Examining the policy mix for broadband deployment in Wales: The role of informal coordination in the last mile

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Abstract

This paper examines the challenges of deploying broadband policies at the local level. It is a topic that has received significant attention in urban and rural areas, with uneven access to broadband identified as an important issue by policy makers and researchers alike. While the broadband and regional development literature has highlighted the complexity of the regional deployment process, with reference to geographical metaphors such as the last mile, it has tended to underplay the underlying policy processes as actors seek to manage the deployment process over time and space. Drawing on the concept of the policy mix, the paper examines how actors seek to manage complexity between policy objectives. It does so by drawing on an in-depth case-study of broadband policy in Wales - 2012 and 2017, and shows deployment to be a contested process in the last mile, characterised by interaction between policy objectives in a range of policy areas including planning and highways. It is argued that coordination of these tensions represents a complex socio-spatial process in which local actors (government, households, businesses and broadband providers) engage in a negotiated process to find place-based, bespoke solutions to deployment problems.

1. Introduction

Cities, regions, firms and individuals are experiencing the consequences of the rapid digitalisation of the economy and society. Such trends are expressed in growing adoption of high speed broadband[1], and use of digital devices and technologies by individuals and organisations. Policy makers and practitioners have observed these trends with interest and have been active in seeking to design policy responses to facilitate the deployment of broadband networks (OECD, 2008; OECD, 2017). These responses have seen states, cities and regions seeking to augment private sector infrastructure investments with subsidies to ensure greater deployment, and prevention of spatial 'digital divides' amongst business and individuals (Grubesic and Mack, 2016; Salemink et al., 2017; Townsend et al., 2013).

Urban and regional scholars have long explored the role and impacts of new digital telecommunications infrastructure (Gillespie and Williams, 1988; Graham, 1992; Tranos and Nijkamp, 2015; Grubesic and Mack, 2016; Malecki and Moriset, 2008). This body of research has highlighted the role of such technologies in converging time and space, but

noting that access is not experienced uniformly across all cities and regions. This research has found that such infrastructure continues to be thickest in cities and urban areas with large subscriber bases (Graham and Marvin, 1996; Graham, 1998; Malecki and Moriset, 2008; Grubesic and Mack, 2016), with rural areas often found to require public intervention to secure access (Salemink et al., 2017; Townsend et al., 2013).

Grubesic and Mack (2016) show how different connection technologies (e.g. copper / fibre optic cables) can produce a bottleneck effect in broadband speeds. This bottleneck occurs in the last mile of deployment - representing the final leg in the connection to household or business, providing a setting for competition between internet service providers to reach customers (Grubesic and Mack, 2016). Yet, while the literature has provided insight into the enabling role of such infrastructure in supporting socio-economic development, comparatively little attention has been given to the policy process surrounding broadband deployment, with the majority of contributions examining individual programme structures and policy outputs (Dabinett, 2001; Gillespie et al., 2001; Huggins and Izushi, 2002; Gillett et al., 2004; Price et al., 2018).

The paper seeks to explore complexity in the broadband deployment process with the aid of the concept of policy mix. This focuses on the interaction between policies as they seek to achieve a particular objective (Howlett and Rayner, 2007; Flanagan et al., 2011). Such interaction has been found to be particularly evident at the sub-national level, reflecting multi-level governance structures (Magro and Wilson, 2013; Matti et al., 2016; Caloffi and Mariani, 2017). Yet, despite the growth of interest in the policy mix concept, it tends to emphasise the formal interactions associated with the policy mix, and gives limited attention to understanding the informal role of agency and processes of policy development in cities

and regions (Uyarra et al., 2017). This paper seeks to cast light on these interactions by examining the role of agency and its spatial dimensions in managing broadband deployment policy. By focusing on the role of informal agency the paper draws attention to the multiplicity of actors in the coordination of policies in regional spaces.

The paper begins by reviewing the literature on broadband deployment, policies and the last mile concept. It then introduces the concept of policy mix coordination. The next section introduces the research case of Wales – a region that exhibits the complexity of governance levels and policy instruments in support of broadband deployment in urban and rural areas. The results are then presented, highlighting the last mile as a multidimensional spatial setting for informal coordination agency, social interactions, and its negotiative nature. The final sections of the paper provide discussion of the main findings and conclusions.

2. Literature review

2.1. Broadband, regional development and public policy in the last mile

Broadband and wider information and communication technologies have long been an area of interest to urban and regional scholars (Graham and Marvin, 1996; Malecki and Moriset, 2008; Tranos, 2013; Grubesic and Mack, 2016). This has seen research explore the spatial dimensions of broadband technologies and their implications for socio-economic development. It has identified the uneven nature of digital infrastructure deployment, with urban areas generally emerging being first to access broadband (Graham, 2004a). The potential development opportunities associated with digital infrastructure have not gone unnoticed by policy makers (OECD, 2008). This has seen extensive efforts, over time, to ensure regions and communities are ‘not left behind’ in the emerging global and digital economy (Gillespie and Williams, 1988; Gillespie et al., 2001). Such research has

increasingly focused on the deployment of broadband infrastructure, but also its use (Grimes, 2003; Price et al., 2018).

