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Ultra-Broadband For All In Europe: Can Access Regulation Hinder Innovation And Welfare Maximisation?

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ULTRA-BROADBAND FOR ALL IN EUROPE: CAN ACCESS REGULATION HINDER INNOVATION AND WELFARE MAXIMISATION?

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The views expressed in this paper are those of the author and do not necessarily represent the official views of Telecom Italia.

Abstract

Most of the European countries risk not reaching the 2020 Digital Agenda for Europe (DAE) targets. In order to achieve these targets, private investments in ultra-broadband networks should be vigorously promoted by access regulation whilst the deployment of ultra-broadband networks in unprofitable areas should be subsidized by means of appropriate public funding.

Fiber to the Cabinet (FTTC) is considered a key technology in order to reach the 2020 DAE targets. This deployment model is widely adopted in a number of countries including, among others, Germany, the UK and Italy. The paper addresses FTTC regulation both at national and local level, that is in geographic areas subsidized by State aids.

First, it emerges a clear trade-off at national level between the goal of infrastructure-based competition at the cabinet level and the achievement of the 2020 DAE targets. Inappropriate access regulation may indeed jeopardize the 2020 DAE targets by decreasing private investors' incentives to roll out FTTC networks, as well as to deploy new technologies such as Vectoring. Access regulation may thus, rather paradoxically, increase the amount of State aid funding which is required in a given country to meet the 2020 DAE targets.

Second, excessive access obligations in geographies subsidized by State aids can also substantially increase State aid funding and, thus, undermine the capability of a given country to reach the 2020 DAE targets.

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1. Introduction

In 2010 the European Commission launched the Europe 2020 strategy for smart, sustainable and inclusive growth. In this framework, the Commission set out seven flagship initiatives which include detailed work programs in key areas for economic growth. The Digital Agenda for Europe (DAE), one of the seven initiatives, has established, among others, ambitious ultra-broadband targets to be achieved by Member States by 2020. Such targets require both ubiquitous coverage and high take-up rates of the new ultra-broadband services. To this end, high levels of both private and public investments shall be required. Private investments alone will in fact not suffice to meet the 2020 DAE targets and, in particular, the very ambitious goal of a universal coverage by ultra-broadband networks. Whilst access regulation remains a fundamental tool to stimulate private investments and a timely transition from copper to NGAN networks, it is by now evident that State aid is the second leg of European public policy for ultra-broadband (Chirico and Gaal, 2014). State aid is indeed a policy tool of the utmost importance in countries that have significant “market failure” geographic areas, i.e. areas that cannot be covered by ultra-broadband private investments.

This paper focuses on the role played by wholesale access regulation in promoting the achievement of the 2020 DAE targets. It is particularly examined the case of Fiber to the Cabinet (FTTC) regulation. FTTC networks shall in fact play a key role in the achievement of ultra-broadband for all in Europe, particularly in large countries including Germany, the UK and Italy. In this framework, it emerges that access regulation can significantly affect private investments in ultra-broadband networks and, thus, the amount of public funding that in a given European country is required to meet Digital Agenda targets.

The paper is organized as follows. Section 2 reviews the 2020 DAE targets, progress to date towards their achievement as well as projections for 2020. Section 3 focuses on some key features of European broadband state aid rules. Section 4 addresses the relation between FTTC access regulation and the achievement of the 2020 DAE targets. Section 5 examines access regulation specifically designed for the subsidized areas and its impacts on ultra-broadband State aid funding. The last section draws the main conclusions.

2. The European Digital Agenda Broadband Targets

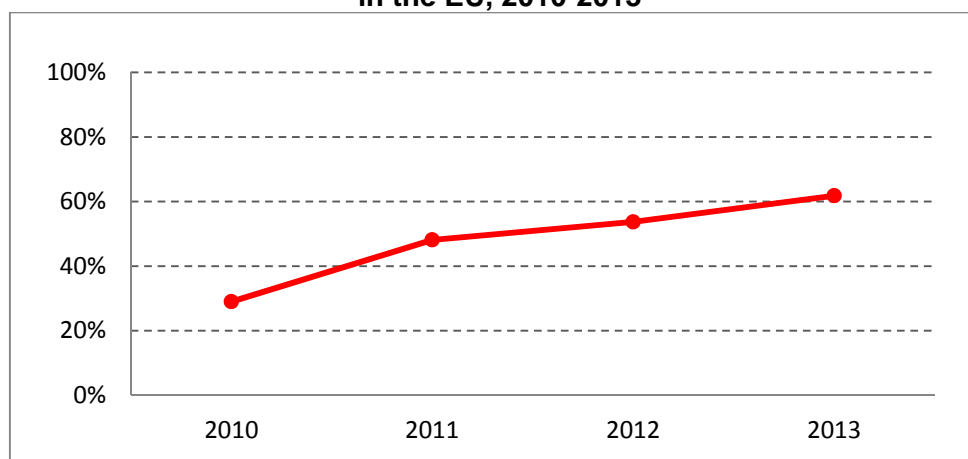
The European Digital Agenda sets two broadband targets for 2020: a *coverage* target for fast broadband and a *take-up* target for ultra-fast broadband. The targets are defined as follows:

- Fast broadband: broadband coverage at 30Mbps or more for 100% of EU citizens;
- Ultra-fast broadband: 50% of European households should have subscriptions above 100Mbps.

These targets are technologically neutral, that is they can be achieved by any technology: it is up to private investors and public policy to find the appropriate technology, or mix of technologies, at country level.

