deployment of ultra-fast broadband networks.

Turning to the specific types of measures that governments might want to use to actively promote the roll-out of FTTH within Europe, we examine the prospects for measures that could help to support a larger gap between copper and fibre access charges, policies that would have an explicit focus on allowable investments (such as the exclusion of investments in assets that are not deemed to be future-proofed), direct contributions towards the building of fibre networks (including assistance in development of co-investment arrangements), direct public involvement in the deployment of FTTH networks and the possible adoption of a EU-wide 'fibre switchover' policy.

155. As Briglauer et al. put it, "[t]here are essentially two ways to achieve a fast and comprehensive NGA roll-out. First, market-based incentives, including US-like regulation strategies as, for example, regulatory holidays, are possible. Second, direct state subsidies as seen in many Asian countries and, more recently, in Australia and New Zealand, will be needed, especially to supply white areas with next generation networks."¹²²
156. So far we have examined the regulatory options that fall into the first category. The existing regulatory framework allows regulators some latitude in pursuing different regulatory objectives, and in order to promote fibre investment there are a number of ways in which they could shift the focus from static to dynamic efficiency. Focusing too hard on promoting retail competition on the basis of fibre networks *assuming they are in place* runs the risk of discouraging the investment needed to turn this assumption into reality. Making sure that fibre investors are in a position to reap the rewards for committing considerable resources and not having their business case undermined by

¹²² W. Briglauer, G. Ecker and K. Guler, "Regulation and Investment in Next Generation Access Networks: Recent Evidence from the European Member States", Working Papers / Research Institute for Regulatory Economics, 2011,4. Forschungsinstitut für Regulierungswirtschaft, WU Vienna University of Economics and Business, Vienna.

distorted consumer valuations would seem to be the key to promoting fibre investment – provided the FTTH business is positive (even though it might be challenging). The main task for regulatory policy in this case is to avoid measures that weaken the business case for fibre investment and to support those that provide as much of a boost as can be achieved without pro-actively pushing the case for fibre. This means avoiding regulatory uncertainty, being careful to avoid regulatory hindsight bias, adjusting appropriately for the risks involved in fibre deployment, and making sure that where the willingness to pay for fibre does not reflect fully the value of ultra-fast broadband, any underlying distortions are removed.

157. However, it may well be that none of the above measures are sufficient to create a positive business case for FTTH investment. The full willingness to pay for ultra-fast broadband, even if it could be converted into fibre revenues to the largest possible extent, might simply be insufficient to justify the investment in FTTH networks. This does not automatically indicate that such investments are undesirable. There may well be societal benefits of fibre access that are not reflected in fibre customers' willingness to pay, suggesting a public policy case for FTTH infrastructure. In this case, small adjustments within the existing regulatory framework would not be sufficient to bring about fibre investment, and more direct public support mechanisms might then be needed.
158. In this section, we look at the case for such additional measures that might be used to drive FTTH deployment and then consider the kinds of policy options that might be considered in order to do so.

4.1 The case for government intervention

159. As discussed earlier in this report, from a potential investors perspective the decision to invest in fibre will depend on a balance of costs, revenues and risks. If expected net revenues are insufficient to cover the investment cost, the investment will not take place. However, the revenues that an investor can expect to earn will not necessarily reflect all the benefits associated with rolling out fibre infrastructure. Like many infrastructure investments, FTTH may create positive spill-over effects that are not captured in any individual user's willingness to pay. This may create a strong public policy case for FTTH investment even if the business case is weak or negative.
160. Widely available, reliable and high-speed broadband access may fundamentally change the way in which we do business and interact with the public sector, and the infrastructure that supports such services is seen as a great enabler of innovation, competitiveness, growth and social inclusion. The Europe 2020 strategy that underpins the Digital Agenda sees broadband deployment as a means of promoting social inclusion and competitiveness in the EU, and many governments look at broadband investment as a tool to drive growth and employment.
161. Looking specifically at the broadband targets set out in the Digital Agenda, the Commission notes that *"[t]he target for fast and ultra-fast internet access was chosen because of the central role it will play in economic recovery and in providing a platform to support innovation throughout the economy, as electricity and transport did in the past. The roll-out of ultra-fast open and competitive*

networks will stimulate a virtuous cycle in the development of the digital economy, allowing new bandwidth-hungry services to take off and fuelling growing citizen demand, which in turn will stimulate further demand for bandwidth. ... [S]mart, sustainable and inclusive growth as envisaged by the Europe 2020 strategy will very much depend on the efficient and effective use of the internet, and internet access speed will be a key factor in achieving this. Internet access is provided by — generally private — network operators under a competitive regulatory framework and driven by commercial interests. Yet because of the critical role of the internet, the benefits for society as a whole appear to be much greater than the private incentives to invest in faster networks.”¹²³

162. For example, faster and more symmetric connections may allow for better-quality video-conferencing allowing individuals to work remotely thus reducing commuting needs and providing greater scope for regional development. Faster and improved connections between hospitals and remote diagnostics may lead to significant improvements in the services provided to patients and reduce the need for expensive home visits or hospitalisation.¹²⁴ E-government services may increase efficiency and transparency in public administration, while e-learning and distance working have the potential to reduce the cost of doing business by increasing labour mobility and potentially reducing traffic congestion.¹²⁵ Access to high-speed internet in rural areas may allow for increased business activity and prevent the shift of economic activity and loss of young professionals to other, better connected areas. Referring to work undertaken by the OECD, the Commission states that *“the cost savings in just four sectors of the economy (transport, health, electricity and education) would justify the construction of a national fibre-to-the-home network.”*¹²⁶
163. A number of empirical studies have sought to establish a link between broadband penetration and GDP as well as broadband penetration and employment, with the research focus shifting towards the impact of higher speed services.¹²⁷ Recent empirical studies have tried to quantify the direct

¹²³ “European Broadband: investing in digitally driven growth”, Communication from the European Commission COM(2010)472, 20 September 2010, p 3.

¹²⁴ Ovum, ‘Fibre: the socio-economic benefits’, FTTH Conference 2009.

¹²⁵ Forzati, M., Mattson, C. “Socio-economic return of FTTH investment in Sweden, a prestudy.” October 2011. Found at <http://www.broadband-europe.eu/Lists/Competences/Prestudy%20socio-economic%20return%20of%20FTTH.pdf>.

¹²⁶ “European Broadband: investing in digitally driven growth”, Communication from the European Commission COM(2010)472, 20 September 2010, p 3.

