Department for
Digital, Culture,
Media & Sport

Call for Evidence:
Improving connectivity for Very Hard to Reach premises

Project Gigabit - building fast reliable broadband for everyone in the UK

Contents

Ministerial Foreword

The government is committed to making the UK a global leader in digital connectivity. Levelling up means not just building new roads and railways, but also ensuring that reliable, long-lasting gigabit-capable connections are made widely available across the UK.

Having robust telecoms networks in place is more important now than ever. Digital connectivity has been a lifeline, permitting millions to work at home, providing information and entertainment to those in isolation and allowing children to continue their education while their schools were closed.

I am proud of the work done so far by the telecoms industry, supported by the government and Ofcom, which has already delivered gigabit-capable broadband to over 11 million premises in the UK, including more than half a million homes and businesses in hard to reach areas. However, there is a lot more to be done.

Our rural communities need good digital connectivity to thrive in an increasingly connected world, and we are committed to ensuring that no part of the UK is left behind. We have always known that it would be more difficult to deliver gigabit connectivity to the hardest to reach parts of the UK, around 20% of UK premises, and that is why we have committed a record £5 billion of capital funding to support deployment in these areas.

This call for evidence is focussed on delivering improved broadband to Very Hard to Reach premises, i.e. the most rural and remote premises within the hardest to reach areas of the country, where the costs of delivering broadband rise exponentially. We are seeking contributions from rural consumers and businesses, as well as telecommunications companies and organisations representative of all of these groups.

Detailed information about the demand for broadband services, their invaluable benefits, current barriers to deployment and take-up, and additional evidence from suppliers and vendors on technology availability, maturity, capabilities and costs to provide connectivity in Very Hard to Reach areas, either in the UK or overseas, will all help inform the government's approach. I am keen that decisions about better broadband are based on evidence from those who will be most affected by them, and I look forward to receiving your responses.

Matt Warman MP
Parliamentary Under-Secretary of State
Minister for Digital Infrastructure

Section 1 - Overview of this call for evidence

The UK government's ambition is to deliver nationwide gigabit-capable broadband as soon as possible. We have set a clear strategy through the Future Telecoms Infrastructure Review, Statement of Strategic Priorities, and the record planned investment in the £5 billion UK Gigabit Programme. In the period to 2025, we are targeting a minimum of 85% gigabit-capable coverage but are working with the industry to accelerate delivery to get as close to 100% as possible.

To support private sector deployment in the most commercial 80% of the UK, the government will continue to implement an ambitious programme of work to incentivise investment in gigabit-capable broadband and remove barriers to rollout. Delivering gigabit-capable broadband in the hardest to reach 20% of the UK is more challenging, which is why the government has set out detailed plans to support the delivery of gigabit-capable connectivity to these areas through its UK Gigabit Programme.

This programme builds on the previous programmes that the government has established to improve broadband in less well-served areas. For example, the £1.9 billion Superfast Broadband programme has delivered superfast broadband speeds to over 5.5 million UK premises (approaching 20% of the UK). Through public and private sector investment, superfast broadband is now available to 97% of UK premises and the UK has one of the highest rates of superfast coverage in Europe, including in rural areas[1].

The Superfast programme is continuing alongside the UK Gigabit Programme, and it is now mainly delivering full fibre broadband to the 3% of UK premises that do not yet have access to superfast speeds. Before the launch of the UK Gigabit Programme, the government also rolled out other programmes such as the Local Full Fibre Networks programme and Rural Gigabit Connectivity programme to stimulate gigabit broadband rollout, including in more rural and remote areas.

Through the broadband Universal Service Obligation (USO), the government has legislated to provide every household with a 'backstop' legal right to request a decent broadband connection, providing a minimum download speed of 10 Mbps and an upload speed of 1 Mbps. The broadband USO is funded by the telecoms industry and is subject to a cost threshold of £3,400 per premise. Consumers are required to pay the excess costs of connection above this threshold.

Since this legislation was enacted in the Digital Economy Act 2017, the number of premises that cannot get a broadband service that meets the minimum specification under the USO has fallen from 1.1 million premises to fewer than 200,000 premises.[2] This is due to the government's Superfast Broadband programme but also significant improvements in 4G network coverage and a wider availability of Fixed Wireless Access (FWA) services. Our £5 billion UK Gigabit Programme will also prioritise premises without access to superfast broadband speeds, wherever possible.

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[1] Check UK Broadband Performance and Coverage Statistics
[2] Figures from Ofcom Connected Nations 2017 and Connected Nations 2020.

We expect that the number of premises that cannot get a USO level service will reduce over time as a result of further government investment in broadband, including through the £5 billion UK Gigabit Programme, as well as the USO itself. In February 2021, eight months after the launch of the USO, BT stated that they were building USO connections to over 5,500 premises across the UK[3]. The vast majority of these premises are being upgraded to a gigabit-capable full fibre connection compared to the minimum download speed of 10 Mbps under the USO. BT's next report is due by 30 April 2021 and we expect that thousands more premises will be benefiting from the USO by that point.

However, the costs of improving broadband coverage rise exponentially as deployment continues into the final percentage point of most remote premises. A very small proportion of premises - potentially less than 100,000 - are therefore likely to be significantly above the broadband USO's reasonable cost threshold and considered "Very Hard to Reach" with gigabit-capable broadband technologies like fibre to the premises technology. This is due to factors like their isolated geographic locations or the often substantial distances between them and existing or planned telecoms infrastructure, which make it challenging to deliver improved broadband.

The government is determined to explore all possible options for improving broadband connectivity for these Very Hard to Reach premises. The purpose of this call for evidence, which will be open for 12 weeks, is to develop our understanding of these areas and seek more information on:

- **Demand:** Consumer and business demand for broadband services in Very Hard to Reach areas. In particular, we are seeking information on current provision and adoption patterns by consumers and businesses in these areas, including businesses in the agricultural sector.
- **Benefits:** Further evidence on the benefits that delivering enhanced broadband services to Very Hard to Reach areas yields, including social, environmental or economic benefits.
- **Barriers:** Evidence of barriers to user adoption (other than services being unavailable in an area), and evidence relating to barriers that may impede infrastructure operators and service providers from offering improved broadband services in these areas. This evidence could also relate to barriers to investment (for parties providing finance for such investments).
- **Approaches:** Evidence relating to the availability, maturity, capabilities and costs of advanced technologies and novel approaches to provide connectivity in Very Hard to Reach areas, either within the UK or from overseas.

We are seeking evidence from four types of stakeholders:

- **Consumer** users of broadband services, in particular those who are resident in remote rural parts of the UK and cannot access broadband speeds that meet the minimum specification under the broadband USO.

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[3] [BT Response to Ofcom's proposed Plan of Work 2021/22](#) (See page 3 for USO data)

- **Business** users of broadband services in these areas, including those working in the agricultural sector.
- **Market participants,** including infrastructure suppliers/operators, retail or independent broadband service providers, mobile network operators and equipment vendors.
- **Representative organisations,** who may for example be representing rural stakeholders, consumer groups or any sub-groups of the stakeholders listed above. This group could also include local government bodies and rural enterprise partnerships.

The approach to responding to this call for evidence differs slightly depending on the type of respondent. Further details on how to respond, including links to the online survey, information relating to how evidence will be handled and used by the government, and how to access alternative format and language versions is set out in the final section of this document.

Section 2 - Background and current broadband programmes

In this section, we outline:
- what we mean by a Very Hard to Reach premises, for the purpose of this call for evidence
- current government broadband policy and how it relates to Very Hard to Reach premises
- current investment programmes and how they relate to Very Hard to Reach premises

2.1 What is a 'Very Hard to Reach' premises?

Whether the future needs of premises can be served commercially with specific telecommunications technologies depends on several often interrelated factors. This includes the geographic location of the premises (and its neighbours), the availability of existing infrastructure and appropriate technologies, and the potential investment return.

This call for evidence focusses on premises that are primarily Very Hard to Reach as a result of their geographic location. Some contributing factors to geographic isolation are set out in Table 2.1 below.

Table 2.1: Factors causing geographic isolation of premises

Factor	Explanation
Physical isolation	The premises is located at a substantial distance from any neighbouring premises.
Sparse distribution	The premises has neighbours, but these neighbours are a considerable distance from each other.
Distance to interconnection or 'backhaul'	The distance from the premises to other accessible points of interconnection for telecommunications purposes is substantial.
Island locations	As above, but a particularly challenging example if there is no submarine cable capacity to the island. Even small towns can prove Very Hard to Reach in this instance.
Occluded by terrain or other barriers	The presence of mountain ranges, valleys/canyons, marshlands/bogs or excessive foliage prevents shorter routes or certain technologies.
Access related issues	Regulatory or climatic hurdles that are linked to the geographic location of the premises. These can be related to weather conditions (build in certain locations cannot occur year-round), or due to regulations in National Parks/Areas of Outstanding National Beauty (AONBs), or other access or wayleave restrictions.

According to data provided by the Office for National Statistics (ONS), there are approximately 420,000 premises in the UK which are classified as 'remote'. This represents 1.4% of the total number of premises in the UK, of which a subset is potentially Very Hard to Reach for broadband services. Premises from some other rurality codes may also be considered Very Hard to Reach.

Figure 2.2: UK Premises by rurality
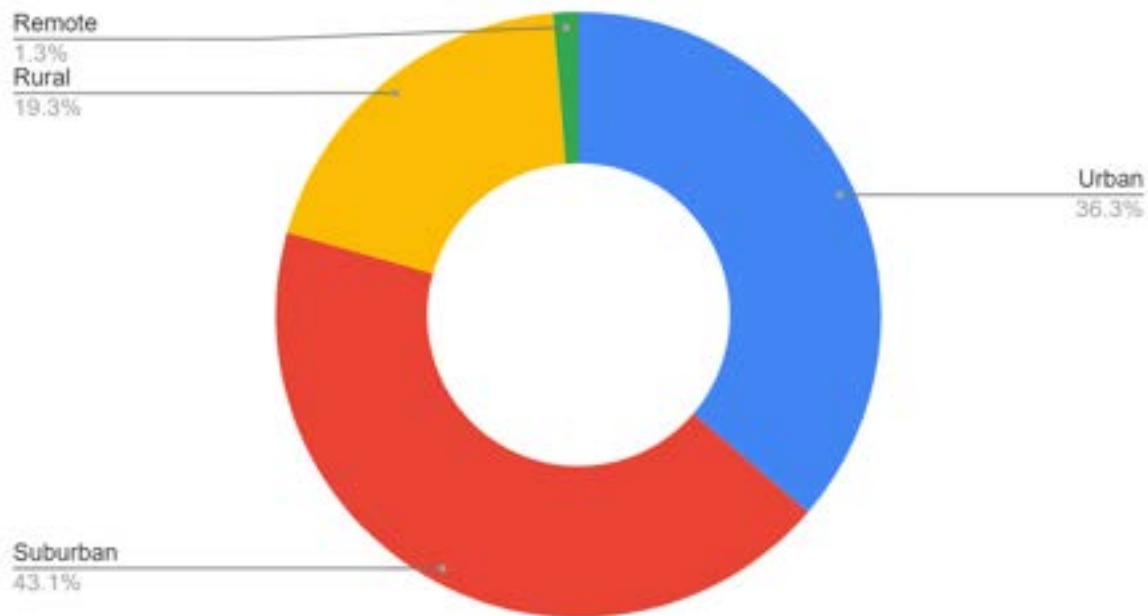
Source: UK Premises defined by Ofcom Connected Nations 2020. Rurality definitions from the National Statistics Postcode Lookup and ONS Postcode Directory[4]

Other premises may not be geographically Very Hard to Reach, but present a potentially high cost to upgrade or serve if economies of scale are lacking as a result of network deployment strategies and the availability of legacy services. For example, this can occur where:

- a telecoms infrastructure provider makes a discrete choice not to include a premises in a network rollout (even though the premises is not geographically Very Hard to Reach), for example, due to access issues at the time of the construction works.
- a technology has been withdrawn or become otherwise unavailable (but neighbouring premises remain served). This can occur where wireless networks are modified, or suppliers become insolvent.
- the technology employed in a rollout has a limitation which has unexpectedly led to the premises not being covered, or an underlying network element is underperforming (for example, fixed wireless coverage issues relative to desk-based

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[4] *Definitions: England, Wales and Scotland rurality categories from National Statistics Postcode Lookup 2011 Census rural-urban classification. Northern Ireland rurality categories from ONS Postcode Directory 2001 Census rural/urban indicator.*
Urban: England/Wales rurality categories - A1, B1; Scotland rurality categories - 1; Northern Ireland rurality categories - A, B
Suburban: E/W - C1, C2; S - 2; NI - C, D. Rural: E/W - D1, D2, E1, E2, F1; S - 3, 4, 5, 6, 7; NI - E, F, G.
Remote: E/W - F2; S - 8; NI - H

radio planning, insufficient cabinet space due to underestimated demand, or poorly maintained legacy copper or aluminium lines reducing actual service speeds).
- the premises is connected to an aggregation point, local exchange or radio mast which is much further away than the one its neighbours are connected to (and the technology used is distance-limited). This can be the case where new settlements have changed the distribution of premises in an area, for example through new estates, or where a communications provider has rationalised telephone exchanges or is using newly available ducts.
- the premises has been inadvertently missed due to inaccurate data on the location or status of the premises.

There are also examples where the premises themselves change over time, resulting in high upgrade costs even though they are not geographically Very Hard to Reach or located in remote rural areas. This can include where:
- a new single premises is created (or an existing premises is subdivided) in an area which has already been otherwise upgraded. The single premises then faces all of the costs of the work required
- a new development of premises is built with a new rollout or technology, but a small number of premises nearby are not connected and are therefore left behind, and are potentially less economic to return to at a later date.

To address issues with new build connectivity, the government is intending to amend Building Regulations to ensure that new build homes in England are built with next generation digital infrastructure. This legislation will build on the commitments that the government has already secured from network operators to work with housing developers to provide gigabit-capable connectivity to new build developments across the UK. New build connectivity in Scotland, Wales and Northern Ireland is a matter for the Devolved Administrations.

'Remote' premises are disproportionately located in the Devolved Administrations, as demonstrated by the map on the left below. However, some areas of England also have a relatively high proportion of remote premises, including parts of Cumbria, the North York Moors and the Quantock Hills in Somerset. We have compared the ONS data on premises per square km with Ofcom data on the percentage of premises with sub-USO speeds (on any infrastructure) and the maps below show clearly that those with sub-USO speeds are usually found in the most remote areas, which is to be expected.