In situating the challenges of deployment in urban and rural areas researchers have drawn on the concept of the last mile (Grubesic and Mack, 2016). This represents a geographical metaphor (Tranos and Nijkamp, 2013) that is used to describe the final stage of connection of users to the telecommunication network. It acts as the physical link between internet service providers (ISPs) and customers (Grubesic and Mack, 2016). The distance of this final connection can vary significantly according to technology, with mobile and satellite connections potentially being far greater than one mile. Literature on the deployment of broadband has identified the last mile as a spatial setting for complex infrastructure and technological challenges, as speeds vary in its final connection to households and businesses (Grubesic and Mack, 2016; Graham, 2004b). This can see properties, that are far from a broadband exchange, struggle to achieve high speeds (Riddlesden and Singleton, 2014). Such challenges are particularly acute for properties and rural areas, and others that are connected by slower networks employing copper, such as ADSL (Philip et al., 2017). Less distance sensitive technologies, such as fibre optic networks, are growing in most OECD countries, as is mobile broadband connectivity such as 4G (OECD, 2017). The deployment of fibre and mobile broadband have, however, tended to benefit urban areas, although calls have been made for public strategies to favour rural last mile areas first (Townsend et al., 2013)[2]. In this respect the concept of the last mile is shaped by market competition, as internet providers jostle for access to subscriber bases (Grubesic and Murray, 2002), but also public intervention to address spatial divides (Philip et al., 2017; Salemink et al., 2017).

Policy implications have emerged from research on broadband and economic development, with researchers identifying a range of different instruments adopted at the local and national levels (Gillet, 2004 2006; OCED, 2008). The literature has, however, given comparatively limited attention to deployment policies, either in their context, or on the processes and interactions between broadband and other domains and levels of policy.

2.2. Policy mixes, interdependencies and coordination

In order to explore the complexity of the broadband deployment process the paper draws on the concept of the policy mix. This was developed in economics, and subsequently expanded to include mainstream policy studies and other policy-focused disciplines (Flanagan et al., 2011). The literature on policy mix draws attention to the composition of policies as they contribute towards a particular aim, and analyses their interdependencies. Policies, it is argued, are rarely introduced into a vacuum, and instead interact with others when implemented (Flanagan et al., 2011).

The multi-level nature of policies highlight the complexity of creating consistent policy mixes (Flanagan et al., 2011; Magro and Wilson, 2013; Magro et al., 2014). This complexity has been identified in terms of multiple levels of governance, with policy responsibilities ranging from supranational bodies, to national, regional, sub-regional and local government bodies. For regional policy makers this introduces the potential for policy arrangements to develop from afar, based on differing goals and governance arrangements, with this complexity challenging the potential for mixes to be managed effectively (Matti et al., 2016).

Policy interactions can produce tensions, trade-offs and synergies, and have been found in a wide range of policy domains (see Howlett et al., 2017; Matti et al., 2016; Rogge and

Reichardt, 2016; Nauwelaers et al., 2009). Such interactions can occur not only between one policy and another in a single domain (a policy issue or area), but between policy domains, which share similar or related policy objectives. In this respect interdependencies are said to have both vertical aspects (with policies deriving from multiple levels of governance) and horizontal aspects (in different domains such as enterprise, innovation, transport, and infrastructure) (Howlett and Rayner, 2007; Río, 2014).

The growing interest of regional scholars in policy mix interactions has seen research examine the role of coordination to manage complexity, synergies and tensions (Braun, 2008; Magro et al., 2014). While there is no agreed definition of coordination in the mainstream policy literature, a number of dimensions have been identified. Painter (1981: p. 275), for example, defines it as '*involv[ing] the resolution of conflicts arising from overlaps, the search for priorities between policies and the injection where appropriate of broader perspectives on the narrower sectoral views of the partisans of different policies'*. Elsewhere, Alexander (1993) adds to this by characterising coordination as '*a deliberate activity undertaken by an organization or inter-organizational system to concert the decisions or actions of their subunits or constituent organizations*'. Despite this lack of an agreed definition scholars are in general agreement that there is no all-purpose, 'ready-made' solution available to address coordination challenges (Boston, 1992).

While central control based on hierarchy has often been seen as the preeminent form of coordination, scholars have challenged this, arguing that alone it is insufficient, and can suffer from limitations associated with flexibility and motivation (Wegrich and Štimac, 2014). Indeed, some have argued that informal coordination has the potential to better manage the uncertainties that derive from policy complexity (Chisholm, 1989; Río, 2014).

Such informal coordination activity, Alexander (1993) argues, can be distinguished by its non-routine character. On the whole, however, both the policy mix and coordination literatures tend to focus on more formal structures associated with the 'machinery of government' (Braun, 2008).

In portraying coordination as a structural process the coordination literature pays little, or no attention to the role of agency (Magro et al., 2014), and instead views it as having largely technocratic foundations (See OECD, 1996). This underemphasises the social nature of informal coordination, and the engagement of a multiplicity of city and regional government and non-government actors in the coordination process (Flanagan and Uyarra, 2016). In this respect the mainstream policy coordination literature largely portrays it as an aspatial process, giving little consideration to the territorial aspects of informal coordination, and governance across and within state boundaries, nor the role of place in mediating informal coordination by social actors in different types of geographical space (Jones and Jessop, 2010).

The findings of this review point towards the complexity of the broadband deployment process, and suggest the potential for tension to be evident at multiple levels and dimensions of the deployment process. This role of public policy to address deployment challenges in broadband points to the potential for multiple actors and policy objectives to mix in the deployment process and that this might have a different spatial expression across urban and regional space in a region. The aim of this paper, therefore, is to contribute to the debate on policy mix coordination at the regional level by asking (1) How do tensions and trade-offs influence the need for informal coordination at the regional level? (2) What informal coordination roles are evident in regional spaces? and (3), How do they mediate the deployment of broadband infrastructure in the case considered? In answering these questions,

the paper seeks to move beyond whether the policy mix can be optimised, and to better understand informal coordination and its effects in managing the policy mix in regions.

