REPORT FOR THE BROADBAND STAKEHOLDER GROUP

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LOWERING BARRIERS TO 5G DEPLOYMENT

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Foreword from the BSG

Forging the UK's 5G future

Introduction

The enormous potential of 5G has led to a world-wide determination from countries eager to lead the way in profiting from the capabilities afforded by the revolutionary technology. The UK Government also has resolved to be amongst the first to enjoy the advantages and benefits on offer.

The potential of 5G is not just limited to a much faster wireless connection. Its ability to support network slicing will make it possible for a network to offer different services – minimal latency to connected cars and high-speed download to businesses – over the same physical infrastructure. The next generation will bring with it new experiences, such as virtual and augmented reality, and the promise of new product and service ideas yet to be conceived let alone developed.

As all stakeholders are working towards developing and preparing for a 5G future the focus is on how to ensure the right foundations are in place to support the delivery of maximum benefits and realise the potential of this innovation. This work is wide-ranging and involves the Government's 5G Testbeds and Trials Programme, university research departments and vendors and operators working collaboratively with market verticals.

This report aims to examine and provide solutions to barriers to 5G network deployment to help the UK meets its ambition to be a 5G leader.

Context

The UK was slow, for a variety of reasons, to commence the deployment of 4G. This ultimately delayed the UK's ability to benefit from the uplift in connectivity provided for by 4G in comparison to 3G. The lag, however, granted industry the opportunity to learn lessons from other countries' deployment experiences and generally provided for lower equipment costs. This in turn led to a relatively aggressive roll-out schedule – in a little over 5 years we have seen over 70% of premises covered by all 4 operators and with individual network coverage extending to over 90% of the UK landmass".[1]

Whilst the 4G roll-out has been relatively rapid, it has encountered several pinch points which have hindered both the scale and speed of network deployment. Government recently sought to address the most stubborn of these through the Digital Economy Act 2017. In this, Government made changes to the Electronic Communications Code – intended to improve access to land for fixed and

1 See https://www.ofcom.org.uk/__data/assets/pdf_file/0017/113543/Connected-Nations-update-Spring-2018.pdf

wireless telecoms infrastructure. In addition, the government also increased permitted development rights for existing and new mobile sites.

Although both these measures are welcomed, the report does highlight that the reform of the Electronic Communications Code has created additional, albeit short-term, issues. It is also clear that seeking to reduce barriers several years after the bulk of deployment has been carried out limits its impact.

If the UK is to be a leader in 5G, we will not have the benefit of shortcutting the lessons learned from the deployment of networks in other countries, nor can we afford to encounter significant barriers hindering our 5G roll-out.

The intention of this report is to build on the BSG's Tackling Barriers to Telecoms Infrastructure Deployment[2] Report published in May 2017. That report identified several barriers and practices hindering the deployment of telecoms infrastructure and set out recommendations for practical steps that Government, local authorities and operators should take to aid the process. The ensuing creation of the Government's Barrier Busting Taskforce to enable solutions and develop and implement best practice has been welcomed across the industry. The BSG will continue to engage with the Taskforce and industry looks forward to progress being made on removing as many of these barriers as possible in order to aid the ongoing and future investments

This report is part of the BSG's contribution to supporting this roll-out, highlighting potential barriers to deployment before they become actual obstacles and ultimately enabling investment to provide more coverage to more of the country.

5G

Given that 5G wireless networks are expected to require far denser coverage than current mobile networks, the deployment of more small cells is a likely outcome. That is why we have focused on the necessary alignment at the local level in order to deliver 5G infrastructure in a timely and efficient manner.

5G will be different from the wireless generations that came before it in terms of network topology. But it is also likely that new services – focused on market verticals and even in specific localities – will come to the fore. We believe that this has the potential to unleash innovation, drive demand and take-up as well as accelerate the digitisation of the wider economy. But this also introduces questions as to who benefits and provides these services, which introduces uncertainty to operators who are planning their investments.

2 See http://www.broadbanduk.org/wp-content/uploads/2017/05/Lowering-barriers-to-telecoms-infrastructure-deployment-Final-report.pdf

Key findings

The UK Government is right to set an ambitious target for us to be a leader in 5G. Reducing barriers to network deployment should therefore be considered a strategic necessity given the potential for 5G to help digitise wider areas of the economy – be that moving the UK towards smart manufacturing or providing the communications backbone for Connected and Autonomous Vehicles.

It is not clear what form of network will be the most appropriate for the UK, particularly the density of small cells. But what we do know is that the challenges that 4G deployment continues to face will be multiplied given the number of new end-points that 5G networks will have.

The current biggest barrier to roll-out is undoubtedly economic, with the business case being balanced against the risks of investing. The higher frequencies that 5G will use can provide more bandwidth but don't travel as far as those used today. This means more infrastructure needs to be deployed (antennae, base stations and small cells – as well as the fibre-optic cables to connect these.) This all costs significant levels of capital, unnecessary barriers to this infrastructure deployment will either increase the capital needed to achieve the same aim, or result in investments becoming uneconomic with consequent impacts on network availability and performance etc.

This report is not intended to explore use cases or look into the business and economic arena. Industry and the natural progressive nature of innovation will stimulate and react to the demand for the technology, products and services it will accommodate. Government can help support industry and prove business cases through the 5G Testbeds and Trials Programme and provide guidance for local authorities so that a more harmonised, standardised approach can be applied across the country.

Nonetheless, it is undeniable that the overarching barrier to the UK being a 5G leader is one of investment uncertainty. The UK is not alone in this position, as operators across Europe have equally voiced concerns. Other nations however may be able to draw on state assistance or funds to overcome this, or face fewer barriers to deploying the required capital thus allowing them to better manage and minimise risks.

There are two caveats to this uncertainty which, whilst not explored in depth in this report, are worth further consideration. The first is what form 5G network deployment will take. This report largely focuses on the impact of small cells and whilst they will undoubtedly play an important role in 5G networks, alternative architectures such as massive MIMO – albeit currently encountering potentially serious planning related barriers – are gaining traction and could reduce the capital investment cost significantly. The second is how 5G may stimulate additional demand, from both consumers and vertical sectors, which could positively impact the business case for network investment.

Even with these two caveats however, the overall investment case remains uncertain. This makes the importance of removing the other barriers that exist in the UK all the greater. The 13 specific blocks identified and explored in this report extend across the legislative arena, through practical deployment concerns, to communication frustrations from all sides. Many are issues being faced

today affecting 4G roll-out, and the dependence on fibre for the backhaul will necessitate combining these issues on top of the barriers which are still being tackled for fixed infrastructure deployment.

The recommendations put forwards in this report apply as much to industry as to central government and local authorities. The key theme cutting through the 21 recommendations is the promotion of a more collaborative approach. This requires greater collaboration between telecoms actors, telecoms and other sectors, between local and central government, and between telecoms and government at all levels. Indeed, since many of the barriers are not stand-alone issues but intrinsically interwoven, a comprehensive overview and approach would deliver maximum benefit.

Whilst each barrier when taken in isolation is surmountable, given the strategic commercial uncertainty about the level and rate of return on investment, a smoothing of the path to deployment will ultimately be a prerequisite if the UK is to achieve its goal of being a 5G leader. Where these recommendations are aimed at Government it is frequently the case that the policy lever lies outside of the Department for Culture, Media and Sport. This means that DCMS will need to continue to make the case for change across Government, citing the overall Government's ambition to be a 5G leader.

By highlighting the areas of friction before mass roll-out has begun and making policy recommendations to address them, this report aims to support the removal of investment slowing complexity. Put simply, if the network cannot be put in place at optimum efficiency, the UK will barely be a 5G player, let alone global leader.

5G – a natural progression in the constantly evolving world of technology – is also a monumental leap forwards in an increasingly digitized and connected world. Removing the hurdles highlighted in this report will place the UK on a far better footing for the 5G race that is already underway around the world.

We look forward to working with central and local government, industry and other stakeholders to help forge our 5G future.

1 Executive summary

The UK government has stated ambitious plans for the UK to be a leader in the development and deployment of Fifth Generation (5G) mobile technology, and more broadly in the deployment of next-generation digital infrastructure. The government is currently undertaking several initiatives to promote further deployment of digital infrastructure, including by lowering barriers to deployment of fixed networks, and to promote further deployment of both fixed and mobile networks.

Within this context, the Broadband Stakeholder Group (BSG) has commissioned Analysys Mason to explore barriers to the deployment of 5G mobile networks in the UK, and to make recommendations on how those barriers might be addressed.

This is the final report from Analysys Mason's study for the BSG on lowering barriers to 5G deployment in the UK, during which we have:

- **Researched barriers to 5G deployment in the UK, from both industry and local authority perspectives**, through a combination of desk research and interviews with industry stakeholders and local authorities
- **Identified the barriers that might affect development of 5G under different deployment scenarios**, including
  - a '5G everywhere' (macro-led) deployment scenario
  - an 'ultra-fast' urban deployment scenario, requiring the deployment of many small cells
  - a 'coverage for specific use cases' scenario
- **Considered possible actions to address identified barriers**
- **Identified a series of recommendations** relevant to different stakeholders (central government, local government and industry).

This report, whilst being specific to mobile infrastructure deployment, builds on an earlier report published by Analysys Mason and the BSG in May 2017[3] exploring barriers to the deployment of fixed telecoms infrastructure. Access to fibre networks will underpin the deployment of 5G, and hence we suggest that the recommendations for lowering barriers to fixed network deployment (from the May 2017 report) are progressed in tandem with the recommendations for lowering barriers to 5G deployment (as presented in this report), to support the UK in becoming a world leader in 5G.

1.1 Key findings

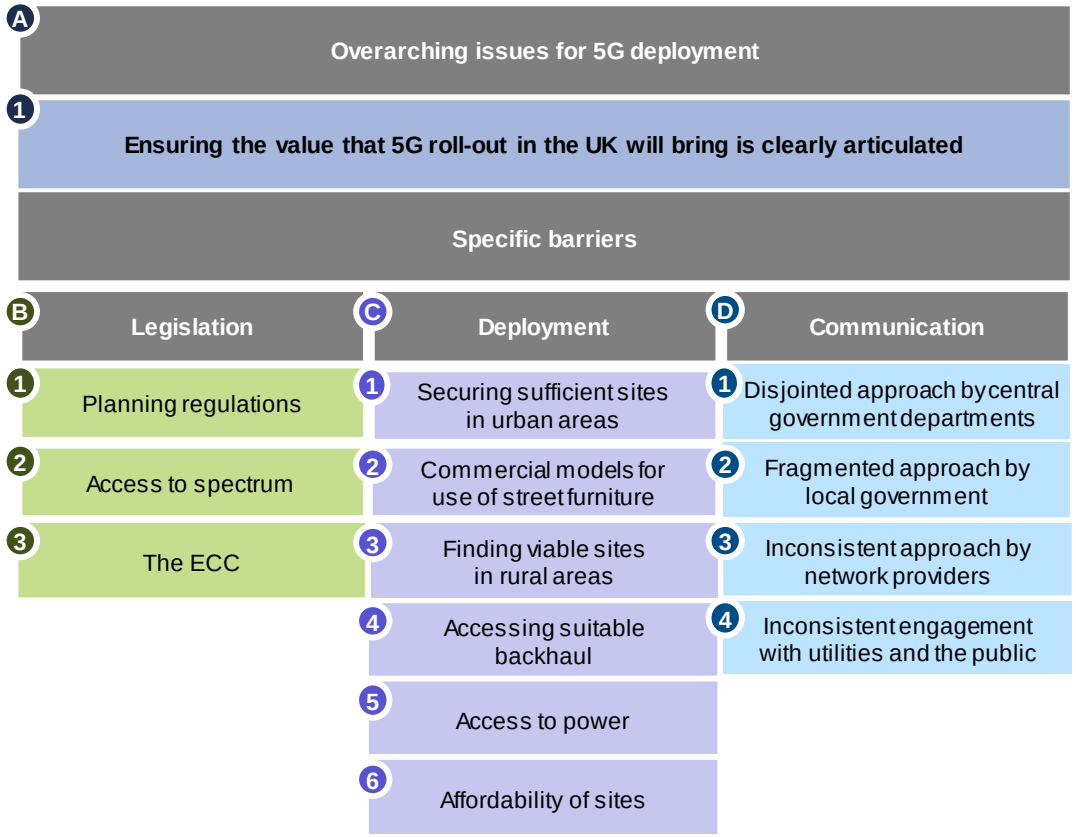
Our analysis has identified one overarching issue affecting market confidence in 5G, and 13 specific barriers that are likely to negatively affect the timing, coverage and/or practicality of 5G network

[3] See https://bit.ly/2FB7LXs for Analysys Mason report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

deployment in the UK. Whilst each barrier taken individually might not inhibit the necessary investment in 5G infrastructure, taken together these barriers could significantly increase the uncertainty around 5G deployment and hence jeopardise the UK's aim of being a world-leading 5G nation.

A summary of the key barriers identified is shown in Figure 1.1 below.

Figure 1.1: Key findings [Source: Analysys Mason, 2018]



Based on the identified barriers **we have developed 21 recommendations**, classified according to whether the recommendations are aimed at UK government, devolved governments,[4] local authorities and/or industry stakeholders. **As such, our recommendations have implications for central government policies on UK-wide promotion of 5G, as well as for local authority processes and engagement on 5G, and industry preparations for 5G launch.**

We have prioritised our recommendations into short-term and other priorities. The short-term priorities are issues that could affect initial 5G roll-out: addressing these will help to support the UK government's ambition to be a world leader in 5G. A summary of the short-term recommendations is shown in Figure 1.2 below.

4 England, Scotland, Wales and Northern Ireland.

Figure 1.2: Summary of short-term recommendations [Source: Analysys Mason, 2018]

ID	Recommendation	Summary
R.1	**Provide guidance on best practice in promoting infrastructure deployment**	Department for Digital, Culture, Media and Sport (DCMS), local authorities and industry stakeholders should collaborate to prepare a guidance document on what local authorities and planners should expect from initial 5G mobile deployment – for example in terms of roll-out priorities, sites needed, coverage expected, assets and facilities that might be needed, timescales for site approval and planning
R.3	**Facilitate discussion on innovative use cases for 5G**	Collaborative groups should be established among interested local authorities, telecoms stakeholders, government and other industry stakeholders (such as 5G user industries, or 'verticals') to exchange ideas on targeted uses for UK 5G. This in turn will allow network coverage requirements to be confirmed (including along roads and rail), and for consensus to emerge on targeted and coordinated use cases of most benefit to the UK market[5]
R.4	**Develop and implement a clear communication strategy to raise awareness on the benefits of 5G roll-out**	DCMS, with industry stakeholders and local authorities, should develop a communications strategy to raise awareness and promote the benefits of 5G deployment, for wider distribution to 5G user industries, businesses and the public
R.5	**Continue to ease barriers to deployment of new fixed networks**	DCMS, industry stakeholders and local authorities should continue to streamline procedures for deploying fixed networks by implementing the recommendations of the review into barriers to fixed network deployment
R.6	**Streamline access to government-owned assets, sites and land for mobile infrastructure**	DCMS, industry stakeholders and local authorities should consider whether further guidance can be provided nationally to help local authorities develop a streamlined and standardised approach to making local authority assets and sites available for mobile infrastructure use – including appropriate design and use of concession models for access to street furniture, and potentially value (i.e. rental) guidance for use of government-owned assets for mobile infrastructure
R.7	**Promote a coherent approach across central government on priorities for 5G roll-out**	DCMS should continue to work with other departments and agencies across central government to ensure a coherent approach to 5G, a coherent application of policy and a clear understanding and promotion of priorities to promote digital infrastructure (specifically 5G roll-out)
R.9	**Review position on ongoing legal issues**	DCMS and the Ministry of Housing, Communities and Local Government (MHCLG) should review the status of the ongoing legal dispute over permitted development rights for mobile poles, keep the impact of the new ECC implementation under review, and consider issuing clarification notes or explanations as needed
R.10	**Review regulation of existing fibre networks**	DCMS and Ofcom should review the existing 'mixed use' regulations for duct and pole access to BT's infrastructure to establish whether a more open approach would support the deployment of 5G
R.12	**Establish a working group to consider access to power and utility infrastructure**	Network providers should establish working groups with power utility companies to facilitate early engagement and to share information on planned deployments

5 It is noted that outputs from ongoing and planned 5G trials will also contribute to a stronger understanding of use case, and deployment models, for 5G (for example, the planned 5G Urban Connected Communities Project).

ID	Recommendation	Summary
R.16	**Develop a proactive approach towards digital infrastructure deployment**	Local authorities should prioritise the deployment of sustainable, long-term digital infrastructure, including for mobile use, in their local plans and establish digital infrastructure teams to manage the deployment of fixed and mobile networks, including a single point of contact for industry stakeholders
R.18	**Leverage Local Full Fibre Networks (LFFN) for 5G**	Local authorities with LFFN funding should encourage fibre operators to plan, design and offer fibre solutions that can be used as backhaul infrastructure for 5G deployment
R.20	**Provide clarity on roll-out requirements for 5G**	Industry stakeholders should collaborate with local authorities to develop clearer guidance for local planners on the core and optional site requirements for deploying 5G
R.21	**Develop standard templates for information sharing**	Local authorities and network providers should develop standard templates for information sharing, designed to ensure that information shared is immediately useful to all involved parties

2 Introduction

2.1 Background and objectives

The Broadband Stakeholder Group (BSG) is the UK government's advisory group on broadband, focusing on complex, industry-wide issues to improve the functioning of the UK telecoms connectivity market. Deploying the next generation of both fixed and mobile telecoms connectivity is a high priority for the UK government and the telecoms industry, with over GBP1 billion of additional public- and private-sector investment having been committed as part of the National Productivity Investment Fund (NPIF).[6]

The UK government has already allocated GBP200 million from the NPIF to the 5G Testbeds and Trials Programme run by DCMS to support a number of 5G projects, and further funding for UK 5G trials was being allocated at the time of writing this report.[7,8] Migration from current fourth-generation (4G) networks to commercial 5G services is also a strategic priority for mobile operators, which expect to make significant investment in mobile network infrastructure across the UK over the next few years.

The BSG previously commissioned Analysys Mason to explore barriers inhibiting current and future deployments of fixed broadband infrastructure.[9] The report from that study, published on 23 May 2017, focused on resolving barriers to fixed network deployment relating to noticing and permit schemes, restriction notices, road traffic management and planning permission for fixed broadband networks. The report identified 19 specific issues deriving from local authorities' practices in implementing legislation, and operators' level of engagement with local authorities that are likely to have a negative impact on the deployment of fixed broadband infrastructure.

Within this wider context of preparation for the launch of 5G services, now is an ideal time for the BSG to focus on supporting the foundations of 5G's deployment in the UK and to identify potential barriers to the deployment of 5G. The BSG has commissioned Analysys Mason to explore barriers to the deployment of 5G in the UK, and to make recommendations on addressing those barriers, with a view to aiding 5G roll-out and accelerating the significant economic and social benefits that deployment of 5G will bring.