Figure 2.3: Maps of UK premises density (left) and the proportion of premises receiving sub-USO speeds (right)
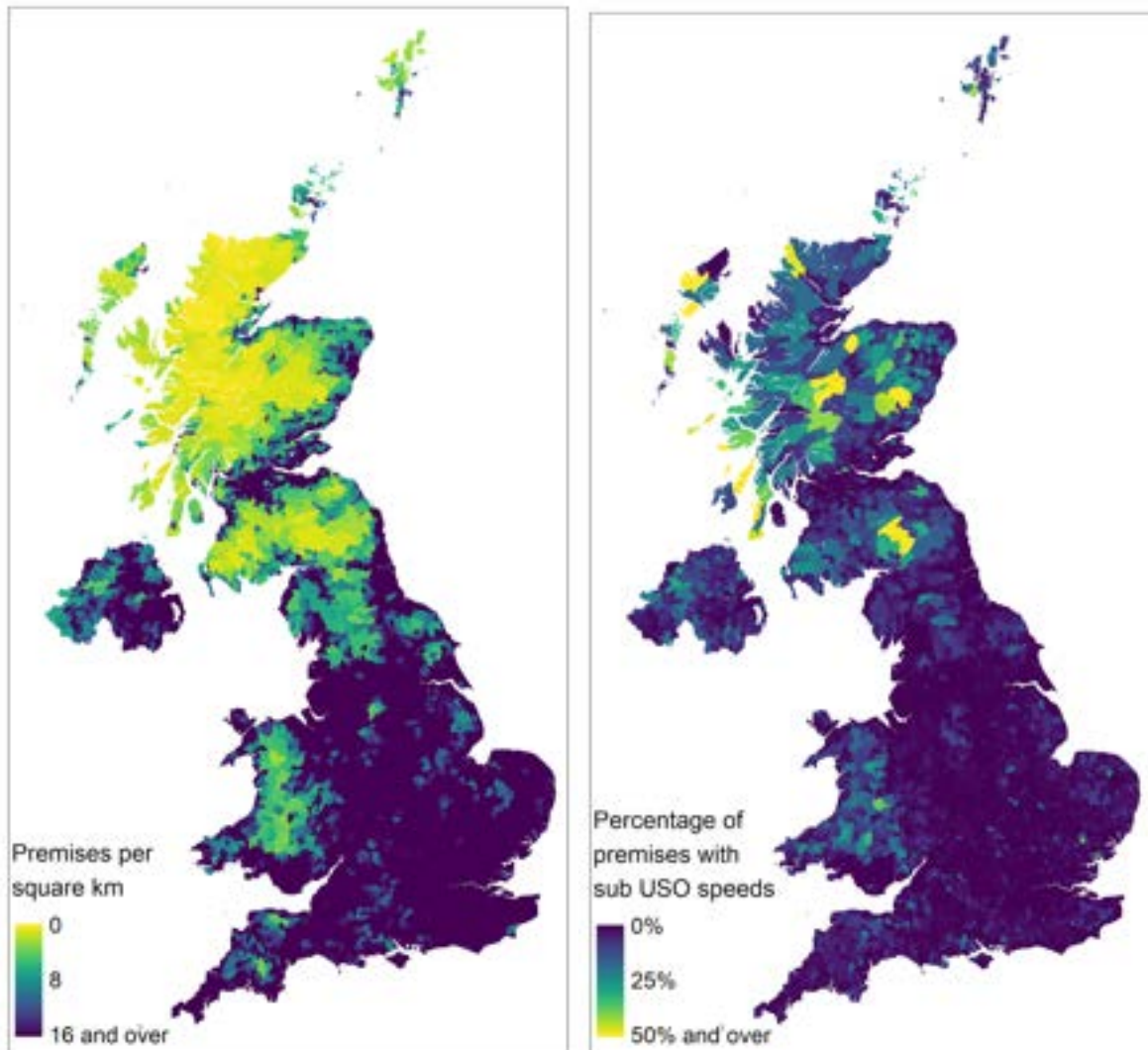
Spatial distribution of premises, based on Epoch 78 of AddressBase Premium, with premises following the Ofcom Connected Nations definition

Potential USO eligible premises, based on Ofcom data to 1st September 2020, mapped via LSOA (England and Wales), Intermediate Zone (Scotland) and SOA (Northern Ireland) as defined in the National Statistics Postcode Lookup. Does not reflect actual USO eligibility due to ongoing network procurements or voucher-based projects supported with government funding, and certain other data adjustments.

Despite geographic and other challenges, telecommunications suppliers are already delivering connectivity to some of these premises, including through commercial deployments, recent UK government supported interventions (such as the Superfast Broadband programme) and community broadband schemes and collaborations being delivered by the likes of B4RN, Balquhidder, Broadway Partners and Wessex Internet. Further examples of what the government has done and is doing to improve digital infrastructure in rural and remote areas are outlined below.

2.2 Ongoing programmes and market interventions

Superfast Broadband programme

The government's Superfast Broadband programme was established in 2010 to ensure that the UK had one of the best superfast broadband networks in Europe. This included subsidising deployment to areas of the country that are less commercially viable.

The programme has already delivered upgraded broadband connections to more than 5.5 million UK premises (approaching 20% of the UK). As a result of this programme and private sector investment, around 97% of UK premises have access to superfast speeds. According to the European Commission's latest Digital Economy and Society report, the UK ranked eighth for superfast connectivity across a selection of countries in Europe and even higher for superfast connectivity in rural areas.

The government's latest evaluation report[5] on its Superfast Broadband Programme found that it has delivered economic benefits of £2.7 billion since 2012, as well as:

- A surge in the value of homes sold in programme areas between 2012 and 2019 by up to £3,500, a rise of 1.16% worth £1.52 billion
- 17,600 more jobs in programme areas, including 2,100 lifted from long-term unemployment creating an increase in gross value added (GVA) by £125 million
- £1.1 billion gained in GVA through increased workplace productivity
- The availability of faster coverage also helped power businesses and sparked a £1.9 billion increase in total annual turnover for firms based in areas upgraded through the programme.

The report also concluded that the programme's value for money is continuing to rise. For every £1 invested by the government in the programme, an additional £2.70-£3.80 of economic and social benefits has already been created in the UK economy.

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[5] Superfast Broadband Programme – State aid Evaluation Report

Figure 2.4: Ongoing Superfast interventions by local authority area and Superfast availability by constituency
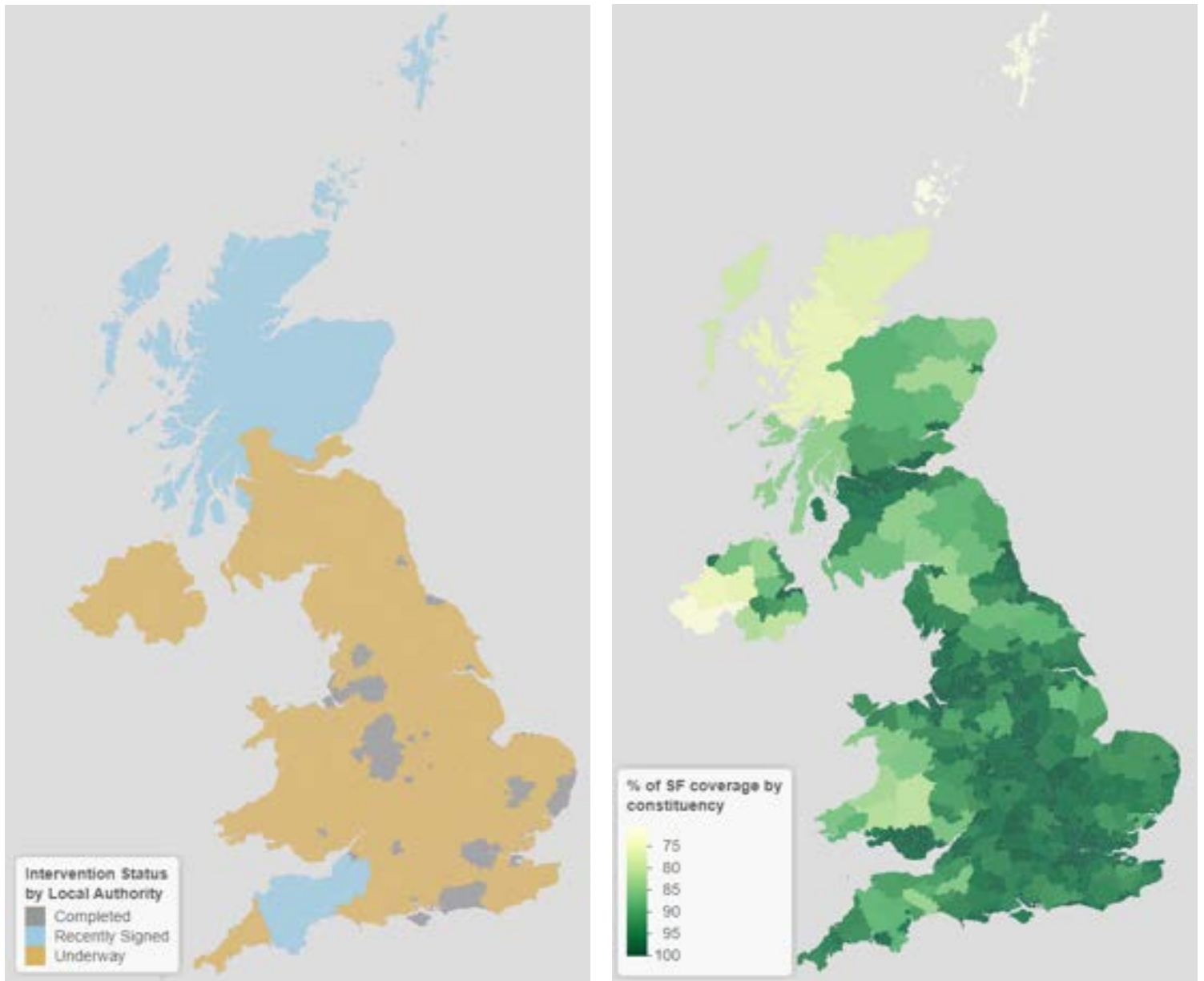
Source: Internal BDUK Superfast Programme data; Ofcom Connected Nations 2020 Constituency level data

Note: Additional contracts in Devon, Somerset and the North of Scotland have been awarded to four suppliers, and detailed remapping and scheduling of the rollout by premises is now being undertaken.

Recent bids under the Superfast Broadband programme illustrate that the appetite of suppliers and the potential reach of their networks into these areas can vary substantially (see table 2.5).

Table 2.5 Public subsidy to recent Superfast procurements using FTTP

Procurement	Supplier	Premises addressed (and degree of rurality)	Solution contracted (FTTP/FTTC[6] and delivery timeframe)	Public Subsidy (announced value)	Subsidy / premises (average)
Connecting Cheshire (East)	Airband	4,000	FTTP, by March 2023	£4.5m	£1,125
Connecting Devon & Somerset (Phase 3)	Airband	37,500	FTTP, by the end of 2024	£25.5m	£680
	Truespeed	15,000		£6.7m	£447
	Wessex Internet	3,600		£4.7m	£1,306
Connecting Suffolk (Phase 3)	Openreach	5,000, rural	Undisclosed	£21.75m	£4,345
Project Stratum	Fibrus	76,000, rural & very remote	FTTP, by the end of 2025	£165m	£2,171
R100 Central	Openreach	32,000, mainly rural	FTTC / FTTP, by the end of 2023*	£83m	£2,594
R100 South	Openreach	21,000, rural, some remote	FTTP, by summer 2024	£133m	£6,333
Superfast Yorkshire (P3)	Openreach	14,329	87% FTTP, rest FTTC	£20.5m	£1,431

Note:
- *All data public domain as announced/published*
- *The table does not include "supplier contribution" to capital or resource build.*
- *Public subsidy is total from the UK Government, Devolved Administrations, Local Bodies and other sources.*
- *R100 Central details exclude additional funding from the UK government to upgrade the remaining Fibre to the Premises Cabinet (FTTC) premises to full fibre connections.*
- *R100 South value is initially announced contract value.*

Gigabit voucher scheme

Starting in March 2018, the government's gigabit voucher scheme provided eligible homes and businesses across the UK with vouchers to support the deployment of gigabit-capable broadband. During the first wave of the scheme, the Government invested over £60 million in vouchers.

In May 2019, the government launched the second wave of the scheme, focussed on rural areas. This scheme is now closed to new project submissions as we migrate to a new voucher under the £5 billion UK Gigabit Programme. The gigabit voucher scheme has

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[6] FTTP: Fibre to the premise, FTTC: Fibre to the Cabinet (see glossary)

issued over 66,000 vouchers to homes and businesses across the UK, worth up to £127 million.

Many vouchers have been awarded to suppliers using novel technologies, low-cost build approaches and extensive community engagement to serve them. For example, voucher-supported efforts of Alncom, Balquhidder, Broadband for the Rural North (B4RN), Hence Broadband Partners, and Wessex Internet have delivered several projects addressing the needs of premises in the hardest to reach 1% of premises, and there is the potential for this to continue under the £5 billion UK Gigabit Programme.

Support from the UK government has been complemented by additional activity in Wales and Scotland, and by top-up funding in 18 English local authorities. By employing various approaches, this additional funding has, wherever possible, been targeted at those most in need.

Figure 2.6: Case studies of Rural Gigabit Voucher projects

Transformative broadband for a garden office

A coaching and training business in a rural Buckinghamshire hamlet was looking unviable due to the Covid outbreak…READ MORE

Speed boosts productivity in the countryside

A country estate in Staffordshire incorporating a heritage property, farms, rented cottages and offices has been transformed by reliable broadband connectivity… READ MORE

Customer satisfaction soars with improved signal

Authentically Scottish, a manufacturer specialising in traditional tartan outfits was struggling with video calls to global customers due to poor broadband signal…READ MORE

Bodmin, Cornwall

This Cornish farmer and his district nurse wife were able to carry on working throughout the Covid 19 pandemic thanks to their broadband… Read more

Grisedale, Cumbria

This couple run a global training business from their Cumbrian dale thanks to their community collaboration to upgrade to gigabit broadband… Read more

Dalton, Northumberland

This enterprise hub proves that you can create a thriving business community in a rural location provided you have the right broadband… Read more

Source: Case Studies – Gigabit Vouchers

Public sector hubs and other contracts

The government has had a programme to provide gigabit-capable upgrades to connectivity for public and community buildings, such as council offices, schools, libraries and GP surgeries, to meet public sector needs and act as full fibre 'hubs' off which industry can build their residential networks and connect surrounding homes and businesses. These are predominantly in rural areas, for example, the Brook Community Primary School in the Kent Downs AONB (Area of Outstanding Natural Beauty), and include some of the most remote locations in the UK, including for example the last school to be connected in Wales (Ysgol Llanychllwydog School, Fishguard)[7].

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[7] BBC News | Broadband: The last school in Wales to get fast internet

These projects are complemented by other public sector investments, including the Maritime and Coastguard Agency's £170 million contract[8] to increase network resilience and upgrade connections to 155 remote radio sites, and the improved broadband connectivity to 110 vaccination sites[9] as part of the recent COVID-19 pandemic response.

Over 40 suppliers are already registered[10] for the government's preferred procurement route, with as many again working through the registration process, and the government expects many more sites to be connected. However, in some of the most remote parts of the UK, there are no publicly-owned assets upon which such interventions can be built quickly and efficiently.

Gigabit procurements

The UK Gigabit Programme is a multi-intervention programme, led by Building Digital UK (BDUK), working in partnership with local authorities and the devolved administrations. The majority of connections in this programme will be delivered through supply-side interventions (procurements), complemented by demand-led measures (vouchers and hub projects delivering improved connections to public sector sites).

In December 2020, the government set out further details of the draft procurement strategy[11] for the UK Gigabit Programme, including its approach to awarding contracts for the £5 billion, which will mean that a range of telecoms providers - from the very small to very large - can take part. Further details are being published today (19th March 2021). A substantial majority of the £5 billion will be invested in such procurements[12].

These procurements have been designed to encourage suppliers to provide gigabit-capable connections to as many premises as possible in the designated intervention areas. The procurements are also technology-neutral, subject to the deployed technology meeting the required service specification and wholesale access conditions.

Broadband Universal Service Obligation

The Broadband Universal Service Obligation came into effect on 20 March 2020, providing consumers with a right to request a decent broadband service, providing download speeds of at least 10 Mbps and upload speeds of 1 Mbps. The last data published by Ofcom in Connected Nations 2020, on 17 December 2020, estimated that around 190,000 premises may be eligible to apply (unless they are due to be covered by a government funded programme expected to roll out within 12 months).

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[8] Technology drives forward new network for search and rescue
[9] BT fibres up network of Covid-19 Vaccination Centres to help NHS protect the public
[10] https://supplierregistration.cabinetoffice.gov.uk/dps#technology (See section on Gigabit-Capable Connectivity Suppliers, and 'View Suppliers" for the current list).
[11] Next steps in Government's £5 billion gigabit broadband plan
[12] NAO Report - Improving Broadband

Delivery of the broadband Universal Service Obligation (USO) is the responsibility of Ofcom as set out in legislation, and has been designated to two Universal Service Providers: BT and KCOM (in Kingston upon Hull only).

Since launching the USO in March 2020:

- BT has approved more than 500 projects, resulting in over 5,500 additional premises, including those in some of the most rural and challenging areas, set to receive improved broadband connectivity as a direct result
- KCOM has indicated that all of the premises within its service area have the potential to access a decent broadband USO level service at prices consistent with, or below, the requirements set out in the Universal Service Conditions. In the first six months of the scheme, KCOM consequently had no eligible applications for USO-level service

The number of eligible premises fell from approximately 2.6 million at the initial stages of policy design in 2016, to 610,000 before the USO was launched in March 2020, to less than 190,000 (or 0.6% of all UK premises) today. Additional government broadband rollout programmes will further reduce the number of premises eligible for the USO in the coming years. The positive impact of this will be particularly felt in the Devolved Administrations.

However, the government is aware that there have been issues arising from the implementation of the USO, primarily relating to high quotes for receiving a connection. As a result, Ofcom opened an investigation into BT's compliance with the USO's regulatory conditions in October 2020, and in January 2021 Ofcom announced that it would provide a further update by the end of March 2021 following additional evidence gathering.

We anticipate that premises will continue to be connected under the USO and that the cost of connecting some of these premises will fall as other infrastructure becomes available nearby.

Mobile Connectivity Strategy

Alongside its work on improving fixed broadband connectivity, the government is committed to extending 4G mobile coverage to 95% of the UK. On 9 March 2020, we agreed a £1 billion deal with the Mobile Network Operators (MNOs) to establish the Shared Rural Network.