3. The research case and methodology

The paper follows a case-study methodology, examining broadband infrastructure deployment in Wales (UK). As one of Europe's less developed regions, the underlying development challenges facing the Welsh economy having changed little over time (Morgan, 2016). Its economy, traditionally dominated by coal and steel, has given way to one characterised by a high degree of services activity, with much of Wales' current population of 3.11 million[3], and economic activity centred in the southern coastal belt cities such as Cardiff, Swansea and Newport, and the South Wales Valleys. A smaller urban concentration can be found in the North East, while Mid Wales and North West Wales have a largely rural character, with agriculture and small market towns.

The Welsh economy has suffered a persistent gap in productivity relative to UK and European regions, associated with the prevalence of low value-added business sectors and a high proportion of non-market sectoral activity (Jones and Henley, 2008). Addressing these challenges has long been a focus of urban and regional policy initiatives going back to the 1930s (Morgan, 2017). Many of these policy initiatives have focused on parts of Wales that have suffered most from the decline of industry (the South Wales valleys), as well as areas peripheral to main markets, such as the West Wales area (Welsh European Funding Office, 2015).

In recent years, infrastructure has come to the fore as an important priority for the Welsh Government, reflecting its belief that such investment can contribute towards growth and jobs development. The Wales Infrastructure Investment Plan (Welsh Government, 2012: 17), for example, highlighted '*improving telecommunications networks and assuring all parts of Wales have access to adequate broadband facilities for their economic needs'* at the heart of its action plan, alongside investment in transport, energy, housing, public services, education and enterprise zones.

The policy objectives established for broadband by the EU and UK Government during the period 2012 to 2017 were to ensure the rapid deployment of high speed fixed and mobile broadband access. The UK's Digital Strategy published in 2017 states that '*Broadband and mobile must be treated as the fourth utility, with everyone benefiting from improved connectivity*' (Department for Digital Culture Media and Sport, 2017b). Similar strategies were developed in Wales with the major focus on ensuring access to high speed (Superfast/ Next Generation/ mobile) broadband across the region (Welsh Government, 2014a; Welsh Government, 2017b). In delivering its strategic objectives for broadband the Welsh Government established the £425 million Superfast Cymru programme, with part-funding from the European Regional Development Fund (ERDF) (National Assembly for Wales, 2013). Additional funding was provided by the UK Government's Broadband Deployment UK programme (SQW, 2016). Operating between 2012 and 2017 Superfast Cymru was delivered through a contract with BT/Openreach with a focus on connecting premises in areas that did not have access to superfast broadband at the time of its launch (Henderson, 2017). This reflected the recognition that private sector deployment of infrastructure in largely urban areas had come to an end, leaving a number of 'not-spots' (National Assembly for Wales, 2013). In addition, this deployment activity also included smaller grant schemes for

businesses and communities to connect, take-up and use broadband.[4] Mobile broadband infrastructure in Wales (and the wider UK), in contrast, has generally received much lower levels of public subsidy[5].

Policies for broadband therefore comprise policy statements (strategies) and policy instruments for deployment. These reflect the complex governance arrangements that have emerged following devolution in Wales in 1999 (Rees and Morgan, 2001). While Wales has been able to incrementally add to its devolved powers, the UK Government has retained direct responsibility for broadband telecommunications policy[6], reflecting the importance of national harmonisation with EU and international bodies (Ofcom, 2017). The Welsh Government has, however, been able to fund broadband infrastructure in Wales (as have other parts of the UK) via its devolved responsibility for economic development (Welsh Government, 2017c).The devolution settlement sets out clear responsibilities for the strategic governance of broadband in Wales, with legal arrangements largely taking precedence in shaping interactions between levels of government. That said, interactions between the levels are reflected in the presence of important institutional bodies such as Ofcom, the UK's regulatory body for telecommunications and media. While Ofcom is responsible for UK-wide regulation, it has representation in Wales via an office, and associated advisory committee[7]. European Union (EU) regulations such as the Digital Agenda (European Commission, 2014), and ERDF funding in support of broadband deployment policy, adds further complexity to the policy mix in Wales, with public instruments in support of broadband subject to rules associated with EU policies, objectives and regulations (including, for example, competition, investment and consumer rights[8]).

The deployment of broadband has been the focus of policy makers seeking to ensure that both households and businesses are able to engage in the modern economy (Henderson, 2017). Policy makers have expressed this in stated objectives to ensure the availability of basic and 'next generation' broadband for all households and businesses, improving mobile broadband coverage (Welsh Government, 2014b), and ensuring fixed access for 95% of households at speeds in excess of 30 megabits per second (Mbps) by the end of 2017 (Welsh Government, 2017c).

The case of Wales was selected to reflect complex multi-level and multi-dimensional policy dynamics described above. Wales has also been able to develop responses to specific challenges faced by mobile broadband deployment, through both its own activities, and those of other multi-level actors. The case of Wales therefore provides a setting in which theory suggests complexity is likely to produce diverse coordination challenges and responses across territorial space.

The decision to focus on a single case-study was taken to allow for in-depth data collection to be undertaken, and to enable all elements of the policy community for broadband to be incorporated in the study. The emphasis on informal coordination activity and perspectives meant that survey methods were less suitable to collecting the rich qualitative and quantitative data necessary to understand informal practices and activities to minimise tensions between policy objectives (Yin, 1994; George and Bennett, 2005).