6 See https://bit.ly/2HSR4ay for details of the NPIF from the Autumn Statement 2016.

7 See https://bit.ly/2oYMEYf and https://bit.ly/2IcYiG7 for further information on government support for 5G networks.

8 See https://www.gov.uk/government/news/search-begins-for-a-uk-5g-city-of-the-future

9 See https://bit.ly/2FB7LXs for Analysys Mason report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

2.2 Scope and approach

In agreement with the BSG, we used a consultation-led approach during the study, allowing stakeholders to identify the areas and issues to be considered. The key areas identified, which this report focuses on, are:

- the deployment of fibre network infrastructure, noting the overlap with our previous report for the BSG
- the ongoing deployment of 4G infrastructure
- the deployment of new 5G infrastructure, including small cells, and how these specific issues may differ from those that affect the deployment of 4G infrastructure.

To gather information for this study, we used a mix of desk-based research and interviews with key stakeholders. In total, we undertook 23 interviews – 11 with local authorities and 12 with industry stakeholders including mobile network operators (MNOs), equipment vendors and infrastructure providers.

All interviews were conducted on the condition of anonymity, to encourage open discussion of the underlying issues. To avoid the risk of disclosing identifiable information, we use the following terms throughout the report:

- **industry stakeholder** – all stakeholders within the fixed and mobile broadband industry
- **network provider** – stakeholders directly involved in the provision of networks, i.e. mobile network operators and infrastructure providers
- **local authorities –** all local authorities irrespective of type, i.e. unitary, district, combined, and including all constituent parts (e.g. planning, highways, economic development).

While we were commissioned by the BSG and the member operators to produce this report, we have undertaken the study as an independent adviser, to give views from both industry and local authority perspectives. Where issues identified overlap with the 2017 report, we have linked back to the recommendations in the previous report rather than develop additional recommendations. This report for the BSG is fully aligned with both the previous work and ongoing work – building on the recommendations provided in these earlier reports.

2.3 Report structure

The remainder of this document is laid out as follows:

- Section 3 provides relevant context for this study
- Section 4 describes our detailed findings on barriers to 5G deployment
- Section 5 outlines three deployment scenarios and the impact of the barriers on each scenario
- Section 6 provides a summary of our recommendations for lowering barriers to the deployment of 5G networks in the UK.

We have also provided two annexes of supporting material:

- Annex A provides a detailed review of the mobile market in the UK and progress towards 5G deployment
- Annex B provides a review of permitted development legislation in England, Scotland, Wales and Northern Ireland.

3 Context for this study

This section outlines the key terms and legislation discussed in this report, to provide context for the findings from the stakeholder interviews (in Section 4). It provides:

- a high-level overview of 5G
- a review of sites and infrastructure used to deploy mobile networks
- an overview of current progress towards 5G deployment in the UK
- a review of relevant legislation.

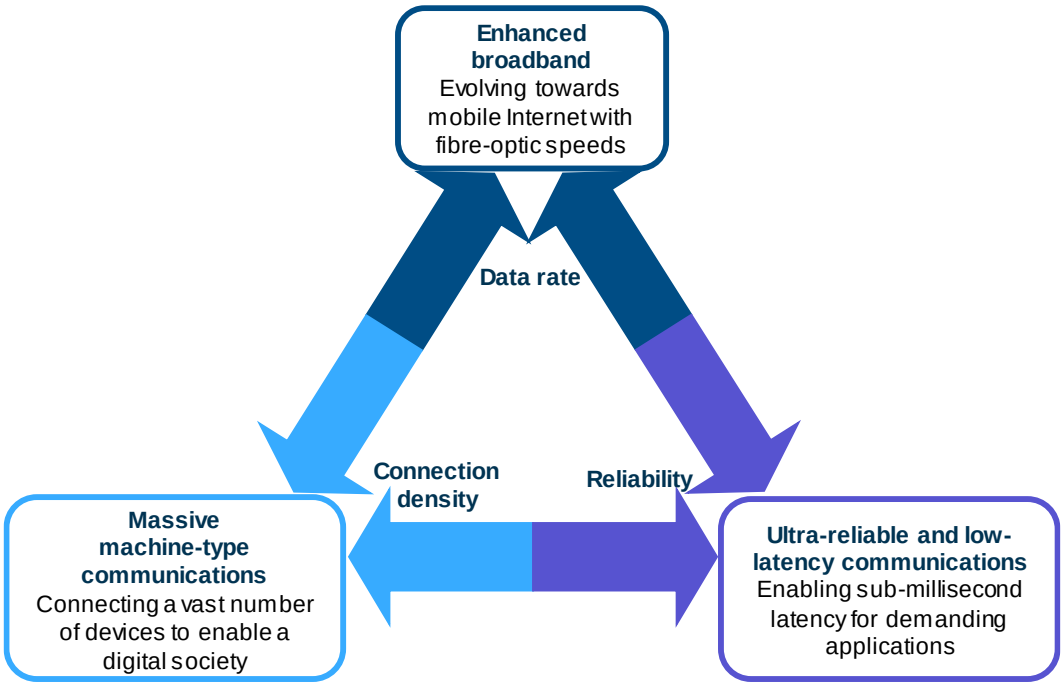
3.1 Overview of 5G

5G is the next generation of mobile technology and is expected to be deployed globally from 2020. Whereas 3G brought mobile data services to consumers for the first time, and 4G created a 'mobile broadband' experience (see Annex A.1 for further details), 5G will deliver a new high-speed, real-time mobile experience. 5G networks will seamlessly connect people with applications, services and things, embracing the so-called Internet of Things (IoT), and creating the opportunity for new and innovative digital experiences for consumers and businesses alike. According to the 5G team at DCMS, "*5G has the potential to revolutionise the way we live, work and travel; from driverless cars to wearable health sensors; to better connecting us with friends and family*".[10]

Initially, 5G is expected to support the delivery of higher-capacity mobile broadband services to consumers and businesses. In the longer term, the scalability of 5G networks will enable a wide variety of services and applications to be provided to consumers, businesses and user industries (or 'verticals'). For example, the '5G experience' is expected to expand beyond mobile broadband to embrace augmented reality/virtual reality (AR/VR), high-quality video and ultra-reliable, low-latency connections, potentially to a diverse range of devices and other things. The telecoms industry has grouped potential 5G use cases into three broad categories, summarised in Figure 3.1 below.

[10] See https://bit.ly/2I0pTi7 for details.

Figure 3.1: 5G triangle of use cases [Source: Analysys Mason, 2018]



3.2 Mobile sites and infrastructure

To provide 2G, 3G and 4G coverage, wireless base stations are located across the UK for transmission and reception of mobile signals. Each of the four MNOs in the UK currently uses between 16 000 and 20 000 base-station sites. These sites are connected via backhaul infrastructure (either fixed wireless links or fibre), into mobile core networks. Site sharing between MNOs means that the total number of mobiles sites deployed in the UK is around 35 000.[11] Mobile sites can be grouped into two broad categories:

- **Macro site**: A site designed to provide coverage over a large area (typically a range of 1km–8km, depending on the spectrum used) using high-power antennas mounted on dedicated towers or masts, or located on rooftops where appropriate[12]
  - see Figure 3.2 for an example of a rural macro site and Figure 3.4 for an example of an urban macro site

- **Small-cell site**: A site designed to provide additional coverage or capacity in a small area (typically less than 1km range) using smaller antenna structures mounted at the side of a road, on street furniture or on the side of a building
  - small cells are typically defined as any non-macro site (i.e. anything other than a tower or a rooftop site). Small cells can be used to provide coverage over a defined outdoor area, or in an indoor area, with more limited coverage than a macro cell

11 Source: operator websites and Analysys Mason estimate.

12 Data from Ofcom.

— small-cell deployments range from microcells (shown in Figure 3.3 and Figure 3.5 below) to picocells used to provide additional in-building coverage for enterprise users, for example.

MNOs are considering a mix of sites types to provide sufficient coverage and capacity for 5G networks. Macro 5G sites (either newly deployed 5G sites or site upgrades to add 5G capability to existing 4G sites) will be widely deployed, and new small-cell sites will potentially be used to provide additional capacity in dense urban areas – augmenting both the coverage and capacity provided by the macro-site network. Forecasts of the numbers of small-cell sites needed vary, and the actual requirements will depend on market circumstances as well as practicalities of deployment. The barriers to 5G deployment discussed in the remainder of this report refer to both macro- and small-cell 5G roll-out.

Figure 3.2: Macro site providing coverage in a rural area [Source: Wireless Infrastructure Group – reproduced with permission, 2018]

Figure 3.3: Small cell mounted on a street light in an urban area [Source: Wireless Infrastructure Group – reproduced with permission, 2018]

Figure 3.4: Macro site providing coverage in an urban area [Source: Ericsson – reproduced with permission, 2018]

Figure 3.5: Small-cell deployment integrated into a street light [Source: Ericsson – reproduced with permission, 2018]

3.3 5G in the UK

The UK government has stated a clear ambition for the UK to become a world leader in the development and deployment of 5G technology and to ensure that the country can maximise the potential productivity and efficiency gains associated with 5G networks and services. Considerable work is being undertaken by the government, local authorities, academics and industry to conduct proof-of-concept tests for 5G, in preparation for widescale commercial deployment. A summary of key UK-wide initiatives is provided in Figure 3.6 below (for full details, see Annex A).

Figure 3.6: Summary of ongoing initiatives to support 5G in the UK [Source: Analysys Mason, 2018]

Initiative	Stakeholders	Details
Providing access to spectrum	• Ofcom	• Ofcom is working towards licensing and auctioning appropriate bands of spectrum to support 5G. Spectrum in the 3.4–3.6GHz band has already been awarded to mobile operators, and further awards are planned. Ofcom is also making spectrum available in the form of innovation and trial licences, to facilitate 5G test and development
Testbeds and trials	• DCMS • Bid consortia • Industry	• The UK government has allocated GBP200 million of funding from the National Productivity Infrastructure Fund to support the 5G Testbeds and Trials Programme • Six testbeds have received GBP25 million of funding in Phase 1 of the programme
Connected Communities	• DCMS • Bid consortia • Industry	• The government is providing funding to develop both urban and rural connected communities' testbeds, to test deployment models for 5G and explore use cases • The location for the Urban Connected Communities Project is expected to be announced in summer 2018, as are further details of the Rural Connected Communities project
Lowering barriers to connectivity	• DCMS	• The Barrier Busting Task Force has been established to facilitate the deployment of digital infrastructure by removing barriers • The Local Connectivity Group has been established to enable local areas to develop policies supportive of digital infrastructure deployment
Future Telecoms Infrastructure Review	• DCMS	• The UK government is exploring how to promote long-term investment in digital connectivity, with the report expected to be published in summer 2018
5G innovation network (UK5G)	• UK government • Industry	• UK5G has been established as an independent body to promote collaboration between organisations working on the development of 5G in the UK
Trial small-cell deployments	• Arqiva / O2 • WIG / Aberdeen	• Arqiva and O2 have formed a partnership to deploy up to 300 5G-compatible small cells across London • WIG has deployed a 4G small cell network in partnership with Aberdeen city council under a concession model

To support the launch of commercial 5G services in the UK, the government published its 5G strategy in March 2017. This strategy sets out recommendations on the steps the government should take to realise its ambition for the UK to become a global leader in 5G.[13] The strategy is described as a 'living document' that will be continuously updated as further research is undertaken; the first update to the 5G strategy was published in December 2017.[14]

The strategy outlines seven key themes that will determine the government's progress towards 5G, as summarised in Figure 3.7 below (for full details refer to Annex A.2.1).

Figure 3.7: Key themes in the UK government's strategy for 5G [Source: Analysys Mason, 2018]

3.4 Relevant legislation for the deployment of 5G

We have identified two key areas of legislation which are currently affecting the further deployment of 4G networks and are expected to have a significant impact on 5G roll-out – the Electronic Communications Code (ECC), and permitted development rights, which vary across England and the devolved nations.[15] We provide an overview of these areas in the following section, to provide context for detailed discussions on the impact of this legislation in Section 4 below. We note that street works legislation is also expected to have a significant impact on the deployment of 5G (as discussed in Section 3 of our previous report).[16]

13 DCMS (2017), *Next Generation Mobile Technologies: A 5G Strategy for the UK*; see https://bit.ly/2FHSDpG

14 See https://bit.ly/2BG0SCt for the December 2017 update to the UK's 5G strategy.

15 England, Scotland, Wales and Northern Ireland.

16 See https://bit.ly/2FB7LXs for Analysys Mason's report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

3.4.1 The ECC

The building of mobile networks in the UK is facilitated by the Electronic Communications Code (ECC). As outlined by Ofcom, the ECC "*provides a statutory basis whereby communications providers […] can place their Apparatus on land or buildings owned by another person or organisation"*.[17] The ECC was first introduced in 1984, amended in 2003 and later amended in 2013.

In response to mounting stakeholder concerns from within the telecoms industry that the ECC was restricting the ability of network providers to deploy infrastructure, DCMS revised the ECC in 2017, focusing on five key areas:[18]

- **Valuations**: The statutory framework for the valuation of potential mobile sites for network providers (i.e. the fee that landowners charge MNOs for using their land to host masts and antennas) has been changed from a market-based approach (i.e. prices determined by the landowner, unregulated), to a 'regulated' approach.
- **Site sharing**: Under the new code, network providers have limited rights to share sites without renegotiation of agreements.
- **Assignment of ownership**: In certain circumstances network providers now have the right to assign agreements without renegotiation.
- **Upgrading sites**: Network providers now have the right to upgrade equipment on sites, providing any visual impact or additional burden on the landowner is minimised.
- **Notice to quit (NTQ)**: The notice period that landowners are required to give network providers to remove their equipment has increased to 18 months. Our understanding is that this is driven by the time it takes MNOs to find and commission a new site to replace one that is subject to an NTQ.

3.4.2 Permitted development rights

Permitted development provides broad rights that allow network providers to deploy equipment without undergoing a full planning application. As set out by permitted development legislation, prior approval of specific issues is required from the relevant local authority to enable an application to proceed without undergoing the full planning process. Under this prior approval process, once an application is submitted, the local authority has 56 days to decide on the application under the prescribed grounds, otherwise planning permission is assumed to have been given.

England and each of the devolved nations have their own planning legislation, with key differences in what is classed as permitted development (or requires prior approval) and what requires full planning applications. The relevant permitted development rights for code operators (those granted

17 See https://bit.ly/2rtpBpQ for further discussion of the ECC.

18 See https://bit.ly/2G0yyeu for further discussion of the revisions to the ECC.

rights under the ECC) in each of the devolved nations are complex, and have recently been updated in England and Scotland, but not in Wales. Figure 3.8 below provides a summary of points relevant to this study (see Annex A for a more detailed discussion).

It should be noted that there are large variations in the restrictions placed on permitted developments in each nation. For example, there are significant variations in the maximum allowable height of masts or the geographical areas where telecoms deployments are considered as permitted development.

Figure 3.8: Summary of permitted development rights [Source: National legislation, 2018]

	England	Wales[19]	Scotland	Northern Ireland[20]
Legislation updated	2018	2014	2017	2015
Masts	Yes (with restrictions)	Yes (with restrictions)	Yes (with restrictions)	Yes (with restrictions)
Small cells	Yes	Yes (with restrictions)	Yes (with restrictions)	No
Cabinets	Yes (prior approval required for mobile)	Yes (prior approval required for mobile)	No	No
Telegraph Poles	Yes (prior approval required for mobile)	Yes (prior approval required for mobile)	Yes (with restrictions)	No

19 See https://bit.ly/2MWsxEn for details of a consultation launched by the Welsh Government in June 2018 to update permitted development legislation.

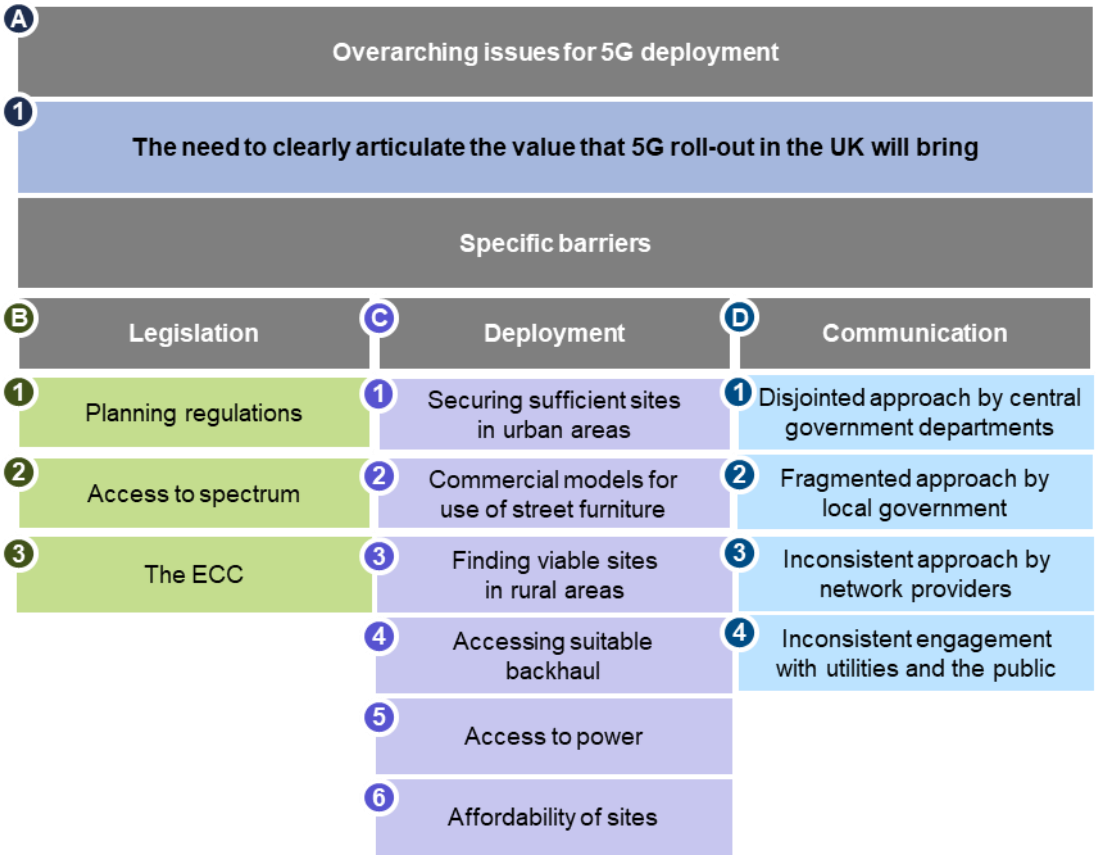
20 The Department of the Environment consulted on changes to permitted development for telecoms equipment in May 2016, but it is unclear if further progress has been made; see https://bit.ly/2K17QFa for further details.

4 Findings

We interviewed a total of 23 stakeholders for this study – 11 local authorities and 12 industry stakeholders. We also received comments from government departments including DCMS and MHCLG. From the interviews and comments received during this study, **we have identified one overarching issue and 13 specific barriers**. We have grouped these specific barriers into three broad categories – legislative barriers, deployment barriers and communication barriers.

A summary of our findings on 5G deployment barriers is shown in Figure 4.1 below.

Figure 4.1: Summary of the findings in this report [Source: Analysys Mason, 2018]



Whilst each barrier, taken individually, might not inhibit the necessary investment in 5G infrastructure, taken together these barriers significantly increase the uncertainty around 5G deployment. Since the barriers identified are interlinked, a piecemeal approach is unlikely to be an effective way to lower these barriers. We therefore believe that a holistic approach to solving the issues highlighted in this report will help provide a consistent and predictable environment to unlock the potential benefits of 5G.