This initiative will see the four MNOs collectively invest over £530 million in a shared network of new and existing phone masts to help address partial 'not-spots' - areas where there is currently coverage from at least one, but not all, operators. Furthermore, the government will invest over £500 million to significantly reduce 'total not-spots' - those hard-to-reach areas where there is currently no coverage from any operator. With funding now available, the government and the operators remain confident that combined coverage will be delivered to 95% of UK geography by the end of 2025, with areas around the UK starting to see improvements to 4G coverage long before completion.

Section 3 - Rationale for this call for evidence

The aforementioned programmes will substantially support the delivery of enhanced broadband services and mobile connectivity to Very Hard to Reach premises over time. However, they are not guaranteed to deliver gigabit broadband to all of these premises since doing so involves substantial and uncertain cost.

Furthermore, based on initial Government analysis, up to 1% of premises could be prohibitively expensive and may require alternative technologies[13]. However, reviewing predicted coverage against actual coverage indicates that some of the most geographically remote 1% of premises have already been connected. In many cases, this is due to the work completed under previous phases of the Superfast programme, as well as gigabit voucher projects and community schemes. A review of recent contracts placed and vouchers issued suggest that we can expect the number of premises with such connections to continue to rise.

We also expect that the commercialisation of new technologies and the greater availability of radio spectrum resources will make it possible to connect many more of these premises to improved broadband services. However, through this call for evidence, the government is seeking evidence about the demand for enhanced broadband connectivity in these areas, as well as the potential benefits, barriers and potential technology approaches.

This call for evidence seeks responses on the following matters:

Table 3.1 - Topics, evidence sought, and rationale

Topic	Evidence sought and rationale
Demand	Information on the current and future anticipated needs of consumers and businesses specifically located in Very Hard to Reach, remote locations. We are also seeking information on current broadband provision and adoption patterns by consumers and businesses in these areas, including businesses in the agricultural sector. The details of the evidence we are seeking on demand are set out in Section 4.
Benefits	The government already reviews the benefits of intervention into broadband market delivery as part of existing programmes. This includes economic, social and environmental benefits. However, qualitative evidence suggests that the circumstances of people living and working in the hardest to reach locations of the UK can differ substantially from even the rural norm. This can be compounded by the lack of other infrastructure and the distance required to travel to physically access services as an alternative.

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[13] NAO Report - Improving Broadband

| | The nature and make-up of the rural economy in the most remote parts of the UK is also exceptional, and evidence provided to DCMS by other departments suggests particularly low productivity versus international comparables.

We are therefore seeking further evidence - in particular, quantitative data - of the benefits that delivering enhanced broadband services to such areas yields. Whilst some data is available to support this assessment, more data from agricultural businesses and consumer representative organisations would be helpful.

The details of the evidence we are seeking on demand are set out in Section 5. |
|---|---|
| Barriers | Availability of services is a barrier in many remote rural locations of the UK. Through this call for evidence and parallel consultation with suppliers, we will establish further details of future availability of new and emerging technologies, to complement existing substantial data on network availability and performance.

The demographics of residents in the most remote rural areas of the UK and the nature of the rural businesses suggest that levels of awareness of the availability and capability of digital technologies are a barrier to adoption.

Consumers and consumer representative groups have provided evidence to DCMS and Ofcom on their experience with previous interventions, and we seek input from those located in the most remote locations to compare their experience with those in other parts of the UK.

Suppliers delivering in, or considering expanding into remote rural areas have told the government that they face particular economic, administrative and practical barriers in addressing this market effectively, and we seek input from them through this call on barriers specific to, or acute in, this particular segment of the market. We are particularly keen to gain further input from smaller suppliers, including independent wireless service providers offering or planning to offer gigabit-capable or upgradeable wireless technologies, and those with a strategic focus on rural areas.

The details of the evidence we are seeking on demand are set out in Section 6. |
| Approaches | The government is aware that innovation continues to make new solutions possible and to improve economic viability in Very Hard to Reach locations. Reviewing approaches taken in other countries to address this challenge - including some with topology and terrain even more challenging than the most remote parts of the UK - suggests that diverse approaches may provide new possibilities and improved value for money for interventions.

We are therefore seeking additional evidence from suppliers and vendors on technology availability, maturity, capabilities and costs relating to advanced technologies and novel approaches to provide connectivity in |

	Very Hard to Reach areas, either in the UK or overseas. We are also engaging with industry directly, in parallel to this call for evidence. The details of the evidence we are seeking on demand are set out in Section 7.

Section 4 - Topic A: Demand for improved broadband in Very Hard to Reach locations

In this section we:
- summarise the sources of current evidence on usage and demand already available
- explain why we are calling for further evidence on demand and needs
- summarise the questions on demand for broadband that we are addressing to different types of respondent through this call for evidence

4.1 Current Evidence on Demand

A wide range of evidence on current levels of demand for, and take-up of, broadband services in rural areas is already available to the government. This includes, but is not limited to:
- information from the BDUK superfast evaluation[14]
- data from Ofcom, including their "Communications Market Report"[15] and consumer "Home broadband performance report"[16]
- line performance from suppliers, via Ofcom, at either the postcode or the premises level
- average usage data (traffic/month), at the postcode level for fixed wired networks (i.e. FTTC, FTTP, and cable networks that rely on a physical medium from the exchange to the premises)
- more general take-up and adoption data from Ofcom, from GigaTAG[17] and the performance monitoring of networks deployed under previous procurements
- the extent of home working by rurality, reported by DEFRA and the UK Government Statistical Service

Previous consultations have also provided evidence on how consumers in rural areas use broadband services and which applications stimulate this demand. This evidence includes, but is not limited to:
- information provided to the government, including during consultations on the Superfast programme, through the work of select committees such as the Environment, Food and Rural Affairs Committee and other Parliamentary groups, such as the All-Party Parliamentary Group for Rural Services.
- evidence provided by suppliers during discussions on the UK Gigabit Programme
- evidence provided as part of consultations on the USO
- work undertaken by Ofcom when advising the government in 2016 on the minimum decent broadband speed for the USO

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[14] Superfast Broadband Programme – State aid Evaluation Report
[15] https://www.ofcom.org.uk/research-and-data/multi-sector-research/cmr
[16] https://www.ofcom.org.uk/research-and-data/telecoms-research/broadband-research/broadband-speeds
[17] Gigabit Take-up Advisory Group - Which? Consumer Insight

- evidence provided by stakeholders and representative organisations as part of discussions before this call for evidence

This evidence suggests that consumers in remote rural areas are more likely to work from home (before the COVID-19 pandemic began) and that remote rural locations contain proportionately more registered businesses than other rurality types.

Figure 4.1: Percentages of homeworkers in England in 2019
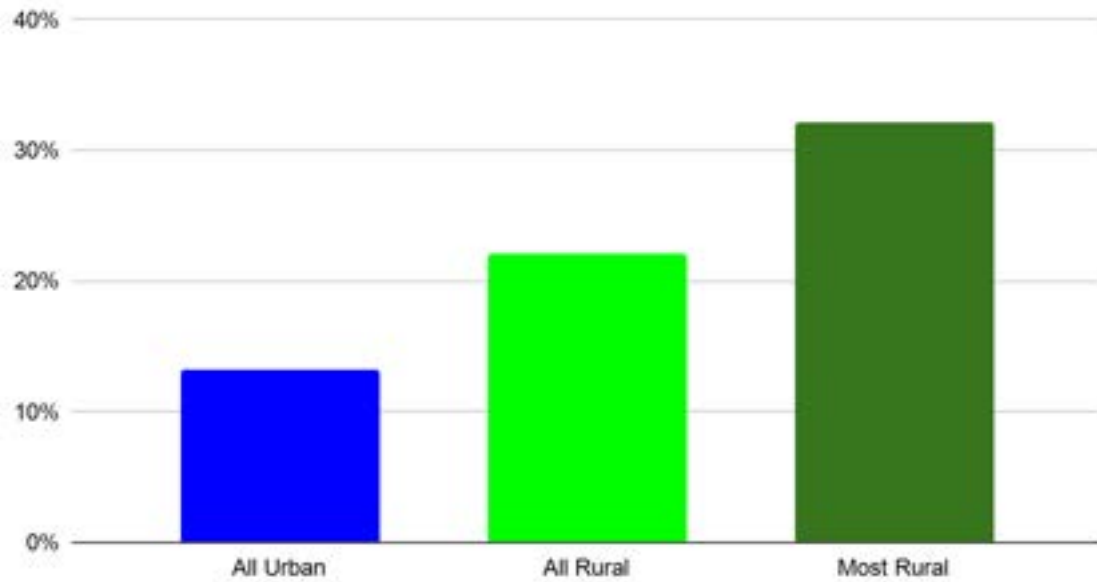
Source: [Statistical Digest of Rural England](#)

Figure 4.2: Number of registered businesses per 10,000 population in England in 2019/20

Source: Statistical Digest of Rural England

Table 4.3: Number of registered businesses in Rural Hamlets & Isolated dwellings split by industry in England in 2019/20

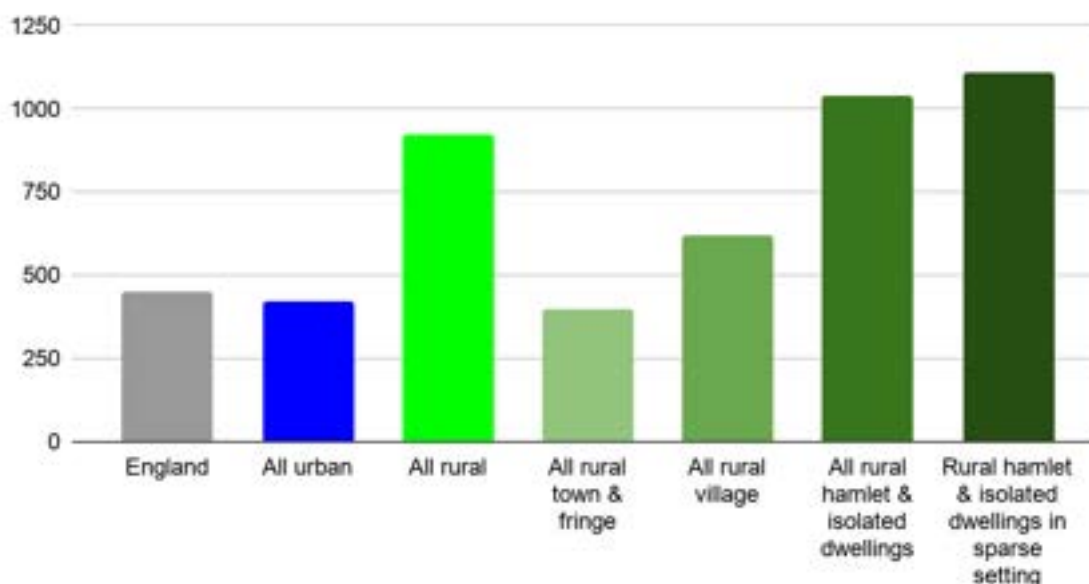| Industry	Number of firms	Percentage of firms
Administrative and support services	765	4.8%
Agriculture, forestry and fishing	8,095	50.4%
Arts, entertainment and recreation	390	2.4%
Construction	1,120	7.0%
Education, health and social work	410	2.6%
Finance	95	0.6%
Accommodation & food service activities	940	5.9%
Information and communication	370	2.3%
Manufacturing	615	3.8%
Mining/quarrying and utilities	170	1.1%
Professional, scientific & technical services	1000	6.2%
Public admin and defence; other services	375	2.3%
Real estate activities	300	1.9%
Transport and storage	290	1.8%
Wholesale, retail & repair of motor vehicles	1,120	7.0%
Total	**16,055**	**100.0%**

Source: Statistical Digest of Rural England

4.2 Why we are calling for further evidence

We need to understand in more detail the specific needs of communities and businesses located in Very Hard to Reach locations. We also wish to understand in more detail how consumers and businesses in these locations expect their needs and requirements for broadband services to change over time. This will help us to optimise future policy for these areas and to compare these requirements to the benefits they expect to derive, in a more geographically specific manner. We wish to further explore how consumers and businesses in these locations expect their needs and requirements for broadband services to change over time. This will help us to optimise future policy for these areas and to compare these requirements to the benefits they expect to derive, in a more geographically specific manner.

Available evidence on demand for broadband services at a granular level is often affected by measurement techniques or substantial aggregation of data. For example:
- information derived about line speed performance suggests substantial limitations on service speeds on remote rural lines using older networks. Estimates for data demand based on measurements in locations where supply has been constrained are problematic, and likely to understate the underlying actual level of demand
- evidence on the usage of customers in these locations using non-wired technologies (i.e. wireless solutions, such as fixed wireless access or non-terrestrial solutions, e.g. satellite-based communications) is generally limited, and not correlated to specific geography
- evidence on demand and usage is often disconnected from relevant background information (for example on the nature or sector of the rural business, or the current occupancy level of the premises)

4.3 Summary of questions on demand, by type of respondent

The evidence we are seeking on demand for improved broadband in Very Hard to Reach areas is set out below, arranged by respondent type. The questions below are summaries of those in the online survey. Please note that the questions may be worded differently for analysis purposes.

Table 4.4: Questions on demand

We are asking **consumers**:	
A1	For basic data to analyse responses (such as household size, etc)
A2	What types of devices and services do the residents in your premises use?
A3	What broadband services do you use today, and how much do they cost?
A4	What are the current speeds that you receive, and are they what was advertised?
A5	How reliable is your current service and how satisfied are you?

A6	What broadband download speed do you think you currently require?
A7	How much would you value an improved connection speed?
A8	To what extent do you have access to and use mobile data alternatives to fixed broadband services?
A9	How has the COVID-19 pandemic affected your needs for broadband/digital connectivity?

We are asking **businesses:**	
A10	Basic data to analyse responses (such as size and type/sector of the business)
A11	Which online applications are essential to the operation of your business?
A12	What broadband services does the business use today? (and for agricultural businesses, further details of their service provision across the farm, etc)
A13	How satisfied are you with your current broadband service?
A14	How reliable is your current service and how satisfied are you?
A15	What broadband product parameters do you think you currently require?
A16	How has the COVID-19 pandemic affected your business needs for broadband/digital connectivity?

We are asking **market participants:**	
A17	Which services and solutions do you offer to customers in rural, remote areas?
A18	How would you describe the awareness of customers (in rural, remote areas) of the connectivity services that you offer?
A19	What product uptake, speed choices, and usage levels do you experience from customers in remote rural areas?
A20	How has the most popular speed choice changed compared to 3 years ago?
A21	Do you supply premises level coverage data to Ofcom for the Connected Nations coverage/performance reporting?
A22	What do you project customer data consumption growth to be in these areas?
A23	How has the COVID-19 pandemic affected consumption patterns and has this changed your plans for launching new services?
A24	When planning your network expansions, how do you consider the varying needs of customers across different premises/premises types?

A25	How current and detailed would you say the data on which you can plan your investment decisions is?
A26	Do you offer a community-based partnership or allow mechanisms for consumers to group together to register interest when expanding your networks? If so, what has been your experience with this?
A27	Do you already utilise UK government funding? (and related details)
A28	Do you offer discounts to install/service costs based on customer or community labour or asset contributions to remote rural projects? (Examples: Self dig, site provision, site power). If so, how has the customer response been?

In addition, we are seeking evidence from representative organisations on this topic. Responses may address any of the themes above in broad or specific terms. Responses from such parties may address any of the themes above in broad or specific terms.