The research examined broadband deployment and coordination in Wales over a five-year period - 2012 to 2017. The period of research coincided with the launch of the first all-Wales policy instrument (Superfast Cymru) to deploy broadband across all areas of Wales lacking access. The research utilised three main data sources: secondary analysis of policy

documents; interviews with the broadband policy community in Wales; and analysis of news sources. Policy documentation was sourced from a literature review of websites, interviews, and analysis of policy statements, operational plans and consultation responses. The fieldwork for the case-study included interviews with representatives of the multi-levels of governance in Wales and the UK, including broadband deployment policy, regulatory bodies, and private telecommunications operators (large and small). A total of 24 interviews were completed between July 2017 and February 2018 (see Table 1). Interview transcripts were coded by both researchers with the aid of Nvivo software. In addition, the authors analysed 44 news articles using the Nexis® news search database.

Table 1. Interviewees

Description	Number of interviews	Department/ agency interviewee belongs to (number of interviews)
Representatives of UK or Welsh Government/ Government Agencies	9	DCMS implementation (1) Broadband policy regulator (1) Welsh Government policy (1) Welsh Government implementation (3) Welsh Government planning (1) Highways Agency implementation (2)
Local Authority representatives	4	Local Authority Digital Champions (3) Local Authority Highways (1)
Business agents	5	Private broadband deployment operatives - large scale (2) Private broadband deployment operatives - small scale (1) Mobile industry operator (1) Business representative (1)
Experts	4	Policy experts (3) Industry expert (1)
Politicians	2	UK Government (1) Welsh Government (1)

Note: DCMS, Department for Digital, Culture, Media & Sport (UK Government).

4. Coordinating the policy mix for broadband deployment in Wales

Policy synergies, tensions and actor roles in Wales

The policy mix for broadband deployment in Wales includes aspects of strong synergy in policy objectives across multi-levels of governance. This synergy is reflected in shared objectives to deploy fixed and mobile broadband rapidly to all areas of the UK (Department for Digital Culture Media and Sport, 2017b; Welsh Government, 2010), as well as UK-wide funding schemes delivered by Broadband Delivery UK[9]. Yet, despite consensus in the policy agenda across multiple levels of governance, broad conflict and tensions have emerged in the deployment process across the region. The results, below, consider these tensions and actor responses in two such policy areas: planning and transport.

Planning Policy in Wales plays an important role in the deployment of mobile broadband, and to a lesser extent fixed broadband[10], providing a framework by which mobile infrastructure is sited. This framework produced interaction between UK Government policy responsibilities for mobile broadband, and Welsh Government's devolved powers for planning. While these powers recognise that '*widespread access to affordable, secure telecommunications infrastructure is important to both communities and businesses*' (Welsh Government, 2017b: p. 4), tensions have occurred in the siting of mobile broadband in communities. This tension was mainly evident in objections by local residents in rural areas (See, for example, Capel-y-ffin, Brecon Beacons National Park[11,12]), but also on the fringes of major cities (See, for example, Pentrych, near Cardiff[13]). As one interviewee put it *'everyone wants mobile access, but no one wants the infrastructure, especially in national parks'* (Interview: Local authority digital champion 2).

While the planning process, itself, provides a mechanism to consider the views of residents, in some instances tensions have spilled over into wider discourse between residents, business, politicians and media commentary (Interviews with: UK Government politician 1; Welsh Government politician 1; and Local authority digital champion 2). This discourse was seen in the latter part of the period, with resident and press campaigning in both urban and rural areas for 'better broadband' in the north of Wales (Hughes, 2016), with similar calls made by business representative bodies such as FSB Wales (Jones, 2015) and NFU Cymru (2015). Other examples included lobbying by mobile phone operators for a more relaxed planning regime across the UK (Mobile UK, 2018), and UK Government ministerial intervention (See Office of the Secretary of State for Wales, 2017; Jackson, 2017b), with the latter calling for a relaxation of Welsh planning regulations for telecommunication mast height in rural areas of Wales (Hughes, 2017):

> *'I don't want Wales lagging behind. I want the businesses in rural parts of the Conwy Valley to have the same service as those in the Ribble Valley…It does not mean littering the whole landscape with masts but it does mean making the planning process more streamlined and cheaper.'*

While these tensions were multi-level in nature, their main focus was on issues centred on the last mile of broadband deployment in Wales, with negotiative practices such as discussion and debate aimed at government actors and agency. Over the course of the research period, this negotiation saw growing recognition by policy makers, households and business, that mobile broadband policy was only one part of the wider digital infrastructure need in Wales (National Assembly for Wales, 2017).

In the absence of devolved policy responsibility for broadband and telecommunications, the Welsh Government actively sought to work with mobile operators through the UK Government's Mobile Infrastructure Programme (MIP) (Department for Digital Culture Media and Sport, 2017b)[14] to install mobile masts in rural 'not spots'. To support MIP, officials from the Welsh Government engaged with communities and partners to address connectivity problems in rural areas such as Crai village, Powys (Brumwell, 2017) and Aberdaron village, Gwynedd (Welsh Government, 2017a). This included activity focused on engagement with local communities and addressing deployment challenges, including concerns raised with Ministers. As one Welsh Government official described: '*I'm often thrown the challenges that come in through the minister's office sometimes, or external stakeholders'* (Interview: Welsh Government, implementation 3). Yet despite establishing a number of masts in largely rural areas of Wales, the UK Government brought the MIP programme to an early close, with progress below anticipated targets (Department for Digital Culture Media and Sport, 2017a). The cessation of the MIP highlighted the distinct challenges of mobile broadband deployment- including delays in securing planning permission and the trade-offs required between policy objectives (planning, visual amenity, landowner rights) needed when securing deployment in rural areas (Jackson, 2017b), but also the Welsh Government's lack of agency in this policy area of mobile broadband deployment.

