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A cost study of fixed broadband access networks for rural areas ☆

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ABSTRACT

The deployment of high-capacity broadband access networks in rural areas in Europe lags behind that in urban and suburban areas. This study assesses the cost implications for the rollout of fixed access networks capable of providing citizens with downstream broadband capacities of 30 Mbps or 100 Mbps, which have been defined in the European Digital Agenda as targets that should be met by 2020. A cost model was employed to determine the cost of a home passed and the cost of a home connected for various fibre- and copper-based networks in rural areas. It was found that the cost of deploying a network outside a town or village in a rural area is on average 80% higher than the cost of deploying the network in the town or village. This situation may lead to a digital divide within the same rural area. For all the geotypes analysed, the following order of costs (in descending order) was identified: FTTH, FTTdp-Building, FTTdp-Street, FTTRN, FTTC and CO-VDSL. Given the long lengths of distribution, feeder and drop segments required, some network architectures will not be able to provide all households in some areas with the minimum bandwidth of 30 Mbps as defined in the European Digital Agenda. Overall, it is possible that operators will need to create a combination of various broadband access networks, due to the significant cost differences between networks. Policymakers will need to address several topics to promote the rollout of broadband networks in rural areas: how the digital divide within a rural area can be avoided; a National Broadband Plan that clearly addresses the provisioning of broadband in rural areas; elaboration of studies on broadband demand in rural areas; and the assessment of costs and technical capacity of wireless networks in rural areas.

1. Introduction

In several regions all over the world, policymakers have defined broadband targets that should be met within a certain period of time in order to improve the national or regional telecommunications infrastructure. In Europe, the European Commission defined the Digital Agenda, which states the following broadband targets: a) basic broadband, which is a connection that enables at least 144 kbps or 1–2 Mbps for all citizens by 2013; b) download rates of 30 Mbps for all the

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citizens by 2020; c) 50% of all the European households should have a broadband subscription of at least 100 Mbps by 2020 (European Commission, 2014a). Whereas basic broadband has been provided for all since 2013, the coverage of Next Generation Access (NGA) networks, which can provide at least 30 Mbps downstream, was 68% in all of Europe in 2014, compared to 62% in 2013. In rural areas, there was NGA coverage of 25% in 2014, compared to 18% in 2013 (European Commission, 2015).

Overall, urban and suburban areas have better broadband coverage than rural areas (European Commission, 2015). Operators are usually motivated to deploy broadband networks in urban and suburban areas rather than in rural areas, because of the high density of users willing to pay for high-speed broadband services and the relatively low network rollout costs in urban and suburban areas. Broadband diffusion begins in general in urban areas, before being expanded to suburban areas and finally reaching rural areas.

One public policy tool that can be employed to facilitate the rollout of a high-speed broadband infrastructure in rural areas is the use of state aid or subsidy (FSR, 2011). The European Commission has defined the conditions that should be met in order to receive state aid for broadband rollout and has classified areas that could potentially receive it (European Commission, 2013). According to the presence of operators that have or intend to have NGA infrastructures in a specific region in Europe, the following three types of areas were defined: white areas are those where there is no NGA provider and where there is unlikely to be any NGA provider in the near future; grey areas are those where there is only one NGA network and where there will not be another in the near future; black areas are those that have at least two NGA networks. Under certain conditions, white and grey areas may be eligible for state aid. The majority of rural areas can be classified as white areas, due to the low NGA coverage in these regions. Different strategic, regulatory, economic, technical and cost aspects need to be studied in order to understand the motivation of operators to invest in broadband networks in rural areas.

One research topic is therefore the analysis of suitable high-speed broadband access networks that can be deployed in rural areas and the quantification of the costs of the corresponding network deployment. This is a subject that has drawn the attention of operators, policymakers, researchers and analysts. A few studies have analysed the cost of broadband networks in different regions. Elixmann, Ilic, Neumann, and Plückebaum (2008) described the cost of the deployment of fibre to the curb (FTTC) and fibre to the home (FTTH) networks in various urban, suburban and rural areas for different countries in Europe. Analysys Mason (2008) studied the cost of FTTC and FTTH networks in different geotypes in the United Kingdom (UK). A study made by the European Investment Bank found that 41.1% of the total investment needed to provide high-speed broadband services in Europe would be allocated to rural areas (EIB, 2011). The FTTH Council Europe (2012) analysed the total cost of deploying FTTH networks in all of Europe. Point Topic (2013) showed that 63.4% of the entire investment required for deploying NGA networks in Europe should be allocated to rural areas. Caio, Marcus and Pogorel (2014) analysed how FTTC/very high speed digital subscriber line 2 (VDSL2) networks could be employed to meet the targets of the European Digital Agenda in Italy. In the wireless arena, Frias, Gonzales-Valderrama and Perez Martinez (2015) compared the costs of providing 30 Mbps downstream through FTTH and wireless Long Term Evolution (LTE) networks in rural Spain. Hallahan and Peha (2010) conducted a cost assessment of a nationwide public safety wireless network in the United States. Prieger (2013) described the differences in broadband availability between urban and rural areas in the United States.

The above mentioned studies did not, however, address in detail the issue pertaining to the cost of different fixed networks that can be used to meet the targets of the European Digital Agenda in rural areas by 2020. It is likely that, when some of the above-mentioned studies had been prepared, the only NGA fixed networks available were FTTC, FTTH and fibre to the building (FTTB). The development of transmission speed over copper lines has since evolved and additional networks that comprise hybrid fibre- and copper-based networks, such as fibre to the remote node (FTTRN) and fibre to the distribution point (FTTdp), can now be employed in rural areas. The objective of this article is to explain the costs of the different fixed access networks that can be employed in rural areas to provide high-speed broadband services according to the targets of the European Digital Agenda. The research questions that are addressed in this article are as follows:

1) *What are the fibre- and copper-based access networks that can be used in rural areas to provide at least the* 30 Mbps *or* 100 Mbps *defined in the European Digital Agenda*? 2) *What is the cost of the rollout of such networks?*

For the analysis of this matter, a cost model was employed to obtain the cost of the different networks. The following six networks, which are being considered by different operators for a possible network rollout in different regions in Europe, were analysed: central office VDSL (CO-VDSL), FTTC, FTTRN, fibre to the distribution point – Street (FTTdp-Street), fibre to the distribution point – Building (FTTdp-Building) and FTTH. The input values employed for the cost model are based on fibre and copper deployments in different regions in Europe. For the characterization of the rural area, we have employed six geotypes that differ according to subscriber density and segment lengths. We have considered that there is only one operator in charge of the rollout of the network, i.e., there is no competition between two or more operators that intend to deploy the same type of network in the same area. The metrics derived were the cost of a home passed and the cost of a home connected.

The rest of the article is structured as follows. A literature review of scholarly articles and studies about broadband in rural areas is presented in Section 2. Section 3 describes the geotypes, network architectures and cost model employed for the analysis. Section 4 presents the results obtained: the investment per home passed, the investment per home connected, a sensitivity analysis and the total cost for all the geotypes considered. A discussion of the results and policy implications are presented in Section 5. Finally, Section 6 presents a conclusion.