¹²⁷ For example, Czernich et al. investigate the effect of broadband infrastructure on economic growth for a panel of OECD countries between 1996-2007. The results show that a 10 percentage point increase in broadband penetration raises per-capital growth by 0.9 – 1.5 percentage points per annum (See N. Czernich, O. Falck, T. Kretschmer and L. Woessmann, “Broadband Infrastructure and Economic Growth”, The Economic Journal, Vol. 121, p505-532, May 2011). Koutroumpis considered that for the EU-15, between 2002-2007 the impact of broadband on GDP was 0.63%, contributing 16.9% of total growth over the period (See O. Koutroumpis, “The Economic Impact of Broadband on Growth: A Simultaneous Approach”, Telecommunications Policy, October 2009).

and indirect effects of ultra-fast broadband in terms of wider benefits to society and the economy. Presenting their findings in terms of increased employment and GDP growth, all show the positive benefits of increased broadband speed and the roll-out of ultra-fast networks. For example:

- A recent study conducted by Ericsson, Arthur D. Little and the Chalmers University of Technology found that doubling a country's broadband speed would lead to a 0.3% increase in GDP growth. The findings rest on an econometric analysis of a panel of 33 OECD countries over the period 2008-2012 using publicly available data. The positive effects of increases in broadband speed for the economy are broken down into three main categories with direct and indirect effects providing a short-to-medium term stimulus, and 'induced' effects having a long-term impact. The direct effects include job creation through civil works, construction and equipment required for building the new infrastructure. The indirect effect includes the spill-over arising from efficiency improvements resulting from the availability of high-speed broadband. Induced effects capture new styles of business caused by the increased speeds including the creation of more online services.¹²⁸
- Katz et al.¹²⁹ considered the level of investment that would be required to meet the German National Broadband Strategy¹³⁰ and the number of jobs and level of growth that would be generated by this investment. Using input-output tables from the German Federal Statistics Office, the study estimated that 541,000 new jobs would be created by network construction alone. A further 427,000 jobs would be created once infrastructure had been deployed, as a result of network externalities, *"such as enhanced innovation resulting in new services, additional business growth, and the attraction of jobs from other countries as a result of a recomposition of industrial value chains."* The authors also showed that there would be significant benefits in terms of economic growth concluding that the effect of significant investment in ultra-fast broadband networks on GDP would likely be equivalent to 0.6% of annual growth over the ten-year period from 2010 to 2020.
- Forzati and Mattsson¹³¹ considered the socioeconomic returns of FTTH roll-out in Sweden with the goal of establishing returns for society from investing in broadband. They estimated that the total level of investment required to reach 100% fibre penetration in Sweden, which would amount

¹²⁸ Ericsson, "Need For Speed – a new study confirms the positive effects of an increased broadband speed on GDP" September 2011 found at http://www.ericsson.com/networkedsociety/media/hosting/Need_for_speed.pdf

¹²⁹ R. Katz, S. Vaterlaus, P. Zenhäusern, S. Suter, P. Mahler, "The Impact of Broadband on Jobs and the German Economy" May 2009; available at http://www.elinoam.com/raulkatz/German_BB_2009.pdf

¹³⁰ The German governments targets are for 50% of German households to have access to at least 50Mb/s by 2014 and 50% of German households have access to 100MB/s and an addition 30% to 50MB/s by 2020.

¹³¹ M. Forzati, C. Mattsson, "Socio-economic return of FTTH investment in Sweden, a prestudy", October 2011.

to 39 billion SEK,¹³² and considered a rapid deployment scenario where the network would be built over a period of four years. Direct returns from the investment were calculated based on an investment multiplier of 0.93¹³³ and, including indirect effects such as reduced telecommunication costs for municipal and regional administrators¹³⁴ and higher quality services for households, the authors considered that the investment would give a cumulative return of about 59 billion SEK in 5 years. Using data from Sweden's 290 municipalities to calculate the short-term effect of increased deployment of FTTH on employment the study estimated that a 10% increase in FTTH penetration would lead to a 0.1% increase in employment.

- Bertschek et al. provide evidence of the impact of broadband internet on labour productivity and on product and process innovations.¹³⁵ Using data from business surveys that looked at the last major shift in technology (the early phase of DSL expansion) in Germany from 2001 to 2003, the authors found a positive correlation between the availability of broadband internet and firms' innovation activity (though they found no significant impact on labour productivity).¹³⁶ Considering both process innovation (i.e. whether a firm has internally introduced new or significantly improved processes) and product innovation (i.e. whether the firm has introduced new or significantly improved products or services innovation), and controlling for a firm's previous innovation experience, the analysis showed that broadband use can increase the probability of innovation by up to 8.83 percentage points. The study concluded that *"[t]he positive and significant effects of broadband use being robust across all specifications, however, suggests that broadband Internet has enabled firms to develop and offer new or considerably improved products and services."*¹³⁷

164. These effects can justify policy measures that are aimed at actively promoting fibre roll-out, including a preferential treatment of fibre investment over investment in upgrading copper. In the EC's view *"the social benefits from*

¹³² Based on an estimated average costs of connecting fibre to a house of around 18,000 SEK and an average cost of connecting an apartment at around 10,000 SEK the estimated cost of connecting all homes in the country was estimated at around 56 billion SEK. This was then adjusted to account for the 30% of homes in the country already connected.

¹³³ Based on calculation results from Katz et al. (2009).

¹³⁴ Forzati and Mattson consider that fibre can allow a saving of around 30% of total municipal data and telecoms costs due to increased efficiency of the network and increased competition in the market.

¹³⁵ I. Bertschek, D. Cerquera and G. Klein, "More bits – more bucks? Measuring the Impact of Broadband Internet on Firm Performance" JEL, March 2011.

¹³⁶ While a positive correlation between productivity (measured as sales per employee) and the use of broadband Internet was found, this effect is not robust when controlling for endogeneity. Endogeneity problems can arise because the link between good performance and broadband adoption may indicate that broadband use boosts productivity, but may also simply flow from higher-performing firms being more likely to adopt broadband. The authors addressed this by using an instrumental variable approach.