Informal coordination agency was further evident in the Welsh Government's subsequent attempts to lead its own cross-departmental responses to the challenge of mobile connectivity. Here, the Welsh Government actors sought to address its lack of policy responsibility for broadband, by developing a plan with input from operators and related, devolved policy functions. This interactive process resulted in the publication of a Mobile Action Plan in 2017 (Welsh Government, 2017b: Interview: Welsh Government, policy 1),

which recognised the Welsh Government's desire to create the right environment for mobile coverage and investment in Wales. One official described this process (Interview Welsh Government, policy 1) as *'…saying, 'okay, what is it you want to achieve?'...gathering evidence, talking to the stakeholders, and coming to a policy position, agreed across the stakeholders, agreed across government'.*

In contrast to the MIP, the focus of the Mobile Action Plan was on government's enabling role, based on negotiating the integration of policy action from across areas such as planning, domestic rates, and harnessing public infrastructure assets (Welsh Government, 2017b). This process was also aided by the compact geographical footprint of Wales, which enabled policy officials to be co-located in a small number of public offices across the region. This geographical compactness, as one interviewee argued, helped discussion across departmental boundaries *'…there's five big buildings and a few others but everybody is pretty much based together…so I can go and tap them on the shoulder and find them. The whole – 'which department are they in?' doesn't really make a difference.'* (Interview: Welsh Government, policy 1).

Highways policy interacts with broadband policy in the process of deployment in the last mile. This results in the installation of fixed cabling in streets and footways, with associated construction work and infrastructure such as roadside cabinets and mobile towers (Analysys Mason, 2017). In the research period such activity led to delays in permission to access the highways (see Penallt, Monmouthshire[15]), as well as indirect tensions that resulted in road closures. As one operator put it:

> *'You can't just go into a town, it would lead to a complete shutdown. Many councils have embargo periods at Christmas shopping, or wintertime, where it is not possible to build…Other problems can come where there is already pre-existing road works. In this case (a medium sized town) politicians were unwilling to allow them to dig up the roundabout without this being out of hours. Issues like this have resulted in some major not spots in Cardiff.'* (Interview: Private broadband deployment operative, large scale 2).

Such tensions reflect the complex and congested nature of urban areas, as well as the regulative nature of responses that can sometimes be required. Transport-related policy tensions were also evident in the form of vehicle collisions with broadband infrastructure (for example, cabinets), impacting on access for households and business while repairs were made (Western Telegraph, 2016). Tensions arising from transport-related policy were expressed in complaints from the households and business to both Welsh Government and private operators (Interview: Welsh Government, policy 1; Private broadband deployment operatives - large scale 2), as well as negative media coverage and involvement of other stakeholders such as politicians (see Llanfair Clydogau and Cellan villages near Lampeter, Ceredigion) (Lewis, 2016). As one interviewee put it '*Politicians can be great supporters of broadband, but they can also be a beacon for complaints from dissatisfied voters'* (Interview: Private broadband deployment operatives - large scale 2).

To address these tensions informal coordination activity was led by officials from the Highways Agency for Wales, as well as local authority highways departments. This informal coordination saw officials seek to pre-empt tensions in the deployment of the Superfast Cymru programme by establishing a group comprising the local authority highways

managers and the main contractor for the programme (Interviews with: Highways Agency, implementation 1; and Highways Agency, implementation 2). From the s' perspective, establishment of this group enabled improved planning through negotiation of measures to speed up the deployment and its efficiency (Interview: private deployment operative, large scale 1). In other examples, operators took care to communicate their work in advance and schedule works to ensure minimal disruption (Private broadband deployment operatives - small scale 1). It also provided a forum for local authorities to address specific issues of concern such as the siting of infrastructure, 'flexing' local regulations for roadway repair following fibre laying, and '*look[ing] for any potential conflicts in our plans'* (Interviews with: Highways Agency, implementation 1; and Highways Agency, implementation 2). While group members were supportive of its role in minimising highways tensions, more place-based problem solving was also required. Here, Welsh Government officials provided dedicated support to working with local authorities and communities to provide funding and support to develop projects, and address issues such as access to private land, often in rural areas (Interviews with: private deployment operative - large scale 1; and private deployment operative – small scale 1) (Jackson, 2017a). As one official put it '*it's better to engage than enrage*' (Interview: Wales Government, implementation 3). These practices supported negotiation between landowners and mobile and fixed broadband deployment. Yet such negotiations could go awry, with prohibitive consequences:

> "…*One of the main deployment costs is private landlords requesting ridiculous sums for crossing a relatively small amount of land. This brings uncertainty in the planning process and contrasts with a greater degree of clarity available when digging up roads…"* (Interview: Private broadband deployment operative - small scale 1).

Highways tensions, while principally negotiated by actors within the region, were in a small number of cases supported by actors from outside the region. Here the UK government's Barrier Busting Taskforce (BBTF) was created in the latter part of the period. Although described as a taskforce the BBTF comprised a small number of individual actors brought together to help speed up the delivery of broadband infrastructure across the UK. The work of these informal coordination roles involves mediation between different parties, and engagement with officials from other policy areas. Such activity was focused on solving problems where possible, but in others recognising the need for trade-off:

> *'…It's my job to stick myself in-between a dispute. I will then create a resolution, however that may be, that will be 95% a compromise between the two, or push for a certain action to take place...'* (Interview: DCMS, implementation 1).

The limited scale of this initiative, and its UK-wide focus, meant that while actors operated in Wales, it was not able to play more than a small role in addressing the overall tensions raised.