Section 5 - Topic B: Benefits of improved broadband in Very Hard to Reach locations

In this section we:
- summarise the sources of current evidence on benefits that are already available
- explain why we are calling for further evidence on benefits for these locations
- summarise the questions on benefits arising from the availability of improved broadband that we are addressing to different types of respondent through this call for evidence

5.1 Current Evidence on Benefits

Similar to demand, a wide range of evidence on the benefits of broadband services to consumers and businesses in rural areas is already available to the government. This includes, but is not limited to:
- quantitative data from the evaluation reports of previous programmes, notably the latest superfast broadband evaluation report[18]
- the SQW UK Broadband Impact Study[19]
- qualitative interviews with the beneficiaries of such programmes, including interviews undertaken as part of the Rural Gigabit programme
- better internet connectivity can lead to efficiencies in service delivery within the public sector. These sectors include, but are not limited to, health services, educational institutions, leisure facilities, local authority functions, criminal justice services and energy and transport sectors. For example, one Government funded fibre project has reported that better connectivity in the health sector can enable an increase in monthly e-consultations by GP surgeries by 400% by 2025 and reduce face-face patient follow up by 35% through the introduction of virtual appointments.
- by improving the availability and reliability of high-speed internet, people feel more digitally included which can lead to an increase in wellbeing. The Superfast evaluation quantified the impact of broadband on wellbeing. It found that increasing household internet speed to superfast speeds was associated with a wellbeing improvement equivalent to £225 per premises per year[20]
- academic studies on the effect of broadband provision on house/asset prices, including Molnar et al (2013)[21], Ahlfeldt (2017)[22]
- information gathered or produced by 5G Rural First[23], a co-innovation project led by Cisco alongside principal partner University of Strathclyde, DCMS and others
- Rural England's unlocking digital potential of rural areas across the UK[24]

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[18] Superfast Broadband Programme - State Aid Evaluation Report 2020
[19] UK Broadband Impact Study
[20] Simetrica (2018), 'Subjective wellbeing analysis of the Superfast Broadband Programme'
[21] Molnar et al 2013
[22] Ahlfeldt (2017)
[23] 5G RuralFirst
[24] Unlocking the digital potential of rural areas across the UK Unlocking the digital potential of rural areas across the UK

- consultancy studies. For example, Analysys Mason estimated the benefits of 5G connectivity[25] in the agricultural sector to be ~£2.2 billion; international benchmarks, for example, the US Federal Communications Commission (FCC) published a report on the impact of broadband penetration on US farm productivity[26]
- DCMS conducted a 5G testbed study, the analysis/evaluations for this examined the impacts of 5G connectivity on farms across the UK.

Previous consultations have also provided evidence on the benefits of improved broadband services in rural areas. This evidence includes, but is not limited to:

- evidence provided by suppliers during discussions on the UK Gigabit Programme
- evidence provided to the government by stakeholders and representative organisations as part of discussions prior to this call for evidence
- Ofcom's 2018 study across 35 OECD countries, assessing the economic impact of broadband and how it exhibits diminishing marginal returns[27].
- Centre for Economics and Business Research Centre for Economics and Business Research report written on behalf of Openreach assessing the economic impacts of full fibre on the UK economy[28]
- The National Infrastructure Commission contacted Frontier Economics to examine the future benefits of broadband, which estimated the benefits of 5G and Full Fibre/G.fast whilst assessing some of the costs[29]
- the Imperial College London land value uplift study[30] which attributed 3% land value increases to broadband and used data from across the UK.

This evidence suggests that remote rural residents face substantially greater travel times and disruption to their working and social time to access basic services. This evidence also suggests that remote rural businesses are disproportionately agricultural. Agriculture is a sector where there is a substantial productivity gap in the UK compared to other sectors and countries. The benefits of 'agri-tech' to improve productivity are partly dependent on the availability of improved digital connectivity.

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[25] £14.8bn of Economic Benefits from Full 5G as UK Cover Hits 30% - ISPreview UK
[26] Impact of Broadband Penetration on US Farm Productivity OEA Working Paper 50 Abstract
[27] The economic impact of broadband
[28] CEBR Openreach Full Fibre economic impact study
[29] Future Benefits of Broadband report
[30] Imperial study suggests that internet speed has an impact on property prices | Imperial News

Figure 5.1: Average minimum travel time to reach the nearest key services by public transport or walking in England in 2016
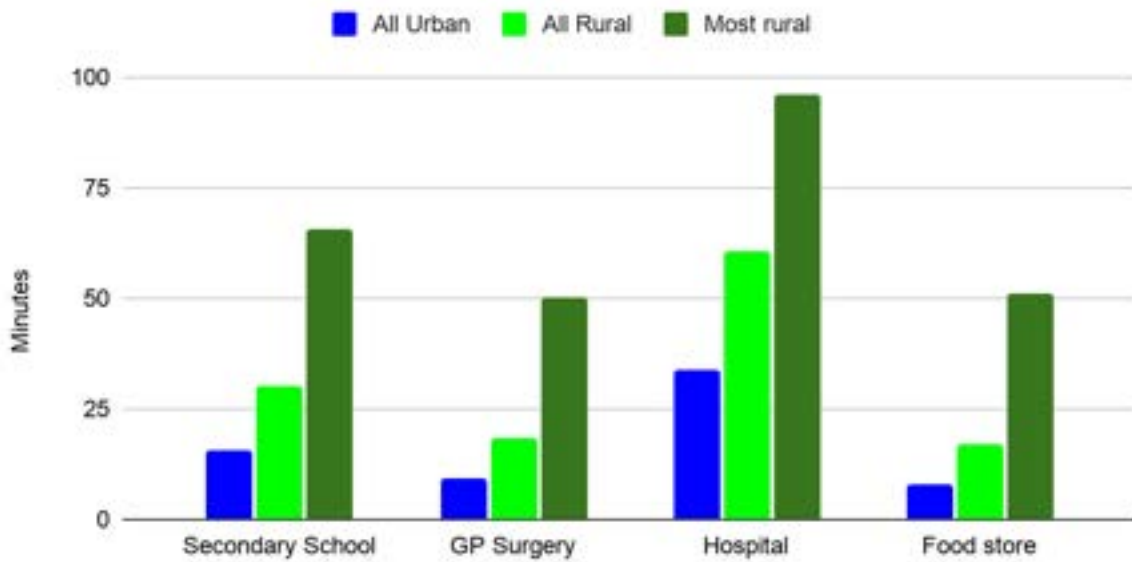
Source: Statistical Digest of Rural England

Figure 5.2: International Index of Agricultural Productivity

Source: International Agricultural Productivity

Figure 5.3: The impact improved connectivity on farms has on productivity

Note that the 5G impacts are measured individually, meaning the impacts do not account for the full number of additional productivity benefits to farms which may be observed following a 5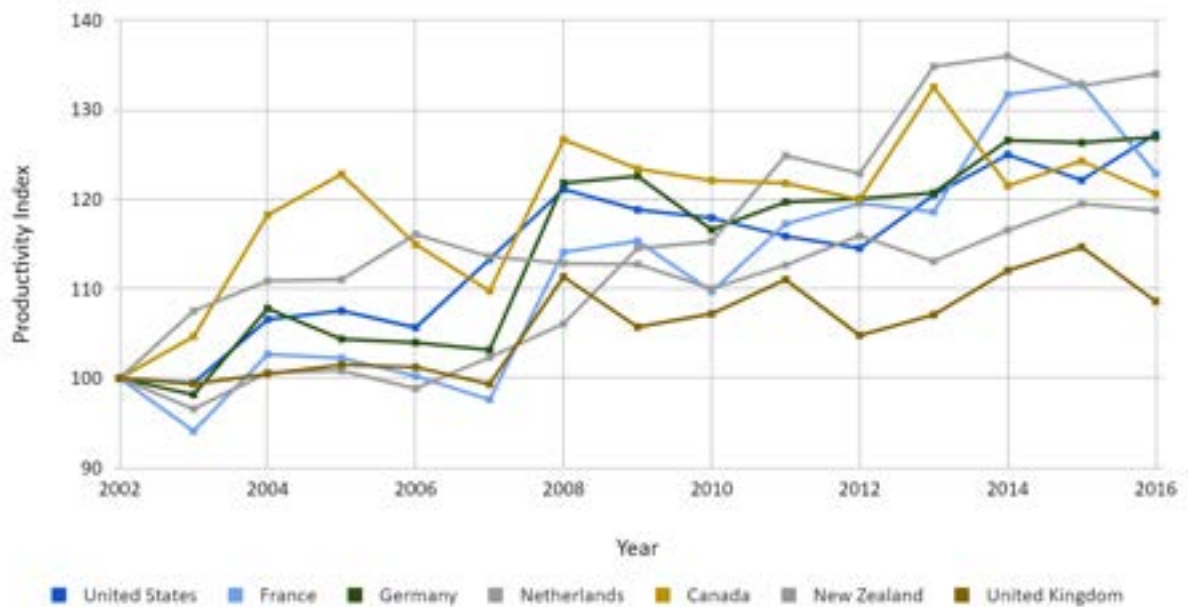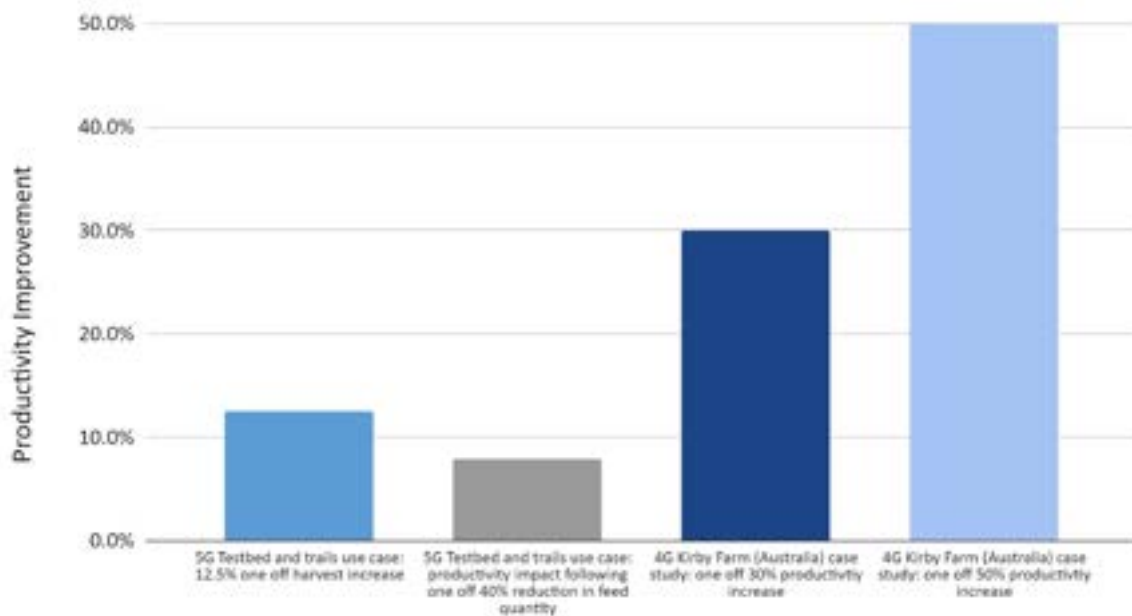G connection. The 5G impacts are also emerging data, so may be subject to change. Kirby Farm is classified as a highly productive farm based in Australia, so may experience differing productivity impacts to the average farm here in the UK.

Qualitative evidence provided to the Department through correspondence with MPs and their constituents also provides examples of mitigation strategies employed by rural businesses in particular, in the absence of appropriate digital connectivity. This ranges from geographic displacement to additional travel to the employment of agents located in market towns with better connectivity to complete transactions and services (with potential delays and inefficiencies).

5.2 Why we are calling for further evidence

We wish to further quantify where possible the social, environmental and economic benefits of the provision of improved broadband for consumers and businesses who are located in Very Hard to Reach locations.

Whilst there is already a substantial evidence base for the benefits of broadband for consumers and businesses generally within the UK, and a selection of academic literature on the potential benefits of rural 'agri-tech', it is difficult to assess how these benefits can be apportioned to specific geographic areas.

Many studies consider rural areas in their entirety and are not focussed only on remote rural or Very Hard to Reach areas. Generally, productivity data has not been linked to the underlying level of availability and adoption of digital connectivity. Furthermore, the

availability of some digital communications and agri-tech applications in the UK is relatively recent and difficult to correlate to economic output data. Data on the (non-digital) alternative strategies available to consumers and businesses in remote rural areas is also difficult to compile.

This evidence will allow us to assess the benefits of improved and more reliable broadband in Very Hard to Reach locations, in relation to their geographic remoteness and current level of access to digital connectivity and alternative services.

5.3 Summary of questions on benefits, by type of respondent

The evidence we are seeking on the benefits of improved broadband in Very Hard to Reach areas is set out below, arranged by respondent type. The questions below are summaries of those in the online survey, where the questions may be worded differently for analysis purposes.

Table 5.4: Questions on benefits

We are asking **consumers**:	
B1	How would access to improved broadband benefit you in particular?
B2	Have you ever used or been offered a virtual health service, such as an online GP session? ○ How would you rate this service based on your experience?
B3	Has your household made use of tele/virtual education? ○ How has your virtual education experience compared before and after March 2020 (the beginning of the first COVID-19 lockdown)?
B4	Do you have access to the following services (regardless of whether your premises has made use of them): ○ Online libraries? ○ Online medical appointments? ○ Online learning? ○ Online banking?
B5	How do you think better broadband would affect: ○ Your ability to keep in touch with friends and family? ○ Your access to online entertainment (e.g. films and TV streaming)? ○ Your access to support services? ○ Your ability to work at home?
B6	How do you think having access to these services would affect your wellbeing and welfare?
We are asking **businesses**:	

B7	How would access to improved broadband benefit you in particular?
B8	Which online applications are important to the operation of your business?
B9	Which of the following does your business have access to and makes use of? ○ Online accounting ○ Online orders ○ Online conferencing ○ Online banking
B10	Does your internet connection enable or inhibit: ○ Remote working? ○ Customer or supplier access? ○ Business efficiency or cost savings? ○ Cloud data storage and security? ○ Business flexibility? ○ Access to new markets? ○ Profitability? ○ Product or service range? ○ Access to training? ○ Staffing and recruitment?
B11	Has digital connectivity enabled your business to enter different markets or sectors in addition to your original business activities?

We are asking **market participants**:

B12	Have you made any assessment of the economic or social benefits of the provision of your services to remote rural customers?
B13	If barriers were removed, how would you rate the improvement in: ○ Capital cost requirements? ○ Operating expenditures? ○ Administrative burdens? ○ The overall business case for investment?

In addition, we are seeking evidence from representative organisations on this topic. Responses from such organisations may address any of the themes above in broad or specific terms.

Section 6 - Topic C: Barriers to delivering or accessing improved broadband in Very Hard to Reach locations

In this section we:
- summarise the sources of current evidence on barriers that prevent the delivery or adoption of broadband in Very Hard to Reach areas that are already available
- explain why we are calling for further evidence on these barriers
- summarise the questions on barriers encountered by consumers, businesses and suppliers with regards to improved broadband services in Very Hard to Reach areas

6.1 Current Evidence on Barriers

The presence and availability of networks is a fundamental barrier to the adoption of improved broadband services. Information is already available to the government on the extent to which broadband services are available to end-users, gathered through:
- Ofcom's Connected Nations reports (based on data provided by operators)
- public disclosure and investor releases by operators
- third party data sources, including proprietary reports
- information provided through consultations and public reviews

The extent and quality of data available to the government on network availability does vary in quality and extent. For example:
- data on 'fixed wired' broadband networks is substantial and detailed, usually to the premises level
- data on 'fixed wireless' networks is less detailed, and by its nature reliant on modelling assumptions. It is more typically predictive than 'measurement' based. Less speed/capacity data is also included than in 'fixed wired' network reporting
- data on independent wireless networks is substantially less detailed and limited to a single speed. In many cases, smaller operators do not provide such data to Ofcom through the Connected Nations data gathering process
- substantive data on broadband delivery through non-terrestrial (for example, satellite) provision is much more limited, and provided on a case-by-case basis by satellite providers

Information on other barriers is also relevant to this call, and some information on this is available to the government, including;
- **pricing of ongoing services:** Generally, price information is in the public domain, though the degree to which prices in remote rural and Very Hard to Reach locations are influenced by lower use of wholesale offerings (and thus a smaller choice of retail ISP offerings) is complex to assess
- **pricing of infrastructure installation costs:** More limited information is available on the cost of installation of services to consumers, where required, given that these are

often bespoke installations and private contractual agreements between consumers/businesses and telecoms suppliers
- **degree of engagement with voucher schemes**: Government is aware of the level of applications for, and delivery of connections supported by voucher schemes in uncommercial areas. However, these applications are only visible to the government once the applicants successfully find a supplier. The main exception to this is areas covered in particular by the Broadband Upgrade Fund[31] pilot run by BDUK in 2020/2021
- **the extent of engagement with Universal Service Providers:** Some information is provided in mandatory reporting by BT and KCOM, under the conditions laid upon them by Ofcom as part of the broadband USO
- **financial investment incentives:** Engagement with suppliers and private debt/equity providers, as well as activity linked to investments made by the government (such as the Digital Infrastructure Investment Fund) or through procurements provides some information on the availability of capital to the sector, and the investor positions on risk and return
- **capital and operational cost of networks:** Substantial detailed data is available to the government on the cost of network infrastructure and the cost of running network infrastructure. However, less information is available on newer technologies, and some costs (and techniques) are substantially different in remote rural areas.