¹³⁷ Bertschek et al., p 16.

investment in digital infrastructures by far exceed the private incentive for investment”,¹³⁸ which implies a clear public policy case for governments to intervene to help drive rollout of FTTH networks. As the Digital Agenda notes, “[w]ithout strong public intervention there is a risk of a sub-optimal outcome, with fast broadband networks concentrated in a few high-density zones with significant entry costs and high prices. The spill-over benefits created by such networks for the economy and society justify public policies guaranteeing universal broadband coverage with increasing speeds.”¹³⁹ Achieving the objectives set out was seen to require action that was “focused on providing the right incentives to stimulate private investment, complemented by carefully targeted public investments, without re-monopolising our networks.”¹⁴⁰

4.2 Potential measures for the active promotion of fibre roll-out

165. The range of public intervention strategies observed outside of Europe (e.g. in Japan, New Zealand, Australia or the Middle East) makes it clear that there are many different ways in which governments and policy-makers could intervene in order to promote FTTH roll-out. Creating a regulatory environment that is conducive to investment and addressing factors that might weaken the business case for investment – such as preventing any detrimental impact on demand for fibre coming from insufficient (and potentially misleading) information about the quality of services available via copper – passively promote investment. But more targeted and direct approaches could also be pursued.

4.2.1 Measures to support a greater spread between fibre and copper access charges in the face of a limited fibre premium

166. More interventionist than addressing the perceived reasons why the willingness to pay more for fibre may be artificially reduced, and with a clearer objective of promoting fibre investment, would be measures that are aimed at propping up the business case for fibre and reducing returns on copper investment. Such measures would try to ensure that a small fibre premium would not limit returns on fibre investment in the face of falling copper access charges.
167. If a larger gap between access charges for copper and fibre than can be sustained in the face of the limited fibre premium were required in order to promote fibre investment, and there were no scope for increasing the fibre premium, a policy that prevented lower copper access prices from feeding through to retail prices might be needed. A number of options exist in this regard:

¹³⁸ European Commission, Proposal for a Regulation of the European Parliament and the Council establishing the Connecting Europe Facility, 14 November 2011, 2011/0302(COD)

¹³⁹ “A Digital Agenda for Europe”, Communication from the European Commission COM(2010) 245, 19 May 2010, p 19.

¹⁴⁰ Ibid., p 6.

- an effective 'tax' on copper-based access, aimed at driving a wedge between access and retail prices and ensuring that large access price differentials do not lead to unsustainable retail price differentials (with the revenues being potentially made available to support fibre deployment);¹⁴¹ or
- allowing incumbents to withdraw copper-based access products as soon as they offer fibre-based access services in order to prevent a situation in which (self-)competition from 'cheap' copper undermines the fibre business case. This would also avoid situations in which parallel network infrastructures are being operated inefficiently and where substantial cost savings could be enjoyed.¹⁴²

168. Alternatively, higher access charges may be set for both technologies, but made contingent on fibre investment taking place. That is, instead of differentiated access charges for copper and fibre, one might consider higher access charges for both technologies, but make levying these charges conditional upon fibre investment (as proposed by EC Vice-President Neelie Kroes).¹⁴³ Plum¹⁴⁴ considered the impact of an increase in copper access price conditional upon fibre investment on the extent of fibre roll out, and found that if the incumbent were to invest in FTTH, a conditional price increase in copper access from €9 to €12 a month over a 5-year linear glide path would lead to a 10 percentage point increase in FTTH coverage for the incumbent under the scenario of limited platform competition and a 17 percentage point increase when faced with competition from cable – not much different from increasing copper prices unconditionally, albeit for different reasons.¹⁴⁵

¹⁴¹ This was proposed by Cave et al. (see M Cave, A Fournier and N Shutova, "Which Price Level for Copper Access in the Transition to Fibre?", 2011).

¹⁴² Requirements to provide both copper and fibre-based access products are another example of the "extreme value problem" problem discussed above (see footnote 101 and accompanying text).

¹⁴³ "In fact, we should not forget that, in some places, copper and NGA are in a close competitive relationship. Where consumers haven't yet seen what fibre offers, they might still be unwilling to pay a premium. In that case, fibre prices mirror copper prices; and lowering copper access prices would send us in the wrong direction. That's why we consider that, in places where there is a firm and credible commitment to invest in NGA, it may not be appropriate to reduce copper access prices. Instead they could be an anchor for higher returns on fibre. That is the first plank of the approach we are exploring." Neelie Kroes Vice-President of the European Commission responsible for the Digital Agenda Incentives to invest in the future: creating an open, competitive telecoms market Speech to ECTA (European Competitive Telecommunications Association) Brussels, 28 November 2011; available at <http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/11/815&format=HTML&aged=0&language=EN&guiLanguage=en>

¹⁴⁴ Plum Consulting, "Copper pricing and the fibre transition – escaping a cul-de-sac", prepared for ETNO, December 2011.

¹⁴⁵ The Plum report states that, "If the incumbent invests, the copper price rises to €12 a month over a 5-year linear glide path. The policy has a number of impacts on the investment decision:

- The increased price of copper means that the revenues from existing copper customers increases; if the copper prices increases to €12 a month, the investor gains an additional €3 a month per copper customer.

- The increased copper price also increases the revenues received from retained customers.

(footnote continued)

169. Perhaps an easier way of implementing such a proposal than tying higher returns on copper explicitly to fibre investment might be to set (substantially) higher fibre access charges and average charges across the two technologies. This would put incumbents in a position where they could increase the price they are allowed to charge for access by rolling out fibre. At identical prices, access seekers would have an incentive to use fibre rather than copper where both were available, which would promote migration (but may require an obligation on the incumbent to offer fibre rather than copper where both were available and where requested by the access seeker).
170. With a blended access price, it could of course be the case that the direct returns on fibre fall below what would be required in order to justify the investment, but this shortfall could be more than made up for by returns on copper access, charged at a rate that leaves the incumbent with a margin. New entrants who might consider investing in their own networks would be disadvantaged, however, from the adoption of such a policy as they would have to compete at the retail level against providers who are using access products that are potentially priced below the actual cost of fibre.

4.2.2 Explicit focus on allowable investment

171. With the exception of the tax on copper access, which is aimed at preventing lower copper prices from feeding through to the retail level, allowing the withdrawal of copper access where fibre is in place, or averaging access charges are measures that sit at the boundary between tweaking the existing regulatory framework and actively promoting fibre roll-out as they imply that regulatory policy is tweaked towards favouring a particular technology. Such measures are aimed at promoting particular technologies and thus seem to go beyond a general shift in regulatory policy towards promoting investment without regard to technology.
172. A more direct, and clearer, way of making the statement that new investment should take place in fibre networks rather than copper upgrades would be to take an explicit position on what investments should count towards the regulatory asset base. Excluding investments in assets that are not considered to be future-proofed, or that are considered to be inefficient would give the regulator an explicit say over the type of network infrastructure it would prefer to see emerge.
173. The explicit involvement of regulatory bodies in assessing investments is not novel. The review of allowable investments for regulatory purposes is common practice in many regulatory contexts. For example, regulators of

- There is no impact on the hurdle rate because although returns on copper are increased, conditionality reduces investor confidence in future decisions – as in the previous case".

