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LTE techno-economic assessment: The case of rural areas in Spain

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ABSTRACT

This paper evaluates whether it is feasible for an LTE operator to deliver a 30 Mbps fixed service in rural areas in Spain and if this is not the case, whether passive network sharing could make it feasible, since this is in fact one of the objectives set out in the Digital Agenda for Europe and a key issue in the national broadband strategy. The research is conducted through a techno-economic assessment in an infrastructure competition scenario. A discounted cash flow method is used to determine the total cost of the deployment for the operator and the minimum average revenue per user (ARPU) which would be required to recover the investment in both approaches: passive network sharing and non-sharing. On the other hand, the three demand scenarios that were considered, depending on the envisaged Spanish broadband penetration by 2020, attempt to calculate what take-up and ARPU are likely in the targeted rural areas. As mobile operators' coverage obligation stipulates covering 90% of the municipalities with less than 5000 inhabitants, extreme rural areas, which correspond to the final 0.7% of the population, are excluded from this assessment. The results indicate that, given the socio-economic characteristics of the assessed area, demand is very sensitive to price and that the existence of other broadband products forces the operator to lower the ARPU. As a result, only very high take-up ratios would make the deployment feasible. The research shows that passive network sharing does not constitute a solution; nevertheless, a single network deployment could solve the unfeasibility problem in rural areas.

1. Introduction

Since the Digital Agenda for Europe (DAE) (European Commission, 2010b) was established, most of the countries involved are searching for the best strategy to achieve it. Despite the DAE objective dates not being mandatory; Spain has made them key issues in the national broadband strategy (Spanish Ministry of Industry, Energy and Tourism, 2013a). In the particular case of Spain, the first step was the 2011 broadband Universal Service Commitment (USC). Since then, the country has been totally covered. The designated operator is Telefónica and it is required to provide a 1 Mbps (average downlink throughput in 24 h) broadband connection with technological neutrality. As regards the *at least 50% of households connected to speeds above 100 Mbps by the 2020* objective, it is assumed that this objective will be achieved through fixed Next

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Generation Access (NGA) networks. The European Commission (2012) reported that in 2012 there was a 40% NGA net coverage amongst all its member States. A recent report from the Spanish Ministry of Industry, Energy and Tourism (2013b) stated that Spain already has a 52% population coverage of more than 100 Mbps broadband with HFC[1] (DOCSIS 3.0 technology) and FTTH technologies. However, there are some uncertainties about how to achieve the objective of *providing coverage of more than 30 Mbps for all citizens*. In the same report it is also stated that there is a 59% population coverage of broadband technologies capable of providing more than 30 Mbps: VDSL, HFC and FTTH. It is important to note that it also mentions the 99% 3 G and 3.5 G population coverage provided by HSPA and HSPA+. This information suggests that wireless networks could be the most cost-efficient solution to achieve the 30 Mbps objective.

The European Commission (2010a), Radio Spectrum Policy Group (2009), and Ofcom (2011), emphasize the importance of the 800 MHz frequency band as the key to the profitable provision of next-generation mobile broadband services in less densely populated areas. This frequency band is harmonized for WiMAX and LTE technologies. Because of LTE's major commercial advantage, which has a direct effect on the price of equipment and devices, and the European operators' commitment to this technology, it is expected that LTE will dominate broadband wireless services as stated in numerous reports (e.g. Arthur D. Little, 2012; GSA, 2013; Norman, 2009).

There is a special concern about the provision of the 30 Mbps broadband service in low population density areas, where the absence of a clear Return on Investment (ROI) makes the deployment of infrastructures through the market forces unlikely. As a solution, governments are encouraging network operators to share investments, at least to share the civil engineering and passive equipment (Passive network sharing[2]) (BEREC-RSPG, 2011). However, there are some experts who believe that this kind of measure is not enough to make the required investments appealing to networks operators by the market forces. Furthermore, they (Cave & Martin, 2010; Falch & Henten, 2010) consider that public initiatives, such as economic incentives, are crucial for its deployment.