The Department receives qualitative evidence through correspondence from MPs and their constituents regarding the barriers they face in improving their broadband connection. The most common barriers to consumers are:
- high quotes are given by broadband providers
- information on future builds or current availability is not clearly available
- general lack of infrastructure, e.g. premises too far away from the cabinet, no/intermittent 4G signal
- the premises has missed out or been excluded from previous network build

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[31] [Broadband Upgrade Fund: Register](#)

Figure 6.1: Rural businesses' constraints to going digital
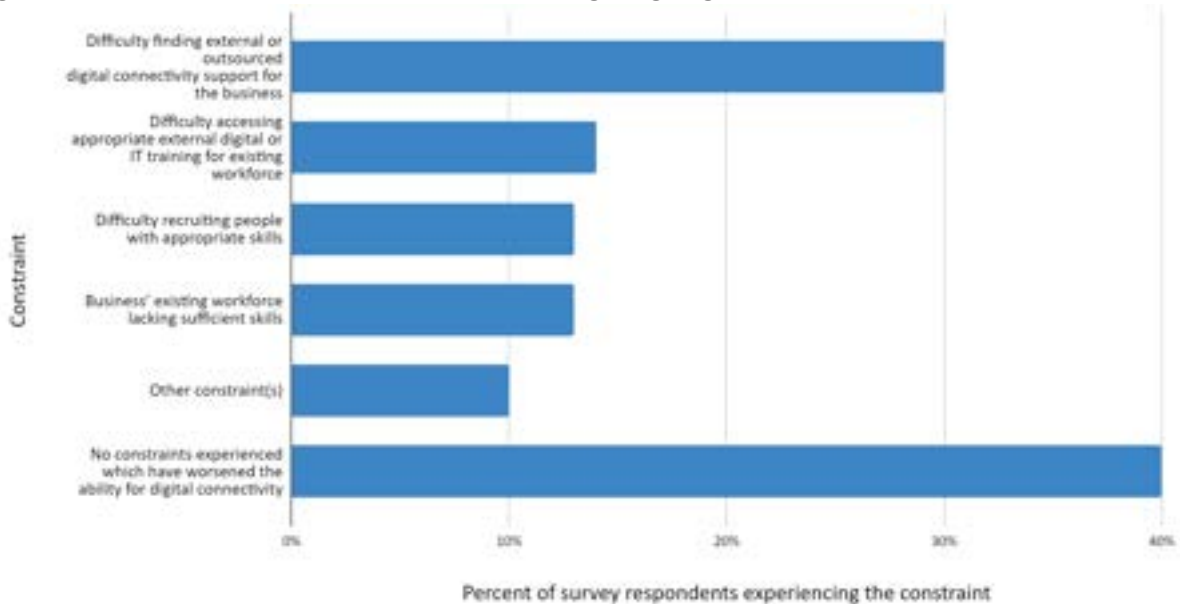
Source: [Rural England](#)

6.2 Why we are calling for further evidence

We wish to assess how best to remove barriers to delivering improved broadband to consumers in Very Hard to Reach locations, to realise its benefits without distorting any existing competitive commercial markets. To do this we require evidence that:

- helps to confirm our existing data on the availability of networks
- provides more information on the extent of upfront costs faced by consumers in Very Hard to Reach areas
- illuminates any price and non-price barriers that are substantially different for users located in remote rural areas compared to rural locations in general
- provides further information on the experience of consumers and businesses with existing schemes in Very Hard to Reach locations

6.3 Summary of questions on barriers, by type of respondent

The evidence we are seeking on barriers to delivering improved broadband in Very Hard to Reach areas is set out below, arranged by respondent type. The questions below are summaries of those in the online survey, where the questions may be worded differently for analysis purposes.

Table 6.2: Questions on barriers

	We are asking **consumers**:
C1	If you do not use a home broadband service, why not?
C2	Have you had to change your use of applications or browsing behaviour as a result of limitations of your broadband service?
C3	Have you changed package, supplier, or technology as a result of constraints with your broadband service in this remote location?
C4	If you changed technology to improve broadband, which technology did you change from and to?
C5	Have you explored the use of fixed wireless services in your area?
C6	Have you explored the use of satellite services for broadband?
C7	Where relevant: ○ Explored new broadband services that are expected to arrive in your area ○ Explored a community broadband scheme (such as a Community Fibre Partnership) ○ Applied for a broadband connectivity voucher (from either the UK government, your Local Authority or a Devolved Government scheme?) ○ Have you been advised (in writing or otherwise) that you are potentially eligible to request an improved connection through the Broadband Universal Service obligation (provided by BT, or KCOM (in Kingston upon Hull only))?
	We are asking **businesses**:
C8	Have you experienced any of the following constraints in adopting digital connectivity for your firm, beyond any connectivity challenges: ○ Finding external digital support ○ Accessing appropriate digital training ○ Recruiting people with digital skills ○ Existing workforce lacks digital skills ○ Other
C9	Have you changed package, supplier, or technology as a result of constraints with your broadband service in this remote location?
C10	If you changed technology to improve broadband, which technology did you change from and to?
C11	Have you explored the use of fixed wireless services in your area?
C12	Have you explored the use of satellite services for broadband?

C13	Where relevant:
	○ Explored new broadband services that are expected to arrive in your area
	○ Explored a community broadband scheme (such as a Community Fibre Partnership)
	○ Applied for a broadband connectivity voucher (from either the UK government, your Local Authority or a Devolved Government scheme?)
	○ Have you been advised (in writing or otherwise) that you are potentially eligible to request an improved connection through the Broadband Universal Service obligation (provided by BT, or KCOM (in Kingston upon Hull only))?

	We are asking **market participants**:
C14	What factors make it challenging to invest in remote rural areas?
C15	How do you consider 'Protected Landscapes' (for example, National Parks, AONB) when making your investment decisions?
C16	How would you describe the disposition of your investors towards investments in remote rural areas?
C17	What do you think the willingness to pay for services in remote rural areas is in comparison to more urban areas?
C18	How much higher or lower do you estimate the average capital costs to be in remote rural areas in comparison to more urban areas?
C19	How much higher or lower do you estimate the average operational costs to be in remote rural areas in comparison to more urban areas?
C20	How would you describe your level of access to information on where underserved premises in remote rural areas of the UK are located?
C21	How would you describe staffing and recruitment challenges to support remote rural network deployment?
C22	Are there other regulatory or administrative barriers to you expanding your offering/presence in remote rural areas?
C23	To what extent is the availability (or otherwise) of competitive provision of backhaul services generally an impediment to your deployment of otherwise economic solutions to Very Hard to Reach premises in remote rural locations?
C24	To what extent are any absent submarine cable (or microwave) links to islands an impediment to your deployment of otherwise affordable solutions to Very Hard to Reach premises located off the UK mainland?

C25	To what extent is the availability (or otherwise) of appropriate access to power supplies services generally an impediment to your deployment of otherwise economic solutions to Very Hard to Reach premises in remote rural locations?
C26	Previous and upcoming legislative changes notwithstanding, to what extent is the availability (or otherwise) is access to potential site locations an impediment to your deployment of otherwise economic solutions to Very Hard to Reach premises in remote rural locations?
C27	Is your organisation registered as a supplier as part of the following schemes and procurements? ○ Superfast Broadband scheme ○ Gigabit Voucher Scheme ○ Public Sector Hub upgrades & Gigabit-Capable Connectivity DPS ○ Market engagement for upcoming UK Gigabit Programme Gigabit Procurements ○ other

In addition, we are seeking evidence from representative organisations on this topic. Responses from such organisations may address any of the themes above in broad or specific terms.

Section 7 - Topic D: Approaches to supplying improved broadband in Very Hard to Reach locations

In this section we:
- summarise the sources of current evidence already available on approaches to supplying improved broadband, including examples of technologies employed in other countries to address this challenge. This includes:
  - new fibre technologies
  - new wireless technologies
  - space-based technologies
  - high altitude platforms
- explain why we are calling for further evidence on these approaches
- summarise our key questions in this call for evidence, which are primarily addressed to market participants, including telecommunications infrastructure and service providers, and telecommunications equipment vendors.
- **do not** set out any policy proposals for supplying improved broadband in Very Hard to Reach locations
- **are not** seeking responses from consumers and business users, due to the technical nature of the topic

7.1 Current Evidence on Approaches

Examples from other countries illustrate that new technology approaches can transform the delivery of improved broadband to Very Hard to Reach locations. However, some technology solutions require compromises in performance and capacity, carry substantial commercial, financial and technical risks, and may have uncertain long-term affordability.

New fibre technologies

Since its invention in 1952 in the UK by Narinder Singh Kapany at Imperial College London, innovation in materials and manufacturing - as well as installation techniques - have dramatically reduced the cost of using fibre in telecommunications networks. Its stability, resilience and upgradability (by replacing active electronics) make it ideal for future-proof networks, wherever deployment costs allow.

Innovation in fibre technologies continues, and as widespread FTTP rollouts continue worldwide, new approaches continue to reduce costs. For example;

- **Connectorisation:** connectorisation is becoming increasingly popular as a method to simplify the construction of networks and minimise the skill level and time required to otherwise manually 'splice' different cables together. This is a key evolving

technology, given skill and manpower shortages in the industry as a result of many rollouts occurring at the same time.

- **Large core fibres (LCF)**: some researchers are experimenting with larger fibre cores that whilst requiring more material, can require less installation skill and potentially lower transmission losses. Small diameter fibres are not always the best solution in some parts of the network even though they take up less space and weigh less, because very light cables can be more prone to damage by wind in aerial deployments on poles.
- **Hollow core fibres**: industrial and academic research[32] has in recent years explored the use of fibres with a hollow core, which may exceed the performance of solid glass fibres, particularly in short pulses. Lumenisity Ltd[33] (a spin-out of the University of Southampton), and NKT Photonics[34] are both working with hollow core technology.
- **Fibre-in-water**: the inert nature of glass/plastic fibre means that it can be deployed inside (as well as alongside) pipes carrying other mediums. The UK hosted several of the earliest commercial networks employing fibre deployed through waste-water mains (including early start-up H20 Networks' academic campus deployments in North Wales, and Scottish Water deployments in Fife). More recently fibre in potable (drinking) water technologies have been developed, which allow FTTP deployment through existing pipes, minimising for example the cost of trenching in suburban environments (see for example CRALEY Group[35], assisted by a government Innovate UK grant). This technology is also deployed in the US and Spain.

Given the pace of innovation and the falling price of some deployment technologies, we are seeking further evidence in this field to inform policy development and our costing tools.

New wireless technologies

Wireless technologies continue to advance rapidly, and the performance of commercial systems based on 4G, 4G LTE and 5G standards continue to rise. The availability of new radio spectrum and advances in technology mean that wireless networks can deliver speeds that are similar to fixed broadband networks. 5G in particular brought Massive-MIMO and a much wider range of frequency bands into scope, subject to the availability and appropriate licensing of such bands in many countries. 5G also supports carrier aggregation (where a device remains connected to two different bands at the same time) and dual connectivity (where a device can draw on bandwidth from multiple types of networks). Further rapid development and innovation is expected.

Low and mid band frequency developments

Ofcom is conducting a further auction[36] of 5G-compatible bands, including 80 megahertz in the 700MHz band and 120 megahertz of spectrum in the 3.6 GHz-3.8 GHz band. These

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[32] Hollow core optical fibres with comparable attenuation to silica fibres between 600 and 1100 nm
[33] New Hollow-core Optical Fiber Is Clearer Than Glass
[34] Hollow core photonic crystal fibers
[35] https://www.craley.com/craley-in-pipe-fibre
[36] A guide to Ofcom's forthcoming spectrum auction

frequencies offer a substantial range due to their propagation characteristics and the greater availability of spectrum in these bands could have a substantial impact on the reach of 4G or 5G networks deployed using them in the UK. The outcome of the principal stage of this auction was announced by Ofcom on 17 March[37], with assignment stage results to follow. This auction is separate to the previous award of 5G compatible spectrum at 3.4GHz in Ofcom's auction in 2019.

Higher frequency developments

In the last two years, a selection of radio solutions have become commercially available based on the 802.11ad (WiGig) standard and supporting the V-band (60GHz) and E-band (70-80GHz). Many of these technologies are gigabit-capable and include point-to-point and point-to-multipoint solutions from vendors including Adtran, Adwin, Aviat, Cambium, MicroTik, Radwin, Siklu and Ubiquiti. Many of these products are already technically compliant with the conditions of some of the government's gigabit-capable investment programmes. Facebook's Terragraph is also a V-band multi-node solution.

Figure 7.1: Topologies for wireless and hybrid wireless gigabit networks

1. Typical Deployment (Fibre)
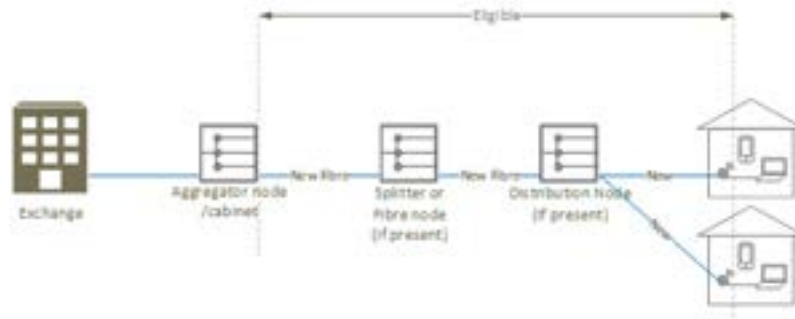
2a. Example Deployment (Wireless)
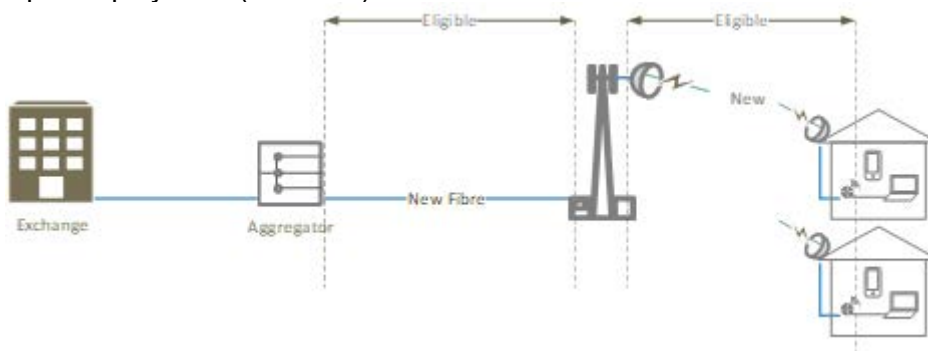
2b. Example Deployment (Wireless)

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[37] Ofcom spectrum auction: principal stage results 17 March 2021

2c. Example Deployment (Wireless)
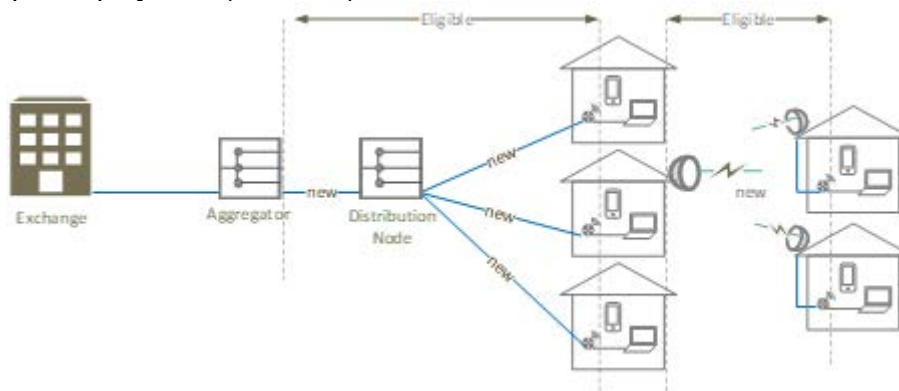
2d. Example Deployment (Wireless)
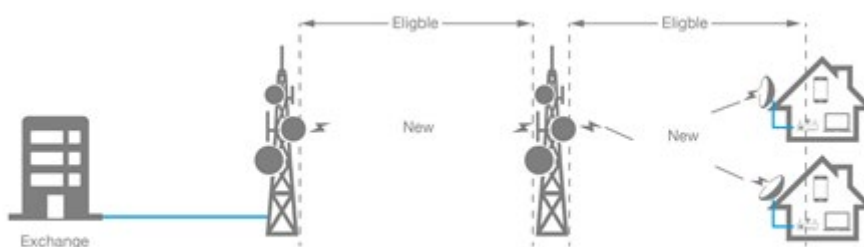
Note: For further details, see BDUK supplier guidance for gigabit-capable deployments

Work on the later 802.11ay WiGig standard has proceeded further recently[38], reaching conditional 802 EC approval in November 2020, pending IEEE Revision Committee (RevCom) and the Sustainability Accounting Stan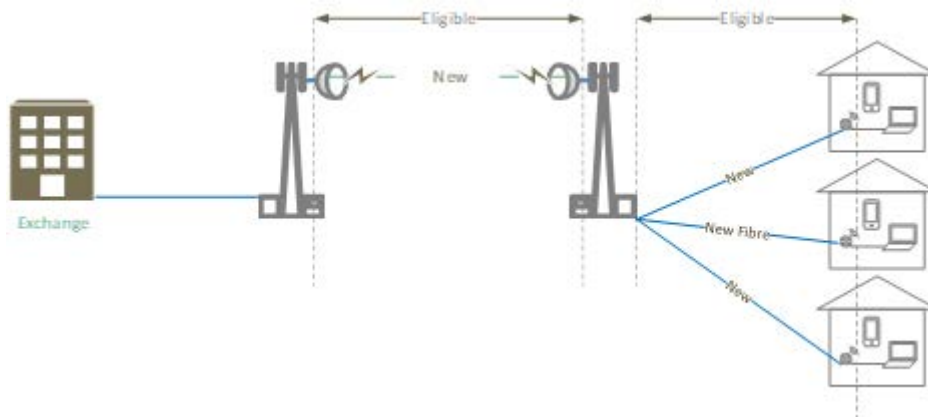dards Board (SASB) approvals expected in Q1 2021. This standard enables at least one mode of operation capable of supporting a maximum throughput of at least 20 Gbps while maintaining or improving the power efficiency per station. It also defines operations for license-exempt bands above 45 GHz while ensuring backward compatibility and coexistence with legacy directional multi-gigabit stations (defined by IEEE 802.11ad-2012 amendment) operating in the same band.