We also note that some of these barriers are already affecting the deployment of 4G networks. Moving to large-scale 5G deployment is likely to widen the impact, due to the increased volumes of work required to support 5G roll-out.

In the remainder of this section we provide details of the identified barriers, based on comments made during the stakeholder interviews and our own analysis. For each barrier, we provide:

- a summary of the barrier
- detailed commentary on its potential impact from the perspective of different stakeholders.

4.1 The need to clearly articulate the value that 5G roll-out in the UK will bring

Both industry stakeholders and local authorities raised overarching concerns that:

- **there is a need for greater clarity and wider promotion of the value of 5G roll-out, and clearer definition of the UK's 5G strategy, to reduce uncertainty for industry**
- **there is a lack of awareness of nationwide 5G priorities within local authorities, which risks delaying 5G roll-out if not addressed in the short term.**

Local authorities are finding it challenging to develop approaches to promote 5G deployment without a clearer understanding of national 5G priorities, and the potential benefits that 5G roll-out will bring for local industries. Without widespread promotion of relevant roll-out benefits, expected use cases, deployment models and their benefits, there is a risk of fragmentation in approaches to 5G, creating additional investment uncertainty for the telecoms industry. Local authorities are also concerned about a lack of examples of best practice for the deployment of 5G equipment on local authority assets, although they recognise that the deployment process is still at an early stage.

Network providers are likely to plan more-conservative roll-outs to mitigate the risk of an uncertain business case as well as challenging, and protracted, deployment processes. Network providers also commented that, whilst the government was instrumental in creating the 5G Testbeds and Trials Programme to promote the development of 5G in the UK, a diverse range of use cases are being considered across the different projects, with limited effort to build consensus around 'key' use cases. As such, some industry stakeholders commented that it is challenging to identify which use cases are likely to be key to supporting a viable nationwide deployment of 5G in the UK.

A1	**The need to clearly articulate the value that 5G rollout in the UK will bring**
Guidance	We received comments from local authorities that there is uncertainty over what 5G services will deliver for local industries, residents and consumers. Local authorities highlighted **a lack of understanding on how 5G services will be differentiated from 4G**, what the most relevant use cases will be for 5G beyond ultra-fast broadband, the roll-out requirements (e.g. types, locations and numbers of sites required) and the timing for new services being available. Local authorities commented that **more-detailed national guidance on best practice in promoting the deployment of 5G is key: without this it is challenging to plan internally on how best to promote 5G**.

National strategy

One local authority suggested that the government's 5G strategy should explain "*what good looks like and how we get there*". We received suggestions that **central government should work with industry, landowners and local planners to produce targeted guidance covering the deployment of 5G and share best practice**. Suggested content included commercial approaches for providing access to infrastructure (see barrier C.2 below), lowering internal barriers (see barrier D.2 below) and best practice by local authorities on promoting digital infrastructure deployment.

We received comments that central government projects are testing a broad range of possibilities for 5G, but that **local authorities are unclear on the national priorities for 5G**. Local authorities commented that greater clarity on the national vision and strategic goals for 5G would support regional and local initiatives. One stakeholder also commented on a possible need for central government to ensure that strategic guidance on relevant use cases in the UK market context is applied consistently across the UK.

Stakeholders recognised the UK government's 5G strategy (see Annex A for further discussion) as an important step on the 5G deployment journey. However, as discussed above there was a lack of awareness of this strategy among some local authorities – with several commenting on the lack of a "coherent" national approach. We believe that internal barriers within local authorities, such as a lack of communication between relevant teams, might be preventing the dissemination of information on the national 5G strategy and creating increased uncertainty about deployment issues.[21]

National priorities

Some industry stakeholders commented that the government's strategy should include **a clear statement on the priorities for deployment of 5G and clearer direction on priority use cases** and industry use sectors of relevance to the UK market. For example, industry stakeholders noted that a more targeted approach to identifying relevant use cases has been adopted by the German government, where two applications – industrial and Connected Autonomous Vehicles (CAV) – have been prioritised as especially relevant to the German market.[22] These stakeholders commented that a similar approach in the UK could support investment decisions and facilitate a tailored deployment of 5G.

However, this view was not universally supported. Some industry stakeholders stated that it is too soon to conclude on relevant use cases and that allowing projects to explore different possibilities will facilitate a longer-term understanding of priorities for the UK.

Trials and testbeds

Industry stakeholders recognised the value of academic research in developing new technologies to support 5G, but commented that the commercial launch of 5G will be within the next two years. Industry stakeholders are confident that the underlying technology for 5G is ready for commercial deployment and commented that now the required specifications for 5G have been developed, network procurement can be undertaken for 3GPP-compliant 5G equipment.[23] They suggested there is **a need to move to a practical test and development phase**.

Both industry stakeholders and local authorities commented that applying key learnings from current 5G projects to inform 5G policies in the UK will be especially important as commercial deployments begin. As such, it will be important that recommendations from each of the current 5G projects are clearly articulated, and widely available.

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21 We are aware that the Local Area Connectivity Group may focus on this issue as part of its scope – see Section A.2.6 in Annex A.

22 See https://bit.ly/2HZnh49 for details of the German 5G strategy.

23 For example, initial 5G specifications were finalised by 3GPP in December 2017, with a further iteration to be finalised in 2018.

	We suggest that a **stronger focus is needed from government on applying findings from the ongoing 5G projects to the deployment of commercial 5G networks,** as well as addressing the deployment challenges of 5G.
Geographical coverage	Several local authorities with rural communities commented that they currently lack reliable 3G/4G coverage. They suggested that local communities **may be concerned about discussing the roll-out of 5G** when improving coverage by existing mobile networks is a more immediate priority. Industry stakeholders commented on the challenging business case for providing coverage in rural areas. However, there is a view that ongoing work – such as the Scottish 4G Infill Programme (see Annex A) – is starting to address the situation. Overall it was felt that **a strategic focus on engagement between central government, local authorities and industry stakeholders is needed** to promote the deployment of both 4G and 5G in rural areas. We note that it is not yet clear whether widespread geographical coverage will form a key part of the UK government's 5G strategy. Widespread geographical coverage may not be a priority for either central government or industry during the early stages of 5G deployment. Ofcom has consulted on several possible coverage obligations for the 700MHz spectrum band, but the final outcomes of this consultation were not known at the time of producing this report.

4.2 Specific barriers

B – Legislative barriers

We received consistent comments from stakeholders that **current planning regulations are likely to create significant barriers to the deployment of 5G**. There is a lack of consistency in how local authorities apply planning rules, and regulations vary across the devolved nations, creating a barrier to the deployment of both macro sites and smaller sites (small cells). The uncertainty this creates is hampering operators from gaining access to new sites and upgrading existing ones.

Both local authorities and industry stakeholders commented that **5G deployment is expected to differ considerably from 4G deployment**, with the range of use cases becoming more diverse, a wider range of devices being supported, and more base stations being deployed (including small cells). From a practical perspective, 5G deployment will involve adding more equipment and antennas to existing macro sites, as well as building new macro sites and creating small cells, at scale. This increased scale and density of sites needed for 5G deployment will require greater certainty that new site deployments can be planned for, and upgrades to existing site deployments can be achieved.

We note that the ECC (as set out in the Digital Economy Act 2017[24]) has recently been revised to provide greater certainty for operators in terms of the placement of mobile equipment and antennas. Given that the new code was only recently implemented, its longer-term impact – which should include greater certainty for the telecoms industry on access to sites for mobile equipment – is yet to be determined. Industry stakeholders commented on a 'freeze' in the market for new sites whilst landlords, and their intermediaries, work to better understand the impact of the revised ECC.

[24] See Section 3.4.1 or https://bit.ly/2rQ3Bo8 for details of the ECC and https://bit.ly/2qjlURv for the Digital Economy Act.

Planning regulations

Fragmented application of planning regulations for mobile equipment, and a lack of best-practice guidance, introduces additional costs for both local authorities and network providers and is limiting the ability of network providers to plan an efficient deployment of 5G.

Guidance

Both local authorities and network providers suggested that the **current planning processes do not support efficient planning of mobile infrastructure deployments**. Network providers recognise the concerns of local authorities about the number of sites required (cabinets, masts and antennas) to support existing mobile networks, and acknowledge that the deployment of 5G will increase this requirement. However, they consistently commented on **the lack of clear guidance from central government to local authorities on the application of planning regulations for mobile telecoms equipment**.

Network providers commented that local planning officers have extensive scope to interpret planning regulations, leading to fragmented interpretations of the regulations. However, network providers acknowledged that it is difficult to implement a harmonised approach, since local requirements must be accounted for. It was suggested that **central government should prepare explicit guidance on planning norms and best practice to support the deployment of 5G** – for example on interpreting and implementing planning regulations that relate to adding 5G antennas to existing sites, planning new 5G sites, and planning small cells.

NPPF

The current National Planning Policy Framework (NPPF)[25] suggests local planning authorities "*should support the expansion of electronic communications networks, including telecommunications and high-speed broadband*."[26] In practice local authorities interpret this in a wide variety of ways and network providers commented that the lack of consistency causes delays and increases the costs involved. Network operators are concerned that some **local authorities have not linked their approach to managing local planning issues to the strategic goals of central government policy on the provision of digital infrastructure.**

Timescales

Network providers highlighted concerns about the lack of target timescales for the approval of full planning applications and the fact that local authorities can attach last-minute conditions to applications. We note that there are statutory requirements for local authorities to determine planning applications for major developments within 13 weeks of validation, or at most 26 weeks if no extended period for consideration of the application has been agreed.[27]

However, industry stakeholders commented that approval of planning applications for mobile masts can occasionally take as long as 18 months. We were also provided with examples where local authorities had granted street works permits for an infrastructure deployment but then refused permission or applied additional restrictions two days before the approval deadline for the planning application. Industry stakeholders suggested that **it is not always feasible to wait to receive full planning permission followed by a further delay for street works**. We were not provided with further details of these cases, and the scale of the issue is unclear from our consultation.[28]

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25 The NPPF is published by MHCLG and aims to provide guidance on the government's planning policies in England and how they should be applied.

26 See https://bit.ly/2roXlU6 for details of the consultation to update the NPPF.

27 See https://bit.ly/2K2A8m4

28 We note that coordination between planning and highways departments in local authorities was covered in Analysys Mason's earlier report on lowering barriers to fixed infrastructure deployment, and we reiterate our recommendations on better coordination between planning and highways departments; see https://bit.ly/2FB7LXs for Analysys Mason's report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

Small cells

Both local authorities and network providers suggested that current planning rules may inhibit the deployment of outdoor small cells on a meaningful scale, although we are aware that planning rules vary across the devolved nations. Some local authorities were of the view that current legislation only allows up to two small cells to be placed on buildings as permitted development, with restrictions on their proximity to roads.[29] However, it is not clear this is correct for all buildings; see Annex A.

The need to obtain full planning permission for siting of small cells (in cases where local authorities do not allow for their treatment as 'de minimis', via 'batch' applications, or where permitted development rights do not apply) will introduce significant levels of uncertainty for network providers during critical phases of 5G roll-out. To reduce financial, time and manpower costs for both local authorities and network providers, and accelerate approvals, several local authorities are exploring treating small cells as de minimis[30] under planning rules. Other local authorities are exploring the use of pilot deployments to establish standard procedures and confidence in small-cell deployment, followed by 'batch' applications for 100–150 small-cell installations at a time. We understand that this work by planning departments is at a relatively early stage but, if successful, could help to reduce planning barriers to small-cell deployment.

Masts

Industry stakeholders noted that, given the potential challenges in obtaining full planning permission, network deployments are often shaped by planning regulations with the simplest route to deploying a network adopted – avoiding full planning applications where possible.

Current planning rules limit the height of masts allowed under permitted development, which has affected the nature of mobile deployment in the UK. Industry stakeholders consistently highlighted this as an issue, suggesting that **UK masts are on average 10 metres shorter than elsewhere in Europe due to current planning rules** – with shorter masts giving less coverage in suburban and rural areas and accommodating less equipment than taller masts.

Historically, masts under 15 metres in height have been allowed as permitted development, with full planning permission required for upgrades that take a mast beyond 15 metres. Any masts over 15 metres either required prior approval or full planning permission, which significantly increased the time and cost to deploy a mast and affected the economic case for deployment. Recent amendments to rules in England and Scotland have increased the height of masts allowed under permitted development to 20–25m and increased the scope of upgrade works outside of protected lands (see Annex A).[31] Industry stakeholders commented that these changes are having a positive impact, but some network providers are concerned that **planning issues still present barriers to creating a less costly network architecture than might be possible using fewer, taller masts to achieve wider coverage in rural areas**.[32]

Legal issues

Several industry respondents referred to **an ongoing legal case on the definition of 'pole' and 'mast' under permitted development regulations involving a network provider, a local authority and a private citizen**. The private citizen objected to a pole deployed under permitted development and successfully argued, in court, that the pole should be considered as a mast for planning purposes. The

29 Although the legislation was amended in England in 2016, some local authorities commented that a large-scale 5G outdoor small-cell deployment in line with government expectations will not be possible due to a lack of feasible locations. It should also be noted that, in the case of Northern Ireland, legislation does not allow any small-cell deployment under permitted development regulations.

30 *De minimis* covers minor works which may not have a material effect on the structure or building and do not require planning permission.

31 We understand that changes to planning legislation are at an advanced stage of development in Northern Ireland, but have not yet been approved by the devolved parliament; see https://bit.ly/2K17QFa for further details.

32 Local authorities did not express views on the potential trade-off between possible planning objections for fewer, taller masts compared to objections against additional lower-height ones.

network provider is seeking leave to appeal against the decision, but there is concern that an adverse ruling of this sort could create precedent to compel other local authorities to remove equivalent infrastructure installed under permitted development rights. In the quoted case the local authority in question sided with the network provider in arguing that the infrastructure was permitted development. We believe that if the network provider loses this case and a precedent is set, **this case could represent a barrier to the deployment of 5G** by increasing the burden of planning regulation and requiring additional expenditure by network providers to replace existing infrastructure.

Access to spectrum

Insufficient spectrum and barriers to accessing spectrum, particularly for local providers and for indoor systems, may inhibit wider deployment of 5G.

Access to spectrum

A range of views were expressed on whether access to spectrum represents a barrier to 5G deployment. Some network providers expressed concerns that the **high cost of spectrum risks reducing the funding available for network deployment.**

Other stakeholders mentioned that more **innovative forms of sharing spectrum to deliver 5G services might incentivise new forms of network provision** – similar to the US 'CBRS' scheme in the 3.5GHz band.[33] However, others noted the limitations of shared use of spectrum, for example in relation to providing the QoS needed for 5G services within a spectrum environment where multiple systems might be competing to use the same resource in a given area.

Localised 5G coverage

Several industry stakeholders, content providers and rural local authorities raised the possibility of **forms of spectrum access to support the deployment of 5G services in local areas, for example where national mobile networks do not provide coverage**. However, other stakeholders commented that there is a risk of local communities unnecessarily funding solutions in areas that nationwide network providers do plan to cover, but have been delayed in doing so due to planning objections or other barriers.

Some stakeholders noted that certain 5G use cases may require coverage optimised for specific locations, including factories for automation, and local tourism apps and mobile broadband connectivity for poorly connected communities. More **innovative approaches to spectrum access may facilitate deployment of private 5G networks** within large buildings.[34]

Localised spectrum access is also of potential interest to support the deployment of 5G in rural areas where the national network providers may not have an economic case for deployment. However, industry stakeholders observed that there is a need to ensure compatibility between any localised solutions and nationwide 5G networks.

Harmonised spectrum

Many industry stakeholders suggested that spectrum harmonisation between the UK and Europe is a prerequisite for successful 5G deployment. Industry stakeholders suggested that – even though the future UK–EU relationship is still being negotiated – **harmonisation through the Conference of Postal and Telecommunications Administrations (CEPT) spectrum planning in Europe is highly beneficial and the UK should remain harmonised with Europe on spectrum planning matters**. Network providers suggested that the costs of managing a diverging regulatory environment and deploying a network compatible with multiple non-standardised spectrum bands would be prohibitive.

33 The Citizens Broadband Radio Service (CBRS) is a 150MHz band of spectrum in the 3.5GHz band allocated for shared usage on a tiered basis in the USA; see https://bit.ly/2IkXLWe for further details.

34 See https://bit.ly/2KMcZ58 for details of Ofcom's April 2016 consultation on a new framework for spectrum sharing.

The ECC

The revised ECC, whilst welcomed by industry stakeholders, is temporarily creating uncertainty around the process of deploying new sites whilst landowners adapt to the market-value implications of the new regulations.

Recent developments

The revised ECC made significant changes to the approach to valuing sites for mobile deployment and clarified the process of siting and removing infrastructure. The new code also provides guidelines and templates for network providers and landlords to manage the process (see Section 3.4.1 for further details). Network providers widely regard the revisions as a positive development, by reducing the risk of unsustainable site rental costs. One local authority highlighted that the new ECC could facilitate access to local authority sites and assets, by providing more certainty around valuation and processes.

However, most network providers and local authorities suggested that **the market for mobile sites is currently frozen whilst all stakeholders work to understand the impact of the new ECC**, and that landlords are unwilling to accept valuations from network providers under the new ECC. Some respondents mentioned that the current delays will not be resolved until test cases are processed via legal challenge, to establish precedents. The timing of this is unfortunate in the context of planning for 5G, with network providers having to understand the impact of the new code whilst also planning their initial 5G deployments.

Several network providers suggested that landlords were attempting to monetise other aspects to compensate for loss of revenue from site rental – such as charging up to GBP20 000 to access a site for maintenance or charging several thousand pounds to allow a site inspection to determine whether a site was suitable. We note that the ECC does not currently cover initial access to sites to assess viability, with **network providers reporting long delays to identifying suitable sites for deployment**.

Network providers commented that **clear guidance is needed on how to interpret the revised ECC**. This, combined with standardised wording for rental agreements (e.g. for site access and wayleave procedures) may accelerate site acquisition procedures, reduce costs (e.g. arising from the need for legal input to interpret bespoke agreements) and lower barriers between operators and landowners.

Improved relationships

Network providers acknowledged that historical issues – such as rent arrears, contractors not following correct access procedures, or unauthorised contractors accessing sites – have had an impact on their relationships with landlords. Some network providers mentioned ongoing attempts to work with key stakeholders in the site rental market to improve communication and avoid issues of this nature, as well as to develop standardised contracts and approaches to ease procedures and minimise risks on both sides. **Improved relationships between network providers and landlords and the agreement of simple, standardised processes are likely to be key enablers of large-scale deployment of 5G**.

Market intermediaries

We received comments from network providers that **market intermediaries (such as agents for landlords) can increase the time and cost involved in site agreements, which in turn can reduce the viability of network deployment if the added time is too great**. Network providers recognised the value of market intermediaries, specifically their detailed understanding of the planning process and network provider requirements but felt there was a risk of introducing additional requirements or costs in the process.