Broadly speaking, both Fibre to the Premises (FTTP) and upgraded cable networks (Cable DOCSIS 3.0) are considered capable of delivering 100 Mbps and even more; FTTC in conjunction with very high-speed digital subscriber line (VDSL) technology can easily deliver 30 Mbps whilst it can deliver 100 Mbps and even more under specific circumstances, including a short copper sub-loop and/or the adoption of further technologies such as vectoring and G.fast; mobile broadband, such as Long Term Evolution (LTE), is expected to deliver 30 Mbit/s under certain conditions whilst it is considered very unlikely to deliver 100 Mbps for a large number of users per base station. According to the latest figures published by the European Commission (EC, 2014a), NGAN, including VDSL, Cable Docsis 3.0 and FTTP, reached a coverage of 62% as of 2013 in the EU (see Figure 1).

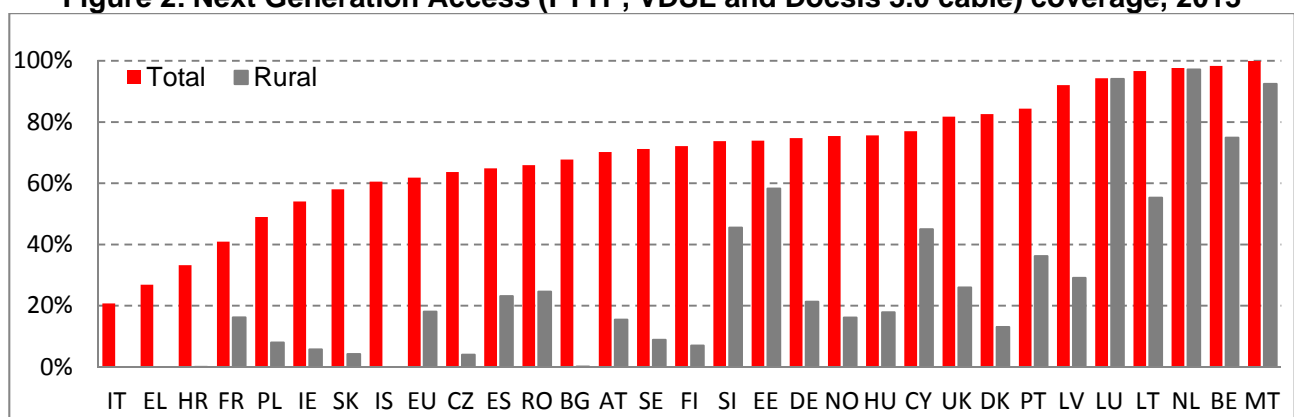
Figure 1: Next Generation Access (NGA) broadband coverage in the EU, 2010-2013



Source: European Commission (2014a)

However, while some countries, such as Malta, Belgium and the Netherlands, are already very close to full coverage, other countries, including France, Croatia, Greece and Italy lag behind (see Figure 2).

Figure 2: Next Generation Access (FTTP, VDSL and Docsis 3.0 cable) coverage, 2013



Source: European Commission (2014a)

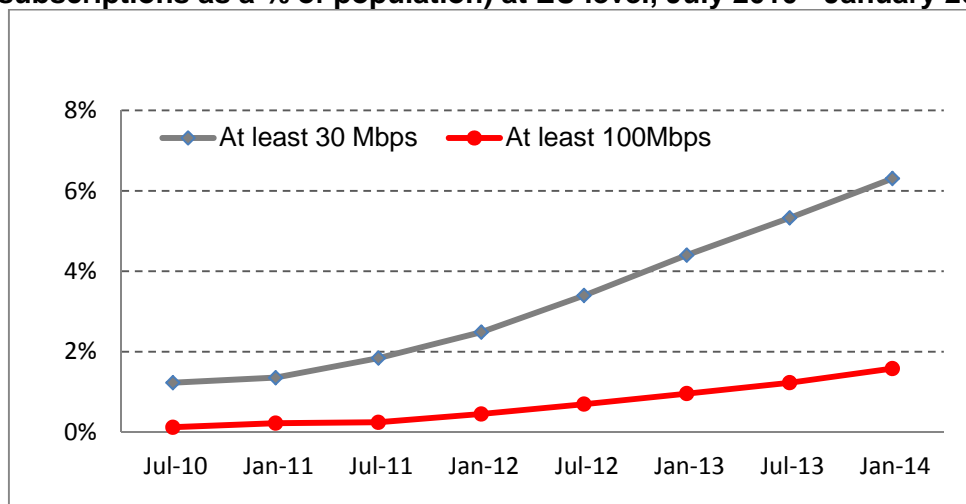
As regards Italy, a special report commissioned by the Italian government has concluded that State intervention shall be an essential pillar to achieve the 2020 DAE targets (Caio, Marcus and Pogorel, 2014).

The large variation of the NGAN coverage among European countries points out that whilst in some countries private investments tend to suffice to achieve the 2020 goals, a certain number of other countries struggle to achieve the same goal. In the case of the latter countries, the public funding is indeed essential to ensure full coverage.

When it comes to rural areas, NGAN coverage is only 18% in the EU: rural coverage for NGAN is indeed a relevant public policy issue for most of the European countries (see Figure 2).

European figures are also very disappointing with regard to the take-up of ultrafast broadband, that is subscriptions above 100 Mbps: only 1.6 subscriptions per 100 people as of 2013, corresponding to 3% of homes (see, Figure 3). The picture slightly improves with regard to the take-up of fast broadband (at least 30 Mbps): the latest figures point to 6.3 fast broadband subscriptions per 100 people (see, Figure 3). Altogether, it is estimated that currently in the EU 15% of homes subscribe fast or ultrafast broadband services (EC, 2014a).