Pre-standard equipment based on 802.11ay is already available, based on chipsets from Qualcomm, who also suggest that as of 2021 commercial 5G mmWave services are now available in more than 55 cities in the US and 160 areas of Japan. However, the potential timing of availability of full standard equipment in substantial volumes in the UK is unclear.

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[38] Status of Project IEEE 802.11ay

These technologies are usually range limited but are of substantial interest for both urban area deployments and for connections in rural and remote environments where final premises are in small clusters, and the connectivity barrier for fixed gigabit services is related to backhaul availability or access issues that prevent fibre build. Whilst much of the initial attention on mmWave technology has been centred on urban and suburban deployments, Qualcomm and Ericsson have also demonstrated the use of 4G/5G standards for extended range;

- With U.S. Cellular having a commercial network in Wisconsin, achieving a 5+ kilometre range while sustaining sub-Gigabit 5G mmWave FWA data rates (of around 100+ Mbps)[39]
- With NBN in a rural location in Australia, achieving a 7.3km line of light link using 28GHz mmWave for 5GNR, another LTE radio for the anchor band and Qualcomm directional antenna.
- With TIM in Italy, achieving speeds of 1 Gbps on 26 GHz millimetre-wave (mmWave) frequencies over distances of 6.5 kilometres on TIM's live network. This again used a 5G mmWave high power antenna-integrated radio, Casa Systems' AurusAI 5G mmWave CPE, and a Qualcomm antenna.

OpenRAN

OpenRAN initiatives are driven by aspirations by some industry participants for vendor diversity (greater choice and resilience in the supply chain), extreme automation for better economics for cloud-based technologies and open interfaces to allow programmable RANs and near-real-time control of radio resources.

The OpenRAN architecture creates a multi-vendor, multi-operator, open ecosystem of interoperable components for the various RAN elements and from different vendors. There is already widespread interest in OpenRAN from many operators, including Rakuten (Japan), Vodafone Group (a co-chair of the OpenRAN project group), Telefonica, Deutsche Telekom (Germany), Sprint (US), and Etisalat (UAE).

OpenRAN is particularly relevant in a rural context, where low total cost of ownership is key to ensuring that base station economics achieve 'break even' as early as possible. The vast majority of the tens of thousands of trial sites for OpenRAN are located in rural areas, in both developed and developing countries. Vodafone, for example, committed in November 2020 to the deployment of OpenRAN at 2,600 cell sites across Wales and the South West of England[40].

Further information on OpenRAN is available in particular from the Telecoms Infrastructure Project (TIP)[41] and the OpenRAN Alliance[42], as well as third party commentators[43].

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[39] US Cellular transmits 5G across 3 miles in mmWave with Qualcomm, Ericsson
[40] OpenRAN: Why Vodafone is taking the lead
[41] Telecom Infra Project | Global Community Connectivity collaboration
[42] O-RAN ALLIANCE
[43] Open RAN 101--Open RAN: Why, what, how, when? (Reader Forum)

Dynamic Spectrum Allocation

This technology combines shared access to spectrum with management via new tools including AI and distributed ledgers. Dynamic spectrum management tools allow for more efficient use of spectrum through enhanced spectrum sharing, and could be particularly beneficial to enable the provision of wireless broadband services in remote and rural areas where pockets of spectrum are potentially underutilised.

Shared access licenses are already available in the UK, in particular in the 1800 MHz, 2300 MHz, 3800 - 4200 MHz band and at 24.25-26.5 GHz (in this band limited to indoor low power licences)[44], though uptake has been limited so far.

This technology is already available but rapid development is expected:
- Dynamic spectrum access techniques are already used in the UK in so-called TV White Space, which is unused spectrum in the frequency bands used for Digital Terrestrial Television broadcasting. This was tested during the DCMS-supported 5GRIT (5G Rural Integrated Testbed) pilot trials, which involved King's College, London and commercial operators Quickline and Broadway Partners, and earlier activity in Argyll and Bute[45].

- In 2019, dynamic spectrum-sharing[46] was demonstrated in Ericsson's R&D lab in Ottawa, Canada using an Ericsson macro radio that supports both 4G and 5G, along with a mobile test device powered by the Qualcomm Snapdragon X55 5G Modem-RF System, and a commercial LTE smartphone.
- In the United States, the Citizens Broadband Radio Service (CBRS) introduced a three-tiered spectrum sharing framework underpinned by dynamic spectrum access technology to enable a variety of users and innovative use cases to access 3.5 GHz spectrum, while protecting government and other incumbent users.

Space-based technologies

Initial generations of communications satellites relied on high geostationary orbits, and the 2000s saw a raft of new broadband satellite constellations trying to achieve commerciality. Recent generations of satellites are utilising new orbits that are closer to the Earth to offer new capabilities. Advances in antenna design, as well as the availability of new spectrum bands, has ushered in an era of 'High Throughput' satellites that employ steerable spot beams to concentrate and enhance the availability of capacity within specific coverage areas.

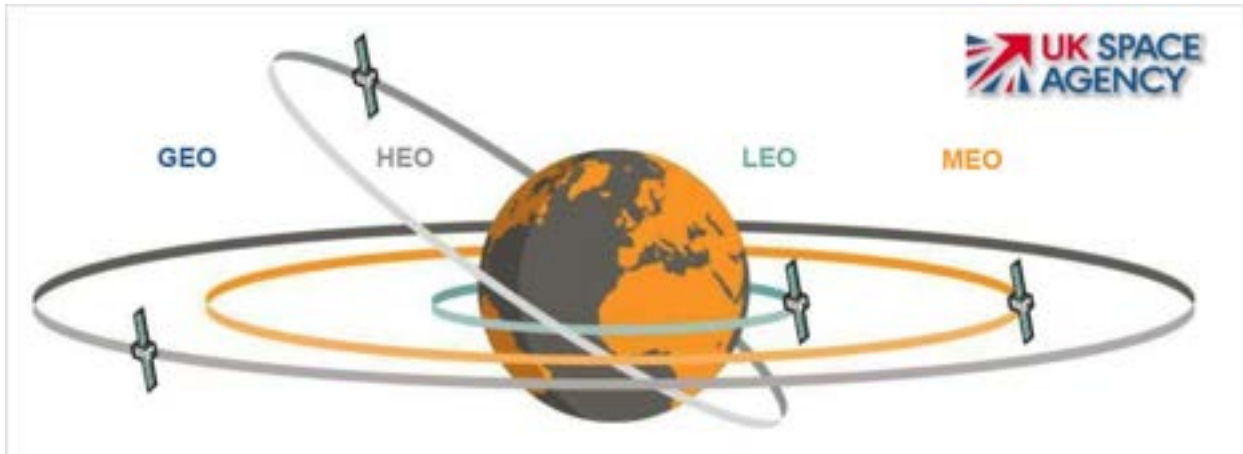The following information details the different types of satellite orbit.

Figure 7.2: Orbits

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[44] Ofcom - Shared access licences
[45] White Space Trial on the Isle of Bute – Centre for White Space Communications
[46] Dynamic spectrum sharing for 5G deployments

Source: UK Space Agency

Satellite Orbit	Orbit Description	Examples (non-exhaustive)
GEO (Geosynchronous Orbit)	At approx. 35,800km. Typically communication, TV and weather satellites, they stay over the same point of the equator by matching the direction and speed of the Earth's rotation. This means that from the ground they appear motionless.	Viasat-2 Inmarsat-4 Galileo Eutelsat Konnect Intelsat EPIC
HEO (High Elliptical Orbit)	Elliptical orbits speed around the bottom of their path, and slow towards the top, allowing them to spend more time in sight of a certain area.	Previous Sirius (satellite radio) satellites.
MEO (Medium Earth Orbit)	At approx. 20,000km. These are mainly GPS and other positioning satellites, often networked together to create a 'constellation', allowing broader coverage.	GPS O3b O3b mPower
LEO (Low Earth Orbit)	Between 180 and 800km. Typically Earth observation satellites, whose close orbits enable better visibility of the Earth's surface.	Iridium / Iridium NEXT Telesat Lightspeed Starlink (Space-X) OneWeb (Bharti, UKG) Project Kuiper (Amazon)

Retail broadband and satellite backhaul services are already available in remote rural areas in the UK from several of these constellations. The capacity, coverage, speed, latency and service price varies greatly from constellation to constellation. The price can also depend on the route-to-market and retail arrangements that the constellation owner or operator has with local telecommunications service providers if selling the service indirectly.

Of particular note in the UK market with regards to fixed (static) broadband services for the Very Hard to Reach premises are the following developments:

- **Eutelsat KONNECT**, a GEO satellite with 75 Gbps of capacity across a network of 65 spot beams in the Ka-band, was placed into orbit in January 2020 and now offers consumer broadband services of up to 100 Mbps download speed. Eutelsat acquired retail distributors to further integrate and accelerate their direct offerings, standard pricing before discounts at 30-70 euro per month for 30 Mbps to 100 Mbps services respectively. Equipment and installation charges to consumers are very low.
- **Eutelsat KONNECT VHTS**, a total 500 Gbps capacity Ka-band high throughput satellite being built by Alenia Space and due for launch in late 2021. This is a key element of the delivery of the European Commission's objective that households and businesses will have access to at least 100 Mbps of internet connectivity by 2025. The European Investment Bank has provided a 200 million euro financing agreement to support procurement and launch.
- **Viasat-3**, a class of three VHTS GEO satellites expected to be launched from 2022. The second satellite is expected to cover the UK market, and the total system capacity is expected to be 1,000 Gbps. The previous generation ViaSat-2 network increased capacity to 260 Gbps, offering customer service plans of up to 100 Mbps. Viasat suggests a x400 reduction in capital cost per megabit versus the Viasat-1 constellation, and x4 versus the more recent Viasat-2, illustrating the extent to which high next generation VHTS GEO satellites may transform industry pricing.
- **Starlink**, a constellation of LEO satellites using both Ku-band and Ka-band, being built and launched by Space-X. Over 1,000 satellites are already in orbit and initial plans are for a 12,000 satellite constellation. Trial ('Beta') services are already available in the US, Canada and the UK, and appear to be delivering speeds exceeding 100Mbps). A UK company has been registered and prepayments to reserve service are being taken from consumers, where constellation capacity already allows. The service is initially priced at £90 per month for UK consumers and has a substantial upfront equipment cost.
- **OneWeb**, a constellation of LEO satellites, being built by OneWeb satellites (a joint venture between OneWeb and Airbus). OneWeb shareholders include the UK government, Bharti Global, Softbank Group and Hughes Network Systems LLC. According to public documents, the initial constellation plan is for 648 satellites, of which 110 have already been launched. OneWeb have stated that they plan to offer a commercial service in the UK, Canada, and the Arctic in 2021, with global service following in 2022 when the constellation is complete.

There is substantial evidence from other countries that such space-based systems may play an increasing role in addressing connectivity needs, particularly in remote locations. This is especially the case in recent developments in Canada, Australia and the US.

- **In Canada**, Telesat and the Government of Canada signed a $600 million (CAD) to allow internet and mobility service providers to acquire Telesat LEO capacity at substantially reduced rates to bring universal broadband connectivity to rural, northern and indigenous communities across Canada. These arrangements in particular, focus on very isolated communities in the far north of Canada, many of

which are inaccessible by road, and areas of exceptionally low population density. The aim is to support fixed broadband end-users with at least 50 Mbps download /10 Mbps upload speeds with 'unlimited' data, and mobility service providers offering LTE services. Telesat launched a test LEO satellite, but the constellation is not yet operational.

- **In Australia**, the state-backed wholesaler, NBNco (National Broadband Network) committed to a minimum of 25 Mbps nationwide coverage and developed the Universal Service Guarantee to deliver this level of coverage. They will use a mix of fixed line connections including both full fibre (FTTP) and fibre-to-the-node, fixed wireless and satellite technologies to provide coverage to all premises in Australia. 92% of premises will receive fixed line coverage, 5% will receive fixed wireless and 3% will have a satellite connection. The satellite connections are delivered by Skymuster, a constellation of 2 GEO satellites, launched in 2015-2016. This is a wholesale service, available to end-users through retail provision, with data packages of up to 150GB per month. Over 108,000 premises were connected by satellite by the end of December 2020, on tariffs typically costing AUS$40-80 (£22-44) per month. NBNco budgeted AUS$2 billion (£1.1 billion) for this service, including the cost of ten ground stations.

- **In the United States**, a Space-X backed bid vehicle won $885.5 million of the $9.2 billion in broadband subsidies the Federal Communications Commission (FCC) awarded in December 2020 under its Rural Digital Opportunity Fund. This accounted for 643,000 locations to deliver a service, at a minimum ≥ 100 Mbps download / 20 Mbps upload speeds, <100ms latency and ≥ 2 Terabyte monthly data usage allowance. This is a substantial coverage and capacity load (see red areas on the map below). Some terrestrial Space-X competitors have challenged whether the constellation can support this level of demand, alongside commercial use of the platform and other (non-consumer broadband) services, since the FCC has licensed up to 1 million terminals in the US, and Starlink has applied for this to be increased to 5 million. However, Starlink does have a steady launch and R&D programme.

Figure 7.3: FCC Rural Digital Opportunity Fund Auction outcome (red = Starlink)

Source: Federal Communications Commission, US

These future constellations are emerging technologies, and as they are developed and come to market, more evidence is required to assess to what extent they may be able to commercially, or otherwise, support the broadband needs of consumers and businesses in Very Hard to Reach locations.

High altitude platforms

High altitude platforms (HAPS) are non-terrestrial and non-space-based technologies used to support communications networks (and sometimes other applications, such as near-earth imaging).

These platforms can be supported in the air by two main technologies;
- Balloons and airships; see Google's project Loon[47] (recently disbanded)
- Unmanned Autonomous Vehicles (UAVs); see for example the Zephyr[48] platform developed by Qinetiq, now Airbus Space and Defence, or the development work being undertaken by Stratospheric Platforms (SPL)[49] and Cambridge Consultants Ltd (CCL)[50].

ITU radio specifications consider HAPS as being deployed within the stratosphere, normally between 20km and 50km above the Earth. The World Radiocommunication Conference (WRC-19) established globally and regionally harmonised designations for HAPS, allowing trials to move towards commercial deployments and identifying worldwide allocations to the fixed service in the frequency bands 31 - 31.3 GHz, 38 – 39.5 GHz for HAPS. They also confirmed the existing worldwide identifications for HAPS in the bands 47.2 – 47.5 GHz and 47.9 – 48.2 GHz are available for worldwide use by administrations wishing to implement high altitude platform stations.