According to Plum, the increase copper customer revenues and the 'customer retention revenues' both have a positive effect on the level of FTTH coverage for the incumbent. See Figure 5-20 of the Plum report and the accompanying text.

airports charges may look at the regulatory treatment of expected investments in significant new facilities at airports (such as a new terminal or a runway).¹⁴⁶ All such consideration would, however, be guided by efficiency considerations rather than a desire on the part of the regulator to push the regulated firm towards a particular investment or technology. It is the case, though, that the institution of such kinds of reviews within the regulatory framework for communications services could be seen as a departure from the principle of technology neutrality, which underpins the current regulatory framework within the sector.

174. Whilst such a policy might be effective in channelling new investment into fibre networks and preventing upgrades to copper, it would not be effective in isolation if there was a limited willingness to pay for higher speeds regardless of whether these would be achieved by fibre or through improved copper technology (although the latter may not be capable of producing the same speeds and quality and consistency of service). In this case, disallowing copper upgrades in order to promote fibre investment would simply remove the scope for any investment in higher-speed networks.

4.2.3 Direct contributions

175. If fibre investment is seen to have large external benefits that will not be reflected in private willingness to pay (not even in the most fortuitous of conditions), direct public funding to reduce the investment cost and reduce the risk for the investor may be the most appropriate form of support to use. Unlike allowing a generous regulatory return on fibre investment, propping up the retail price for fibre-based access products and remove competition for funds from copper upgrades, such a contribution would avoid the inevitable allocative welfare loss that is associated with pricing fibre products above their cost in order to provide a commercial return on investments that are desirable for their wider societal benefits.
176. Such contributions can take a variety of forms. Co-investment by the public sector (e.g. municipalities or regional bodies) would seem to be a powerful way of achieving a sharing of the costs and a consideration of the public benefits in the planning and deployment of fibre networks. For example, a public-private partnership in Amsterdam, has provided an FTTH network to 43,000 homes in the city. The local authority, together with private investors and housing associations invested €18m in an FTTH broadband access network, with a further €12m provided by debt financing. The Amsterdam municipality owns one-third of the shares, with the remaining two-thirds shared between private investors including Reggefibre and five housing corporations.¹⁴⁷

¹⁴⁶ See Civil Aviation Authority, "Review of price and service quality regulation at Heathrow, Gatwick and Stansted airports: Setting the Scene for Q6 Consultation", July 2011.

¹⁴⁷ FTTH Council Europe, FTTH Business Guide Second Edition, 16 January 2011, Case Study number 6: Amsterdam City net. Found at <http://broadband.cti.gr/download/FTTH-Business-Guide-2011-2ndE.pdf>.

177. Telecom Italia have entered in to a public-private-partnership with the Autonomous Province of Trento. An agreement between the private company and the municipality has resulted in the formation of 'Trentino NGN', a company responsible responsible for rolling out FTTH to households in the region with the aim of connecting around 60% of the province's houses (over 150,000 homes). The Autonomous Province of Trento holds the majority stake in the company with a share of 52%, with Telecom Italia holding a 41.1% share.¹⁴⁸ However Telecom Italia has negotiated the possibility of acquiring the province's stake in the company after 6 years. With an initial capital outlay of €92 million, and €165 million of spending planned for the next 10 years, the company hopes to achieve its goal and provide ultra-fast broadband to the municipality's residents.¹⁴⁹ Furthermore, the terms of the agreement are such that once a certain level of penetration as been reached Telecom Italia will hand over its copper network – this will further aid the transition from copper to fibre networks.¹⁵⁰
178. NRAs in Portugal, France and the Netherlands have been involved in co-ordinating discussions between municipalities and telecoms operators. French regulator ARCEP has recently released a web application that provides local authorities and operators involved with FTTH roll-outs with access to a model that simulates the costs associated with FTTH roll-out based on geographical information. Potential investors can use the application to choose a geographic area in which they may be interested in investing and receive estimates of the potential costs of investment needed to deploy an FTTH network in that area. While the initial cost of network roll-out is of course just one factor contributing to the decision to invest, the availability of a central cost model provided by the national regulator can be used to provide valuable information to potential investors.¹⁵¹
179. Funding FTTH infrastructure is of course the other main way of promoting fibre roll-out. The definition of NGA 'white' and 'grey' areas for EC State aid

¹⁴⁸ The remaining 6.7% share will be split between two further partners: MC Link and La Finanziaria Trentina. See Telecom Italia press release, "NGN Network: new company to deliver fibre to 60% of Trentino households", available at <http://www.telecomitalia.com/tit/en/archivio/media/comunicati-stampa/telecom-italia/corporate/economico-finanziario/2012/05-18.html>

¹⁴⁹ See Telecom Italia press release, "NGN network: company to deliver fibre to 60% of Trentino households os ready to start", available at <http://www.telecomitalia.com/tit/en/archivio/media/comunicati-stampa/telecom-italia/corporate/economico-finanziario/2011/12-16-B.html>

¹⁵⁰ Ibid

¹⁵¹ ARCEP press release, "ARCEP provides local authorities with a web application for accessing its FTTH rollout cost model" available at http://www.arcep.fr/index.php?id=8571&L=1&tx_gsactualite_pi1%5Buid%5D=1515&tx_gsactualite_pi1%5BbackID%5D=1&cHash=28b46607da

purposes¹⁵² is aimed at providing clarity for the public sector as to what contributions towards the cost of fibre investment are compatible with EC State aid rules, and conditions attached to such support should help to maximise the impact of public funding.¹⁵³

180. The European Commission has also pledged €9.2 billion for use between 2014 and 2020 on pan-European projects aimed at giving households and businesses access to higher-speed broadband networks. This funding, aimed at promoting FTTH roll-out across the EU is part of a wider funding scheme, the "Connecting Europe Facility" (CEF), which will fund up to €50bn worth of investment in transport, energy and digital networks throughout Europe. The aim of the Scheme is to support investment projects outside urban or densely populated areas where private investment in broadband infrastructure is less obviously attractive. The scheme is expected to *"leverage other private and public money, by giving infrastructure projects credibility and lowering their risk profiles. On the basis of conservative estimates, the Commission considers that the network infrastructure finance could stimulate investment worth more than €50 billion"*.¹⁵⁴
181. In the UK budget of 2012, the Chancellor of the Exchequer also confirmed plans laid out in the UK's Autumn Statement of 2011 for government investment in ultra-fast broadband. In that Statement, the UK government proposed to invest £100 million in order to create ten 'super-connected cities' across the UK, each with broadband connections providing speeds of up to 100Mbps.¹⁵⁵ It is believed that by 2015 this scheme will ensure ultra-fast

¹⁵² European Commission, Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks, (2009/C 235/04), September 2009. At the time of writing, these guidelines were under consultation with scope for revision; available at http://ec.europa.eu/competition/consultations/2011_broadband_guidelines/index_en.html.