Figure 3 : Fast and ultrafast broadband penetration (subscriptions as a % of population) at EU level, July 2010 - January 2014



Source: European Commission (2014a)

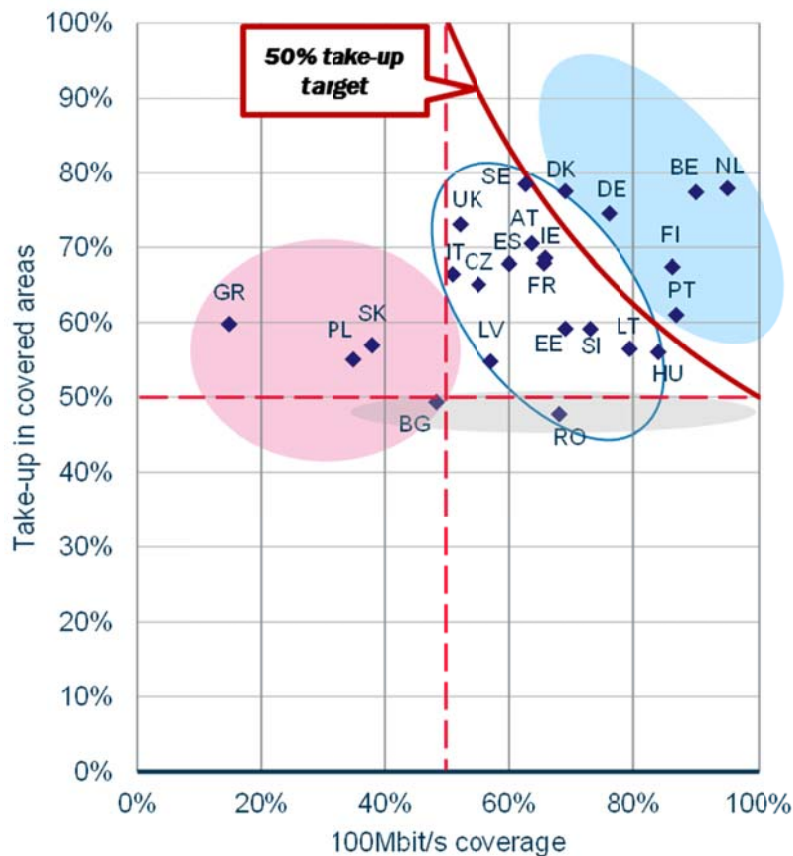
All in all, the current figures show some progress towards the 2020 DAE targets but, with the exceptions of some countries, it appears very difficult that these objectives can be achieved in most of the European countries.

Analysys Mason (2012) has investigated the likelihood of achieving the 2020 DAE targets by means of a forward-looking analysis based on projections in terms of coverage and take-up rates. It emerges that the 30Mbps universal coverage target is only attainable with a fit for purpose contribution of both mobile and satellite technologies. Accordingly, the coverage of LTE by 2020 as well as the availability of a satellite system able to deliver 30 Mbps is a key policy issue. Interestingly, Analysys Mason (2012) does not consider that fixed ultra-broadband networks can

deliver, on a stand-alone basis, the 30Mbps objective since the universal coverage would be unaffordable. The entire coverage of remote and rural areas by fixed technologies alone would indeed be very expensive.

Analysys Mason (2012) is however much more concerned with the 100 Mbps target. According to their forecast only Belgium, Denmark, Germany, Finland, The Netherlands and Portugal are likely to reach this target. The remaining countries are instead likely to fall short of the 100Mbps target due to a combination of limited coverage and/or limited take-up (see Figure 4).

Figure 4: Forecast of reaching 100 Mbps take-up target



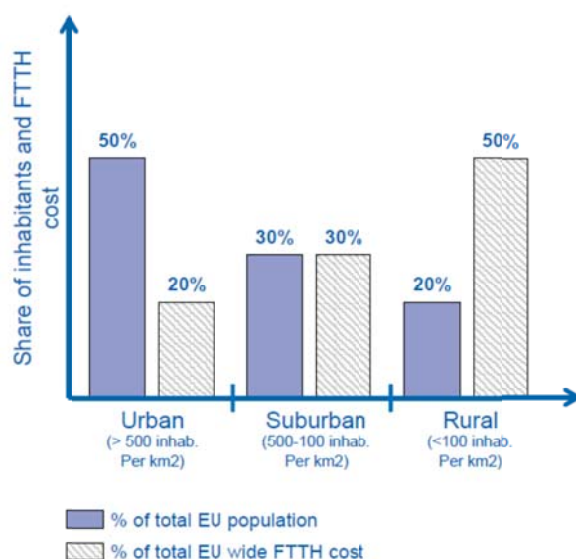
Source: Analysys Mason (2012)

Bock et al. (2014) corroborate the worrying findings emerging from EC (2014a) and Analysys Mason (2012): they find that European investments in telecommunication infrastructures have declined by around 2 percent a year in the period 2008-12 and expect that the revenues of European telecom operators will continue to fall by around 2 percent per year until 2020. Accordingly, they conclude that European infrastructure investments are likely to continue to shrink, which means that the 2020 DAE targets are expected to be missed by a wide margin. Bock et al. (2014) estimate that the shortfall in investments needed to meet these targets will be between 110 and 170 billion euro. Yet, the digital Agenda targets achievement could bring up to €750 billion in GDP growth and as many as 5.5 million jobs by 2020 (Block et al., 2014).

The investment gap estimated by Bock et al. (2014) is confirmed by the European Investment Bank. Gruber (2014) reports that building a nation-wide FTTH network in Europe would cost

around €220 billion.¹ According to Gruber (2014), 50% of this cost is required to cover the 20% of European population living in rural areas (see Figure 5). Taking into account the financial viability threshold of a FTTH project, with an assessment range of €600-700 per home passed, Gruber concludes that around 75% of the total investment cost for a European-wide FTTH network would be required in unprofitable geographical areas. This would mean an additional €160 billion to the overall investment, a measure of the investment gap assuming the target of a universal FTTH coverage.

