

5G Wales Unlocked.

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Abstract

This paper examines Department for Culture, Media and Sport (DCMS) and Welsh Government support for 5G deployment in rural areas of Wales. This project introduced several use cases based on 5G-enabled digital applications in Monmouthshire and Blaenau Gwent. The findings highlight the ongoing challenges associated with 5G deployment in rural Wales, and the current lack of a business model for 5G deployment by Mobile Network Operators (MNOs) in such areas. The report illustrates how the public sector may collaborate with private actors to develop an experimental approach to 5G deployment challenges faced in rural areas. This approach is based on an iterative learning process, in which small-scale experimental actions aimed at identifying sources of demand and understanding the potential impacts of new technology solutions are established. The report suggests that policy action is required at multiple levels of governance in such experimentation to address the challenge of deploying new 5G, and to ensure that firms and public service provision in rural parts of Wales are not disadvantaged.

Introduction

The 5G Wales Unlocked project sought to address the challenges of supporting deployment in rural areas of Wales. Similar predecessor technologies such as 4G and fixed-line broadband have tended to be deployed in urban areas in the first instance by commercial operators (Welsh Government 2017a). Deployment in such areas has benefited from large subscriber bases and dense network connections, all of which have provided a strong commercial business case for action (Henderson & Roche 2019). The weakness of such an approach is that rural areas tend to lag behind urban areas in their access to such technologies and associated services, and with this potentially compounding spatial socio-economic disparities between core and peripheral areas (Jones & Henderson 2019).

In response to these challenges the 5G Wales Unlocked project was based on a multi-agency response by the UK Government Department for Culture, Media and Sport (DCMS), Welsh Government and Local Authorities (RSM 2023). Given the early-stage nature of such technologies and the limited commercial business model for their deployment in rural areas, the project has developed a number of experimental testbeds to examine the potential of such technologies to support commercial use cases in rural areas of Wales. These test-beds have sought to explore the commercial potential of such technologies in a number of thematic areas, with activities focused on farming, tourism and education (Henderson et al. 2022). This approach was also used to explore the rural challenges to deployment and to learn lessons about potential solutions to such deployments alongside a Mobile Network Operator (MNO).

The aim of this paper is to examine these experimental activities, the challenges and their learning outcomes. In doing so it

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considers the potential for public sector actors to support the deployment process and their outcomes, as well as the implications that such activities have for future policy support for deployment in rural Wales. It builds on the author's involvement in the project, alongside colleagues, as part of the Welsh Economy Research Unit's '5G Wales Unlocked Observatory' in 2021-2022 (Henderson et al. 2022).

The remainder of the paper is as follows. The first section explores the deployment challenges of 5G in rural areas of Wales and the existing policy responses. This is followed by analysis of the 5G Wales project and its learning outcomes. The paper concludes by summarising the project's outcomes and their policy implications.

Challenges and opportunities for 5G in rural areas of Wales

Rural areas of Wales have lagged behind cities in terms of access to advanced telecommunication technologies. This reflects the private sector's approach to deploying such technologies and the associated business case based on subscribers. Such an approach and its implications for rural areas of Wales has been evident in the development of fixed-line broadband solutions such as superfast and fibre broadband, as well as mobile telecommunications solutions such as 4G. In each of these technological areas the dispersed nature of the rural population in Wales and the hilly topography of places have limited the commercial case for investment in, and deployment of, the infrastructure necessary to reach such communities (cables, masts, cabinets etc.). Reaching remote communities presents additional challenges, such as the distance from telecommunication exchanges, as fibre is required to connect to mobile networks. This is equally pertinent for mobile telecommunications, which rely on fibre connections to the wider network.

Historically the public sector has sought to address the problems of rural telecommunications deployment through a range of mechanisms (Henderson et al. 2018). This has included offering financial subsidies for investment in infrastructure, such as the Welsh Government Superfast Cymru programme to deploy superfast broadband in Wales (Welsh Government 2017b) and the Access to Broadband Voucher scheme for individuals. Local authorities have also sought to support this deployment process and address the complexity of 'last mile' challenges that have been found to pervade broadband deployment (Henderson & Roche 2019). Subsidy approaches to mobile broadband have been less successful, as illustrated by attempts to replicate the success of financial subsidies in encouraging private sector deployment of fixed-line broadband in mobile telecommunications (McCaskill 2016).