Deutsche Telekom (DT) was an early investor in SPL, and has conducted test flights using SPL's technology, over the state of Bavaria in southern Germany, using a remotely piloted adapted H3Grob 520 propeller plane. This flew to an altitude of 45,000 feet to test an antenna offering broadband LTE communication services to an area approximately 87 miles across. DT was an early investor in SPL and plans to be the launch customer.
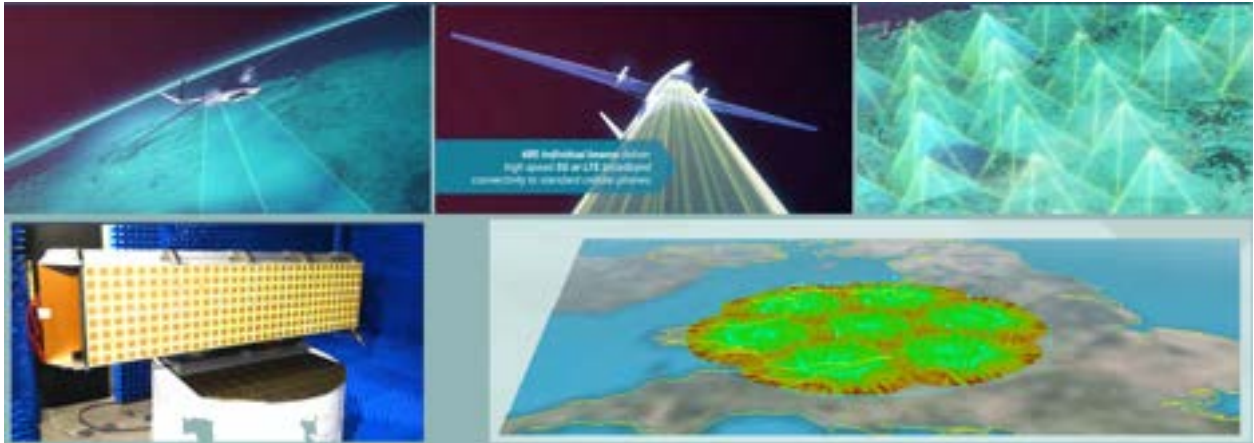
Figure 7.4: Conceptual coverage of HAPS using 4G/5G antenna, relative to UK landmass

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[47] Project Loon
[48] Zephyr - UAV
[49] Stratospheric Platforms | Affordable & Reliable Connectivity
[50] Cambridge Consultants Ltd | The world's largest commercial airborne antenna

Source: SPL

Whilst this technology is pre-commercial, it offers the advantage of close-Earth proximity (this lowers latencies for telecoms services), and the ability to move, reconfigure and redeploy at short notice or in response to demand. The lack of dependence on some types of ground infrastructure also makes it well suited for some disaster response communication applications.

7.2 Summary

Current evidence suggests that:
- **hybrid networks** (combining multiple access technologies) may become increasingly common as telecommunications infrastructure solutions continue to converge at the network and customer premises equipment level. Hybrid networks utilise common network elements, but have different access network layers available. Depending on the level of intelligence built into the network control layer and devices on the network, resources and capacity can be dynamically allocated to manage demand and to ensure network resilience
- **new fibre deployment technologies** may further reduce the cost of deployment of gigabit-capable networks, in both urban and rural environments. Over time, this may bring an increasing number of premises within the scope of current programmes and interventions, including the UK Gigabit Programme. These technologies also promise to lower investment barriers, improve returns and potentially increase the extent and pace of competitive fibre rollout (including in dense urban and suburban locations)
- **new wireless technologies** may extend the economic reach of gigabit-capable and gigabit-upgradeable networks over time. Some of these technologies bring benefits in some remote rural contexts (clusters) but range limitations will remain a constraint for some technologies. Some solutions are dependent on appropriate spectrum availability and licensing
- **new space-based platforms**, and in particular new high throughput GEO and commercial and emergent LEO satellite constellations will change cost economics for broadband delivery for some use cases. However, future performance and price points remain particularly uncertain
- **new high altitude platforms** appear further from widespread commercialisation and currently have less investor backing. However, given their proximity to the ground,

they may in future offer broadband capabilities and system performance that exceeds space-based platforms, should they reach maturity and be more widely available

7.3 Why we are calling for further evidence

Whilst some information relating to technology and system performance is in the public domain and accessible to the government, a great deal is commercially confidential, especially where it relates to platforms that are still in development or not yet fully commercialised.

Furthermore, the development of these technologies continues apace, and we wish to base policy development for Very Hard to Reach premises on the latest available information and to discuss with market participants, based on their replies to this call for evidence the potential effect of their offerings on the future market for telecommunications services in such locations.

7.4 Summary of questions on approaches to supply, by type of respondent

We are not asking consumers or businesses (as end-users) questions relating to technology supply approaches, as they do not supply such services. If a business is a supplier of such services, they should address the questions set out for 'market participants'. Some representative organisations, including local bodies with experience of planning or managing the procurement of alternative technologies including fixed wireless access solutions may wish to contribute evidence in relation to this part of the call.

Table 7.4: Questions on approaches

We are asking **market participants,** who are **telecommunications equipment vendors**:	
D1	Which existing products in your portfolio do you consider to have particular relevance to delivery of improved broadband connections to premises in Very Hard to Reach areas (either due to extreme rurality and/or low premises density)?
D2	What is the operator/customer response to these products today in the UK?
D3	Which elements of your future product/product development roadmap are most relevant to the challenge of delivering to these premises?
D4	To what timescales do you anticipate any new products or solutions that you can disclose becoming commercially available in the UK market?

D5	Do you see more substantive demand for these products in other countries, and why do you believe this to be the case, compared to the UK market?
D6	What do you believe are the impediments to a wider adoption of these technologies?
D7	Are the resources required to deploy these technologies in the Very Hard to Reach areas of the UK available today? (For example, industry capacity, industry skills, supply chain capacity, spectrum requirements, etc)
D8	Do you develop or manufacture substantial parts of these solutions in the UK?
D9	Are there any substantial issues relating to the importation, certification or approval of these technologies that may otherwise slow the adoption of these technologies?

We are asking **market participants,** who are **owners and operators of non-terrestrial infrastructure** (such as space-based systems or high altitude platforms):

D10	Details of the portfolio of services that they currently have available in the market, and how they expect these services to develop over the next five years.
D11	Details of the capabilities of their platform and system performance, including user experience, delivered throughput, reliability, latency and system capacity.
D12	Details of the timing of availability of the services, in context of broadband service delivery in the UK market, and in particular to Very Hard to Reach locations.
D13	Details of their route to market delivery and product retail relationships
D14	Details relating to the marketing of their products to consumers, including their approach to explaining to consumers the geographic availability and the performance (and any limitations of their systems)
D15	Details of the current and potentially anticipated future pricing structures and levels for their product portfolio, and payment processing mechanisms
D16	Details relating to their resilience, security and locations of infrastructure
	These questions should primarily be read in the context of new systems and platforms (HTS GEO, MEO, and LEO and HAPS), rather than older generations of satellite systems (such as non-HTS geostationary satellite systems).

We are asking **market participants,** who are **infrastructure providers or retailers** of telecommunication services:

D17	How does your technology delivery strategy for remote rural and Very Hard to Reach premises differ from general rural provision and network planning?

D18	Which current technologies are most important to your delivery to remote rural locations and why?
D19	Which future technologies are you considering deploying in remote rural communities and why?
D20	How do you think the services supported by these technologies compare to the current and future requirements of consumers and businesses located in these areas (where you have evidence of their needs)? To what extent do you think that they will meet, or exceed these needs and why?
D21	Given the spatial distribution of assets and equipment in serving such remote communities, how do you ensure that these technologies are deployed and maintained in a manner that ensures reliability, availability and quality of service and user experience?
D22	How have new fibre deployment technologies changed the effective capital cost per metre distance for the deployment of gigabit-capable fibre based networks in remote rural areas? How does this compare to published reference data on the typical cost of network construction?
D23	How do you anticipate newly available wireless technologies will change the potential cost of your approach to remote rural areas, and why?
D24	How do you anticipate newly available non-terrestrial technologies will change the potential cost of your approach to remote rural areas, and why?
D25	Which technologies do you think will have a further impact on such costs, by when and to what degree?
D26	Besides availability of equipment supply, is there anything impeding you from incorporating these technologies into your solution for remote rural premises today? E.g. availability and cost of wholesale or open access fibre backhaul (if you have not addressed this in questions C22-C25 on 'barriers').
D27	For infrastructure providers, does the potential use of these technologies impact the availability of wholesale propositions/products or influence choices available to consumers?
	These questions are asked in the context of this call for evidence on Very Hard to Reach premises and remote rural locations. We are not asking for evidence in relation to technology deployment in urban, suburban or rural areas with a substantive density of premises, or close proximity to other deployed infrastructure, which will therefore either be commercially viable or well within the scope/reach of existing programmes.

We anticipate that some information that is provided to the government by market participants to this section of the call for evidence is likely to be commercially confidential.

We ask such respondents to clearly distinguish in their replies between:
- information that is already published or in the public domain
- information that is unpublished but could be published by the government in any summary of responses to this section of this call for evidence
- information that is commercially confidential

Section 8 - How to respond

8.1 How to respond - Consumers and Business users of Rural Telecommunications

The easiest way to respond and ensure that evidence from you as an individual or from your business is taken into account is to respond to the online survey available for the general public.

Call for evidence online survey

You may also wish to provide your views through a relevant representative organisation or membership-based organisation.

8.2 How to respond - Market Participants (Providers, Suppliers, Vendors)

We welcome extended submissions from market participants such as telecoms service providers, telecoms infrastructure providers, and equipment vendors. These parties can provide details of their organisation and initiate their submission via this link:

Call for evidence online survey

Extended submissions from market participants can include the contribution of published data, research, and other reports of relevance to rural and remote communities experiences with digital connectivity, particularly in Very Hard to Reach areas. Responses will be most useful if they are framed in direct response to the questions posed, though further comments and evidence are also welcome.

Written submissions from market participants should be sent to VHTR@dcms.gov.uk.

Meetings with certain important stakeholders may be held during or after the call for evidence period.

8.3 How to respond - Representative Organisations

We welcome extended submissions from representative organisations including local government bodies and rural local enterprise partnerships. These parties can provide details of their organisation and initiate their submission via this link:

Call for evidence online survey

Extended submissions from representative organisations can include the contribution of published data, research, and other reports of relevance to rural and remote communities

experiences with digital connectivity, particularly in Very Hard to Reach areas. Responses will be most useful if they are framed in direct response to the questions posed, though further comments and evidence are also welcome.

Written submissions from representative organisations should be sent to VHTR@dcms.gov.uk.

Meetings with certain stakeholders may be held during or after the call for evidence period.

8.4 Accessibility

If you or the person you are helping cannot complete an online survey form or would like a more accessible version, or another language, additional versions of the survey may be available. Please email VHTR@dcms.gov.uk for further information.

8.5 Confidentiality and data protection

Information provided in response to this call for evidence including personal information may be subject to publication or disclosure in accordance with the access to information legislation (primarily the Freedom of Information Act 2000, the Data Protection Act 1998 and the Environmental Information Regulations 2004).

We produce a summary of the responses to the online survey of consumers and businesses, in particular those from areas we identify as Very Hard to Reach based on the information supplied in the survey, and other analysis. We will aggregate such responses appropriately to ensure anonymity and appropriate protection of personal data.

We will also summarise all relevant written responses from market participants and representative organisations and place this summary on the GOV.UK website. This summary will include a list of names or organisations that responded but not people's names, addresses or other contact details.

We may also quote the evidence received, attributed to the individual or organisation that supplied it, in any published report. If you would like all or part of your response **not** to be published, please explicitly mark it as 'not for publication' with an explanation and we will not publish it. However, as explained above, we may be required to disclose this information under FOIA.

If you want information that you provide to be treated as confidential please say so clearly in writing when you send your response to the consultation. It would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information, we will take full account of your explanation, but we cannot give assurance that confidentiality can be maintained in all circumstances. An

automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded by us as a confidentiality request.

8.6 How we will use this information

Online Survey

Any information submitted through the online survey is done so voluntarily. We will not ask for any information that means you can be identified as an individual and/or premises (beyond the postcode related to your premise address). You must be aged 18 or over to answer the online survey.

The results from the online survey will be aggregated and used to inform policy officials of patterns in the way the Very Hard to Reach premises use and access the broadband services.

DCMS's personal information charter explains how we deal with your information. It also explains how you can ask to view, change or remove your information from our records.

If you have any questions about how the information you have provided is used, please email VHTR@dcms.gov.uk.

Data Protection Officer

The Department for Digital, Culture, Media & Sport (DCMS) is the "data controller". This means that we are responsible for any of your personal data that we collect or use. We will ensure that we will treat all personal information in accordance with data protection legislation, including the General Data Protection Regulation and Data Protection Act 2018.

If you have any concerns about how the Department is handling your personal data, you may contact the Department's Data Protection Officer (DPO). The DPO provides independent advice and monitoring of DCMS's use of personal information. They can be contacted at the following postal and email addresses:

DPO,
Department for Digital, Culture, Media & Sport,
100 Parliament Street,
London,
SW1A 2BQ
Email: dcmsdataprotection@dcms.gov.uk

How do I complain?

If you're unhappy with the way we have handled your personal data and want to make a complaint, please write to the department's Data Protection Officer or the Data Protection

Manager at the relevant agency. You can contact the department's Data Protection Officer using the details above.

How to contact the Information Commissioner's Office

If you believe that your personal data has been misused or mishandled, you may make a complaint to the Information Commissioner, who is an independent regulator. You may also contact them to seek independent advice about data protection, privacy and data sharing.

Information Commissioner's Office
Wycliffe House
Water Lane
Wilmslow
Cheshire
SK9 5AF
Website: www.ico.org.uk
Telephone: 0303 123 1113
Email: casework@ico.org.uk

Any complaint to the Information Commissioner is without prejudice to your right to seek redress through the courts.

Section 9 - Questions & Answers

In this section, we clarify some of the key questions stakeholders asked us during pre-call discussions whilst preparing this call for evidence.

Why is this call for evidence focussed on remote rural areas? (vs. towns)

This call for evidence is focussed on locations that are geographically Very Hard to Reach. These are almost exclusively in remote rural areas. Most urban, suburban and generally rural areas are either already well served, part of the committed build plans of commercial operators, or already addressed by other initiatives including proposed procurements and demand-based initiatives through government programmes. In general, urban locations have multiple routes to improved broadband services. They are typically also below any cost thresholds for the current broadband Universal Service Obligation, where eligible.

How does this call for evidence differ from information sought in the call for evidence[51] launched in October 2020 by the Gigabit Take-up Advisory Group (GigaTAG)?

The GigaTAG call for evidence focussed primarily on the barriers to the adoption of gigabit broadband services, where they are available[52], rather than the barriers and approaches to delivering this infrastructure. Unlike this call for evidence, the GigaTAG call was also not focussed on rural areas, nor specifically on remote rural or Very Hard to Reach areas, including those where gigabit delivery might be disproportionately very expensive.

How does this call for evidence differ from Public Reviews of the UK Gigabit Programme, including any ongoing Open Market Reviews?

The focus of the Public Reviews[53] during the UK Gigabit Programme is to validate BDUK's mapping to ensure that it correctly represents the information provided by suppliers in the course of Open Market Reviews and to ensure that the right areas are targeted for government investment (as opposed to commercially viable areas). Stakeholders (the public, businesses, internet service providers and broadband infrastructure operators) provide feedback through such public reviews about the proposed eligible areas set out in the documents related to that review.

An example of such a review is the 'Public Review for the UK Gigabit Programme in Cumbria'[54], which was launched on 9 February 2021 and ran until 9 March 2021. The information gathered through these reviews helps to finalise eligible premises and proposed Intervention Areas are then submitted to BDUK's National Competence Centre (NCC) for approval against the UK Subsidy Control Regime.

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[51] GigaTAG - Call for Evidence
[52] GigaTAG interim report – Broadband Stakeholder Group
[53] UK Gigabit Programme: public reviews
[54] UK Gigabit Programme: Cumbria Public Review

The focus of this call for evidence, on the other hand, is to gather other information relating to the demand for, benefits of and barriers to the provision of improved broadband services in Very Hard to Reach areas.

How does this call for evidence relate to the broadband policy in the Devolved Administrations? Do you want replies from Northern Ireland, Scotland or Wales?

Broadband policy is reserved and the UK government is committed to supporting the achievement of improved broadband across the UK, working closely with the Devolved Administrations. We are certainly interested in responses from consumers, businesses, market participants (including suppliers) and representative organisations from the Devolved Nations.

Why does this call for evidence use an online survey for consumers?