Aid for broadband network deployment in white areas (rural areas with low broadband coverage and no expectation of new FTTH investors within 3 years) will be viewed as compatible with existing Community policies as it promotes territorial, social and economic cohesion and addresses market failures. In contrast, the Commission considers that there is no need for State intervention in black areas (areas with two or more broadband networks) as broadband services are being provided under competitive conditions and there is no market failure. Support provided in grey areas (areas with one broadband network) will require a more detailed assessment, but may be allowed if no affordable or adequate services are offered to satisfy the needs of citizens or business users and if there are no less distortive measures available (including ex ante regulation).

¹⁵³ Where aid is agreed for NGN, the recipient will be subject to additional obligations designed to ensure a competitive market going forward. The beneficiary of the State support must provide third parties with effective wholesale access for at least seven years; in setting the conditions for wholesale access, Member States should consult with the relevant NRA; and whatever the type of NGN network architecture, it should support effective and full unbundling and satisfy all different types of network access that operators may seek. (See European Commission, Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks, (2009/C 235/04), September 2009).

¹⁵⁴ European Commission, Press Release, IP/11/1200 available at <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1200&format=HTML&aged=1&language=EN&guiLanguage=fr>.

¹⁵⁵ HM Treasury, Autumn Statement 2011, Cm8231, November 2011, found at http://cdn.hm-treasury.gov.uk/autumn_statement.pdf, p 32.

broadband is available for 200,000 businesses and 1.7 million households across the ten cities.¹⁵⁶ The UK government also committed to providing £50m to fund a further ten smaller cities.

182. Finland has also established a “Broadband 2015” project, which aims to *“provide nearly all Finns with fast fibre-optic or cable network by the end of 2015. The objective of the project is that nearly all (more than 99% of the population) permanent places of residence and places of business and public administration are no further than two kilometres from a 100Mbit/s fibre-optic or cable network.”*¹⁵⁷ €66m in public funding is available to support the project between 2009-2015. In February 2012, the Finnish government made the first payment of state aid as part of the scheme, with the purpose of building ultra-high speed broadband infrastructure covering the municipality of Karvia in Western Finland. The aid to this sparsely populated area totalled €334,824.¹⁵⁸
183. In October 2011, the EC approved a French programme aimed at providing around €750m of support for the deployment of ultra-fast broadband networks in France. Since 2010, the French government has been seeking approval of its programme aimed at supporting nation-wide construction of very high-speed broadband networks. The programme would look to provide speeds of 100Mbps to customers and would provide support to those areas where no commercial deployment of NGA networks is likely in the near future. Furthermore, access to infrastructure benefiting from the scheme would be *“open and non-discriminatory”* under the control of the French regulatory authority, ARCEP. Such a scheme was deemed to be in line with European guidelines on state aid for broadband and was thus approved by the EC.¹⁵⁹
184. In Italy, the Ministry of Economic Development states that *“[T]he implementation of Next Generation Access Networks, according to the relevant aims of the Digital European Agenda- that is: 50% of citizens subscribed to 100 Mb/s services within 2020 - is a very ambitious objective. But no-one can press telco operators to make investments towards NGN, because the demand is still low to have rapid return of investment. At the same time we cannot wait, we must accelerate because the investments we need to make are very lengthy and pricey: we must rely on public funds, but we must take into account the unavoidable rigid balance policies: nowadays it is not possible to spend public money easily... The State should act as a temporary entrepreneur in order to guarantee sufficient*

¹⁵⁶ HM Treasury, Budget 2012, HC 1853, March 2012, p 5. The ten ‘super-connected cities’ will be Belfast, Birmingham, Bristol, Cardiff, Edinburgh, Leeds, London, Manchester and Newcastle, p

¹⁵⁷ Finnish Communication and Regulatory Authority (FICORA), <http://www.viestintavirasto.fi/en/index/internet/laajakaista/laajakaista2015-hanke.html>.

¹⁵⁸ Finnish Communication and Regulatory Authority (FICORA), http://www.viestintavirasto.fi/en/index/asiointi-info/ajankohtaista/uutiset/2012/P_9.html.

¹⁵⁹ European Commission, Press Release, IP11/1211 found at <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1211>.

*strength and financial weight to the investments which the market cannot provide by itself...*¹⁶⁰.

185. In November 2010, the Italian Ministry of Economic Development signed a Memorandum of Understanding (MOU) with twenty of the major telecommunication operators in Italy, setting up a new company (New Co) in a private-public partnership to plan, develop and manage a national passive NGN infrastructure that would be open and neutral. The Italian government aims to privatise this New Co within ten years, leaving the roll-out of NGNs completely to the market. In the meantime however, up to €8 billion in funding provided by public and private institutional investors, with a contribution from industry will be available over the course of 10 years for the infrastructure build and about €2 billion, funded mainly by the industry, will be spent on electronics and software services. In line with state aid rules, in areas where NGN is planned by private operators, only common, shared infrastructure (consisting of vertical connections in buildings and building terminations) will be built using these funds while in areas where NGN development is not planned in the short term by operators, complete infrastructure will be built. Further, roll-out efforts are being co-ordinated amongst operators to avoid inefficient duplication of resources spent on infrastructure installation.¹⁶¹