The feasibility of the deployment, which is defined as the ability, at least, to recoup the investment at the end of the study period, is highly related to network take-up and, therefore, on service adoption. In scarcely populated areas, adoption tends to be lower than in urban areas, as a result of several barriers. The FCC (2011) states that these barriers are: the cost of broadband, lack of a computing device in the home and low levels – or complete absence – of digital literacy. Information provided by Howick and Whalley (2008) concluded that: "Although broadband is available to 99.9% of households and businesses across the UK, broadband adoption rates are far lower. Internet adoption varies from between 48% and 59% depending on the part of the UK". Davidson, Santorelli, and Kamber (2012), highlighted that despite the near-universal access to broadband in the United States, less than 70% of households subscribe it. In Spain, the adoption gap depending on the population of the municipalities has been assessed in the most recent regulator's broadband geographical report (CMT, 2013). The penetration rate of fixed broadband lines (the national mean value of 24.3 lines per 100 inhabitants) fell to 17.9 in municipalities with less than 5000 inhabitants and to 12.6 in municipalities with less than 1000 inhabitants.

As a solution to the investment in scarcely populated areas, some Member States have linked population coverage obligations to the 800 MHz spectrum's holders. In Spain, this obligation fell to Telefónica, Vodafone and Orange who acquired 2×10 MHz FDD in the 2011 Spanish spectrum auction (Spanish Ministry of Industry, Tourism and Trade, 2011a). They are required to jointly provide 30 Mbps broadband to 90% of the population in rural areas. It is important to note that rural areas refer to the 6809 municipalities with less than 5000 inhabitants, representing 69% of Spanish territory.

A recently published techno-economic assessment (Feijoo & Gomez-Barroso, 2013) has considered that it would take at least 12.6 billion euros (present value) to cover 100% of Spanish households and businesses with next generation networks in 2020. Different technologies (FTTH, VDSL, DOCSIS and LTE) were considered and the most efficient use of the existing network infrastructure per type of municipality was selected. This research also makes a classification depending on the population of each municipality. Although in the LTE scenario very considerable differences with respect to that proposed herein (e.g. carrier bandwidth, antenna configuration and throughput per user[3]) are contemplated, it is very important to bring up two outcomes. The first one is that in rural areas the only feasible NGN deployment is LTE. It also set at 100 inhabitants per square kilometer as the limit in terms of commercial viability. This information has been corroborated by the fact that in the Telecommunications and Ultra-fast Networks Plan (Spanish Ministry of Industry, Energy and Tourism, 2013c) LTE was the only NGN considered to achieve 30 Mbps in rural areas. The second one is the affirmation that the achievement of the objectives set out in the Plan Avanza (Spanish Ministry of Industry, Tourism and Trade, 2011b) and the Digital Agenda for Spain (Spanish Ministry of Industry, Energy and Tourism, 2013a) looks too difficult (especially if there are quality limits that must be ensured). There is a strong belief that if LTE is not the solution to providing 30 Mbps broadband in rural areas, then rural areas may not be covered by any other technology. This is the main motivation of this work.

The aim of this paper is to evaluate whether it is feasible for an LTE operator to deliver the 30 Mbps fixed service in rural areas in Spain and if this is not the case, whether passive network sharing could make it so. The research is carried out

[1] Acronyms: Long Term Evolution (LTE), Hybrid Fiber Coaxial (HFC), Fiber To The Home (FTTH), Very High bit-rate Digital Subscriber Line (VDSL), High-Speed Packet Access (HSPA) and Worldwide Interoperability for Microwave Access (WiMAX).

[2] For the type of network sharing, we use the classification described in Table 1 in Khan, Kellerer, Kozu, and Yabusaki (2011). Regarding passive network sharing, we considered the sharing of civil engineering and passive equipment.

[3] The carrier bandwidth considered for this assessment was 20 MHz. The frequency band was not specified. The antenna configurations were MIMO2 × 2 and MIMO 4 × 4. The downlink throughput considered was from 1 to 5 Mbps, which is not enough to consider it as a solution for the 30 Mbps DAE's proposal.