Figure 5: European population density and total cost of DAE targets



Source: Gruber (2014)

The huge investment gap to reach the 2020 DAE targets is however just a component of a general lack of investments in Europe, a point clearly stressed by Juncker (2014): *"The level of investment in the EU dropped by just under €500 billion, or 20%, after its latest peak in 2007. We are facing an investment gap. We have to work to bridge that gap. Europe can help make this happen. As you know, I intend to present an ambitious €300 billion Investment package for Jobs, Growth and Competitiveness."*

Even if digital policy and the objective of a Digital Single Market are priorities for Juncker's Commission, it is however unlikely that the European Investment package for Jobs, Growth and Competitiveness may suffice to fill the gap for the achievement of the 2020 DAE targets.

To this end, an innovative European regulatory policy aimed at supporting private investments (i.e. the roll-out of Next Generation Networks and innovative services) along with national public funding for the development of ultra-broadband networks in market failure areas, are two key

¹ Based on consultancy assignment commissioned by the EIB.

pillars. In the next section, we will address the latter one from a specific viewpoint: the main features of European State aid rules for ultra-broadband.

3. The European State aid rules for ultra-broadband

In the EU the first State aid measure in support of the roll-out of a broadband network dates back to 2003. As of May 2014, the European Commission had already adopted 132 decisions concerning State aid measures in the broadband sector, regarding both basic broadband and NGA networks.

Chirico and Gaal (2014) report that, as of October 2013, the European Commission had scrutinized projects involving a total of €13 billion of subsidies across Europe. They also point out that EU State aid to broadband has been gaining importance over time: from an average of €30-55 million in 2003-2005, aid to broadband networks jumped to €6 billion in 2012, which, however, is a figure representing multi-annual schemes to be implemented in the coming three to five years.

Furthermore, over the last three years, the Commission approved over €10 billion of broadband State aid, an amount that does not include all government support to the telecom sector, as not all State measures fall under the definition of State aid (EC, 2015).

The guiding principle in the EU is that State aid does not substitute or distort investments of market players. Accordingly, any State intervention should limit as much as possible the risk of crowding out or replacing private investments, altering commercial investment incentives and distorting competition.²

Until 2009, State aid interventions were assessed and approved with direct application of Article 107(3)(c) of the Treaty on the Functioning of the European Union (TFEU). The Commission's approach with specific regard to State aid control in the broadband sector was then codified in the 2009 Broadband Guidelines (EC, 2009) and in the 2013 Broadband Guidelines (EC, 2013a). The Broadband Guidelines (BG) are very complex and it is not the purpose of this paper to discuss them at length³. We will just focus on some key features of the 2013 BG.

First of all, the distinction between basic broadband and NGA networks is of the utmost importance. Basic broadband access includes ADSL networks, non-enhanced cable (e.g. DOCSIS 2.0), third generation mobile networks (UMTS), and satellite systems. At the current stage of market and technological development, NGA networks instead include fibre based access networks (FTTC, FTTB and FTTH), advanced upgraded cable networks (HFC/DOCSIS 3.0), fourth generation mobile networks (LTE), and certain advanced wireless access networks (WLAN and WiMAX).

² According to Art. 107 (1) of the Treaty on the Functioning of the European Union (TFEU) "*any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favoring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the internal market*".

³ For a presentation of the 2013 European broadband State aid rules, see EC (2014b).

The widening of the NGA definition, with the inclusion of both LTE and advanced fixed-wireless networks, is one of the main changes introduced by the 2013 BG. As pointed by Kliemann and Stehmann (2013), the broadening of the NGA definition entails that, whilst State aid may be considered for a larger number of NGA technologies, the actual Commission approval of the State aid projects becomes less likely due to the fact that competition at the local level between different NGA technologies is easier to be found (i.e. State aid may not be justified due to the risk of crowding out private investment already in place at local level).

The second key feature of European State aid for ultra-broadband is the detailed geographic approach which is required by national granting authorities when they intend to adopt a given measure.

In order to assess market failure and equity objectives, the aid granting authorities are requested to distinguish between three different types of geographic areas, named “white”, “grey” and “black” areas, on the grounds of the current and expected degree of competition at local level. To this end, the aid granting authorities should not only consider whether ultra-broadband infrastructures already exist at local level, but whether private investors have concrete plans to roll out their own infrastructure in the near future, which is considered the next 3 years.

In this framework, the following distinction is made.

- An area is considered a white NGA area if NGA networks are not present and if they are not expected to be built within 3 years. The lack of interest of private investors make these areas clearly eligible for State aid to NGA, provided the fulfilment of a number of conditions (the so-called compatibility conditions).
- An area is considered a grey NGA area if only one NGA network is in place or is expected to be deployed within 3 years. Therefore, no additional NGA network should be expected to be built in the coming 3 years. In case an aid granting authority notifies the Commission a measure concerning a grey NGA area, the Commission shall carry out a detailed analysis to verify whether State intervention is needed, since State aid in this type of areas entails a high risk of crowding out existing investors and distorting competition.
- An area is considered a black NGA area if at least two NGA networks of different operators are either in place or expected to be deployed in the coming 3 years. *Prima facie* the Commission will consider that a State aid measure for these areas is likely to seriously distort competition and therefore shall be deemed not compatible with the internal market.