4.2.4 Direct state intervention on creating a network

186. A more interventionist approach to public funding of fibre networks would be where there is State intervention either to create a specific company that is mandated to roll out an FTTH network or to enter into a partnership arrangement in order to fund (either in part or totally) FTTH deployment. In both cases, such intervention by the State appears to be based on a recognition that neither the fixed incumbent nor other market players (such as cable operators) are prepared to engage in nationwide FTTH deployment within a reasonable timeframe. As a result, this approach sees the State itself taking on a lead role in promoting, funding and perhaps even owning (at least in the short-term) the fibre network.
187. Australia is an example of a country where direct State intervention has occurred in order to drive the deployment of FTTH on a nationwide basis. The Australian government decided to embark on the deployment of a National Broadband Network (NBN) and it established a specific company – NBN Co Limited (NBN Co) –with a mandate to design, build and operate the NBN,

¹⁶⁰ See "A way to use public funds for next generation access network implementation", presentation by the Italian Ministry of Development at the EIB NGA roundtable, February 2011, (<http://www.eib.org/epoc/resources/presentations/nga-roundtable-lehnus.pdf>)

¹⁶¹ See Ministry of Economic Development, "The "Digital Italy" Plan – The Digital Agenda to boost efficiency, competitiveness and employment in our country", 15 December 2010, initially available at http://www.sviluppoeconomico.gov.it/index.php?option=com_content&view=article&idarea1=1665&idarea2=0&idarea3=0&idarea4=0&andor=AND§ionid=0&andorcat=AND&partebassaType=0&idareaCaledario1=0&MvediT=1&showMenu=1&showCat=1&showArchiveNewsBotton=0&idmenu=2381&directionidUser=0&page=2&id=2018667&viewType=0

which is being deployed using a mix of optical fibre, fixed wireless and satellite technologies.¹⁶² At 93%, the vast majority of connections to home and businesses would be via fibre, with the network supporting data speeds of up to 1Gbps. The remaining 7% of connections would be via fixed wireless and satellite where 'peak' speeds of 12 Mbps would be supported.¹⁶³

188. The Australian government's aim is to position the country to be within the world's leading group of digital economies by 2020 and it envisages the NBN as "an essential first step" in realising this aim.¹⁶⁴ Rollout of the NBN is now underway: the Australian government stated that NBN Co's publication in October 2011 of its first 12-month national fibre rollout schedule marked the end of the NBN's trial phase and signalled the commencement of "volume roll-out to Australian premises".¹⁶⁵
189. In New Zealand, a different approach to State intervention in the deployment of FTTH infrastructure is being pursued. Instead of creating an entity such as NBN Co, the New Zealand government opted instead to establish a State agency – Crown Fibre Holdings ('CFH')¹⁶⁶ – whose task it would be to contract on a regional basis with a number of so-called Local Fibre Companies ('LFC') who would then deploy and operate Ultra-Fast Broadband ('UFB') networks under a Public-Private Partnership ('PPP') arrangement with CFH.¹⁶⁷
190. CFH's mandate is to manage the New Zealand government's planned NZ\$1.5bn investment in UFB infrastructure. The government's aim is to provide UFB network access to 75% of New Zealanders by 2019, with a concentration in the early years on priority users, such as businesses, schools and health services.¹⁶⁸ Over the course of 2011, the government approved proposals by CFH to contract with a number of parties – including Telecom New Zealand ('Telecom') – to roll out UFB infrastructure on a nationwide basis.¹⁶⁹
191. A common feature of the Australian and New Zealand approach to FTTH deployment is that both governments specified in advance a clear operating model for the publicly-funded FTTH networks. In Australia, NBN Co is obliged to provide services on the NBN on a wholesale-only, open access basis while in

¹⁶² Further details on Australia's NBN are at: <http://www.nbn.gov.au/>.

¹⁶³ See: <http://www.nbn.gov.au/about-the-nbn/>.

¹⁶⁴ Ibid.

¹⁶⁵ See: <http://www.nbn.gov.au/frequently-asked-questions/>.

¹⁶⁶ See: <http://www.crownfibre.govt.nz/home.aspx>

¹⁶⁷ The New Zealand government has defined UFB to mean the availability of broadband services that support minimum download speeds of 100 Mbit/s and upload speeds of at least 50 Mbit/s. See: <http://www.crownfibre.govt.nz/ultra-fast-broadband/what-is-ultra-fast-broadband.aspx>

¹⁶⁸ Ibid.

¹⁶⁹ See: <http://www.crownfibre.govt.nz/ultra-fast-broadband/how-is-the-ultra-fast-broadband-initiative-progressing.aspx>

New Zealand the LFCs face similar constraints in relation to service provision of the regional UFB networks. In the latter case, Telecom's involvement in the UFB programme has led to it de-merging its network assets from its retail business, with its network business – Chorus – becoming the most significant UFB provider that CFH has partnered with. The wholesale-only structure adopted in both Australia and New Zealand in relation to the entities that are deploying FTTH networks means that the provision of retail FTTH services in both countries will be provided by operators that are completely separate from those who will deploy and manage the FTTH infrastructure.

192. Wholesale-only operating models for fibre networks that are in part (or wholly) publicly-funded are not confined to Australia and New Zealand. In Singapore, for example, two different operators have been mandated to provide wholesale services on the publicly-funded FTTH network, with OpenNet¹⁷⁰ (a consortium which includes the fixed incumbent SingTel) providing access to the passive fibre network while a separate entity, Nucleus Connect,¹⁷¹ provides wholesale-only managed bandwidth services across it. In the UK, meanwhile, Fujitsu announced in April 2011 that it plans to deploy FTTH infrastructure to serve 5 million homes and businesses in rural Britain.¹⁷² The company stated that it intends to access the UK government's planned £500m rural broadband budget and that it plans to operate the FTTH network on a wholesale-only, open access basis. In addition, e|net – the company granted the concession to manage and operate the Irish government's Metropolitan Area Networks (MANs) – has a mandate to provide metro-based fibre services solely on a wholesale-only, carrier neutral basis.¹⁷³
193. The above developments would suggest that wholesale-only operating models for fibre networks are gaining in popularity. Where FTTH networks are being deployed with the support of substantial public funding, there is an obvious incentive for governments who are providing this funding to ensure that retail providers of FTTH services are in a position to secure wholesale access to the new network. By prohibiting the FTTH network provider from operating in the downstream retail market, governments can at the same time claim that their investments in fibre networks are geared towards the maintenance of retail competition, albeit by helping to install de facto FTTH monopoly networks at the wholesale level.
194. It is still too early to judge whether or not such operating models will prove supportive either to faster deployment of FTTH networks or to more rapid take-up of fibre-based services by end-users. It may, perhaps, be noteworthy that in those countries where FTTH take-up is at its most advanced, i.e. Japan and South Korea, there is no operator split in terms of FTTH network

¹⁷⁰ See: <http://www.opennet.com.sg/>

¹⁷¹ See: <http://www.nucleusconnect.com/>

¹⁷² See: "Fujitsu unveils plans to bring fibre to 5 million homes and businesses in rural Britain" at http://www.fujitsu.com/uk/news/pr/fs_20110413.html.