Landlord classification

We received comments from one network provider that some landlords are asking to be classified as neutral infrastructure providers rather than landlords. Arrangements for site access between neutral infrastructure providers and MNOs are exempt from the ECC, with agreements reached on a commercial basis. Whilst the scale of the

issue is unclear, **if this issue becomes widespread then the impact of the revised ECC on site valuations could be significantly reduced**.[35]

C – Deployment barriers

We received comments from industry stakeholders and local authorities on various issues affecting network provider's ability to find suitable sites for 5G in both urban and rural areas. Access to power, and to suitable high-quality, high-capacity backhaul were highlighted – as well as more general challenges linked to finding enough new sites. Two issues around the affordability of sites were also raised:

- the overall cost of deploying and maintaining a site
- the potential effects on the cost of network deployment from local authorities prioritising revenue generation (from rental of their assets) over the promotion of longer-term infrastructure deployment.

It was also noted that access to fibre backhaul will be needed to support 5G and that more fibre deployment will be needed.

C1	**Securing sufficient sites in urban areas**
Access to sufficient government-owned sites and private sites to support 5G roll-out in urban areas was highlighted as a significant challenge. Given the importance of urban coverage for the early stages of 5G deployment, a lack of sites could introduce significant barriers to the roll-out of 5G.	
Availability of sites	Network providers commented that infrastructure supporting 2G, 3G and 4G is already deployed on many 'prime' sites, and **both planning regulations (see barrier B.1 above) and agreements under the ECC (see barrier B.3 above) could limit the ability of network providers to add 5G equipment and antennas to these sites**. Network providers consistently mentioned a lack of available sites to support new macro sites as a potential barrier to achieving high-quality coverage in urban areas. They commented that uncertainty around the deployment of outdoor small cells means that initial 5G deployment in the UK is likely to be from macro sites.[36] Other stakeholders commented that **a limit on new locations for macro sites will reduce the ability of network providers to plan optimal deployments** and force network providers to look at deploying more expensive small cell driven networks. Network providers also highlighted challenges due to some existing sites being unsuitable for 5G deployment. Some existing masts for UK mobile coverage date back to when 2G was first deployed (i.e. the mid-1990s). New 5G antennas will be heavier than 4G ones, meaning much **existing infrastructure will require upgrades or rebuilding to support continued evolution of 4G and addition of 5G services**

35 See https://bit.ly/2MOznvK for an example of ongoing discussions around access to sites for mobile infrastructure deployment.

36 It should be noted that network providers are considering the value of indoor small cells and suggest that more indoor small cells are likely to be needed to cover specific locations such as transport hubs, conference and event venues and airports, among others.

	– for example 5G 'massive MIMO' antennas where required.[37,38] This will create additional costs and may be challenging under the current planning regulations (see barrier B.1).
Access to government-owned sites	Gaining permission to use public-sector assets (both central and local government building rooftops and land) for macro sites was highlighted as a challenge by both network providers and by multiple local authorities. **Network providers suggested there will be clear improvements in mobile coverage if central and local government agencies provided rooftop sites and/or land for macro sites based on a standardised rate card**,[39] but network providers have struggled to reach agreement with central government departments to use their rooftops for mobile sites. Several network providers commented that government- and local-authority-owned assets are often viewed as 'sites of last resort', due to the high levels of uncertainty and additional costs associated with gaining permission. Local authorities and network providers also highlighted the existence of 'embargoes' by local authorities in some areas on the use of their assets to host mobile infrastructure. One network provider highlighted a recent case where a local authority had reintroduced an embargo whilst it worked to understand the implications of the ECC for the local authority. **Embargoes prevent the deployment of mobile infrastructure in an area and will be a significant barrier to the deployment of 5G**. Several local authorities commented that they had recently removed embargoes, or are in the process of removing them, to facilitate network deployment, but that **network providers are not engaging due to historical perceptions of the local authority being 'difficult'**.
Suitability of street furniture	5G roll-out in urban areas is expected to make significant use of street furniture to support small cells, although there is a lack of agreement among network providers over the scale of outdoor small-cell deployment needed for 5G. Lamp posts are expected to be the preferred host for small cells for both local authorities and network providers. However, interviewees raised **significant concerns about the viability of using lamp posts for 5G small cells**. Both local authorities and network providers commented that many existing lamp posts (and street poles) may not be suitable for 5G infrastructure deployment due to a lack of access to fibre backhaul and power, or because it has **already been used to support the deployment of free Wi-Fi or CCTV and will not be available for 5G deployment**. Other local authorities reported concerns that there was insufficient street furniture to support 5G roll-out, especially in town centres with 'clean streets' initiatives.
Access to street furniture	The installation and maintenance of street furniture can be outsourced through public–private partnerships (PPPs), with access controlled via the contractor. Where suitable requirements to support mobile deployment are not included in the PPP contract, it is often not possible for a network provider to access the assets without incurring significant additional costs. There is significant variability in the degree of co-operation from PPP contractors on mobile network deployment. We were provided with good-practice examples of PPP contractors working with local authorities and network providers to support infrastructure roll-out by actively engaging with the process and lowering financial and uncertainty barriers. However, other examples suggested that **PPP contractors require network providers to use the PPP's own contractors**, **or refuse access**

37 Network providers currently expect 4G and 5G deployments to co-exist on the same sites, requiring additional or upgraded antennas and network equipment to support both networks.

38 Massive MIMO is the term for antenna systems containing a large number of smaller antennas. It will be used to achieve capacity and performance improvements in 5G mobile networks, including beamforming, which will allow more targeted use of spectrum in a cell; see https://bit.ly/2kvVzh7 for further details.

39 For example, cost recovery with an agreed margin on top.

	to the assets completely, thus significantly increasing potential costs and uncertainty for 5G network deployment.
Quality of information	Network providers expressed concern that many local authorities provide large amounts of raw data when asked for information on assets. They noted that there were examples of good practice, but this was often driven by whether the council had mapped its infrastructure, for example during the procurement of a concession model agreement (see Barrier C.2 below). In turn, local authorities commented on a lack of communication from network providers on their requirements when requesting data. The **lack of communication between local authorities and network providers over site requirements** is potentially a significant barrier to the roll-out of 5G, in terms of both cost and time (see barrier D.2 below).
Railway stations	We are aware of capacity issues at railway stations where the landlord has refused to grant permission for network providers to deploy new infrastructure or upgrade existing infrastructure. **Continuing challenges with access to railway stations are likely to exacerbate capacity issues** and prevent the roll-out of 5G in locations with a high and predictable density of users.

Commercial models for use of street furniture

Network providers commented that proper use of concession models by local authorities to manage access to street furniture could be effective in promoting the deployment of 5G networks. However, there is currently inconsistent application of the model, with no clear guidance on best practice from central government.

Concession model	There is a **tension for local authorities between promotion of longer-term economic gain and short-term revenue aspirations** when determining terms for providing access to street furniture for mobile deployment. One common model is for local authorities to sign a fixed-term concession agreement providing exclusive access to their infrastructure for a defined period to the concession holder, in return for upfront payments or, sometimes, revenue-sharing agreements. When local authorities permit access to street furniture, provision of a public 'free' Wi-Fi service is often included as a requirement of the concession. Industry stakeholders expressed varying views on the value of concession models for promoting longer-term investment in infrastructure rather than as a means for the local authority to monetise street-level assets. One concern shared by many network providers is that **some local authorities have unrealistic expectations of the value of concessions**. Some network providers commented that concession models could be more valuable to industry stakeholders if they included both the street furniture and access to fibre connecting the street furniture into telecoms networks.[40] We were informed of one instance where industry stakeholders believe a small-cell concession was offered at well above what industry considers to be market value for access to street furniture. The suggestion was that the local authority's main goal was to maximise revenue, rather than encourage sustainable infrastructure deployment. When we discussed this issue with the local authority in question, it was clear in its belief that the concession was at a fair rate. The local authority stated that it was working to promote network deployment by making the concession holder responsible for providing access to all network providers and recovering the costs of the concession. This suggests a potential **mismatch between the expectations of local authorities and network providers on the value and role of concession contracts,** creating a barrier to 5G small-cell deployment.
Exclusivity	Both **local authorities and network providers expressed concerns about the effects that exclusivity granted by concession models can have on market developments (e.g. by preventing operators from being able to access the**

40 We note that different entities might own and/or control street furniture and the fibre that connects street furniture, which can form a barrier to offering both street furniture and fibre within a single concession.

infrastructure needed). One local authority suggested best practice should involve providing exclusivity to an infrastructure provider rather than to an MNO (to reduce the number of sites and lower the costs of 5G deployment), while another expressed concern about providing exclusivity to any party.

Some network providers were more open to the use of exclusivity arrangements by local authorities than others, suggesting that such arrangements could provide economic incentives for infrastructure deployment if properly designed. Network providers commented that areas with exclusivity arrangements tended to be more expensive for network roll-out, and will increase the cost of 5G deployment, as the use of infrastructure owned by third parties introduced additional cost and complexity to their network deployments.

Network providers also commented that **'use it or lose it' clauses in concession agreements could be an effective method of promoting infrastructure deployment**. Such clauses provide a period of complete exclusivity, with requirements to deploy a minimum number of sites each year. Following the end of the blanket exclusivity, zones of exclusivity around deployed sites could be designed to protect the investment of the concession holder whilst allowing other network providers to deploy their own infrastructure.

Lack of viable sites in rural areas

5G deployment in rural areas without 4G coverage is not viable, and even with 4G coverage, upgrade to 5G in rural areas will require innovative approaches to support the economic case.

Deployment viability	Both local authorities and network providers expressed concern about the commercial viability of 5G deployment in rural areas. All stakeholders recognised the potential importance of 5G for rural areas, but also commented that **it is likely to be challenging to bring 5G coverage to rural areas under a purely commercially driven model**. Network providers consistently mentioned the lack of a business case for 5G in rural areas, whilst local authorities expressed concern that **many areas with poor 4G coverage face being left further behind during the 5G deployment**. Several network providers commented that the initial deployment of 5G will use 4G network coverage – possibly including use of 4G spectrum for connectivity of devices to networks, with 5G spectrum providing fast downlinks from the network to the device.
Additional infrastructure requirements	There were several comments about challenges associated with deploying additional infrastructure in rural areas e.g. finding new sites for additional macro coverage and ensuring that sites are viable for use. Some network providers suggested that site sharing, including both active and passive components, is needed to support viable 5G roll-out in rural areas. Other providers highlighted the Scottish Government's 4G Infill Programme as a positive step towards providing 4G coverage in remote not-spots of rural Scotland. The new sites being installed by BTEE for the Emergency Services Network were also mentioned as an opportunity to encourage multi-operator site sharing in rural areas to the benefit of 5G roll-out (see Annex A.1.2).
Planning regulations	Specific known challenges arise when deployment occurs on planning-restricted land such as Sites of Special Scientific Interest, national parks and Areas of Outstanding Natural Beauty (see Annex B).[41] Both network providers and local authorities commented that they were aware of **additional complications caused by the involvement of multiple planning teams in planning-restricted areas**. We were not provided with specific examples and it is unclear how significant a barrier this may be for 5G deployment.
Local authority sites	Network providers identified concerns that **the potential for using local authority buildings in rural areas to support mobile deployment is not being realised**.

41 See https://bit.ly/2KInzzc for details of the June 2018 agreement between mobile UK and National Parks England, to boost mobile coverage in National Parks.

They suggested that local authorities should provide access to rooftop sites on their buildings on reasonable terms (possibly using a standard rate-card approach). However, rural local authorities commented that their buildings tend not to be in the most remote areas since they need to be accessible for citizens and local authority staff. As such, **the use of local authority buildings is unlikely to alleviate coverage issues in the most remote areas** for either 4G or 5G deployment.

Road and rail corridors

Network providers acknowledged the need for improved mobile coverage along road and rail corridors and expressed support for ongoing government initiatives.[42] However, they noted that **providing sufficient mobile coverage and capacity along railways is complex due to the range of stakeholders in the UK**. Industry stakeholders noted that access rates, and terms and conditions for access to railway land, present challenges (particularly health and safety restrictions and limited access to trackside locations). It was suggested that these issues, combined with the high cost of accessing Network Rail assets, generally make the use of rail assets for mobile network deployment unviable.[43]

Industry stakeholders also noted that UK **road and rail networks have extensive private telecoms networks, with assets which could be shared to support 5G deployment**.[44] However, network providers reported that gaining access to this infrastructure for mobile network deployment is challenging, due to health and safety requirements as well as operational/institutional barriers.

Accessing suitable backhaul

Network providers suggested that, within the next four years, up to 70% of sites will need upgraded backhaul to meet the requirements of 5G. Accessing existing fibre and deploying new fibre are challenging for network providers, and this is likely to have an impact on the deployment of 5G – particularly in rural areas.

Accessing existing fibre

Higher data usage, driven by both growth in 4G networks and the introduction of 5G will increase industry's demand for backhaul. Industry stakeholders and local authorities highlighted that **access to suitable backhaul connectivity at the right locations will be a key challenge for the deployment of 5G**. Network providers mentioned sites where microwave or satellite backhaul is currently used to support 3G and 4G but will not be suitable for 5G. The consistent view across industry is that fibre backhaul is needed to support 5G. Network providers also commented that the cost of providing multiple microwave links to support backhaul was greater than the cost of providing increased capacity through fibre connectivity.

Access to fibre networks for backhaul will therefore be key to meeting these demands, but it involves significant challenges for network providers. One network provider reported that it was able to organise fibre backhaul connections for new sites with sufficient notice, but that any change in plans cause significant delays whilst the connection to backhaul was rearranged. **A lack of flexibility in the process of providing new backhaul connections** is likely to cause a barrier to 5G.

Dark fibre

Network providers also raised the issue of dark fibre and the level of control available to them when using Openreach's fibre network. The November 2017 Competition Appeal Tribunal (CAT) ruling on dark-fibre access stalled Ofcom's plans to require Openreach to provide wholesale regulated dark-fibre access,[45] although a range of fibre-based connectivity products are available from Openreach. It is not clear

42 See https://bit.ly/2zGUsAc for details of an ongoing trial to improve mobile coverage on the Trans-Pennine route between Manchester and Leeds.

43 See https://bit.ly/2FxDjvR for Part 2 of the 2016 *Connected Future* report by the National Infrastructure Commission, which considered enhanced rail connectivity.

44 The road network includes infrastructure to enable active traffic management, and the rail network includes network signalling and railway operations both trackside and in stations (e.g. CCTV in stations).

45 See https://bit.ly/2HL5l96 or https://bit.ly/2KrJCVr for further details on the CAT ruling.

	whether network providers' key concern relates to flexibility for deployment or certainty over long-term pricing, but **for some stakeholders, access to dark fibre seems to be a concern for the roll-out of 5G**.
Deploying new fibre	Local authorities and network providers commented that **the process for deploying new fibre networks needs to be simplified**. Access to Openreach's ducts was raised as a potential barrier, and it was also mentioned that greater clarity on accessing ducts for mobile broadband use was needed. Ofcom's 'mixed use' remedy did not resolve the issue although it was noted that the next 'Business Connectivity Market Review' (BCMR) might review duct-and-pole access remedies.[46]
Cost	Network providers highlighted the cost of accessing suitable quantities of backhaul as an ongoing challenge to the roll-out of 4G, particularly in rural areas. Even in cases where a site is shared and the cost of backhaul can be reduced through sharing, network providers reported that **the cost of backhaul could be prohibitive to deploying a site**. Given expected increases in demand for backhaul on 5G networks, the cost of accessing sufficient backhaul is likely to be a major barrier to 5G roll-out in rural areas.

Access to power

Access to power for 5G equipment and antennas, both at macro sites and via small cells, is likely to create a barrier to the deployment of 5G.

Access to power	Industry stakeholders highlighted issues with provisioning power for existing sites and noted that these are expected to increase during the deployment of 5G, as 5G network equipment will have increased power demands. They commented that street furniture often does not have sufficient power to support mobile infrastructure (such as small cells). **Providing power to a small cell site often requires a significant upgrade of the street furniture, which introduces a lead time of several weeks.** In rural areas, the economic case for site deployment can be improved if the site already has power provisioned. If there is no pre-existing power network nearby, network providers reported that **the cost and lead time to obtain a connection can affect the viability of a site** and force them to use an alternative site to guarantee access to power, potentially result in a sub-optimal deployment. One local authority suggested that **early engagement with utility companies is essential**. Improved collaboration between network providers and utility companies can provide early warning of requirements to provide power connections for new sites, and thus remove a potential barrier to the deployment of 5G.

Affordability of sites

The cumulative costs of deploying and maintaining sites is a challenge, and non-hardware costs are expected to be a significant component of 5G small cells.

Cost of network provision, and operating costs	Network providers commented that the installation and ongoing costs of sites can vary significantly depending on location, and that this variation (especially higher deployment and running costs for sites in remote areas) could form a significant barrier to 5G deployment. A portion of the upfront cost relates to planning of the site, and these planning costs are highly variable. Capital costs for new macro sites can exceed GBP100 000 in urban areas and GBP300 000 in rural areas. The cost of deploying a particularly challenging site, for example in remote areas, can exceed GBP1 million, according to some industry stakeholders. Up to 70% of the current cost of macro sites is for hardware, but even in urban areas around GBP30 000 of the cost of a new site relates to site planning (such as arranging power, backhaul, overseeing

46 Current Duct and Pole Access (DPA) regulations allow access to BT's ducts for the provision of broadband, and also for mixed uses (i.e. the provision of broadband alongside other services (including mobile backhaul)), provided the primary purpose is broadband.

	planning permission and street works permits, and obtaining permissions to deploy the site). Once a site is operating, a high proportion of ongoing costs can consist of business rates. Other annual costs include site rental (see barrier B.3 above) and wayleaves, as well as provisioning of power, and the backhaul network. Network operators expressed concern that the **cost of operating sites will make the roll-out of 5G unviable outside urban areas** (see barrier C.2 above for further discussion). For small cells, the hardware is expected to be significantly cheaper than a macro site. However, the capital cost per small cell can still exceed GBP20 000, and according to some industry stakeholders up to 80% of small-cell provisioning costs are not hardware-related. The high proportion of cost associated with non-hardware elements of the installation also increases risks for network providers when confirming investment, given there can be larger variations in non-hardware costs between locations. This **variability of small-cell deployment costs can change the economic viability of a deployment**, delaying or even preventing roll-out entirely.
Costs and disruption for local authorities from site planning and preparations	Local authorities commented that planning for the deployment of mobile sites (macro, and small cells) incurs internal costs for local authorities. Costs related to traffic disruption during street works (including parking spaces being temporarily disabled, resulting in loss of revenue for the local authority), and costs related to upgrading street furniture to accommodate small cells were cited as being of concern, with local authorities suggesting **the cumulative effect of these costs inhibits their ability to support network deployments**.
Wayleaves	Local authorities and network providers commented on **the logistical and financial challenges involved with arranging wayleaves for mobile deployments** – particularly with the volume required to support 4G (and 5G) deployment. **The lack of a standard template for wayleave agreements** was highlighted as a key barrier.

D – Communication barriers

We received comments from both network providers and local authorities that inconsistent approaches by local planners to the approval of mobile sites is a large and growing barrier to both 4G and 5G deployment. Network providers highlighted a lack of alignment between national policy and the approaches taken by both central and local government to promote consistency in local practices. Industry stakeholders and local authorities commented that structural and operational tensions can exist between different departments within a local authority. These tensions:

- lead to conflicting priorities,
- create communication barriers between departments,
- exacerbate planning issues,
- lead to information gaps (e.g. local planners being unaware of strategic objectives relating to digital infrastructure).