The 2013 BG introduced, however, a second relevant change with respect to the 2009 BG in order to take the 2020 DAE targets into account. In fact, to align the BG with the 2020 DAE targets, a specific chapter dealing with “ultra-fast” NGA (speeds well above 100 Mbps) was added. In particular, the 2013 BG establish new conditions for allowing State aid also in black NGA areas. An exception is in fact envisaged in case the subsidized NGA network is able to provide ultra-fast

speeds well above 100 Mbps. However, such intervention could only be allowed provided the fulfilment of stringent conditions including, among others, the following provisions:

- a) the existing or planned NGA networks do not reach the end-user premises with fibre networks;
- b) investment plans of commercial operators do not point to the provision of ultra-fast services above 100 Mbps;
- c) the aid does not lead to an “*excessive distortion of competition*” with regard to existing NGA players, which means that such players, in spite of the distortion effect of the aid, shall in any case be able to recoup the infrastructure investments undertaken in an appropriate period of time;
- d) the subsidised network shall be operated as a wholesale only network.

Ultra-fast projects in black NGA areas are therefore very likely to be incompatible with the common market. In particular, the risk of litigation is very high since the two incumbent NGA operators could challenge these initiatives by pointing out the detrimental effect on their NGA investments

4. Wholesale access regulation vs. public funding

In this section we will address the relation between wholesale access regulation and ultra-broadband State aid funding.

We will consider this relation by focusing first on access obligations and secondly on access prices. We will assume, in the following, that the quick deployment of a FTTC network is a very effective option, at least in a number of countries, in order to meet the 2020 DAE targets. The merits and drawbacks of access regulation will be specifically assessed in terms of its impact on the extension of public funding required in a given country.

4.1 Access obligations in a FTTC network architecture

As already pointed, FTTC is rightly included by the State aid guidelines in the new definition of NGA. Such network architecture shall indeed be key in order to achieve the universal coverage at 30 Mbps or more in a large number of European countries. In addition, FTTC can also strongly contribute to reach the more ambitious target of a very high ultra-fast broadband coverage (services above 100 Mbps) which, in turn, is a pre-requisite in order to reach the 50% take up rate of these services set by the DAE.

In a FTTC architecture, a number of different technologies, and mostly a combination of them, such as VDSL2, G.fast and Vectoring, can deliver the latter target depending on both copper line conditions and loop length.

VDSL2 (Very high-bit-rate Digital Subscriber Line 2), an enhancement of VDSL, has the potential to reach 100 Mbps, but noise among the lines in the cable can substantially reduce performance. Vectoring has been developed exactly to address crosstalk limitations. Vectoring can thus enhance

VDSL2 performance by cutting out all of the noise, or interference, among the VDSL2 lines in a bundle. VDSL2 Vectoring technology boosts upstream and downstream bandwidth between 90% and 150% depending on line conditions and loop length (<https://www.alcatel-lucent.com/solutions/vdsl2-vectoring>).

G.fast, a technology standardised by ITU in 2014, can instead allow transmissions up to 1 Gbps on copper networks. G.fast exploits a wider frequency band than VDSL2 and is particularly suitable for application in short loops. However, performance is also greatly affected by crosstalk when multiple G.fast lines occupy the same cable binder. This is because Vectoring is an essential complementary technology also for G.fast systems. The gains that can be achieved when Vectoring is used with G.fast are remarkable, particularly with regard to copper loops shorter than 200 m. (Spruyt and Vanhastel, 2013).

All in all, it is now widely acknowledged that both VDSL2 and G.fast technologies, coupled with Vectoring, can be suitable technologies in order to achieve the 100 Mbps target set by the DAE.

In addition, a FTTC deployment model is undoubtedly less expensive than a FTTH one. Reusing the copper infrastructure in the last mile significantly reduces the civil works costs: the results of a modelling approach for NGA networks in Germany show that greenfield investment required for FTTC are, on average, 77% lower compared to FTTH (Pluckebaum, Jay and Neumann, 2014). These figures explain why FTTC tend to be the reference network architecture in most of the European countries, including, among others, Germany, the UK, Italy, the Netherlands, Austria, Belgium, Poland and Switzerland. Overall, in the EU 28, FTTC coverage is around 2 times FTTH coverage (EC, 2014c).

Italy stands as one of the most suitable country for a FTTC deployment model. As a matter of fact, in Italy the average loop length is about 300 metre. In this scenario, VDSL2 Vectoring, implemented in a FTTC architecture, can provide speeds up and well above 100 Mbps. Accordingly, FTTC deployments, along with upgrades to G.fast in the last three years of this decade, is considered the most suitable and cost-effective solution for Italy to reach both the 2020 DAE targets (Caio, Marcus and Pogorel, 2014).

As already stressed, the ability of VDSL2 and G.fast to deliver the 100 Mbps called for by the DAE is heavily dependent on cross-talk among copper pairs in a binder. Hence the adoption of Vectoring technology is key. However, for cross-talk cancellation to be effective all copper pairs have to be connected to the same vectoring processor. This implies that all lines are operated by the same DSLAM. Therefore, in order to benefit from the adoption of Vectoring, the street cabinet should be run by one operator. Thus, the adoption of Vectoring *de facto* results in a kind of monopolization of the cabinet infrastructure.

Such a situation creates a complex trade-off between the ability to reach the 100Mbps target set by the DAE, on the one hand, and the promotion of infrastructure competition at the cabinet level. The solution to this puzzle needs to be found by regulation.

In this regard, three major regulatory approaches have been established⁴.