Compounding the challenges of rural telecommunications deployment in Wales is the multilevel nature of policy responsibilities for telecommunications. Telecommunications policy responsibility is a 'reserved' power for UK Government, which means in practical terms, that the UK government is responsible for deployment as well as spectrum arrangements for mobile broadband. Although this may limit Wales' ability to intervene in this area, both Welsh Government and local authorities do have a number of policy levers at their disposal, not least the ability to financially support deployment of infrastructure (for example, through European funding), and to develop planning policies and regulations for highway works. This has enabled Welsh Government and local authority partners to intervene where it has perceived the UK's response to be lacking in addressing such rural responses (Wilkinson 2022).

The commercial focus of mobile telecommunication investment has therefore led to the emergence of significant 'not spots', primarily in Wales' rural areas. Ofcom (2022) estimate that while 78% of Wales now has access to 4G coverage from all four mobile

operators, this falls to below 50% for harder to reach, largely rural areas such as Gwynedd (46%), Conwy (46%) and Powys (49%). Such disparities have resulted in renewed multilevel activities to address rural deficits in 4G through efforts to stimulate a more collaborative approach among MNOs. Here, the UK Government and four MNOs have created the Shared Rural Network (SRN) programme that will see rural 4G masts deployed across rural areas of Wales and other parts of the UK¹. The impact of this scheme is anticipated to increase rural coverage of 4G substantially in Wales between 2020 and 2025 (see Figure 1)

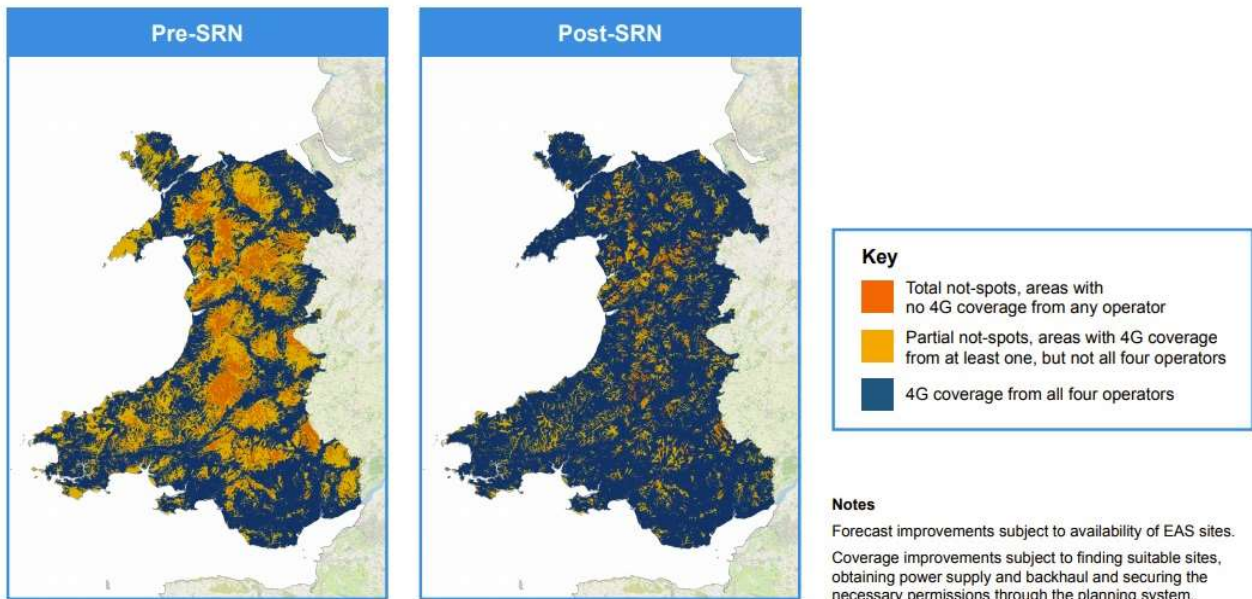
While there is potential for SRN infrastructure to be upgraded to 5G in the future, MNO representatives confirm that the major focus of current deployment is to fully exploit the potential of 4G investments in rural areas, with an uncertain business case for 5G in such areas (Henderson et al. 2022). Indeed, evidence suggests that 5G availability in Wales is among the lowest of the nations of the UK, and that 5G outside premise coverage across Wales from at least one

mobile network operator is predicted to be between 58% (UK 77%) for High Confidence and 46% (UK 67%) for Very High Confidence (Ofcom 2022).