Disjointed approach by central government departments

Central government departments should have strong awareness of the priorities for 5G deployment, but in practice DCMS is the only central government department consistently promoting 5G as a priority, which creates a barrier to the deployment of 5G.

Lack of coherent approach	Network providers reported barriers to providing enhanced capacity and coverage in areas of central London (such as Whitehall and Westminster), which could be lowered through better access to central government sites. We received comments that DCMS is undertaking valuable work on 5G connectivity and coverage. Industry

	stakeholders commented that, in the past year, DCMS has significantly developed its 5G capabilities and is undertaking cross-government initiatives to support 5G. However, stakeholders commented that **other parts of central government appear less aware of a national 5G strategy** being a priority. They stated that other departments also seemed less aware of the implications of delivering 5G (e.g. the need to facilitate access to government sites to host mobile equipment).
Site rental costs	Network providers commented that agreements for rental of **central government sites included higher than market rents as well as more-restrictive access and upgrade terms**. The effect of this is to limit the viability of government sites to support the widespread deployment of 5G, with operators typically considering government buildings as 'sites of last resort'.

Fragmented approach by local government

Fragmented approaches towards promoting digital infrastructure both across and within local authorities is a significant barrier to national 5G roll-out.

Lack of coherent approach	Industry stakeholders commented that **approaches to promoting digital infrastructure are variable at the local government level in the UK**, ranging from local authorities which are strongly proactive in improving mobile coverage, to those which are uncooperative regarding the installation of new sites to address coverage gaps. Most local communities want to have mobile connectivity, and local authorities will promote the benefits (e.g. remote working, digital enablement), but installation of new mobile sites is often challenged by communities or by local authority planning teams. Several local authorities provided examples of best practice aimed at harnessing the long-term benefits of digital infrastructure: for example, by promoting the use of local authority assets for telecoms, actively engaging with network providers to facilitate deployment, engaging in demand generation and information sharing on benefits of mobile connectivity with local businesses, and several initiatives to lower internal barriers to fixed network deployment, as recommended in Analysys Mason's previous report.[47] Network providers suggested that **an informed and proactive local authority 'digital champion' was a key enabler of infrastructure deployment**, considerably easing the planning and deployment process. However, a key barrier mentioned by network providers was that some **local authorities appear to approach digital infrastructure planning without alignment to national policy**. Network providers also mentioned the tension between short- and long-term goals – particularly the use of concession models designed to raise short-term revenue rather than promote sustainable longer-term investment in digital infrastructure and services for the benefit of local communities (see barrier C.1 above). Several local authorities have also implemented measures that act as direct barriers to 4G and 5G infrastructure deployment – such as enforcing embargoes or moratoria on telecoms sites (see barrier C.1) or charging high levels of pre-application fees. We are aware of one urban local authority proposing charges of ~GBP5000 for pre-application consultations, over 30 times the rate charged for an equivalent service by another (rural) local authority.
Fragmented internal approach	Both network providers and local authorities commented on the **barriers raised by the fragmented approaches of individual teams within a local authority**, such as the economic development, planning, and highways teams. Internal barriers and a lack of information exchange (caused by different teams having different priorities and incentives) create uncertainty in the deployment process for network providers and limit the ability of local authorities to effectively promote 4G and 5G deployment. We

47 See https://bit.ly/2FB7LXs for Analysys Mason report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

were provided with an example where two similar planning applications were submitted to a rural planning authority by a network provider – one application was accepted, and the other was rejected. The authority's economic development team was asked to step in by the network provider to resolve the situation.

Regional cooperation

The creation of regional combined authorities is a growing trend which brings an additional challenge when ensuring a coherent approach between authorities. Co-ordinating highways, planning and economic development teams across district and county councils – as well as combined authority teams and mayoral teams – is a significant challenge for regional combined authorities. **Both local authorities and network providers highlighted a lack of regional co-ordination as a significant barrier to large-scale deployment of 5G**.

We are aware that several regions are exploring the possibility of setting up a memorandum of understanding (MOU) between neighbouring local authorities to drive a coherent approach to a range of issues. **Ensuring that digital infrastructure is included within the scope of regional MOUs is likely to be an important step in promoting 5G deployment in a region**.

Inconsistent approach by network providers

A lack of engagement between network providers and local authorities, particularly a lack of early information sharing about mobile deployment plans, will create increasing barriers as 5G deployment accelerates over the coming 12–18 months.

Lack of coherent approach

Several local authorities commented on challenges raised by inconsistent approaches between network providers, including the use of different approaches when designing, installing and maintaining sites. The local authorities suggested that standardised installation models could simplify the network deployment process, particularly for small cells. However, network providers raised concerns about this approach, saying it would restrict flexibility when deploying their own networks or reduce competition by tying network providers to infrastructure providers for 5G deployment (see barrier C.1 above).

Given the early stage of 5G development, local authorities are aware that there is still significant commercial sensitivity associated with network providers' requirements and deployment plans. However, some local authorities raised concerns that **a lack of information sharing from network providers has created barriers for 4G deployment, and that similar barriers will occur with 5G** – with information not shared in some cases even after a local authority approached MNOs directly.

Inconsistent engagement

We received comments that **levels of engagement with local authorities vary between network providers**. One local authority reported using a corporate contract with a network provider as 'leverage' to ensure engagement from the network provider on its future deployment plans within the local authority area **A lack of clear routes for engagement via single points of contact is a key barrier for local authorities when working with network providers, and vice versa**. Local authorities also suggested that MNOs and the associated joint ventures are not always in alignment, with local authorities receiving contradictory answers from connected stakeholders on the same issue.

Local authorities also commented that **network providers are not always flexible in altering their approaches to meet specific local needs**. Network providers are often seen as taking a 'monolithic' approach with little consideration for local needs – for example, submitting applications for sites in inappropriate locations in rural areas.

Inconsistent engagement between network providers and utility companies, and a lack of engagement with local communities

Lack of early engagement between utility companies and network providers can cause challenges related to access to power. A lack of engagement between industry, local authorities and the public also creates a barrier of understanding for less digitally-aware consumers.

Utility companies

Network providers commented on significant challenges when engaging with utility companies – particularly related to gaining access to utility ducts and infrastructure to support fibre roll-out, as well as provisioning of power for mobile sites. In some cases, they stated that utility companies are unwilling to provide access to infrastructure; in contrast, other utility companies have established internal network provision teams.

We are aware that utility companies have demonstrated their enthusiasm to engage with network providers to support network deployment for smart grids but believe that Inconsistent **engagement between utility companies and network providers will create additional uncertainty** around the roll-out of 5G.

Public engagement

We were provided with several examples of issues caused by a lack of communication between local authorities, network providers and the public. In general terms, the public often mistrusts new technology, and especially wireless technology (e.g. concern about emissions from mobile masts, or street poles that appear to have antennas attached).

Several local authorities also provided anecdotal evidence of public concerns around the deployment of 5G when the area in question doesn't have adequate 4G coverage yet and the potential for digital exclusion and a lack of opportunities if areas continued to face challenges with mobile coverage.

We suggest that **clear communication from central to local government, and clear communication from both central and local government to the public, on the benefits of 5G will be key to obtaining acceptance for widespread 5G network roll-out.**

5 Barriers by scenario

5.1 Potential deployment scenarios in the UK

In this section we provide examples of how the barriers identified in Section 4 above may affect the deployment of 5G. We have developed three deployment scenarios for 5G in the UK to:

- illustrate how the barriers to 5G deployment may change between urban, rural and industrial locations
- demonstrate how the barriers may change as new use cases emerge for 5G.

These scenarios broadly align with the industry's vision for 5G use cases (as shown in Figure 3.1), and are summarised in Figure 5.1 In Figure 5.2 we provide a summary of how we believe each of the deployment scenarios are likely to be affected by the barriers identified in Section 4.

Figure 5.1: Potential deployment scenarios for 5G [Source: Analysys Mason, 2018]

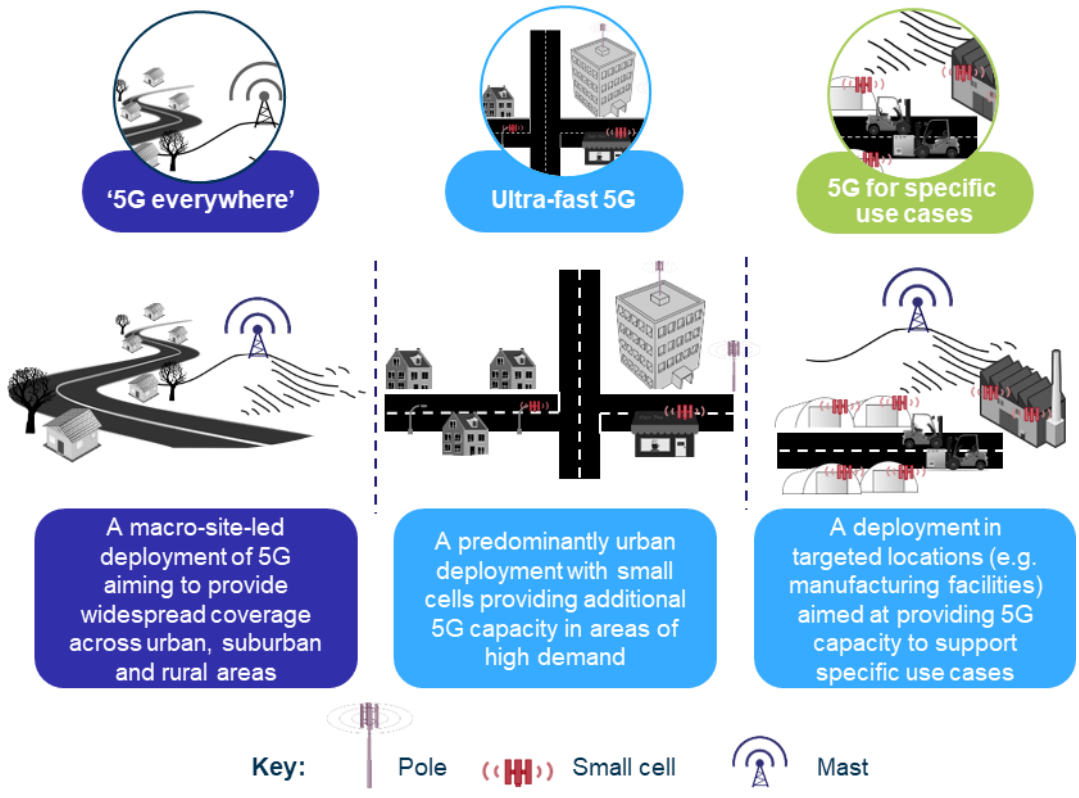
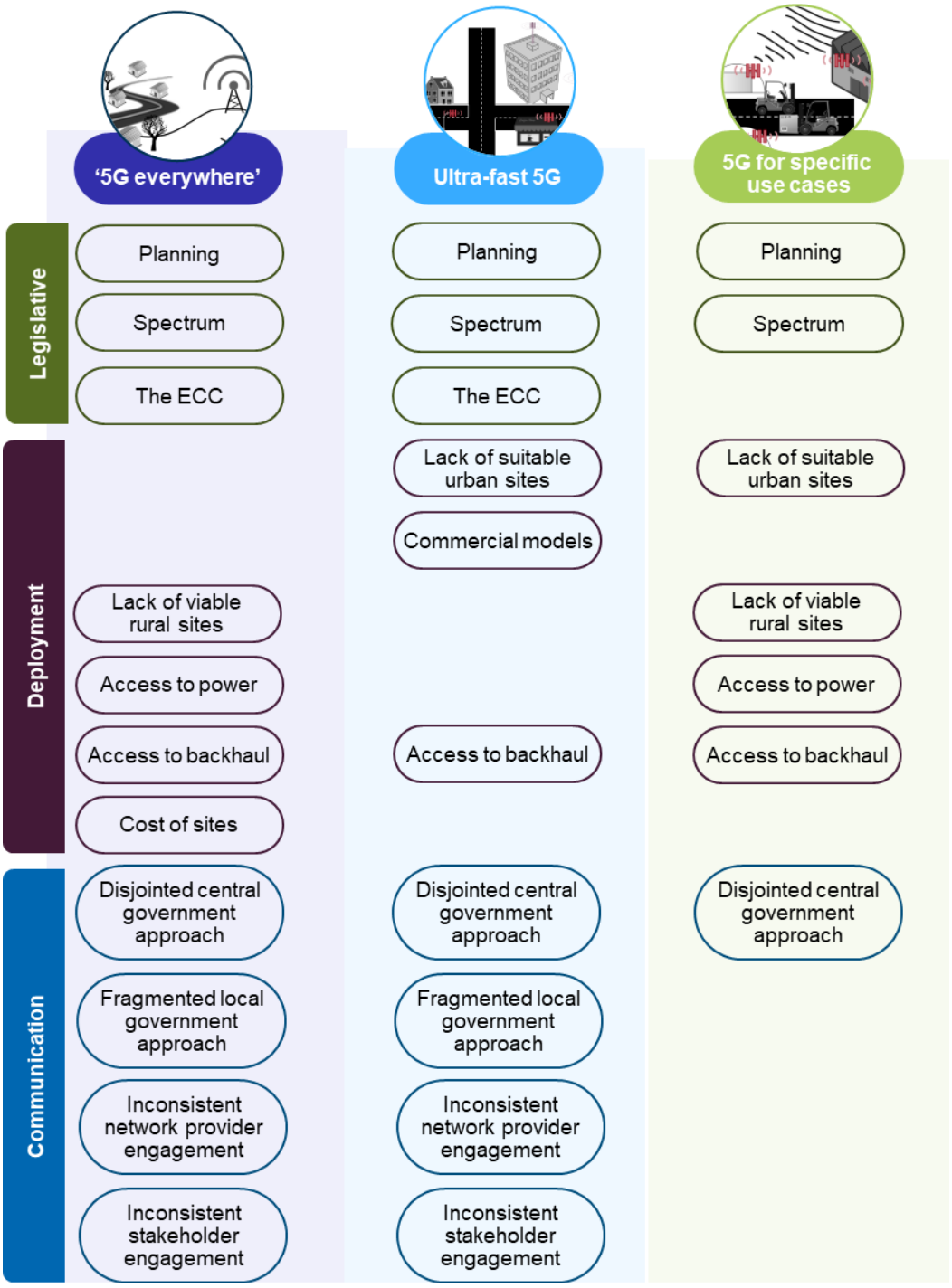


Figure 5.2: Summary of barriers by potential deployment scenario [Source: Analysys Mason, 2018]



In the following subsections we provide a more-detailed explanation of the possible impact that these barriers could have on the three potential deployment scenarios. For each scenario, we:

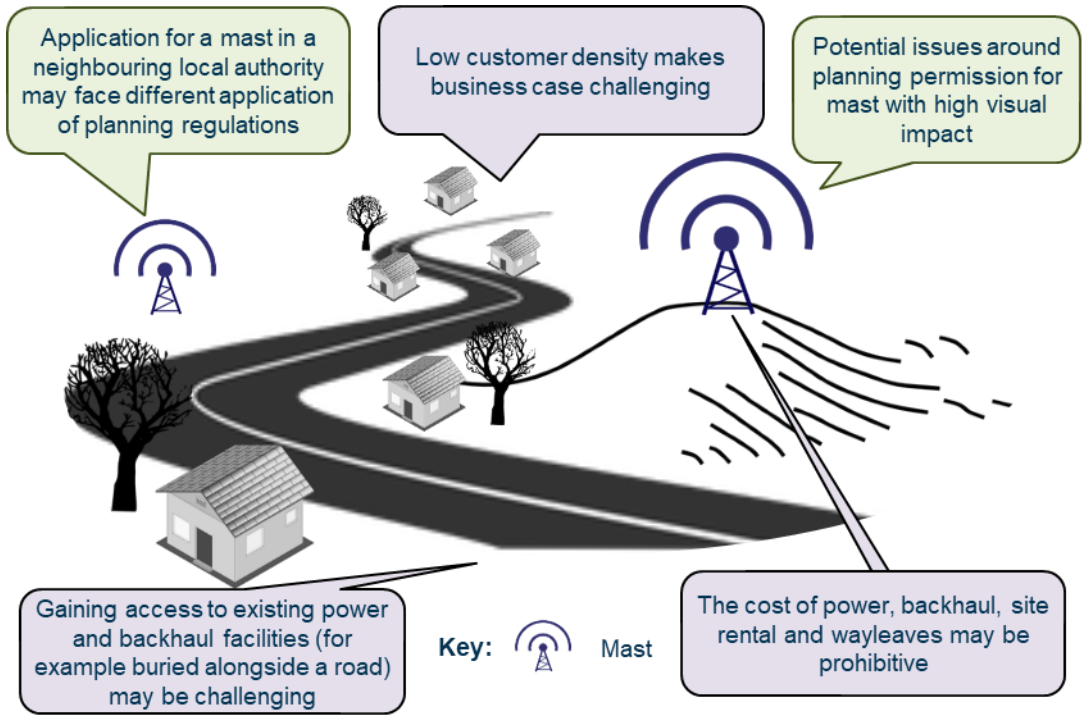
- identify key barriers to its deployment, based on the findings of this study
- illustrate the scenario, highlighting significant barriers.