1. A first regulatory scheme only allows the incumbent to deploy VDSL2 Vectoring and G.fast Vectoring. Accordingly, the SLU access service is not mandated. This approach has been introduced by Belgium and Denmark. Typically, the incumbent must offer a VULA (Virtual Unbundled Local Access) product at a MDF location. The virtual product shall allow competitive operators to provide the same ultra-broadband retail services.
2. A second regulatory option is to grant exclusive rights of using the sub-loop to the first operator installing VDSL2/G.fast Vectoring at the street cabinet. Such a regulatory scheme, followed by Germany, promotes a first mover monopoly setting. Street cabinets may therefore be run by different operators, an approach that leads to local monopolies (i.e. at the street cabinet level). Under this scheme, a suitable wholesale broadband access product is offered either by the incumbent or the alternative operator, i.e. by the operator that has installed VDSL2/G.fast Vectoring at the street cabinet. Such a regulatory scheme is clearly a symmetric one.
3. The third regulatory approach assumes that future Vectoring technologies may also be implemented in a multi-operator scenario, which means that the lines in the same VDSL2 binder could belong to different operators. Such an assumption leads to asymmetric access obligations on the incumbent including, typically, the interconnection of its own street cabinets with other players' street cabinets. So far the third regulatory approach has been only adopted by Italy.

Divergent regulatory schemes, which heavily affect the rate and speed of adoption of Vectoring technologies, are therefore currently implemented in Europe. It is too early to draw a firm conclusion on the merits and limits of such regulatory schemes. However, it is clear that the third regulatory approach is currently preventing the adoption of Vectoring technologies in Italy, that is in one of the European countries that could better exploit this technology. Furthermore, the lack of deployment of Vectoring has not helped Italian policy makers to develop a fit-for-purpose ultra-broadband strategy. As a matter of fact, the draft proposal is strongly focused on the need of a nation-wide FTTH network and overlooks the merits of a FTTC model (Presidenza del Consiglio dei Ministri, 2015).

4.2 Access prices in a FTTC network architecture

The relation between access prices, competition and incentives to invest in NGAN has been the subject of a number of recent studies, especially at the European level as input to the EC Recommendation on non-discrimination and costing methodologies (EC, 2013b). Though these studies have not specifically addressed the interplay between regulated access prices and State aid, they provide a broad theoretical reference that allows focusing also on such a relation.

⁴ For a discussion about the regulatory challenges raised by Vectoring see Pluckebaum, Jay and Neumann (2014).

The study carried out by Charles River Associates (CRA) for the EC is the most thorough attempt to investigate the effect of access prices on investment incentives (CRA, 2012)⁵. The findings of the study have been very influential in the design of the EC Recommendation on non-discrimination and costing methodologies (EC, 2013b) and, for this reason, we will develop our reasoning mostly on the ground of the CRA study.

CRA (2012) addresses, among others, two crucial and separated issues: the effect of fibre access prices on investments in new fibre infrastructure; and the effect of copper access prices on investments in new fibre infrastructure.

As regards fibre access pricing, CRA (2012) concludes that fibre access prices higher than suggested by standard cost-oriented pricing, will generally entail positive effects on fibre investments. To this end, regulators should offer an expected return on capital beyond the cost of capital, that is a return on investment beyond cost. This regulatory approach has also been referred as the introduction of a risk premium on top of the normal cost of capital in order to create appropriate incentives for fibre investments.

As regards copper access pricing, the economic analysis is much more complex. According to CRA (2012), there are three main effects that drive the relationship between copper access pricing and the incentives to invest in fibre by incumbents.

The first one is called "*the replacement effect*". The owner of an existing copper network shall have lower incentives to deploy a fibre network the higher the access prices for copper. This situation arises due to the fear of the copper network owner of losing existing wholesale revenues. The reverse relation would clearly hold.

The second effect is called "*the business migration effect*". Once a copper network is operated by an incumbent in parallel with a fibre network, wholesale copper prices will constrain retail copper prices which in turn will constrain retail fibre prices. Accordingly, lower wholesale copper prices will imply lower retail copper prices and, then, lower retail prices for fibre-based services. The *business migration effect* leads therefore to the opposite direction of the *replacement effect*.

The third effect is "*the pre-emption effect*". If there are potential investors in fibre network, the owner of the copper network will carefully evaluate the risk given by alternative new networks competing with the existing copper network. The higher the risks of being a second or even a third mover in the fibre market, the higher the incentives for the owner of the copper network to invest in the new fibre network. However, the extent of such risks also depends on existing copper prices: the higher are the copper prices, the higher is the likelihood of losing both wholesale and retail revenue in the copper market due to the market entry of new players in the fibre market.

⁵ On the relation between access prices and investment in fibre networks see also the divergent conclusions by Plum (2011) and WIK (2011) and the overview by Borreau et al. (2012).

Summing up, assuming the viewpoint of the owner of the copper network, according to the replacement effect, low copper prices are an incentive to invest in fibre network whilst according to the business migration effect and the pre-emption effect the opposite relation holds.

Let's now consider the access seeker's viewpoint: the higher are copper access prices, the greater the incentive to avoid these prices by investing in the new network. In this case the relation is hence straightforward.

On the grounds of the above analysis, CRA (2012) concludes that the effect of copper access prices on fibre investments is very complex and should therefore only be addressed at country level by taking into account a number of factors including, among others, the demand density (i.e. the relevance of densely populated areas) and the patterns of competition. Even if it is not possible to draw a general conclusion, CRA however points out that reducing copper access prices would be unlikely to increase incentives to invest in fibre. This assessment has driven the European Commission to state that regulators should aim at a substantial stability of copper access prices over the long term (EC, 2013b).

We can now address the relation between copper access pricing and ultra-broadband State aid funding. We argue that low copper access prices are likely to increase ultra-broadband State aid funding. In fact, it seems reasonable to predict that low copper access prices are likely to determine the increase of NGA white areas in a given country. This assumption is particularly reasonable with regard to those countries where the incumbent is the only player participating in open tenders aiming at ensuring the deploying of NGAN networks in white areas: in such countries it is very unlikely that lowering copper access prices would determine a decrease in the number of unprofitable NGA areas⁶. The increase of NGA white areas would therefore require a greater amount of public funding to reach the 2020 DAE targets.