Coordination actors and challenges in the last mile

The preceding sub-section has identified a number of 'coordination actors' who interact within the policy mix for broadband infrastructure deployment with the objective of addressing tensions. These actors include purposive agency focused on seeking to address real time disruptions in the deployment process (for example multi-level conflict over mast location), foresee and prevent deployment challenges through planning and stakeholder interaction (for example, highways groups), and others seeking to promote synergies between policy objectives (for example Welsh Government officer attempts to develop the cross-departmental Mobile Action Plan). These different forms of (public) agency were

complemented by various forms of household and business agency, including those seeking to challenge both deployment operators and policy makers to address problems rapidly and enable swift deployment, and those seeking to resist infrastructure being sited in particular areas (for example, areas of natural beauty).

The conflict resolution activities of coordination actors were expressed in the large number of often small-scale interactions in the deployment process, with the last mile acting as the locus for both tensions to emerge and coordination agency to engage in addressing challenges. The spatial targeting of deployment was determined by Welsh Government (and the operator BT) and linked to the policy objectives to target those areas that had not been covered by private sector broadband infrastructure. That such areas were primarily rural in character points to the potential for policy targets to shape the emphasis of deployment, tensions and coordination of the last mile. By addressing challenges in the last mile of deployment, the form of the tensions varied across regional space. In rural areas, for example, major tensions in policy objectives were often influenced by the topographical features of the landscape and population spread (for example Monmouthshire, Powys, Ceredigion and rural fringes of urban areas) – '*we've got a bigger spread of population, our hills are lower (than Scotland) but we've got more people hidden behind them, so you need more infrastructure to get to a higher proportion of the population*' (Interview: Welsh Government, Policy 1). Such

In contrast, urban areas in Wales benefitted from their longer history of deployment and the ability of operators to build business cases for investment:

> *'…the fixed broadband rollout was run on the basis of, partly, wealth, where the number of customers, and businesses in particular was important- So Wales didn't do*

very well after [major urban areas such as] Swansea, Cardiff and Newport.'

(Interview: Policy expert 1)

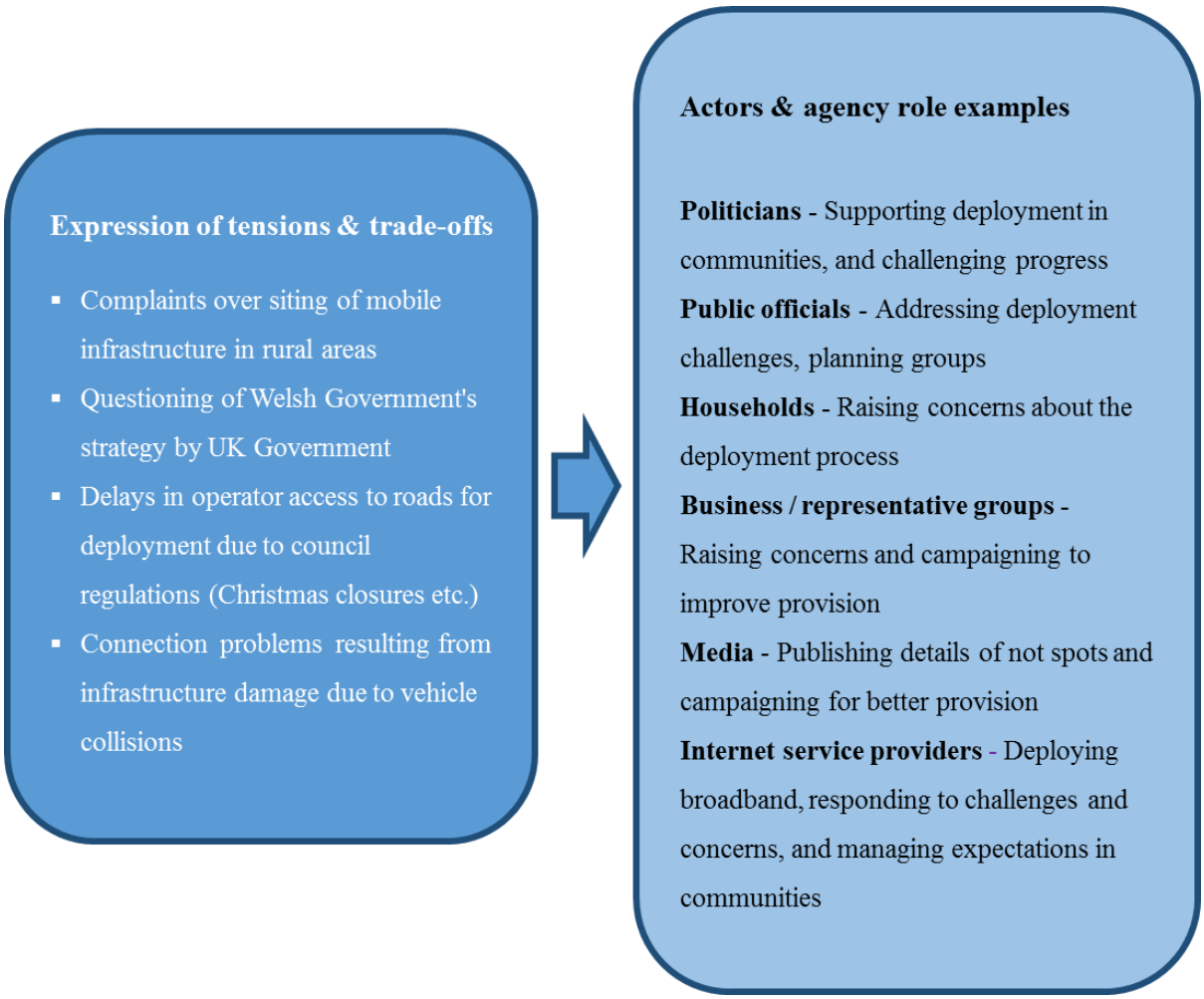
This history of deployment provided pre-existing infrastructure on which to deploy broadband (for example, cable ducts, poles and broadband cabinets). While the main challenges in urban areas, were sometimes less pervasive (given their longer history of deployment by the private sector – and the limited requirement for policy intervention), they were most often associated with the congested and cluttered nature of the urban environment (Interview: private deployment operative, large scale 2). In this respect challenges were influenced by factors such as the natural environment and man-made aspects of the deployment environment for broadband. This was not, however, a question of urban areas benefitting from first mover advantages in infrastructure deployment. The greater sparseness of population and households in rural areas means that digging up and siting infrastructure is often more visible, meaning policy conflicts can be a similarly discernible feature of deployment.