5.1.1 Scenario 1: '5G everywhere'

Figure 5.3: Potential barriers to the deployment of '5G everywhere' [Source: Analysys Mason, 2018]

Area	Key barriers
Legislative	• Inconsistent application of planning regulations between neighbouring local authorities • Access to spectrum for rural providers (if different from nationwide MNOs) • Uncertainty around deploying new sites whilst the market adjusts to the new ECC
Deployment	• Lack of viable sites for rural macro coverage, and cost of deploying sites • Power connections to sites (provisioning power) • Backhaul infrastructure – e.g. fibre at the required locations, access to Openreach ducts ('mixed use' remedy)
Communication	• Joining up central government's approach to promote mobile deployment and 5G, and raising awareness within local authorities • Local variations in engagement between network providers and local authorities, and with utility companies

Figure 5.4: Illustration of '5G everywhere' deployment [Source: Analysys Mason, 2018]

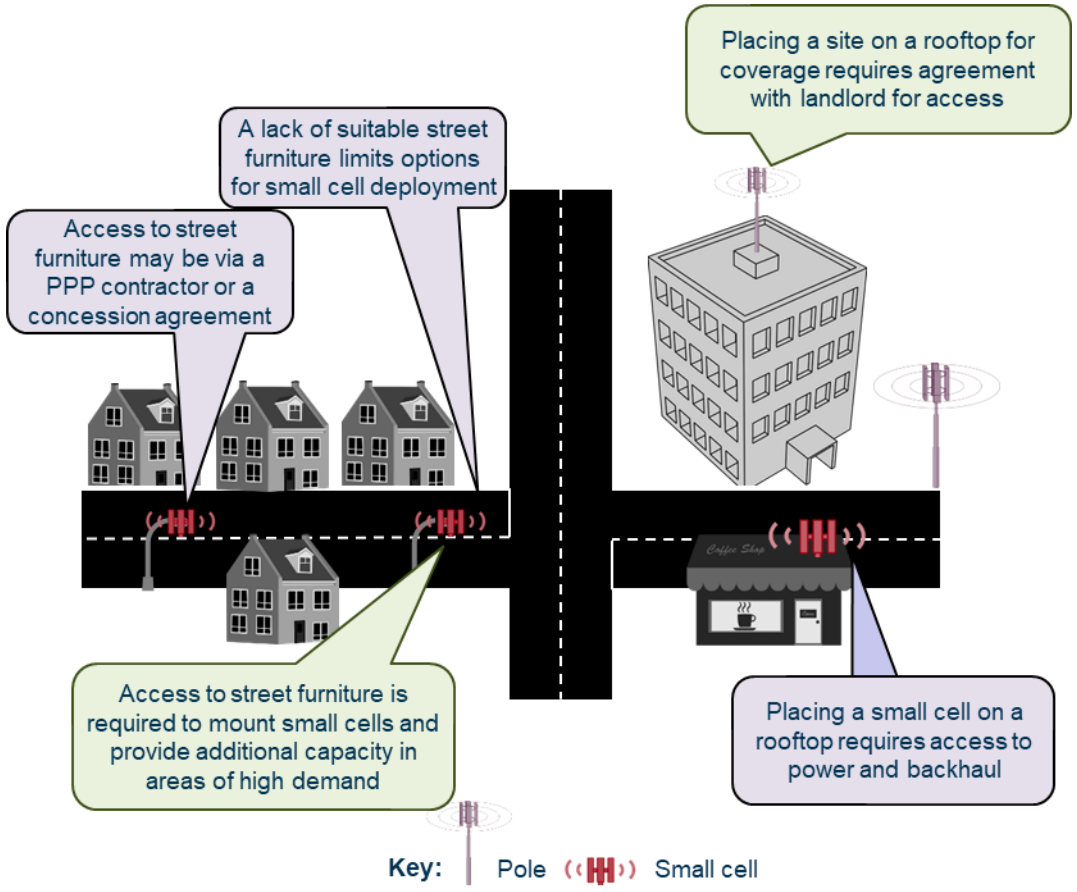


5.1.2 Scenario 2: Ultra-fast 5G mobile broadband in densely populated areas

Figure 5.5: Potential barriers to the deployment of ultra-fast 5G [Source: Analysys Mason, 2018]

Area	Key barriers
Legislative	• Inconsistent application of regulations/lack of planning precedents • Uncertainty around hosting small cells on buildings • Spectrum (e.g. private 5G networks for industrial use cases, and for indoor systems)
Deployment	• Finding sufficient street furniture/locations for small cells (including challenges with application of small cell concessions, if not properly designed, and identifying fit-for-purpose locations) • Backhaul infrastructure
Communication	• Promoting best practice within concession models, aimed at harnessing the long-term benefits of small-cell infrastructure deployment • Co-ordination among local authority departments and contractors • The need for early engagement with utility companies

Figure 5.6: Illustration of ultra-fast 5G deployment [Source: Analysys Mason, 2018]

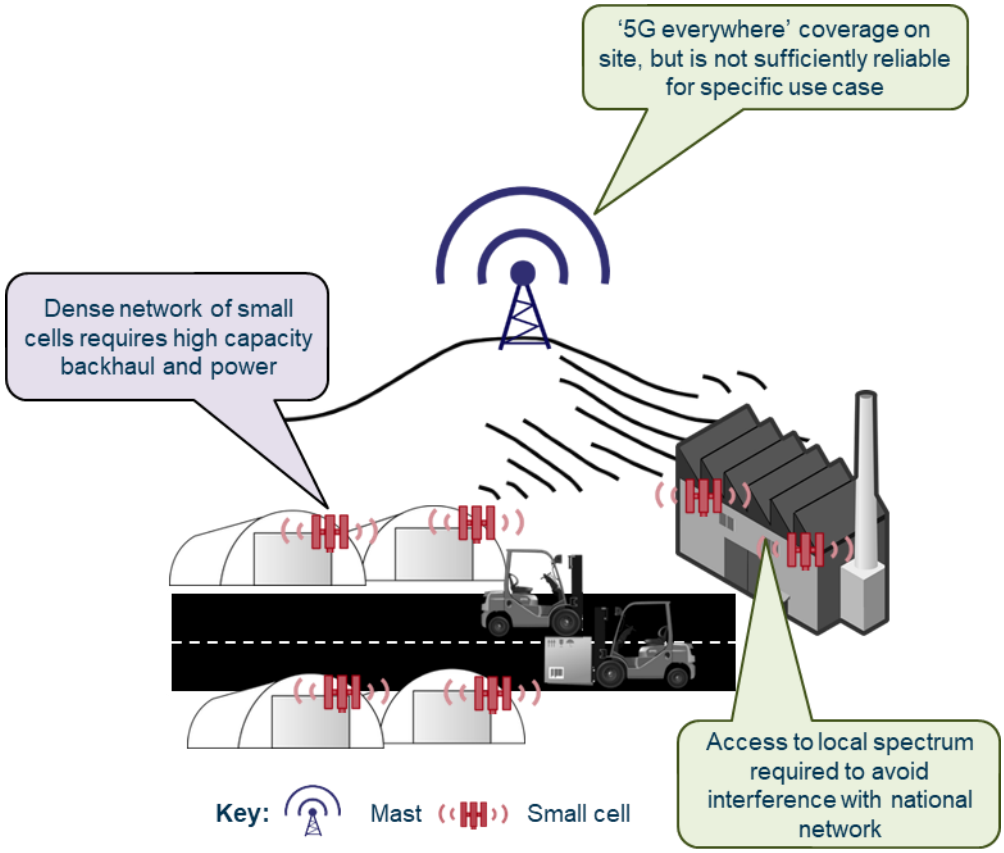


5.1.3 Scenario 3: 5G for specific use cases

Figure 5.7: Barriers to the deployment of 5G for specific use cases [Source: Analysys Mason, 2018]

Area	Key barriers
Legislative	• Access to rail and road assets and infrastructure • Spectrum – for example, private 5G networks for industrial use cases and for indoor systems)[48]
Deployment	• Access to sufficient backhaul and power • Providing road and rail coverage • Use of 5G technology for road and rail operations (as well as for 5G experiences for road and rail users)
Communication	• A disjointed central government approach • Complex operational models across UK rail and road networks (multiple stakeholders, complex structure, regional differences)

Figure 5.8: Illustration of 5G deployment for specific use cases [Source: Analysys Mason, 2018]



48 For example, the evolution of LTE 'ProSe' to 5G.

6 Recommendations

We have identified a series of 21 recommendations that we believe should be acted upon by industry, central government, devolved governments and local authorities to lower barriers to the deployment of 5G networks. These recommendations are based on the findings discussed in Section 4 and on comments provided by a wide range of stakeholders during this study.

Many of the barriers identified in this study are interlinked. Similarly, many of the recommendations aim to resolve issues across multiple barriers. Since access to fibre is a key requirement for 5G networks, the recommendations in Analysys Mason's previous report for the BSG are also relevant and should be acted on in tandem with the recommendations in this report.[49]

A summary of the recommendations is provided in Figure 6.1 below, with each recommendation numbered (R.*x*) to provide clarity for further discussions. The remainder of this section presents the detailed recommendations for stakeholders, grouped into the following categories:

- recommendations for all stakeholders
- recommendations for the UK government
- recommendations for industry
- recommendations for local authorities
- recommendations for industry and local authorities.

To help facilitate the enactment of the recommendations in this report, we have classified the recommendations as either:

- **Short-term priorities**: recommendations which can be enacted quickly (ideally before the launch of commercial deployments of 5G) and/or will encourage early 5G deployment
  - These recommendations are shown in green in Figure 6.1

- **Other priorities**: recommendations which can be enacted in the longer term to support the UK in harnessing the innovative potential of 5G networks.

It should be noted that this prioritisation represents Analysys Mason's independent opinion, and that different stakeholders expressed wide variations in their suggested priorities for lowering barriers to the deployment of 5G.

49 See https://bit.ly/2FB7LXs for Analysys Mason report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

Figure 6.1: Summary of recommendations in report [Source: Analysys Mason, 2018]

6.1 Recommendations for all stakeholders

Figure 6.2: Recommendations for all stakeholders [Source: Analysys Mason, 2018]

ID	Recommendation	Details
R.1	**Provide guidance on best practice in promoting infrastructure deployment**[50]	• DCMS, local authorities and industry stakeholders should collaborate to prepare a guidance document on what local authorities and planners should expect from initial 5G mobile deployment – for example in terms of roll-out priorities, sites needed, coverage expected, assets and facilities that might be needed, timescales needed for site approval and planning • We recommend that this guidance is collated in a single document (consistent with best practice in fixed network deployment) covering: – government priorities for 5G and how local authorities and industry can contribute – interpretation of planning regulations to support 5G macro sites and small-cell deployment – guidance on co-ordinating street works and planning processes[51] – engagement between local authorities and industry – potential approaches by local authorities to lower internal barriers (see R.16) • Network providers should continue to develop and maintain best practice standards for mobile site development taking account of 5G, including mast design, to provide assurance to local authorities and to work towards futureproofing of sites – for example by ensuring capacity for future upgrades by providing extra load-bearing capacity or space on masts – we understand that a code of practice on mobile site deployments in England was adopted in November 2016 and suggest that this code is reviewed in light of 5G requirements and expanded to cover Scotland, Wales and Northern Ireland[52]
R.2	**Promote 5G deployment in non-commercially viable areas**	• DCMS, industry, local authorities and target users of 5G networks (e.g. broadcasters, utility companies, emergency services, transport, agriculture) should form a working group to consider approaches to aid roll-out in non-commercially viable areas • We suggest that these discussions should consider several possible methods to lower deployment costs, for example: – facilitating site sharing – continuing to consider innovative deployment models if relevant to extend 5G coverage into remote areas, e.g. in relation to access to spectrum – providing access to ESN sites funded as part of the Home Office Extended Area Services contract (see Annex A) for 5G coverage – exploring business rates relief for mobile infrastructure in rural areas

50 We note that this is within the scope of the Local Connectivity Group (see Annex A for further discussion).

51 See https://bit.ly/2FB7LXs for Analysys Mason report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

52 See https://bit.ly/2kpulc9 for the Code of Best Practice on Mobile Network Development in England.

ID	Recommendation	Details
R.3	**Facilitate discussion on innovative use cases for 5G**	• Collaborative groups should be established with interested local authorities, telecoms industry stakeholders, government and other industry stakeholders (such as 5G user industries, or 'verticals') to facilitate discussions on targeted uses for UK 5G deployment– for example to identify coverage requirements (including along roads and rail), and targeted and coordinated use cases, building on the outputs of 5G trials from the existing DCMS testbeds and trials programme, and other planned deployment initiatives – we note the Local Connectivity Group (discussed in Annex A) could facilitate this – we suggest these collaborative groups consider 5G coverage for roads and railways, building on existing DCMS testbeds and trials
R.4	**Develop and implement a clear communication strategy to raise awareness on the benefits of 5G**	• DCMS, with industry stakeholders and local authorities, should develop a communications strategy to raise awareness and promote the benefits of deployment of 5G, for wider distribution to 5G user industries, businesses and to the public. We recommend that the strategy should: – introduce 5G, place it in the context of previous mobile connectivity developments and manage expectations on what 5G is expected to deliver, and where UK market priorities lie – have targeted messaging for both local authorities and the public on the benefits of 5G, whilst also addressing any concerns (e.g. proliferation of masts, antennas on street furniture, human exposure to emissions)
R.5	**Continue to ease deployment barriers to new fixed networks**	• DCMS, industry stakeholders and local authorities should continue to streamline the procedures for deploying fixed networks by implementing the recommendations of the review into barriers to fixed network deployment
R.6	**Streamline access to government-owned assets, sites and land for 5G mobile infrastructure**	• DCMS, industry stakeholders and local authorities should develop a streamlined and standardised approach to local authority assets and sites access, considering: – wayleaves – fair valuation (i.e. rental) of government and local authority owned assets for mobile infrastructure, considering wider social benefits of improved mobile connectivity – best practice processes and timescales – prioritisation of longer-term infrastructure deployment benefitting local citizens and the community, over shorter-term revenue generation for the local authority – appropriate lengths of contracts to encourage sustainable investment – appropriate use of exclusivity clauses for assets, for example target 'use it or lose it' clauses to ensure infrastructure is utilised • DCMS should build on ongoing work to agree approaches and fair terms with Highways England, Network Rail and other key stakeholders for mobile network providers to access to existing telecoms infrastructure on roads and railways for 5G deployment

6.2 Recommendations for the UK government

Figure 6.3: Recommendations for the UK government [Source: Analysys Mason, 2018]

ID	Recommendation	Details
R.7	**Promote a coherent national approach to 5G across central government on priorities for 5G**	• DCMS should work with ministries, departments and agencies across government to ensure a coherent approach to 5G, and a coherent application of policy and priorities to promote digital infrastructure
R.8	**Update and harmonise planning legislation**	• DCMS and MHCLG should review Part 16 of the GPDO to facilitate 5G deployment by: – exploring the impact of current mast height restrictions under planning regulations, and whether these restrictions remain valid for 5G – clarifying the rights of operators to upgrade masts and small cells under permitted development or prior approval procedures • We note that planning legislation in the devolved nations is independent of DCMs and MHCLG, but recommend that, where appropriate, DCMS and MHCLG should collaborate with the devolved governments to develop a harmonised approach to planning regulations for mobile infrastructure
R.9	**Review position on ongoing legal issues**	• DCMS and MHCLG should review the status of the ongoing legal dispute over permitted development rights for mobile poles mentioned in this report and consider submitting a brief to clarify the intent of planning regulations • DCMS should review the effects of the ECC on the market for mobile sites and: – review the effects of the revised ECC at regular intervals to ensure the revisions are securing the desired benefits – support legal disputes as required to clarify the intended interpretation of the new code • We also recommend that DCMS reviews the process for NTQs, including potential requirements for temporary sites during redevelopments, during the next review of the ECC
R.10	**Review regulation of existing fibre networks**	• DCMS and Ofcom should review the existing 'mixed use' regulations for duct and pole access to BT's infrastructure to establish whether a more open approach can support the deployment of 5G • Ofcom should continue to review potential opportunities for lower cost backhaul to be made available to support emerging 5G/small-cell requirements – we suggest that Ofcom engage in discussions with Openreach and the mobile network providers on appropriate regulations to facilitate access to existing fibre assets for the purpose of supporting mobile backhaul[53]
R.11	**Facilitate spectrum access for local use cases**	• DCMS and Ofcom should explore potential flexible licensing approaches for suitable spectrum to support local 5G service deployment

53 See https://bit.ly/2kmMfw6 for Ofcom's 2016 Business Connectivity Market Review.

6.3 Recommendations for industry

Figure 6.4: Recommendations for industry [Source: Analysys Mason, 2018]

ID	Recommendation	Details
R.12	**Establish a working group to consider access to power and utility infrastructure**	• Network providers should establish working groups with power and utility companies to: – establish standardised templates, processes and timescales to obtain access to power for new-build sites – discuss best practice for accessing utility infrastructure to support the roll-out of fibre and small-cell networks (in line with the cost reduction directive)[54]
R.13	**Develop commercial models to support access to backhaul**	• Fixed and mobile network providers should continue to collaborate to develop viable commercial models for access to sufficient capacity of fibre backhaul – including the use of the concession model where appropriate
R.14	**Ensure consistency between stakeholders**	• MNOs and joint ventures should maintain common positions when communicating with local authorities to avoid confusion
R.15	**Improve relationships with landlords**	• Network providers should continue to seek to develop standardised code agreements with agreed terms on site access and site upgrades – this agreement should be linked to the code of practice published by Ofcom in December 2017 to provide assurances for both parties • We understand work in this area is in progress, both with the Greater London Authority (GLA) and with regional and national bodies representing landlords across the UK. We suggest this work is completed as soon as possible to 'unblock' the mobile sites market

6.4 Recommendations for local authorities[55]

Figure 6.5: Recommendations for local authorities [Source: Analysys Mason, 2018]

ID	Recommendation	Details
R.16	**Develop a proactive approach towards digital infrastructure deployment**	• Local authorities should prioritise the deployment of sustainable, long-term digital infrastructure in their local plans, considering: – requirements for new developments to include infrastructure to support fibre connectivity – requirements to provide suitable space for mobile infrastructure[56] • Local authorities should establish digital infrastructure teams with responsibility for managing digital infrastructure related issues

54 The EC cost reduction directive aims to facilitate deployment of high-speed broadband by reducing the costs of deploying new infrastructure and encouraging sharing of existing infrastructure; see https://bit.ly/2jnEPcE.

55 We note that many of the recommendations in this section complement those made in the previous report on lowering barriers to fixed infrastructure deployment. We reiterate our recommendation that the recommendations in the previous report are enacted in full; see https://bit.ly/2FB7LXs for Analysys Mason report for the BSG (2017), *Lowering barriers to telecoms infrastructure deployment*.

56 See https://bit.ly/2roXlU6 for details of the consultation to update the NPPF.

ID	Recommendation	Details
		– the digital team should work to ensure there is a consistent approach towards digital infrastructure across all relevant teams e.g. street works and highways, planning and economic development teams – all key departments with responsibility for delivering digital infrastructure should be represented – a single point of contact should be appointed from within the digital team to manage interactions with network providers
R.17	**Co-ordinate regional approach**	• Local authorities should collaborate with neighbouring authorities, including regional partnerships, to establish regional guidelines that can be applied consistently for promoting digital infrastructure deployment – these guidelines should consider planning, street works and access to assets, and should be in line with the approach recommended by central government
R.18	**Leverage LFFN for 5G**	• Local authorities awarded funding in LFFN should encourage fibre operators to offer fibre solutions that can be used for 5G deployment
R.19	**Facilitate access to assets by removing non-commercial barriers**	• Local authorities should facilitate access to local-authority-owned land, sites, and assets (including street furniture) by removing existing embargos and moratoriums on the use of local authority assets for digital infrastructure • Local authorities should consider making their assets available for pilot 5G deployments to test procedures and build public awareness • Local authorities should ensure adequate access to assets and street furniture for digital infrastructure deployment are included in PPP contracts – we recommend local authorities avoid requiring network providers to utilise specific contractors, but instead mandate minimum works standards that network providers must meet

6.5 Recommendations for industry and local authorities

Figure 6.6: Recommendations for industry and local authorities [Source: Analysys Mason, 2018]

ID	Recommendation	Details
R.20	**Clarity on roll-out requirements for 5G**	• Industry stakeholders should collaborate with local authorities to develop clear guidance on the core and optional site requirements for deploying 5G macro sites and small cells
R.21	**Develop standard templates for information sharing**	• Local authorities and network providers should develop standard templates for information sharing on: – local authority assets and sites suitable for 5G deployment – existing infrastructure available to support 5G deployment – proposed network deployments • These templates should be designed to ensure that information shared is immediately useful to all involved parties, and to reflect the confidential nature of the information involved • We understand that some network providers are exploring the use of seminars to share information with local authorities and initiate discussion. We recommend that, if seen as successful, this approach should be widely adopted

Annex A Mobile connectivity in the UK

In this annex, we provide:

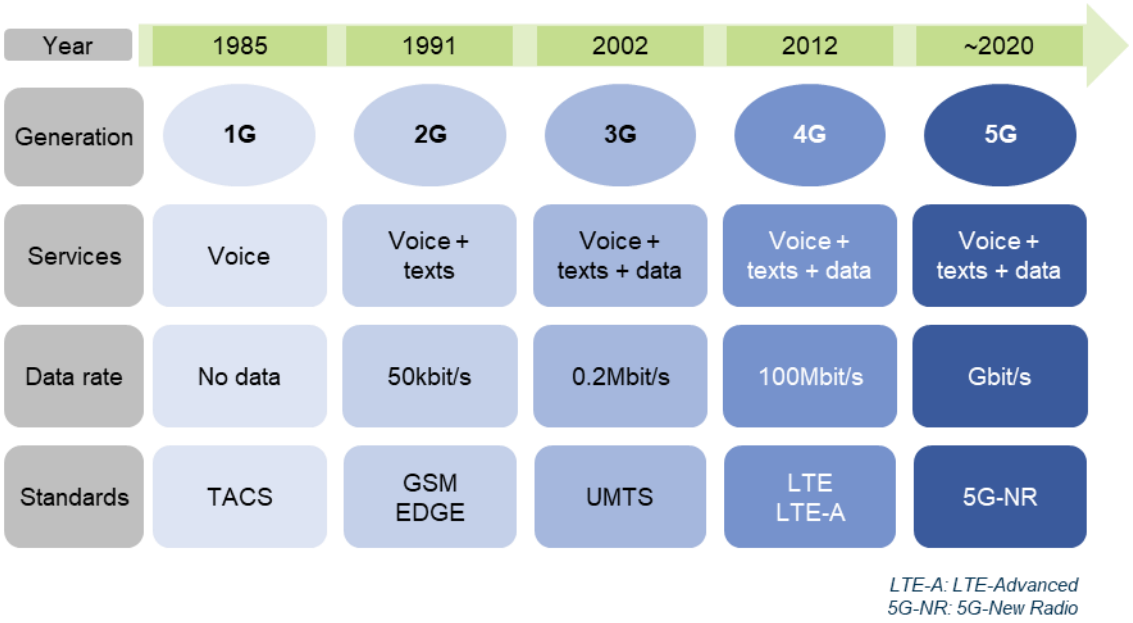
- an overview of the mobile connectivity market in the UK
- a summary of the development of 5G in the UK.