The analysis so far has not considered any specific NGA target architecture. If, however, we assume that the target architecture is FTTC, the economic analysis of the relation between copper access pricing and the incentives to invest in fibre becomes much less uncertain. As a matter of fact, in this case, the three main effects identified by CRA (2012) go in the same direction: the lower are the copper access prices, the lower are the incentives for the incumbent to invest in a FTTC network.

In a FTTC setting, the replacement effect would in fact work in the opposite direction as compared to the general case: indeed, FTTC is a hybrid architecture, based on both fibre, (the link between the central office and the street cabinet) and copper (the sub loop between the street cabinet and the customer premises). Accordingly, lowering copper access prices would at the same time reduce prices for both existing copper services and FTTC products. In particular, prices for all

⁶ Following CRA (2012) one can hardly imagine that a regulatory policy aiming at the reduction of copper access prices could stimulate overall fiber investment at country level. If any, such a policy could support some NGA access seekers in some selected urban areas. Accordingly, the reduction of the number of NGA white areas as a result of the reduction of copper access prices only appears as a theoretical conjecture.

FTTC products would unavoidably go down due to the lowering of the sub-loop access price. This means that any reduction of copper access prices would not increase incentives for the incumbent to invest in FTTC. Rather, the incumbent would suffer a decrease of both retail and wholesale copper revenues that could not be mitigated by additional revenues in FTTC. Such regulatory policy would ultimately reduce the incumbent's capability to develop in the marketplace.

Let's now consider the incentives for current copper access seekers. In the short run the reduction of sub-loop access prices could stimulate, if any, the development of a model of competition based on FTTC products in some selected densely populated geographies. However, low retail FTTC prices, triggered by lowering of sub-loop prices, would over time:

- a) hamper FTTC investment in a broader number of geographic areas that would become unprofitable for both the incumbent and the access seekers due to the reduction of the expected FTTC retail revenues;
- b) pre-empt the deployment of pure fibre-based NGAN architecture due to the lock-in effect determined by low FTTC retail prices.

We can now address again the relations between copper access pricing and ultra-broadband State aid funding in the specific case of a country which is pursuing the 2020 DAE targets by means of a FTTC architecture.

All in all, in a FTTC setting, lowering copper access prices would certainly reduce the incentives to invest in this architecture with the partial exception, in the short term, of some selected metropolitan and urban areas. Such a general effect would be clearly visible at local level: the reduction of sub loop access prices would alter the threshold between profitable and unprofitable areas in terms of FTTC investment. Assuming the viewpoint of the copper incumbent, FTTC unprofitable areas would increase depending on the actual decrease of sub loop access prices. Let's now also consider the access seeker behaviour: we can simply consider as a minor theoretical conjecture the case where, due to lower sub loop access prices, the access seekers would invest in areas which have become unprofitable for the incumbent.

We can therefore conclude that lowering sub loop access prices would very likely broaden the extension of "*white NGA areas*". Accordingly, lowering sub loop access prices shall ultimately increase the ultra-broadband State aid funding needed to meet the 2020 DAE targets.

5. Access conditions in the subsidized areas

In this section we will examine how access conditions imposed in the subsidized areas may affect ultra-broadband State aid funding.

The 2013 BG establish all the conditions that every State measure in support of broadband deployment should fulfil. Wholesale access obligations and wholesale access prices play a key role in ensuring that the distortion of competition introduced by the aid is limited as much as possible. To this end, the role of National Regulatory Authorities (NRAs) is crucial. The BG stress

that NRAs should be consulted with regard to determining both wholesale access obligations and prices.

We shall first review wholesale access obligations. The BG point that wholesale access obligations imposed on a subsidized network should be aligned with existing wholesale regulation. However, it is also pointed that, in principle, subsidized companies should provide a wider range of wholesale access products than those mandated by NRAs to operators who have Significant Market Power (SMP).

In addition, whilst access obligations imposed to SMP operators are to be re-examined every three years, wholesale access to the subsidized infrastructure should be available for at least a period of 7 years.

With specific regards to NGA networks, it is stated that the subsidized network shall provide, among others, a full unbundling product to access seekers. However, if the selected bidder rolls out a point-to-multipoint topology network, and therefore the physical unbundling is not technically feasible, a virtual unbundling product shall be made available.

Besides full unbundling, the access obligations should include the rights to use ducts and poles, access to dark fibre, access to street cabinets and access to active network infrastructure (bitstream access).

The portfolio of access obligations that might be imposed on the subsidized network is therefore very broad in scope. As a consequence, the effective implementation of the guidance given by the Commission is far from being a simple task.

In case the subsidized network is a FTTC architecture, an in depth investigation is required to ascertain whether the imposition of some costly obligations is reasonable or not. This is the case of the provision of additional street cabinets fit for purpose for the access seekers. Such access products on the one hand allow an infrastructure-based competition at cabinet level, on the other hand undoubtedly increase the burden of the public subsidy.

It is for the latter reason that the BG stress that, especially in areas with low population density, *“the imposition of all types of access products might disproportionately increase investment costs without delivering significant benefits in terms of increased competition”* (EC, 2013a, article 80(a)).

In such cases, the aid granting authority should therefore first of all ascertain the existence of a reasonable demand for these costly access products. Among others, the demand is considered reasonable only if *“the access seekers provides a coherent business plan which justifies the development of the product on the subsidized network”* (EC, 2013a, article 80(a)).