¹⁷³ See: <http://www.e-net.ie/>

deployment on the one hand and the provision of retail FTTH services on the other. In both countries, however, significant public subsidies have been directed towards the rollout of FTTH networks. This would suggest that it is likely to be the public funding element of the FTTH deployment plans in Australia, New Zealand and elsewhere that will drive FTTH rollout and the take-up of fibre-based services and not any constraints that governments in these countries might place on the operating model to be adopted by the chosen fibre company.

4.2.5 Fibre switchover policy

195. A more interventionist policy to ensure the realisation of the public policy aim to switch from copper to fibre within the EU could be via the adoption of a 'fibre switchover' policy. This could occur by setting a date – which would need to be done several years in advance – from which communications services across the EU would be provided over fibre networks instead of legacy copper, with services over the latter being discontinued at that stage. Given that 2020 has already been identified as the year in which the targets under the Digital Agenda are meant to be achieved, that year may be an obvious one to be also used for 'fibre switchover'.
196. The obvious analogy that policy makers might want to make in pursuing such a policy would be that of Digital TV switchover. This move – which is set to be completed across the EU by the end of this year – has involved the mobilisation of significant resources, not least in respect of informing the public about the move. Because Digital TV switchover has placed material inconvenience on many end-users of TV services, the move has had to be accompanied by substantial public information campaigns within each Member State, where the switching method has had to be clearly identified while at the same time the public and private benefits arising from switchover have had to be carefully outlined. In this way, public goodwill has been achieved for the move.
197. A similar EU-wide effort would obviously be required to support a 'fibre switchover' campaign. Significant public support for the move from copper to fibre would clearly be vital and, to do this, end-users would need to be informed about the benefits - to society as well as to consumers and providers of fibre-based services – that would accrue from such a 'switchover'.
198. The analogy with Digital TV switchover, however, only goes so far. A 'fibre switchover' would not result in any 'Digital Dividend' in terms of valuable spectrum being freed up for re-use and neither would the discontinuation of copper-based services of itself enable the deployment of any new and improved service using the same resource. Instead, customers would be prevented from continuing to use what many might still believe was an adequately functioning network, one that continued to meet their own particular needs for communications services. As such, it might prove more difficult to win public acceptance for a 'fibre switchover' compared to that which was been garnered in the case of Digital TV switchover.
199. Further practical issues would need to be addressed in relation to imposing such a plan on a nationwide basis. In the case of Digital TV, the entire analogue network in each Member State is being shut down and replaced by a

digital equivalent. The adoption of a 'fibre switchover' policy would presumably require that a similar nationwide replacement of the network take place. In Australia where as we have discussed earlier the government is putting in place an entirely new NBN, fibre is being augmented by fixed wireless and satellite in order to ensure that the new network is available on a nationwide basis. The same kind of approach would, one assumes, be required if a 'fibre switchover' policy were to be implemented across the EU.

200. The adoption of a 'fibre switchover' across the EU would also be likely to give rise to significant difficulties in co-ordinating such a move across all the Member States, given the different rates at which FTTH networks are being deployed and the varying population densities and topologies involved. Those Member States that are already most advanced in terms of fibre rollout are likely to be the ones that will also be best prepared to implement a 'fibre switchover' on the chosen date. Conversely, those countries where fibre deployment is only commencing could face significant difficulties in completing the switchover ahead of the deadline, perhaps requiring the granting of derogations from the deadline in some instances. Funding would also be likely to prove an issue in such Member States.
201. Finally, the adoption of a 'fibre switchover' policy would create obvious legal difficulties, requiring as it would that all operators of copper-based networks across the EU should cease providing services to their customers. As we have seen, it is not always the case that the operators of legacy copper networks are the ones who are moving to deploy fibre networks. A mandatory 'fibre switchover' policy, therefore, would see such operators having to move from being the incumbent provider of services over their own copper network to becoming instead an operator that had to secure wholesale access to the new fibre network in order to continue servicing its customer base. It is difficult to imagine that powerful fixed incumbent operators of copper networks across the EU could, in practice, be obliged to move to such a position. Even if they were, it seems inconceivable that all would be prepared to accept such a move without resorting to legal action to protect their existing business models and their contractual arrangements with customers. Seen in this light, it is difficult to envisage a 'fibre switchover' policy working in practice.

5 Conclusions and recommendations

In this final chapter, we set out our conclusions and recommendations in relation to the way in which regulatory policy within Europe might best be geared towards meeting the Digital Agenda targets for the availability and take-up of broadband services.

In our view there is a strong case for the Commission being more explicit and specific in relation to the targets it has set for required upload and download speeds. There needs to be a clearer acknowledgement of the need for appropriate reward of FTTH investors and a commitment to protect these rewards into the future. Initiatives to help customers to understand more fully the benefits of fibre should be considered, along with measures to promote co-operation between network operators and those providing services on fibre networks to ensure more concerted development of networks and services. Higher access charges for fibre may be justified but, to better incentivise fibre deployment, access charges should be averaged across copper and fibre; or regulated firms should be able to withdraw copper-based access products where fibre networks are in place. Finally, where public funds are being used to drive fibre roll-out, they must be disbursed effectively and be aimed at projects delivering the greatest benefits.