We need to analyse the consumer responses in a structured and quantitative manner at pace. To ensure that we can do this efficiently and effectively, we are using an online survey, which is available on both desktop/laptop browsers and mobile devices. The platform supports OEM (Original Equipment Manufacturer) supported versions of the following browsers: Apple Safari, Google Chrome, Microsoft Edge, Microsoft Internet Explorer, Mozilla Firefox.

Why do you ask for the location/postcode on responses from consumers?

There are two reasons:
- this call for evidence is focussed on locations that are geographically Very Hard to Reach and these are relatively few. We need to be able to cross-check the responses such that we can analyse the specific areas in question, and compare them to other information we have on rural areas in general.
- the consumer and business survey is also designed to provide links to further information relating to ongoing interventions and potentially available schemes on a postcode basis, at the end of the survey, based on the responses provided.

Is this call for evidence related to Ofcom's investigation into the delivery of the broadband USO by one of the Universal Service Providers, BT?

No. Compliance with existing obligations set out in the law and placed upon both designated Universal Service Providers are a matter for Ofcom, as the independent regulator.

How does this call for evidence relate to the consultation on the broadband USO referred to on Ofcom's work Programme for 2021?

Ofcom has stated that they expect to consider any funding claims for the connections that have been built under the USO, should any be placed by the universal service providers. Ofcom's consultation is therefore expected to relate to the ongoing implementation of the current USO, in line with the process set out in Ofcom's funding regulations statement.

Ofcom also state in their plan of work that they expect to continue their work more generally to improve access to broadband services in the hardest to reach and most remote locations and to understand how people's future needs for connectivity will evolve in the future.

Appendices

Appendix 1. Glossary of terms and acronyms

Category	Term/acronym	Meaning
Broadband technology	**NGA**	**Next Generation Access** – This refers to new or upgraded access networks that will allow substantial improvements in broadband speeds. This includes Fibre to the Cabinet, Fibre to the Premises (Fibre to the Home), Wireless and Cable broadband connections.
	FTTP/FTTH	**Fibre to the Premises/Fibre to the Home** - This refers to an access network structure in which the optical fibre runs from the local exchange to the end user's living or office space. Also known as 'full fibre'.
	FTTC	**Fibre to the Cabinet** - An access network structure in which the optical fibre extends from the exchange to the cabinet. The street cabinet is usually located only a few hundred metres from the subscriber's premises. The remaining part of the access network from the cabinet to the customer is usually copper wire
	Cable	Telecommunications infrastructure which uses cable networks, such as Data Over Cable Service Interface Specification (DOCSIS-3) networks.
	Superfast Broadband (SFBB)	Download speeds from 30 Mbps up to 300 Mbps.
	Ultrafast Broadband (UFBB)	Able to deliver download speeds equal to or greater than 300 Mbps.
	ADSL	**Asymmetric Digital Subscriber Line** - A technology used for sending data quickly over a conventional copper telephone line. It is used in current internet services with download speeds up to 24 Mbps
	Gigabit	A unit measurement of data. One gigabit is the equivalent of 1,000 Megabits. Gigabit-capable broadband provides a broadband connection of at least 1 Gigabit per second (Gbps) data download speeds.
	Gigabyte	A unit measurement of data. The equivalent of 8 gigabits (or 8,589,934,592 bits of information). Each byte is eight bits.
	Terabit	A unit measurement of data. The equivalent of 1,000 Gigabits. In test environments, FTTP connections have

		achieved speeds of more than 1 terabit per second.
	Terabyte	A unit measurement of data. There are 1000 gigabytes in a terabyte (or 1,024 in a Tebibyte, if using binary prefixes).
Wireless technology	**Wireless**	High-speed internet access where connections to the premises use radio signals rather than cables.
	4G	**Fourth-generation mobile phone standards and technology.** Provides faster mobile data speeds than the 3G standards that it succeeds.
	4G LTE	A type of 4G technology. Short for "Long Term Evolution", it's slower than "true" 4G, but significantly faster than 3G.
	5G	The term used to describe the next generation of wireless networks beyond 4G mobile networks. 5G is expected to deliver faster data rates and better user experience.
	GEO	**Geosynchronous Orbit** satellites, operating c.35,800km from Earth. These are typically, communication, TV, and weather satellites that stay over the same point of the equator by matching the direction and speed of the Earth's rotation.
	HEO	**High Elliptical Orbit** satellites. HEO satellites increase speed around the bottom of their path, and slow towards the top, allowing them to spend more time in sight of a certain area. They were used for previous Sirius (satellite radio) satellites.
	MEO	**Medium Earth Orbit** satellites, operating c.20,000km from Earth. These are mainly GPS and other positioning satellites, often networked together to create a 'constellation', allowing broader coverage.
	LEO	**Low Earth Orbit** satellites, operating between 180 and 800km from Earth. Currently, they are typically Earth observation satellites, whose close orbits enable better visibility of the Earth's surface. LEO satellites are increasingly used to provide digital connectivity through companies like Starlink and OneWeb.
	FWA	**Fixed Wireless Access.** Internet access provided over the airwaves using wireless network technology, rather than a physical connection through traditional fibre or copper wiring.
	GHz	**Gigahertz.** A unit of measurement for alternating current or electromagnetic wave frequencies equal to

		one billion Hz (hertz). Radio frequencies are typically measured in GHz.
	HAPS	**High altitude platforms**. Non-terrestrial but also non-space based technologies used to support communications networks (and sometimes other applications, such as near-earth imaging). ITU radio specifications consider HAPS as being deployed within the stratosphere, normally between 20km and 50km about the earth.
	HTS	**High Throughput Satellite.** HTS satellites offer many times the throughput of the traditional Fixed Satellite Service (FSS) using the same amount of allocated orbit space. This is done by taking advantage of frequency reuse and spot beams. By doing so, the cost per bit delivered is reduced, regardless of spectrum choice.
	ITU	**International Telecommunication Union.** A specialised agency of the United Nations responsible for all matters related to information and communication technologies.
	Ka-band	Satellite services using the **26.5-40GHz** segment of the electromagnetic spectrum. In satellite communications, the Ka-band allows higher bandwidth communication. It was first used in the experimental ACTS Gigabit Satellite Network and is currently used in the Inmarsat I-5 system and the SpaceX Starlink system
	Ku-band	Satellite services using the **12-18GHz** segment of the electromagnetic spectrum. The Ku band is most notably used by direct broadcast satellites to broadcast satellite television, and for specific applications such as NASA's Tracking Data Relay Satellite used for International Space Station (ISS) communications.
	802.11ad	A wireless networking standard developed to provide a Multiple Gigabit Wireless System (MGWS) standard at 60 GHz frequency. Many of the technologies using this standard are gigabit-capable
	802.11ay	A proposed enhancement to the 802.11ad standard, which enables at least one mode of operation capable of supporting a maximum throughput of at least 20 Gbps while maintaining or improving the power efficiency per station. This standard is currently under development.
	MIMO	**Multiple Input Multiple Output.** A method for multiplying the capacity of a radio link using multiple transmission and receiving antennas.
	Massive-MIMO	An extension of MIMO, expanding beyond the legacy systems by adding a much higher number of antennas

		on the base station. The "massive" number of antennas helps focus energy, which brings drastic improvements in throughput and efficiency.
Broadband / connectivity Terminology / regulation	**Backhaul**	The connection from a mobile mast (or fixed network access node) back to a data centre (or other point of interconnection). While a backhaul can be done via a wireless or satellite connection, typically it is conducted via fibre networks wherever possible.
	Connected Nations	A report published or updated by Ofcom three times a year, reporting on statistics for broadband and mobile coverage in the UK.
	FTIR	**Future Telecoms Infrastructure Review** - A white paper published in 2018, outlining the government's future plans for Telecoms Infrastructure.
	GigaTAG	**Gigabit Take-Up Advisory Group** - An Advisory Group to encourage consumer and business take-up of gigabit-speed internet connections.
	Latency	The time it takes for data to travel from an end-user to a data centre server and back. High latency means broadband connections feel slow to end-users and cause issues for certain activities, like online gaming.
	VHTR	**Very Hard to Reach premises** - as defined in this document, see Section 2.
	WFTMR	**Wholesale Fixed Telecoms Market Review** - Ofcom's published plans for regulation of the fixed telecoms markets that underpin broadband, mobile and business connections. These cover a five-year market review period.
Government market interventions and other relevant programmes	**GBVS**	**Gigabit Broadband Voucher Scheme -** Since May 2019, eligible homes and businesses in rural areas that are part of a group project have been able to access a voucher to help fund an improved connection. As per the scheme's Terms and Conditions, voucher requests from suppliers must be received by March 31 2021, before closure and the opening of a subsequent voucher scheme as part of the UK Gigabit Programme.
	SRN	**Shared Rural Network** - An initiative led by DCMS to get 4G mobile connectivity to 95% of the UK's landmass, working with four leading mobile operators.
	Superfast Broadband Programme	A BDUK-led programme committed to subsidising the roll-out of broadband infrastructure in harder-to-reach areas. The programme launched in 2010 and has

		predominantly focused on providing superfast (30 Mbps) broadband speeds.
	Project Stratum	Northern Ireland's arm of the Superfast Programme. The funding comprises £150 million funding from the Confidence and Supply Agreement and £15 million from the Department of Agriculture, Environment and Rural Affairs (DAERA) in NI.
	R100	Scotland's arm of the Superfast Programme. R100 provides capital funding of £600 million to target premises that do not currently have access to superfast broadband. This programme was recently augmented with further funding from the UK Gigabit Programme.
	Superfast Cymru	Wales's arm of the Superfast Programme. Split into three contract areas, to continue to deliver to areas without superfast, under the 2016 State aid notification.
	UK Gigabit Programme	A new £5 billion programme to support the rollout of gigabit-capable broadband in hard to reach parts of the United Kingdom. The UK Gigabit Programme will be managed by Building Digital UK.
	USO	**Broadband Universal Service Obligation** - a digital 'safety net' for premises currently unable to access a decent broadband connection of at least 10 Mbps download and 1 Mbps upload. The USO was launched in March 2020 and gives every premises the legal right to request a decent, affordable broadband connection subject to meeting the necessary eligibility criteria, up to a reasonable cost limit. It is overseen by Ofcom and funded by the telecoms industry.
Type of telecoms provider	**ISP**	**Internet Service Provider** – An organisation which provides households/businesses access to the internet. ISPs do not always own the infrastructure used to provide services and can utilise the infrastructure owned by network providers to provide services.
	WISP	**Wireless Internet Service Provider** - As 'ISP' above, but specifically using a wireless network for services
	Network provider	Telecommunications providers that own infrastructure which is used to deliver internet services.
	Alt-nets	**Alternative network** – Smaller network providers that are typically not reliant on the Openreach network (though they may make some use of Openreach's passive infrastructure).

	MNO	**Mobile Network Operator** - a provider of wireless communications services. The UK's four largest mobile networks are EE (BT), O2, Three and Vodafone.
Public sector organisations involved in policy, regulation or delivery	BDUK	Building Digital UK.
	DCMS	Department for Digital, Culture, Media and Sport.
	DEFRA	Department for Environment, Food and Rural Affairs.
	Local Bodies	Local Authorities and Devolved Governments responsible for delivering local Superfast Broadband Programme projects. Some also deliver other digital infrastructure projects or have provided 'top-ups' to the Gigabit Broadband Voucher Scheme.
	Ofcom	Office for Communications. Ofcom is the independent regulatory body responsible for telecoms and digital infrastructure issues.

Appendix 2. Other Useful Information and Links

Further information and links to resources discussed in the call for evidence document can be found below:

The UK Gigabit Programme

- Building Digital UK: https://www.gov.uk/guidance/building-digital-uk

- Gigabit Broadband Voucher Scheme: https://gigabitvoucher.culture.gov.uk/

- The UK Gigabit Programme - Public Reviews:
  https://www.gov.uk/government/collections/uk-gigabit-programme-public-reviews

Ongoing Superfast programmes

- Overview:
  - BDUK Local Broadband Project Delivery Summary (Superfast)

- England
  - Bedford and Milton Keynes:
    https://www.centralbedfordshire.gov.uk/info/58/business/11/broadband
  - Better Broadband for Norfolk:
    http://www.betterbroadbandnorfolk.co.uk/default.aspx
  - Better Broadband for Nottinghamshire:
    https://www.nottinghamshire.gov.uk/business-community/better-broadband-for-nottinghamshire-programme/where-and-when
  - Better Broadband for Suffolk: https://www.betterbroadbandsuffolk.com/
  - Connecting Cambridgeshire: http://www.connectingcambridgeshire.co.uk/
  - Connected Counties: http://www.connectedcounties.org/
  - Connecting Cumbria: http://www.connectingcumbria.org/
  - Connecting Devon and Somerset:
    https://www.connectingdevonandsomerset.co.uk/
  - Connecting Solihull and Warwickshire: https://www.cswbroadband.org.uk/
  - Connecting South Gloucestershire: http://sites.southglos.gov.uk/broadband/
  - Digital Derbyshire: https://www.digitalderbyshire.org.uk/home.aspx
  - Digital Dorset: https://www.dorsetcouncil.gov.uk/business-consumers-licences/superfast-dorset/digital-dorset.aspx
  - Digital Durham: https://digitaldurham.org/
  - Digital Infrastructure Oxford:
    https://www.oxfordshire.gov.uk/residents/community-and-living/digital-infrastructure

- ○ Fastershire: https://www.fastershire.com/
- ○ Kent County Council: https://www.kent.gov.uk/leisure-and-community/broadband
- ○ On Lincolnshire: http://www.onlincolnshire.org/
- ○ Superfast Berkshire: http://www.superfastberkshire.org.uk/
- ○ Superfast Cornwall: https://www.superfastcornwall.org/
- ○ Superfast East Riding: https://broadband.eastriding.gov.uk/
- ○ Superfast East Sussex: https://www.eastsussex.gov.uk/business/developing/broadband/
- ○ Superfast Essex: https://www.superfastessex.org/
- ○ Superfast Hampshire: https://www.hants.gov.uk/
- ○ Superfast Lancashire: https://www.superfastlancashire.com/home
- ○ Superfast Leicestershire: https://www.superfastleicestershire.org.uk/
- ○ Superfast Northamptonshire: https://www.superfastnorthamptonshire.net/Pages/home.aspx
- ○ Superfast North Yorkshire: http://superfastnorthyorkshire.com/
- ○ Superfast South Yorkshire: http://www.superfastsouthyorkshire.co.uk/
- ○ Superfast Surrey: https://www.surreycc.gov.uk/business-and-consumers/superfast-broadband-in-surrey
- ○ Superfast West Yorkshire and York Broadband: https://www.westyorks-ca.gov.uk/projects/superfast-west-yorkshire-and-york-broadband/
- ○ Wiltshire Online: https://www.wiltshireonline.org/index.php
- ○ Superfast Worcestershire: https://www.superfastworcestershire.com/
- ○ West Oxfordshire: https://www.westoxon.gov.uk/communities-and-leisure/broadband/

- ● Northern Ireland
  - ○ Project Stratum - Northern Ireland: https://www.economy-ni.gov.uk/articles/project-stratum-introduction

- ● Scotland
  - ○ Digital Scotland: https://www.scotlandsuperfast.com/

- ● Wales
  - ○ Broadband in Wales: https://gov.wales/broadband-in-wales

Additional Broadband Upgrade Programmes

- ● Ofcom Information on the broadband Universal Service Obligation: https://www.ofcom.org.uk/phones-telecoms-and-internet/advice-for-consumers/broadband-uso-need-to-know

- ● BT Universal Service Obligation Postcode Checker: https://www.bt.com/broadband/USO

- BT Universal Service Helpdesk: 0800 783 0223

- [For Kingston upon Hull Only] KCOM Universal Service Obligation Information: https://www.kcom.com/universal-service-obligation/

- [For Kingston upon Hull Only] KCOM Universal Service Helpdesk: 01482 602555

- Community-Led Schemes: https://www.gov.uk/government/publications/community-led-broadband-schemes/introduction-to-community-led-schemes

Further Resources

- Ofcom Consultation: Wholesale Fixed Telecoms Market Review 2021-26: https://www.ofcom.org.uk/consultations-and-statements/category-1/2021-26-wholesale-fixed-telecoms-market-review

- Ofcom Broadband and Mobile Coverage Checker: https://www.ofcom.org.uk/phones-telecoms-and-internet/advice-for-consumers/advice/ofcom-checker

- Ofcom Connected Nations 2020: https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-2020

- UKWISPA: https://www.ukwispa.org/

- INCA: https://www.inca.coop/