The portfolio of access obligations imposed on the subsidized network cannot therefore be assumed for given. A specific assessment is required to avoid that disproportionate and costly access obligations are imposed on the beneficiary of the aid. Clearly, such an investigation is essential before the aid measure is actually designed since the imposition of access obligations affects the level of costs incurred by the beneficiary and, in turn, the design of the tender.

Particularly in a FTTC setting, the aid granting authority should evaluate the pros and cons of costly access products, such as the availability of additional street cabinets. In such an assessment it should be taken into account that third party operators can also compete in the retail market by means of virtual access products available at switch level. The fundamental question here is: for a given European country, struggling with the 2020 DAE targets, does it make economic and social sense using the limited funding available for the promotion of competition at the street cabinet in unprofitable areas? The same amount of money could in fact be used for the deployment of a subsidized ultra-broadband network in broader geographies.

Let's now consider wholesale access pricing. The BG establish that "*wholesale access price should be based on the pricing principles set by the NRA and on benchmarks and should take into account the aid received by the network operator*" (EC, 2013a, article 78(h)). Regarding benchmarks, it is also pointed that in case wholesale prices prevailing in other comparable areas of the country or of the European Union are not available, the reference should be given by prices already set or approved by the NRA for the markets and services concerned.

Having established these methodological principles, the BG also state that "*A detailed description of the aid project should be sent to the NRA at least 2 months prior to the notification to allow the NRA to have a reasonable period of time to provide its opinion ... The aid granting authority should seek advice from the NRA in setting the wholesale access prices and conditions. The benchmarking criteria should be clearly indicated in the tender documents*" (EC, 2013a, article 78(h)).

It is therefore clearly established that:

- the aid granting authority has the full competence to set wholesale access prices by taking into account the preliminary advice given by the NRA;
- bidders shall submit their bids on the grounds of wholesale access prices set by the aid granting authority.

We can now address a possible controversial methodological aspect in setting wholesale access prices. As already pointed out, according to the BG the aid received by the network operator should be taken into account. It follows that the NRA should assess the provisioning costs of the subsidized services in specific geographical areas by also focusing on the foreseen aid. However, such a task is extraordinarily difficult for any NRA, since it requires an in-depth evaluation of the ultra-broadband service provisioning costs at local level. Indeed, European NRAs have barely attempted so far to set de-averaged regulated prices.

Setting wholesale access prices in the subsidized areas equal to the regulated national prices for the same services appears a more reliable approach. This solution, which is fully consistent with the BG, would make the quite complex definition of *de facto* geographical wholesale access prices not necessary. Furthermore, such approach does not risk inflating the profits, if any, of the subsidized network. In fact, the granting authorities usually adopt claw-back mechanisms which

ensure that any extra-profit of the beneficiary of the aid would be returned to the aid granting authority, so to be used for the deployment of ultra-broadband networks in other unprofitable geographic areas.

6. Conclusions

The European Digital Agenda adopted by the European Commission in 2010 has set very ambitious and challenging goals for Member States to be achieved by 2020: fast broadband coverage at 30Mbps or more for 100% of EU citizens and 50% of European households with subscriptions of ultra-fast broadband services above 100Mbps. As a result, the European public policy for the so-called Digital Industry and Society is currently substantially shaped around the achievement of these targets.

However, most of the European countries risk not reaching the 2020 DAE targets. It is therefore widely acknowledged that access regulation should vigorously promote private investments in new networks, whilst the deployment of new networks in unprofitable areas should be subsidized by means of appropriate public funding. Both access regulation and State aids are therefore key in order to ensure that the 2020 DAE targets are reached throughout Europe.

In this paper we have pointed out that “adverse” access regulation may however jeopardize the 2020 DAE targets. Indeed, “adverse” access regulation may end up by decreasing incentives to invest in ultra-broadband networks as well as to slow-down their deployment. Such an outcome would ultimately broaden the extension of geographies to be subsidized.

In case of a FTTC architecture, that is a hybrid copper-fibre architecture widely adopted in a number of European countries, it emerges that both access obligations and access prices can substantially affect ultra-broadband State aid funding.

First, access obligations at the cabinet level can heavily affect the rate and speed of adoption of ultra-fast technologies such as Vectoring. The ability of VDSL2 and G.fast to deliver speeds up and well above 100 Mbps is crucially dependent on the complementary adoption of Vectoring. Accordingly, regulatory policy aiming at the development of infrastructure-based competition at the cabinet level is currently hindering technical change and, ultimately, the ability to reach the 2020 DAE targets.

Second, lowering the sub-loop access price would increase the extension of unprofitable NGAN areas in a given country. As a result, lowering sub loop access prices would, ultimately, increase ultra-broadband State aid funding and, needless to say, the burden for tax-payers. In addition, such a regulatory policy would also pre-empt the deployment of pure fibre-based NGAN architecture due to the likely lock-in effect determined by low FTTC retail prices.

Third, wholesale access conditions and wholesale access prices in the subsidized networks may also increase State aid funding. Wholesale access conditions in the subsidized areas can in fact substantially broaden the need of State aid funding by pursuing the achievement of very costly pro-

competitive measures. In particular, the goal of more infrastructure-based competition in a limited number of subsidized areas may not help the achievement of the 2020 DAE targets. Moreover, regulated national prices along with the introduction of appropriate claw-back mechanisms appear to be an effective approach in setting wholesale access prices in the subsidized areas.

The overall conclusion is that access regulation can indeed hinder innovation and welfare maximisation. Such “*unintended consequence*” of regulatory policy may be spurred by an excessive focus of regulators on the development of infrastructure-based competition at the cabinet level. The 2020 DAE targets should instead become the more prominent goals of access regulatory policy in each Member State of the European Union.

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