202. The Digital Agenda for Europe sets out ambitious targets for the availability and take-up of broadband services, both in terms of achieving practically universal coverage with fast services, and with regard to the adoption of ultra-fast services. In setting these targets, the European Commission was guided by the understanding that there are substantial societal benefits that flow from the deployment of a high-speed broadband infrastructure. It appears rather likely that these targets cannot be achieved without the widespread deployment of fibre in the local access network, in particular where they involve commensurately higher upload speeds and consistent and reliable service quality – but greater clarity about the role that fibre access networks are likely to play would be welcome. This could be achieved by **being more explicit and specific about the broadband targets (e.g. in relation to required download and upload speeds), similar to what has been done elsewhere.**
203. Whilst there seems to be a clear public policy case for the roll-out of FTTH networks, the business case facing investors remains challenging. Consequently, policy makers should avoid anything that might weaken investment incentives. Any investment decision by necessity involves the investor taking a view on the risks he or she faces and the likelihood of being able to make a return on the investment that is commensurate with the identified risks. The greater the uncertainty in relation to achieving the expected returns, the stronger the likelihood that the planned investment may be delayed, curtailed or abandoned altogether. This is as true in the case of decisions made in relation to fibre investments as it is in any other areas of the economy.
204. This would involve an application of the current regulatory framework for electronic communication services in a manner that focuses on investment incentives rather than the promotion of retail competition on the basis of

existing infrastructures. This means taking proper account of the risk associated with fibre investments, and accepting that a certain level of profits will be needed in order to provide investment incentives. Pursuing strong retail competition by facilitating access to network infrastructure may work where existing networks are in place, but could be self-defeating where this infrastructure needs to be built first. A **clearer acknowledgement of the need for appropriate reward of investors** would seem to help in strengthening investment incentives – but to be effective this would have to be combined with a **clear indication of the magnitude of the reward that successful investors should be allowed**, and a **commitment to protect such returns** from being eroded through a process of frequent reviews.

205. A particular challenge for regulatory policy in the case of fibre build is that it is dealing with a transition from one technology to another. With copper-based broadband services continuing to be available, many end-users could decide to continue using these services even where they have the option of switching to far superior fibre-based services. Where operators deploying fibre networks have been designated with SMP in relation to wholesale access provided over these networks, a key question is whether or to what extent the risk premium that regulators might allow to be included within the wholesale fibre access charge is, in fact, sustainable in the face of on-going competition from legacy copper services.
206. A key concern in this regard is that end-users may fail to perceive the full value of fibre networks and that therefore their willingness to pay for fibre is artificially depressed. This may be because information about the differences in service quality is incomplete, distorted or difficult to understand, or because the services that would make full use of the higher bandwidth of FTTH are not at present available. These services may, in turn, be slow to emerge, with their development held back by the low take-up of fibre.
207. A limited fibre premium not only makes the business case for rolling out FTTH more challenging, but it will also dilute the effect of any other policy intervention that might be contemplated. Therefore any measures that address the reasons why the full value of fibre access might not be reflected in customer willingness to pay should be welcomed. These may include **requirements (rather than voluntary codes) for clearer advertising of broadband services that help customers to understand the benefits of fibre, a more pro-active role of the public sector in the development of services that utilise the capacity that FTTH is capable of delivering, and measures to promote the co-operation of infrastructure and service providers in the concerted development of networks and services**. Overcoming the co-ordination problems that hold back the development of an attractive ecosystem of high-bandwidth services and connections may require some concessions in relation to net neutrality and so careful consideration would need to be given to the pros and cons of such policies.
208. The sustainability or otherwise of the regulatory risk premium on wholesale fibre access charges would also suggest that any measures to boost fibre roll-out by bringing down the regulated wholesale copper charges are likely to be self-defeating. Whatever the incentive effects such a move might have on legacy network SMP operators, there is a real risk that this policy could simply increase the competitive threat posed to fibre from copper-based services and,

as a result, could act to delay rather than speed up the deployment of fibre. This is not to ignore the fact that, from an economic standpoint, it could prove efficient for copper access to be priced on a legacy basis. In practice, however, neither regulators nor legacy network incumbents who are planning to deploy fibre are likely to want to see copper access being priced in this way.

209. Instead, there are good arguments for ***allowing higher access charges for fibre networks but averaging charges across copper and fibre (which would imply that regulated firms can increase their returns on access services by increasing the proportion of fibre within their access networks), allowing regulated firms to withdraw copper-based access products where fibre networks are in place, promoting the use of a broader spectrum of pricing models that provide greater flexibility in terms of risk sharing, and supporting co-investment and infrastructure sharing and re-use beyond the prospect of withdrawing regulatory obligations in cases where such co-investment leads to competitive access offers.***
210. In terms of putting in place policies that actively support speedier fibre deployment and take-up, it is important to look at the severity of interventions that might be contemplated. Some measures – such as tying higher returns on copper access to the deployment of fibre, or taxing copper access charges to prevent downward pressure on retail prices that can be achieved for fibre, appear relatively mild, whilst others such as a ‘fibre switchover’ could really only be considered as a last resort and only then if there is sufficient acceptance that the need to promote fibre take-up is so compelling that such a drastic way to wean customers off their existing copper-based connections is required.
211. As things stand, the European Commission through its clarification of the state aid rules in relation to broadband rollout and the funds provided via the CEF appears to be making a serious effort to promote investment in fibre. At the same time, the Commission’s NGA Recommendation does not seem to have provided a strong stimulus for investment in new network infrastructure. This may be fairly seen as a policy decision to rely more on public funding than private investment incentives in order to maximise access to the new infrastructure, but it is worth being clear about the fact that making fibre deployment less attractive as a commercial proposition will require increased public sector involvement in the construction and deployment of FTTH networks.
212. Assuming that support measures for fibre investment will go beyond dealing with the artificial depression of demand for advanced fibre-based broadband services, the choice would appear to lie between measures which might help to tilt the balance towards increased fibre investment by private operators (where changing the allowable regulatory asset base would be one way of doing this) or more activist policies by national governments, in particular the funding – either by direct subsidies, tax breaks or a mix of the two – of fibre deployment.
213. It is very unlikely that a “one size fits all” approach may be arrived at to help provide the boost to fibre investment that will be required if the 2020 targets for ultra-fast broadband availability and take-up are to be met. Direct public supports for fibre deployment would appear to be the most effective and

efficient way to deal with any perceived market failure in this area – certainly if the experience of fibre deployment in Asia is considered as a comparator.

214. How such public support is provided – and, in particular the procedures used to disburse public funds – is of key importance in this regard, with governments needing to ensure that such funding is provided using open and transparent procedures. Where reliance is placed on the public sector to contribute to, or even drive the roll-out of fibre networks, it is important to ***ensure that maximum impact is achieved. Where funds are being made available, they need to be disbursed effectively and on those projects with the greatest benefits. This will require clear rules on what projects (and potentially what technologies) should be supported, and an effective administration for implementing such support.*** Issues such as the prescribed operating model would appear to be of lesser importance in driving fibre deployment, although it is understandable that such issues would be of concern to governments who may be keen to ensure that publicly-funded networks are accessible to all players on the same terms and that the presence of the new wholesale-only fibre network does not act to distort competition at the retail level.