The potential impacts for areas lacking access for 5G connectivity have been found to be significant, with potential to exacerbate the productivity and innovation differences between urban and rural areas of Wales (Henderson et al. 2022). Here the technical benefits of 5G technology include high capacity and connection density, wide coverage, reduced latency, seamless connectivity and improved spectral and network energy efficiency (Tang et al. 2021). The positive economic impacts of technological advances in telecommunications are also widely acknowledged (Lehr et al. 2021).

While the precise impact of 5G availability for rural areas of Wales is unknown, a range of potential benefits can be inferred from the academic literature. In the agriculture sector, for example, 5G technology may provide the basis for improving quality and yields of crops, reducing labour and overall cost, and thus

Figure 1: Shared Rural Network coverage forecast improvements in Wales.



Source: <https://srn.org.uk/forecast-coverage-improvements/>

¹ <https://www.gov.uk/government/news/shared-rural-network>

improving productivity in farming (Tang et al. 2021). It may also enable the automated operation of smart farming applications including real-time monitoring, virtual consultation, predictive maintenance, artificial intelligence robots, data analytics and repository, use of unmanned aerial vehicles, as well as augmented and virtual reality. These economic and innovation benefits for farming and wider regional development provide a rationale for public sector investment to support the pace and spatial coverage of new 5G deployment. More general benefits may emerge from improved digital connectivity such as encouraging businesses to (re)locate in rural areas, accessing both connectivity benefits, but also quality of life benefits (Norris & Henderson 2019).

The 5G Wales Unlocked project activities

The 5G Wales Unlocked project formed part of the DCMS '5G Rural Connected Communities Project' and was delivered by partners in Wales led by the Welsh Government, local authorities (Monmouthshire County Council and Gwent County Borough Council) BT / Openreach, and a range of private sector providers. The geographical focus of the project incorporated two rural and adjacent areas in Wales and a number of experimental use cases, with a focus on learning lessons and adapting future practices for 5G deployment in such areas. The individual use cases were led by the two local authority partners (with input from private sector partners) with responsibilities for reporting progress. An Observatory, led by Cardiff University was also established to capture lessons and assess impacts.

The use cases were supported by BT's deployment of 5G masts in the two local authority areas. A number of challenges were evident in the deployment of 5G, including the significant distance from the telephone exchange (in Newport) and the need to ensure that mast structures were capable of carrying the additional weight necessary for

5G equipment, but also unexpected problems such as periodic power cuts, limiting access to connectivity at certain points during the use case period.

The review of progress of the use cases suggests that despite the early stages nature of adoption by end users, 5G Wales Unlocked has largely succeeded in achieving its objectives for supporting 5G deployment and use in different rural areas of Wales (Monmouthshire and Blaenau Gwent) and sectors (farming, education, tourism). This has enabled testing of a new 5G network and associated technologies. Delays in establishing the project (due to Covid-related factors) have meant that much of the use case implementation was undertaken towards the end of the funding period. While this limited the potential to fully capture impacts from the project activity, the findings suggest that the use cases were able to reveal lessons that will be valuable to subsequent deployment of 5G in Wales' rural areas.

In assessing the cost and benefits of the 5G Wales Unlocked project, the research found difficulties in valuing the benefits of the use cases at such an early stage. In this respect, the delays in establishing the project did not allow sufficient time for the users to fully benefit from the 5G connectivity in the period before the final evaluation. It does, however, point to the potential areas of new service opportunities, efficiencies and supply models, with direct benefits to business, citizens and public sector bodies in rural areas of Wales. Based on a demand and impact discussion model (using Monmouthshire as a reference case) the research suggests that 5G adoption in rural Wales could produce an uplift in Welsh gross value added (GVA) of 1% across all sectors (Henderson et al. 2022).