A.1 Mobile communications in the UK

Mobile networks, or mobile radio systems, provide high-mobility, wide-area, wireless voice and data communications using frequencies in suitable ranges of the radio spectrum. The first mobile networks were launched in the UK in 1985 as an analogue system based on the first-generation (1G) Total Access Communication System (TACS) standard. This was followed by second-generation (2G) digital networks, launched in the early 1990s. Subsequent generations of mobile technology have provided 3G and then 4G services, with each generation introducing new features and increased connectivity and data-transmission speeds. Across the UK today, consumers receive a mix of 2G, 3G and 4G services, depending on their location and type of device.

Figure A.1 below illustrates the evolution of mobile communication technologies in the UK.

Figure A.1: Evolution of mobile communication technologies in the UK [Source: Analysys Mason, 2018]



Since the launch of 4G in the UK in 2012, there has been a rapid migration from use of 2G and 3G devices, to 4G. According to Analysys Mason's Research division, 4G currently accounts for 72% of all connected devices in the UK, and this figure is projected to rise to over 90% by 2020.[57]

5G networks are likely to be launched commercially in the UK from 2020. Network providers are upgrading their current networks to be 5G-ready and are undertaking test deployments to establish the requirements and procedures for full commercial deployment over the next 12–18 months. In parallel with making networks 5G-ready, MNOs are also seeking to expand 4G network coverage across the UK. Hence, several of the barriers to deployment that we discuss in the main body of this report are already being experienced by operators in the context of their 4G network expansion.

Responsibility for managing radio spectrum assignments for mobile network operation lies with Ofcom, the communications regulator. Ofcom is responsible for assigning licences and for defining the rights for use of spectrum in the UK, typically by issuing individual licences. The spectrum used in the UK for mobile networks has been harmonised across Europe, and internationally, for these purposes. The frequencies used by mobile networks today are concentrated within the ultra-high frequency (UHF) up to microwave ranges of electromagnetic spectrum, in bands from around 700MHz to 3.5GHz. 5G will also use frequencies above this, including frequencies around 3.5GHz that were recently auctioned by Ofcom, and new frequencies in the millimetre-wave (mmWave) portion of spectrum (above 24GHz),[58] as discussed in Section A.1.3 below.

A.1.1 Key players

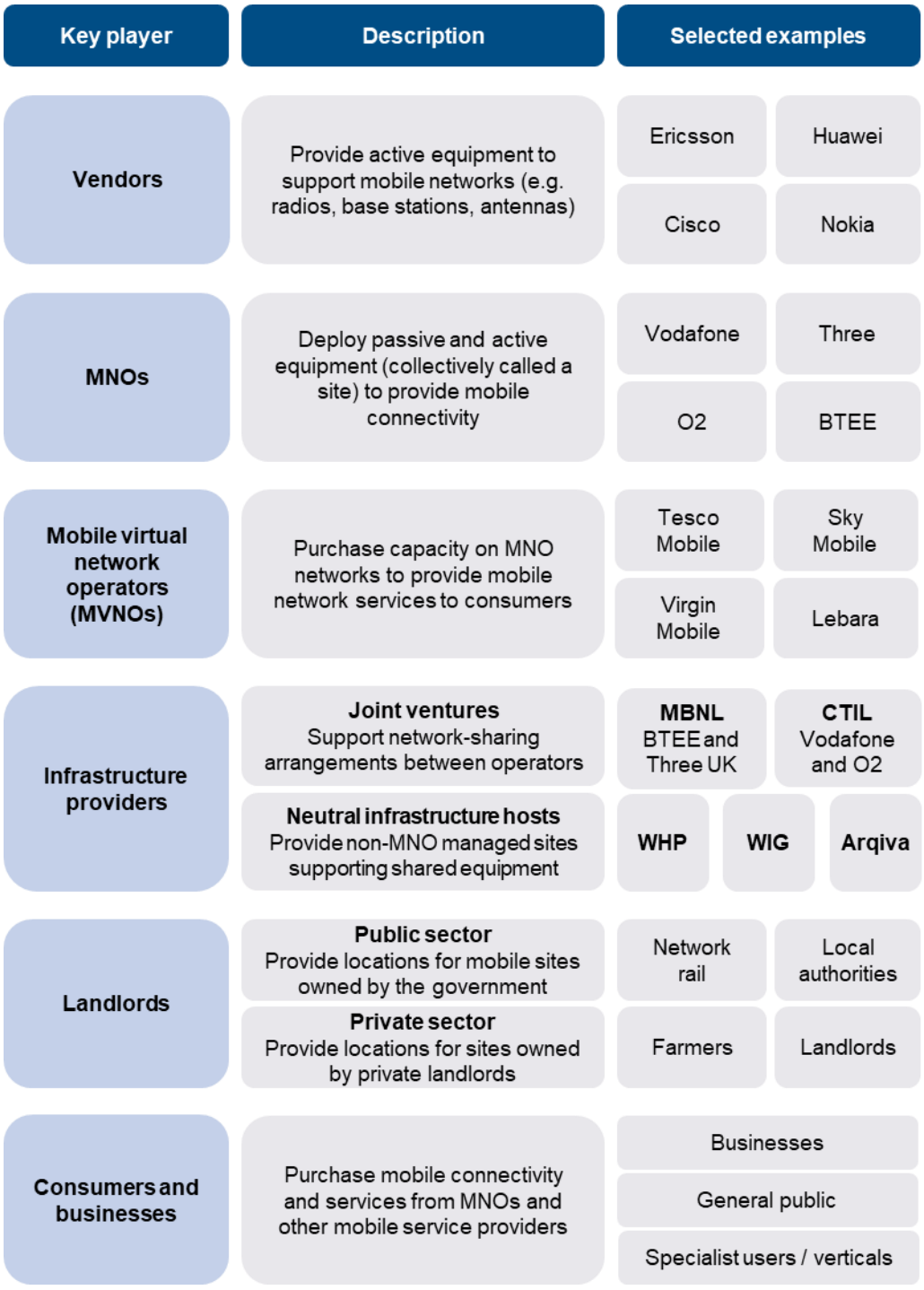
The UK's mobile market is, by international standards, a mature market, underpinned by a complex value chain within which multiple network and/or service providers offer mobile networks for business and consumer use. There are four MNOs in the UK (Vodafone, Three, O2 and BTEE). Several types of infrastructure provider are involved in deploying sites, and a range of vendors provide network equipment and consumer devices.

A summary of key players in the UK mobile market is shown in Figure A.2 below.

57 Data from Analysys Mason Research, available at https://bit.ly/2rvtmLh

58 mmWave refers to the spectrum from 30GHz to 300GHz. However, the term mmWave is commonly used to refer to frequencies above 24GHz, which includes the '26GHz band' which has been identified in the UK, and across Europe, as a 'pioneer band' for 5G mmWave deployment.

Figure A.2: Summary of key players in the UK mobile market [Source: Analysys Mason, 2018]



A.1.2 Expanding 4G coverage

With 4G networks well established in most urban areas in the UK, operators are now focusing on expanding their networks further, to cover more of the population. As with previous generations of mobile network technology, providing widespread rural 4G connectivity is challenging due to the limited economic viability of site deployments in rural areas and related barriers. Several projects

are currently underway in the UK that will deliver improved 4G coverage in rural areas – two examples are provided below.

Initiative: The Emergency Services Network (ESN)

Start date: 2015

Key providers: BTEE, Motorola, the Home Office

Status: Deployment in progress

Plan: The ESN will be the new emergency service communications network, replacing Airwave (the existing network). The GBP1.2 billion ESN contract has been in the delivery phase since 2015 and will use EE's mobile network to provide widespread geographical coverage across the UK for use by the emergency services. 4G-enabled ESN handsets will be used by the emergency services to provide secure connectivity to the network.[59] As part of the ESN, the Home Office is providing funding for ~300 additional sites to provide coverage in very remote areas under the Home Office Extended Area Services contract.

Initiative: The Scottish 4G Infill Programme

Start date: 2017

Key providers: *Not yet known*

Status: Procurement phase

Plan: In 2017, the Scottish Government announced a GBP25 million programme to address 4G 'not spots', aimed at selected remote areas in the Scottish Highlands, and other locations where no mobile coverage currently exists. The objective is to cover around 60 specific locations, by providing masts and connectivity that MNOs can use to deploy their networks. An initial 16 sites have been identified and a total of 60–70 sites will be targeted through the initiative.[60]

A.1.3 Alternative wireless solutions

Alongside the different generations of nationwide mobile networks provided by UK MNOs (discussed in Section A.1.1 above), there are several alternative options for providing wireless connectivity. We have identified three solutions that can complement and work alongside current mobile networks, and may also augment the capabilities of 5G networks:

- **Wi-Fi** – A low-power, short-range wireless technology that is widely used internationally and integrated into many smartphones, tablets and connected devices. Wi-Fi commonly uses 2.4GHz and 5GHz frequency bands. Wi-Fi is widely used for data connectivity within the home (e.g. within wireless routers), or in outdoor Wi-Fi hotspots. The widespread adoption of Wi-Fi has revolutionised in-building wireless connectivity and has also been used to provide public wireless hotspots in many locations across the UK.

- **Microwave** – High-bandwidth, low-latency point-to-point and point-to-multipoint fixed wireless connectivity can be provided in several higher-frequency bands in the UK. These

59 See https://bit.ly/1QUUOF0 for details of the ESN.

60 See https://bit.ly/2HHu1zj for details of the Scottish 4G Infill Programme.

'microwave links' are widely deployed within UK mobile networks. Fixed links deployed in MNO networks typically use licensed spectrum managed by Ofcom.

- **mmWave and gigabit wireless** – Wireless-to-the-premises services can also be provided using licence-exempt spectrum in the mmWave portion of spectrum, such as the 60GHz band in the UK. Companies such as Blu Wireless in the UK have pioneered equipment that can be used to provide high-speed wireless-to-the-home (WTTH) or wireless-to-the-building (WTTB) connectivity. Future 5G mobile services are also expected to use mmWave spectrum, and Ofcom has published a roadmap of potential bands that 5G mobile might use in the mmWave range.[61]

A.2 Development of 5G in the UK

The UK government has stated a clear ambition for the UK to become a world leader in the development and deployment of 5G technology and to ensure that the country can maximise the potential productivity and efficiency gains associated with 5G networks and services. Considerable work is being undertaken to prepare for 5G, including 5G network planning by network providers. Ofcom's recent auction of 2.3GHz and 3.4GHz spectrum has provided spectrum (at 3.4GHz) that can support initial 5G deployment in the UK, and further 5G spectrum auctions are proposed.

To frame its overall 5G strategy, in 2016 the UK government commissioned two reports which assess the current mobile landscape in the UK and identify what the UK needs to do in order to 'take the lead' in 5G:

- In December 2016, the NIC's *Connected Future* report defined the steps the UK should take to help improve the deployment of 4G and 5G mobile services (e.g. infrastructure solutions).[62]

- In January 2017, the Future Communications Challenge Group (FCCG), which was established by DCMS in 2016, published a report identifying ways to encourage the development of 5G mobile telecoms networks in the UK (e.g. use cases, technological developments).[63]

Both reports recommended that the government should act quickly to ensure that the UK is not left behind in the development of 5G, given that other leading nations worldwide are also actively preparing to launch 5G. Both reports also encouraged the government to set out a clear vision and strategy for 5G. They specifically highlighted spectrum policy, planning policy and regulation (at both local and national levels), and government funding (e.g. 5G trials) as critical factors that the UK strategy for 5G should address.

61 See https://bit.ly/2KOWKTT for Ofcom's 5G strategy.

62 National Infrastructure Commission (2016), *Connected Future*, available at https://bit.ly/2FxDjvR

63 Future Communications Challenge Group (2017), *UK strategy and plan for 5G & Digitisation – driving economic growth and productivity;* see https://bit.ly/2ic4L6S

A.2.1 UK government's 5G strategy

The UK government's 5G strategy sets out recommendations on the steps the government should take to realise its ambition for the UK to become a global leader in 5G.[64] The strategy is described as a 'living document' that will be continuously updated as further research is undertaken; the first update to the 5G strategy was published in December 2017.[65] The strategy outlines seven key themes that will determine the UK government's progress towards 5G:

Building the economic case

The government will stimulate investment in 5G technology through the 5G Testbeds and Trials Programme, which aims to co-ordinate industry and academia in developing new 5G services and applications. Initial trials have been selected to provide testbeds for a broad range of uses and operating environments (e.g. urban and rural) and to build the business case for 5G applications.

Fit-for-purpose regulations

The government has stated it does not believe the current regulatory framework is acting as a barrier to infrastructure sharing. However, it will review the current planning and regulatory system based on the 5G Testbeds and Trials Programme and will report back by the end of 2018 with relevant findings to ensure that regulations do not act as a barrier to deployment of 5G. See Section A.2.6 below for further discussion of ongoing work on developing fit-for-purpose regulations.

Local areas – governance and capability

Local governance has been identified as a critical area in assisting 5G deployment. The UK government is currently consulting on whether local areas should be required to publish policies setting out how digital infrastructure and mobile connectivity will be delivered in their areas.[66] See Section A.2.6 below for discussion of the Local Connectivity Group – which aims to support local authorities developing plans for local connectivity.

Coverage and capacity

The government has instructed Ofcom to introduce meaningful coverage metrics and will consult on different models to improve mobile coverage on roads and railways. Ofcom has recently issued a consultation on possible coverage obligations in 700MHz spectrum (the consultation period closed in early May 2018).[67]

Safe and secure deployment of 5G

The government has stated that the 5G Testbeds and Trials Programme will be used to help ensure that the correct security architectures that meet the requirements of customers and industry are developed and implemented (working with other government bodies such as the Home Office and the National Cyber Security Centre).

64 DCMS (2017), *Next Generation Mobile Technologies: A 5G Strategy for the UK*; see https://bit.ly/2FHSDpG

65 See https://bit.ly/2BG0SCt for the December 2017 update to the UK's 5G strategy.

66 See https://bit.ly/2Fr9Vvu for details of the government's consultation on the National Planning Policy Framework.

67 See https://bit.ly/2tHJZHk for details of Ofcom's consultation on 700MHz spectrum.

Spectrum

In its 5G strategy, the government instructed Ofcom to review the scope for a spectrum licensing regime to help facilitate further mobile deployment, and to ensure that 5G spectrum is made available in the 'most appropriate and timely manner'. Ofcom has since published a review of its approach to spectrum access.[68] The government will also prioritise making spectrum released from public-sector use available for 5G, where feasible.

Technology and standards

The government is engaging with appropriate technology standards bodies to support the take-up of UK needs and ideas in the emerging 5G specifications.

In addition to the themes raised in its 5G strategy, the government is also considering how it can promote long-term investment in digital connectivity, through its *Future Telecoms Infrastructure Review*, which is scheduled to be published in summer 2018. This review will assess barriers to investment in digital infrastructure and next-generation digital connectivity, review current investment incentives and identify if policy interventions may be required to encourage further investment in full fibre and 5G mobile telecoms infrastructure.

A.2.2 Ofcom's role

Ofcom, as the communications regulator, has a key role in ensuring that 5G deployment is delivered within the government's expected timeline. Ofcom's remit on 5G includes European and international spectrum harmonisation, and 5G licensing. The UK government is currently developing a strategic policy statement for Ofcom (to be published in 2018), which will set out the government's priorities for 5G. In addition to this statement, Ofcom is working towards enabling 5G in the UK by:[69]

- completing the licensing of the 700MHz and 3.6–3.8GHz bands as soon as possible (including consulting on coverage obligations linked to 700MHz)
- considering the benefits of allowing the assembly of large contiguous blocks of spectrum between the 3.4–3.6GHz spectrum that was awarded in 2018, and the adjoining 3.6–3.8GHz band which is being planned for auction
- progressing the licensing of the 24.25–27.5GHz ('26GHz') band in line with European policy of this band being the 'pioneer band' for 5G mmWave deployment in Europe
- ensuring access to sites is not a barrier, building on recent reforms to the Electronic Communications Code (ECC) and to planning regulations in England – Ofcom will regularly review this area as it expects further action may be required to assist the roll-out of small cells
- exploring how to provide access to sufficient backhaul connectivity between 5G sites and the core network
- exploring potential frameworks to encourage spectrum sharing
- encouraging site and asset sharing, as long as it does not have an impact on competition.

68 See https://bit.ly/2MAvomq for details of Ofcom's Review of the authorisation regime for spectrum access.

69 See https://bit.ly/2wYWfVp for a discussion of Ofcom's approach to 5G in the UK.

In the first stage of 5G licensing, Ofcom completed an auction of 2.3GHz and 3.4GHz spectrum in April 2018. Further auctions of spectrum for 5G in the 700MHz, 3.6–3.8GHz and 26GHz bands are being planned over the next one to two years. The results of the recent spectrum auction for 2.3GHz and 3.4–3.6GHz licences are shown in Figure A.3 below. The licensing of this spectrum to mobile operators is a key step in enabling 5G, allowing the operators to develop detailed network plans based on new spectrum holdings.