The role of the natural and manmade environmental features in policy tensions was also reflected in the mix of coordination activity that came to bear on tensions. Here the results point to coordination having more formality in urban areas (for example rules and regulations surrounding deployment on highways in certain times of year), reflecting the need to regulate deployment in complex settings. Rural areas of Wales also exhibited similar rules and regulative aspects of coordination, but with a greater degree of informal interactions coming to bear on deployments in context requiring negotiation and trade-offs regarding highly visible forms of infrastructure (for example, mobile towers), and the enhanced tensions

associated with firms, households, politicians, media and representative body demands for connection in not spots.

Figure 1 provides an overview of the tensions, trade-offs and coordination actors and agency found in the case study.

Figure 1. Tensions, trade-offs and coordination activity in the deployment of broadband in Wales



While the effect of these interactions was not always visible to the general public, their effect was to contribute towards reducing tensions, improving certainty and efficiency of deployment. As a representative of a large mobile operator put it '*These challenges impact on the ability of the [mobile] operators to make additional investments, and secure coverage'* (Interview: Mobile industry operator 1). In this respect, while the role of coordination actors aided the negotiation of solutions to problems, and reduced pressure on governments and other organisations responsible for deployment, the overall scale and complexity of these tensions meant that it was not possible or practical for such roles to fully eliminate conflict in the deployment process. The difficulties of pre-empting (and eliminating) such challenges was expressed by one highways interviewee when talking about their efforts to minimise disruption from broadband deployment:

> *'We only tend to hear about it when it goes wrong. What we get right, nobody ever even sees or hears about. It's only when things go wrong that we tend to get involved.'* (Interview: Highways Agency, implementation 1).

In building synergies and addressing prospective and actual tensions the coordination actors have contributed towards the overall success of the delivery of fixed line broadband in Wales. This has seen some 600 thousand premises connected over the period, reaching 96% coverage of premises in Wales with fixed line broadband at speeds above 30 Mbps (Welsh Government, No date). Without the work of the coordination actors, however, it is likely that tensions in the deployment process would have been higher. The limits of coordination agency, in this respect, suggest that it is not possible to develop optimal response to policy mix tensions. Indeed, the ongoing difficulties faced by mobile broadband deployment, and the efforts of policies such as the Mobile Action Plan (Welsh Government, 2017b) suggest

continuing challenges, as does the remaining 88 thousand premises in Wales that have yet to be reached by either the private sector or Superfast Cymru (Welsh Government, 2018a), and capacity upgrades in urban areas (Welsh Government, 2017b).

5. Discussion and conclusions

The results of this paper find that, despite the high level consensus for broadband policy mix, tensions emerge in city and regional places as these priorities for broadband converge with other policy priorities for governments - such as ensuring that highways are open, and that planning rules are upheld. While some of these policy tensions can be managed by existing formal structures for coordination such as the planning system, many require more informal approaches. This is characterised by its 'non routine' character (Alexander, 1993), but also a messier process in which actors coalesce to address particular problems, often in an improvised manner during the deployment process.

The findings show city and regional policy coordination for broadband to be a placed-based process, centred on the last mile of deployment. This represents the point at which broadband connections reach households and businesses, and the point that policy objectives converge (for example, transport and planning tensions). Convergence sees the 'hidden' qualities of broadband associated with underground cables (Tranos, 2013; Graham, 2004b) exposed in the siting of cabinet and mast infrastructure, and clashes between policy objectives. This highlights the contested nature of broadband deployment and the challenges of ensuring coverage for all.

The characteristics of the last mile are not uniform, however, and vary across regional space. Here the results show that the majority of policy tensions occur in rural areas, reflecting the

dispersed nature of population settlement and topography, adding to the costs of deployment, as well as the limited level of private sector broadband deployment and multi-level policies targeting such areas. Yet, despite the largely rural character of tensions, the presence of denser broadband coverage in urban areas, can also amplify conflicting objectives, and see deployment blockages. Indeed, while infrastructure can often be hidden in the complex urban environment, through the use of legacy infrastructure (Grubesic and Mack, 2016), the results show that urban policy mix tensions can continue to occur, particularly as infrastructure is upgraded.

These findings extend existing urban and regional literature on the last mile, which situate it as the final connection to broadband infrastructure, competition between suppliers for subscriptions, and differing technologies (copper, fibre) and connection speeds (Grubesic and Mack, 2016; Graham, 2004a), by pointing to it as a space where (multi-level) policy objectives and targets mingle with the social and contested nature of deployment. These contested aspects of deployment further impact on the coordination activity that comes to bear on tensions and trade-offs. Here, the last mile provides a setting for both formal mechanisms such as planning and transport regulations, but also informal coordination agency. The results highlight the presence of such agency in negotiative practices, such as the recourse of households to media coverage to raise concerns. This research shows, however, that in rural areas coordination agency tends to be more informal in character, associated with seeking to use negotiation and information to address tensions and trade-offs. In contrast urban area coordination and the presence of established and dense infrastructure contexts, often relies on formalised practices (e.g. local authority regulations), with these limiting the potential for negotiation (for example, in scenarios where a council requires roads to remain

open at Christmas). These findings, therefore show that the last mile concept is one that is both wider than earlier conceptions, but also has nuanced characteristics at the spatial level.