The primary purpose of the experimental use-cases, however, may be their potential to advance learning about how 5G 'not spots' in rural areas can be addressed in the future. While it was anticipated that evidence could be collected to provide support for an MNO

Table 1. 5G Unlocked use cases.

Farming

The use case aimed to support farmer well-being, mental health improvements, combatting isolation, and upgrading workplace health and safety on farms, through security and video analytics. It was implemented on a single farm in Monmouthshire and incorporated the installation of 5G enabled cameras across the farm, sensors, as well as software to provide a suitable user interface for the farmer.

Education

The use case sought to enhance the teaching and learning experience through 5G enabled technologies, providing opportunities for live and interactive teaching access to resources worldwide. This responded to the need to foster high quality, technology engagement in the education curriculum, to enrich the teaching and learning experience of pupils. It comprised the provision of CISCO Webex boards (handheld touch screen devices that enable users to access collaborate and access information resources) in local schools in the use case areas, plus installation of an immersive classroom in Ebbw Vale for use by the schools and local businesses for training.

Tourism

The use case addressed the need to increase tourism visits to Monmouthshire, through the creation of an immersive augmented reality experience. It was anticipated that this would provide a more engaging experience for visitors to Raglan Castle, and act as a marketing tool to attract more visitors. The use case further focuses on identifying installation challenges for 5G networks in rural areas and heritage sites by ensuring local network equipment installations blend into sensitive environments and preserve visual amenity. It included the addition of 5G enabled cameras and sensors with a focus on security, health and safety applications, as well as the introduction of a fully functional augmented reality experience at Raglan Castle. This offered the potential to engage visitors in immersive education, content-sharing and story-telling capabilities, and improve the wider offer of a key visitor attraction in Monmouthshire.

Transport

The transport use case responded to the growing focus on reducing the impact of car use, including efforts to reduce single-occupant car journeys. By introducing 5G enabled digital technologies the use case has the potential to address both transport and environmental concerns in Wales, as well as addressing aspects such as anti-social behaviour at rural and valleys bus stops and offering more integrated on-demand mobility services for residents both within and travelling to Blaenau Gwent. It incorporated the establishment of a smart car park in Ebbw Vale to all users and the Council to monitor use, and the launch of a smart business service. This bus service incorporated a journey planning app, live transmission of data insights and 'smart business stops' to provide further user information.

Source: Henderson et al. (2022)

business case, the findings suggest that further use cases may be required to support this outcome. This further highlights the potential for other public sector actors to collaborate and 'aggregate' their demand for 5G connectivity in order to advance a case for infrastructure investment². Other emerging complementary policies such as the UK Government's incentivisation of upgrading telecommunication masts with new technologies such as 5G³, as well as the emergence of technologies that might provide similar levels of connectivity, and satellite services such as Starlink.⁴

Conclusions and implications for 5G networks and policy in rural Wales

The findings from this study reveal the challenges of deploying 5G in rural areas of Wales are multidimensional and rest on developing a suitable business case for MNO investment. The role of the public sector in addressing these challenges is similarly complex with potential for them to support use cases through their responsibilities for

economic development, planning and highways, as well as their position as substantial users of telecommunications services. Yet while Wales has a number of policy levers to support 5G deployment in rural areas, the results highlight the importance of multilevel collaborations to address these challenges.

At the heart of the 5G Wales Unlocked project is an experimental process of learning. This has seen multilevel partners working to co-create potential solutions to the challenges of 5G and learning how deployment approaches may need to be adapted. In this respect, the results suggest that the challenge of deploying 5G is likely to require iterative policy action over a number of years. In addition, alternative technology, such as satellite services may need to be explored if the harder to reach rural areas are able to fully access 5G connectivity. This points to the important ongoing role of the public sector to mitigate the costs and risks of 5G deployment to ensure rural areas are not disadvantaged by connectivity improvements taking place in urban areas.

Funding information

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² This approach has been used over a number of years to provide fixed line broadband to public sector buildings in Wales (<https://www.ispreview.co.uk/index.php/2022/03/bt-continues-to-dominate-public-sector-telecoms-in-wales.html>)

³ <https://www.gov.uk/government/news/new-laws-to-wipe-out-rural-mobile-not-spots-and-speed-up-rollout-of-next-generation-5g-technology>

⁴ <https://www.starlink.com/>

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