Figure A.3: Outcome of 2018 spectrum auction [Source: Ofcom, 2018]

Operator	2.3GHz		3.4GHz	
	Allocation (MHz)	Price (GBP million)	Allocation (MHz)	Price (GBP million)
O2	40	206	40	318
Vodafone	–	–	50	378
Three	–	–	20	164
EE	–	–	40	304

A.2.3 5G Testbeds and Trials Programme

The 5G Testbeds and Trials Programme was first announced by the UK government in the Autumn Statement 2016, with details published in November 2016.[70] The programme has two specific aims:

- to help establish the conditions under which 5G can be deployed quickly and efficiently
- to develop the UK's 5G ecosystem to ensure the UK can become a world leader in the deployment of 5G mobile telecoms networks.

The government has allocated GBP200 million of funding from the NPIF for the programme to date. The programme aims to encourage collaborations between industry, public bodies and academia in order to test deployment, trial 5G applications and build the 5G ecosystem. Funding for the 5G Testbeds and Trials Programme has been allocated to a range of initiatives, including GBP16 million for the creation of a 5G Test Network at the University of Surrey, the University of Bristol and Kings College London.

In October 2017, the government announced GBP25 million for Phase 1 of a competition to test 5G in a number of sectors. The winners of the competition will receive a total of GBP25 million from DCMS, supported by a further GBP16 million investment from the private sector.[71] An outline of the six projects that are being supported in Phase 1 of the trial is provided in Figure A.4 below.

70 See https://bit.ly/2ggFVpk for the government's 2016 Autumn Statement.

71 See https://bit.ly/2oYMEYf for further details of the GBP25 million for 5G Testbeds and Trials.

Figure A.4: Summary of Phase 1 5G projects [Source: Analysys Mason, 2018]

5G Rural First

- **Focus** – rural coverage / dynamic spectrum access
- **Participants** – Cisco, University of Strathclyde, Shropshire County Council, Orkney Islands Council, BBC
- **Goals** – trial on exploiting 5G benefits for rural communities and industries such as agriculture, broadcasting and utilities (will consider smart farming, radio broadcast and rural IoT)

5G Smart Tourism

- **Focus** – smart tourism / delivery of enhanced visual experiences
- **Participants** – BBC, Aardman Animations, University of Bristol, West of England Combined Authority
- **Goals** – trial in delivery of virtual and augmented reality (VR / AR) experiences at tourist attractions in Bath and Bristol. Will explore network slicing, self-provision of 5G and Wi-Fi

Liverpool 5G

- **Focus** – smart delivery of health applications across deprived communities in the Liverpool City Region testbed
- **Participants** – public-sector health suppliers, NHS, SMEs and Sensor City
- **Goals** – trial remote health applications, using technology to reduce the digital divide, measuring the impact on patient monitoring and community communications

Worcester 5G

- **Focus** – Industry 4.0 / ways to improve industrial productivity through preventative and assisted maintenance (e.g. robotics, big data analytics and AR)
- **Participants** – Worcester County Council, Huawei, O2, BT, Malvern Hills Science Park, QinetiQ, 5GIC, AWTG
- **Goals** – with local businesses, Worcester Bosch and Yamazaki Mazak, focus on industrial productivity and cyber security

AutoAir

- **Focus** – development / validation of connected autonomous vehicles (CAV)
- **Participants** – Airspan, ARM, Blu Wireless, McLaren, Quortus
- **Goals** – based at the UK's vehicle-proving grounds at Millbrook, the trial will test 5G connectivity solutions in CAV, use of small cells on a shared, neutral host platform and network slicing

5G Rural integrated Testbed (5GRIT)

- **Focus** – innovative use of 5G technology for rural applications
- **Participants** – Quickline Communications, Cumbria, Northum., N. Yorkshire, Perth & Kinross, Monmouthshire and Highland Councils
- **Goals** – use of TV white spaces and drones for rural applications such as agriculture, tourism and connecting rural communities

In addition, the government has allocated GBP35 million to projects that will support improvement to rail passenger connectivity, including the Trans-Pennine Initiative (TPI). The latter is a joint project between the 5G and Local Full Fibre Networks (LFFN) programmes.

Future testbeds and trials

As part of the NPIF, the UK government has allocated GBP159 million of funding to testbeds and trial activity between 2018 and 2021, including:

- GBP5 million for an initial trial (expected to start in 2018) on deploying 5G and delivering 5G applications to road environments

- creation of large-scale testbeds – 'Connected Communities' – in both rural and urban settings
- GBP10 million to create facilities to test the security of 5G networks, in collaboration with the National Cyber Security Centre.

A.2.4 Other 5G-related projects

In addition to the announced 5G projects, the UK government is currently looking to fund projects that support the development of 5G applications and services, specifically those that will help to develop strategic partnerships.

The Urban Connected Communities project

In March 2018 the government announced plans for an Urban Connected Communities (UCC) project, which will see the development of a large-scale testbed in a UK city. The project is expected to launch in 2018 and run until 2021.[72] The UCC project aims to:

- support the design and deployment of wireless infrastructure in a major city that delivers high-quality connectivity and allow new 5G applications to be trialled in a number of sectors
- allow industry to test different deployment models for 5G infrastructure and help inform the development of policy and regulation to support 5G deployment
- support economic growth and improve the quality of life using 5G to meet people's connectivity needs.

The government is seeking expressions of interest from local and combined authorities to lead on the project, as well as private-sector organisations who are interested in collaborating with the public sector. The selected urban location is set to be announced in summer 2018. The urban project will be followed by a project to set up a large-scale testbed in a rural setting, referred to as the Rural Connected Communities project. More details on the Rural Connected Communities project are expected to be announced in summer 2018.

UK5G Innovation Network (www.uk5g.org)

At the 2017 Spring Budget, the UK government announced its intention to create a national UK5G Innovation Network to complement the 5G Testbeds and Trials Programme. This Innovation Network is intended to further promote developments across the 5G ecosystem, including trials of new use cases. UK5G will be a 'network of networks' to facilitate engagement and co-ordination of organisations working on 5G activities across the UK. It aims to enhance links between ongoing research and development on 5G, as well as other activities being undertaken by organisations across telecoms and other sectors. It will also facilitate collaboration between businesses, academic institutions and the public sector throughout the UK.

72 The European 5G Action Plan (5GAP) proposes that at least one city in each European nation will be 5G-enabled by 2020.

While the UK5G Innovation Network has been established by the UK government, it will work independently. It will be overseen by an appointed advisory board of 5G industry leaders, which is planned to advise the government's 5G Testbeds and Trials Programme, providing feedback from industry, identifying industry priorities and advising on future areas of focus.

The network will be delivered by Cambridge Wireless, in association with TM Forum and Knowledge Transfer Network, and was formally launched in March 2018. It is expected that the network will be supported by other associate partners (Digital Catapult, Real Wireless Ltd and DG Cities Ltd) and by the expertise of leading academic institutions from across the UK.

A.2.5 Other developments with local authorities

Aberdeen and WIG small-cell testbed

Following a competitive tender in October 2014, Aberdeen City Council awarded a concession contract to the Wireless Infrastructure Group (WIG) to deploy an urban small-cell network at selected locations in the city. The council formed a group with representatives from different internal departments – including highways, planning, street lighting and digital economy – to work with WIG and lower internal barriers to the small-cell deployment. Following a two-year planning and deployment period, a fibre-connected 4G small-cell network has been successfully launched with O2 as the anchor tenant and the capacity to support multiple operators and future 5G networks.

Arqiva and O2 small-cell deployment

O2 has partnered with Arqiva to deploy up to 300 new small cells across London using existing 4G mobile technology and mmWave backhaul – deployment is being targeted at areas of high demand for data services. Roll-out is expected to commence in summer 2018 and planned to be complete by 2020. The small cells will be deployed under Arqiva's concession agreements with various London boroughs, and are expected to be compatible with both existing 4G networks and future 5G deployments.

A.2.6 Lowering barriers

The UK government has set up several initiatives focused on addressing known challenges in the deployment of digital infrastructure, and barriers that may hinder the deployment of full fibre 5G networks. It should be noted that widespread coverage by fibre networks will be key to supporting the delivery of 5G, as fibre networks provide sufficient capacity and speeds to deliver 5G services. The UK government's ongoing work on lowering barriers to deployment is considering barriers that affect both fixed and mobile deployment. We have highlighted two initiatives below:

- **Barrier Busting Task Force** – led by DCMS, the aim of this taskforce is to facilitate the deployment of digital infrastructure, and to remove barriers. The Barrier Busting Task Force (sometimes also referred to as the Barrier Removal Task Force) will feed into the National Planning Policy Framework which sets out the government's planning policies for England and

how these are expected to be applied.[73] The Task Force was set up following the BSG's 2017 report on lowering barriers to infrastructure deployment. Its remit has since broadened to cover a wide range of potential barriers that need resolution, such as wayleaves, new-build developments and street works.

- **Local Connectivity Group** – set up by DCMS with assistance from techUK, this group aims to encourage local areas to develop policies supportive of digital infrastructure deployment (e.g. hosting mobile infrastructure on publicly owned assets, and co-ordination of street works for telecoms deployment). The Local Connectivity Group will bring together local authorities, government departments, Ofcom, landowners and industry stakeholders to identify best practice for digital deployments at a local level. The group aims to develop guidance on good practice, highlighting practical ways to overcome barriers to the deployment of digital infrastructure, looking at areas including street works, digital infrastructure planning, and access to public-sector infrastructure.

73 See https://bit.ly/1rESt8S for details of the NPPF.

Annex B Review of permitted development rights

In this annex we present an overview of permitted development rights in England and the devolved nations. For each nation, we have prepared an overview of:

- relevant legislation
- key definitions
- permitted development rights for masts and antennas, small cells and small antennas
- other relevant information.

B.1 Permitted development in England

Legislation

- Town and Country Planning (General Permitted Development) Order 2015 – Schedule 2 – Part 16
- The Town and Country Planning (General Permitted Development) (England) (Amendment) (No. 2) Order 2016
- The Town and Country Planning (General Permitted Development) (England) (Amendment) Order 2018.

Definitions

Figure B.1: Definitions for planning legislation in England [Source: Planning legislation, 2018]

Term	Definition
Small cell system	An antenna which may be variously referred to as a femtocell, picocell, metrocell or microcell antenna, together with any ancillary apparatus, which – (a) operates on a point to multi-point or area basis in connection with an electronic communications service (as defined in section 32 of the Communications Act 2003(7)) (b) does not, in any two-dimensional measurement, have a surface area exceeding 5000 square centimetres (c) does not have a volume exceeding 50 000 cubic centimetres
Small antenna	An antenna which: (a) is for use in connection with a telephone system operating on a point to fixed multi-point basis (b) does not exceed 0.5m in any linear measurement (c) does not, in two-dimensional profile, have an area exceeding 1591 square centimetres
Article 2(3) land	Conservation areas, Areas of Outstanding Natural Beauty, national parks, the Broads and World Heritage Sites
Dwelling house	A self-contained building or part of a building used as a residential accommodation, and usually housing a single household. A dwelling may be a house, bungalow, flat, maisonette or converted building.

Permitted development rights for masts and antennas

Figure B.2: Summary of permitted development rights for masts [Source: Planning legislation, 2018]

	Outside Article 2(3) land	Inside Article 2(3) land
Building new masts	Permitted if the height (excluding antenna), will be less than 25m	Permitted if the height (excluding antenna) will be less than 20m*
Upgrading or replacing existing masts	Permitted if the height of the mast does not exceed the greater of the height of the existing mast or 25m	Permitted if the height of the mast does not exceed the greater of the height of the existing mast or 20m
Upgrading or replacing antenna on masts	Permitted if the total width of the existing mast and any antenna support structures is not exceeded by more than 1/3 at any height along the mast	Permitted only if replacing the existing antenna with no alterations
Installing and upgrading antenna on buildings other than masts	Permitted with no limitations if the building is over 30m high Permitted with conditions on the number of antennas present on the building and the size of antennas if the building is less than 30m high	Permitted with conditions on the number of antennas present on the building and the size of antennas

* Also applies if land is on a highway.

Permitted development rights for small cells and small antennas

Small cells and small-cell antennas are now permitted development providing the visual impact is minimised.

Figure B.3: Permitted development rights for small antennas [Source: Planning legislation, 2018]

	Dwelling house	Non-dwelling house
Non-article 2/3 land	Permitted if not located on a wall or roof slope facing a highway within 20m, would not result in the presence of more than 1 antenna, and does not exceed the height of the roof or chimney.	Permitted if not located on a wall or roof slope facing a highway within 20m, would not result in the presence of more than 1 antenna on a building less than 15m, or would not result in more than 2 antennas if the building is more than 15m but less than 30m. There are no restrictions on buildings above 30m in height.
Article 2(3) Land	Permitted if not on a chimney, on a building exceeding 15m in height or on a wall or roof facing a highway. Also permitted if not located on a wall or roof slope facing a highway within 20m, would not result in the presence of more than 1 antenna, and does not exceed the height of the roof or chimney.	Permitted if not located on a wall or roof slope facing a highway within 20m, would not result in the presence of more than 1 antenna on a building less than 15m, or would not result in more than 2 antennas if the building is more than 15m but less than 30m. There are no restrictions on buildings above 30m in height.

Other notes

The installation, alteration and replacement of cabinets and telegraph poles are classed as permitted development (without prior approval) providing they are for use in connection with the provision of fixed line broadband. These rights were made permanent by an amendment passed in April 2018. Cabinet and telegraph poles for the purpose of providing mobile connectivity are also classed as permitted development, but require prior approval from the local authority.

B.2 Permitted development in Wales

Legislation

- Town and Country Planning (General Permitted Development) Order 1995 – Schedule 2 Part 24
- Town and Country Planning (General Permitted Development) (Amendment) (Wales) (No.2) Order 2014.

Definitions

Figure B.4: Definitions for planning legislation in Wales [Source: Planning legislation, 2018]

Term	Definition
Small-cell antenna	An antenna which – (i) operates on a point to multi-point or area basis in connection with an electronic communications service (ii) may be variously referred to as a femtocell, picocell, metrocell or microcell antenna (iii) does not, in any two-dimensional measurement, have a surface area exceeding 5000 square centimetres (iv) does not have a volume exceeding 50 000 cubic centimetres
Article 1(5) land	Conservation areas, Areas of Outstanding Natural Beauty, national parks, the Broads and World Heritage Sites

Permitted development rights for masts and antennas

Figure B.5: Summary of permitted development rights for masts [Source: Planning legislation, 2018]

	Outside Article 1(5) land	Inside Article 1(5) land
Building new masts	Permitted if height does not exceed 15m	Permitted if height does not exceed 15m
Upgrading or replacing existing masts and antennas	Permitted if the height does not exceed 20m, and if the total width of the existing mast and any antenna support structures is not exceeded by more than 1/3 at any height along the mast	Permitted if the height does not exceed the greater of 15m or the height of the existing apparatus

	Outside Article 1(5) land	Inside Article 1(5) land
Installing and upgrading antennas on buildings other than masts	Permitted with conditions on the number of antennas present on the building and the size of antennas Different restrictions if the building is under or over 15m high	Not permitted except in an emergency, except for like-for-like replacement

Permitted development rights for small cells and small antennas

Small-cell antennas are classed as permitted development in Wales, providing:

- there are no more than two small-cell antennas on a building or structure
- the building or structure is not a dwelling-house or within a site of special scientific interest.

Other notes

The installation of cabinets and telegraph poles in Article 1(5) land in connection with the provision of fixed line broadband is classed as permitted development before 30 May 2018.

B.3 Permitted development in Scotland

Legislation

- Town and Country Planning (General Permitted Development) (Scotland) Order 1992 – Schedule 1 Part 20
- The Town and Country Planning (General Permitted Development) (Scotland) Amendment Order 2017.

Definitions

Figure B.6: Definitions for planning legislation in Scotland [Source: Planning legislation, 2018]

Term	Definition
Mast	A structure erected by or on behalf of an electronic communications code operator for the support of one or more antennas and includes any mast, pole, tower or other similar structure
Small antenna	An antenna which – (a) operates on a point to multi-point basis or area basis in connection with an electronic communications service (b) may be described as a femtocell, picocell, metrocell or microcell antenna (c) has, in two-dimensional measurement, a surface area of 5000 square centimetres or less (d) has a volume of 50 000 cubic centimetres or less
National scenic areas	A national scenic area, national park, conservation area, historic garden or designed landscape, site of special scientific interest, historic battlefield, European Site or World Heritage Site, or within the setting of a category A listed building or a scheduled monument

Term	Definition
Link antenna	A satellite antenna together with the structure on which it is installed and apparatus which is ancillary to the satellite antenna, where the satellite antenna is used in connection with an existing ground-based mast

Permitted development rights for masts and antennas

Figure B.7: Summary of permitted development rights for masts [Source: Planning legislation, 2018]

	Outside national scenic areas	Inside national scenic areas
Building new masts	Permitted development if the total height (including support structures and antenna) is less than 25m	Not permitted development
Upgrading or replacing existing masts and antenna	Permitted development if: • the height of a mast under 20m would be increased by less than 7m and does not exceed 25m • the height of a mast between 20m and 50m would be increased by no more than 5m • the height of a mast greater than 50m would be increased by less than 15% of the original height • the width of the mast would not exceed more than one third extra of the original mast There is a maximum structure height for link antennas of 4m	Not permitted development
Installing and upgrading antenna on buildings other than masts	Permitted development with conditions on the maximum height of the apparatus above the building and the maximum size of the antenna	Not permitted development

Permitted development rights for small cells and small antennas

Figure B.8: Permitted development rights for small antennas [Source: Planning legislation, 2018]

	Dwelling house	Non-dwelling house
Outside national scenic areas	Permitted development providing there are no more than four small antennas and the height of the antenna does not exceed the highest part of the roof	Permitted development
Inside national scenic areas	Permitted development providing there are no more than two small antennas present, the antenna does not front a road and the highest part of the antenna does not exceed the highest part of the roof	Permitted development providing there are no more than two small antennas present

B.4 Permitted development in Northern Ireland

Legislation

- Planning (General permitted Development) Order (Northern Ireland) 2015 – Schedule 1 Part 18.

Definitions

Figure B.9: Definitions for planning legislation in Northern Ireland [Source: Planning legislation, 2018]

Term	Definition
Small apparatus	(a) A dish antenna not exceeding 5 metres in diameter and 7 metres in height (b) An antenna, other than a dish antenna, not exceeding 7 metres in height (c) A hard standing or other base for any apparatus described in (a) and (b), not exceeding 7 metres in diameter.

Permitted Development rights for masts and antennas

Figure B.10: Summary of permitted development rights for masts [Source: Planning legislation, 2018]

	Outside protected land*	Inside protected land
Building new masts	Not permitted development	Not permitted development
Upgrading or replacing existing masts and antenna	Permitted if the installation, alteration or replacement of an antenna or mast would exceed 10% of the existing masts original permitted height	Permitted development
Installing and upgrading antenna on buildings other than masts	Not permitted development	Not permitted development

* Defined as a conservation area, an area of outstanding natural beauty, an area of special scientific interest, a World Heritage Site, a national park or on a listed building.

Permitted development rights for small cells and small antennas

- For every four items of apparatus which existed on a site on 30 April 2013, one additional item of *small apparatus* may be installed
- No explicit reference to small cells.