While formal accounts of policy mix coordination highlight the role of government 'machinery' in coordinating policies (Pelkonen et al., 2008; Peters, 1998; OECD, 1996), the results highlight the role of government actors in seeking to pre-empt and solve coordination problems. They also show that this is not a technocratic process, but rather one that is based on an interactive and negotiative process between households, businesses, policy makers, politicians and media bodies in urban and rural areas. In this respect the policy mix tensions for broadband do not have 'ready-made' processes that can be brought to bear (Chisholm, 1989; Flanagan et al., 2011; Magro et al., 2014), but instead require a process in which actors seek to find place-based, bespoke solutions to deployment problems.

The presence of policy mix tensions associated with broadband and common policy areas such as highways and planning, suggests that similar types of tension may be experienced in other urban and rural areas. The results show, however, that these are particularly significant in Wales, due in part to its higher proportion of rural households relative to other parts of the UK (ONS, 2013) and its hilly landscape (Welsh Government, 2017b). Further, the devolved status of Welsh Government provides it with partial control over policy levers (albeit excluding digital), not available to other parts of the UK. This, the results show, provides Welsh Government with the ability to contribute towards monitoring and responding to problems, but also aids local informal interaction amongst policy makers and other actors. Further research could usefully explore informal coordination in different spatial and multi-level governance settings, to better understand informal coordination practices.

Other useful areas for future research include considering the institutional foundations of the broadband policy process within cities and regions. Here, research in the wider regional development literatures has begun to highlight the interplay between structural and institutional factors (Sotarauta and Pulkkinen, 2011; Sotarauta and Beer, 2017). The findings of this paper point towards important contextual factors such as public and business pressure for improved broadband connectivity and the growing use of digital technology, as well as the role of political consensus in shaping the role of coordination agents. In this respect the interaction between structure and agency at the regional level is an area where further research could usefully add to understanding of regional coordination action and agency. Questions here could include what institutional routines and practices are employed by policy actors in this coordination process? To what extent is this activity purposive? and what structural constraints do actors face in coordination?

Finally, although the results of the research provide evidence of spatial tensions and informal activities to resolve them, it also shows that the deployment efforts of policy makers in Wales have largely met deployment targets in most areas of Wales (ensuring fixed access for 95% of households at a speed in excess of 30mbps). The continuing emergence of digital technology use, and the need to upgrade digital networks may see ongoing roles for informal coordination activity in urban and rural areas. Here the future direction of policy, towards 'full fibre', 'gigabit' broadband solutions, and new mobile broadband standards (5G) suggests ongoing policy mix tensions, and the role of policy coordination in this area, is likely to continue into the future.

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Endnotes

[1] This paper uses the term broadband to refer to high speed fixed and mobile broadband with a download speed for 30 megabits per second or above. Such speeds have been achieved by operators deploying a greater volume of fibre optic cables in place of / in conjunction with the traditional copper telecommunications network (for example so-called 'fibre to the cabinet' and 'fibre to the home/premises' fixed broadband, and cellular technologies such as 4G and 5G) (Townsend et al., 2013). In the literature high speed broadband has been described as superfast or next generation by policy makers (Jones and Henderson, 2019), but such terminology tends to emphasise fixed broadband. This paper therefore uses the term broadband as an integrative, technologically neutral concept.

[2] https://www.oecd.org/sti/broadband/broadband-statistics-update.htm

[3] https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/nationallevelpopulationestimates-by-year-age-ukcountry

[4] These projects included Access Broadband Cymru (individuals, households and business) and Ultrafast Connectivity (business) vouchers to support premises not served by Superfast Cymru, a marketing campaign in in the Superfast Cymru intervention area and the Superfast Broadband Business Exploitation (SFBE) project part-funded by ERDF through Welsh Government (National Assembly for Wales, 2017).

[5] The UK's Mobile Infrastructure Project (MIP) was a notable exception. MIP was a UK Government project launched in 2013 to improve coverage and quality of (commercially) hard to reach areas. Progress in delivering its target of 575 new masts was limited by challenges associated with site acquisition and planning regulations. (Department for Digital Culture Media and Sport, 2017b) .

[6] https://www.gov.uk/guidance/devolution-settlement-wales

[7] https://www.ofcom.org.uk/about-ofcom/how-ofcom-is-run/committees/wales

[8] https://ec.europa.eu/digital-single-market/en/telecoms

[9] BDUK is an agency of the UK Government's Department for Media, Sport and Culture (DCMS).

[10] The roadside cabinets used to connect fixed cables are 'permitted developments', and as such do not require planning permission (Welsh Government, 2018b)

[11] https://planningonline.beacons-npa.gov.uk/online-applications/applicationDetails.do?previousCaseType=Application&keyVal=P09XXNSYGU500&previousCaseNumber=18%2F16390%2FFUL&activeTab=summary&previousKeyVal=PC028JSYINR00

[12] https://planningonline.beacons-npa.gov.uk/online-applications/applicationDetails.do?activeTab=documents&keyVal=PC028JSYINR00

[13] http://www.pentyrch.cc/wp-content/uploads/2017/09/September-2017-Minutes.pdf

[14] A similar plan had been developed by the (Scottish Government, 2016).

[15] http://www.penallt.org.uk/broadband/bt-broadband/march-meeting