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## **Written evidence submitted by the University of Strathclyde**

### DCMS Committee Inquiry on “Broadband and the road to 5G”

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#### Acknowledgement:

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#### Author Bio:

Greig has been a consultant working on projects with small international mobile network operators, advising on their network design and technology. More recently, a Cyber-Security Lead working in the utilities sector (critical national infrastructure), and Chief Information Security Officer for a pre-launch UK start-up bank. He bridges the technology and executive divide in a range of fields, having advised at board level to household names on cyber-security, foreign governments on spectrum policy and mobile auction design, FinTech start-ups on security and strategy in the banking and payments sectors, to name a few. He is also the only academic member of the UK 5G Security Group, based on his industry experience in the sector.

Since then, he led the architecture & design, deployment and operation of the 5G RuralFirst end-to-end cellular network in Orkney, including network security considerations, and continues this work with the 5G RuralDorset DCMS funded project. These projects have shown how mobile and fixed broadband infrastructure can be deployed on a significantly reduced cost base, compared with traditional mobile network operator or telecoms provider deployment costs, by working in partnership with local communities, internet providers, and innovative technology companies.

## Executive Summary

- High quality, reliable, fast connectivity (i.e. Gigabit capable) is very important for the UK economy, but the Committee should ensure Government does not underestimate the scale and difficulty of this task.
- **Current commitment** is to reach every home with **10 Mbps**, and this only started March 2020. This intervention doesn't have an obligation to delivering Gigabit where feasible, meaning it will not deliver a true "outside-in" solution.
- Increasing ambition to 1 Gbps is sensible, but in a time of clear pressure on public finances due to Covid-19 for the foreseeable future, **costs must be carefully managed, to ensure we do not spend more money than is required to deliver this.**
- **5G will not replace the need for investment in fibre infrastructure to the premises** – we need fibre backhaul for 5G anyway, and it would be so close to premises that it may as well be used to also provide broadband.
- Since 5G that is capable of higher speeds to end users needs to use higher frequencies, this means it travels a lower distance, requiring more base station sites, and increasing the costs significantly. For this reason, **5G will not solve Government's problem of getting rural areas connected to Gigabit speeds.** 5G can and should be used to drive roll-out of fibre, which can and should be shared with mobile networks and consumers alike. We should **deploy connectivity in a unified and coherent manner**, rather than as a series of disconnected projects.
- Traditional approaches to building mobile networks do not utilise this kind of agile and flexible provision of infrastructure – **mobile operators want to have their own dedicated networks**, since it is how they have always done things. We should not allow their desire for this (it is not a requirement, simply a desire) to **hold back rural connectivity**. If Government uses public money here, it has a duty to **ensure efficient use of this money.**
- Connectivity can be delivered to areas requiring Gigabit speeds by local SMEs that already provide broadband in their own communities. They are doing this today, and **delivering higher speeds to farms and hamlets than the national scale operators are giving businesses and people in major top-5 cities.** From a simple economic perspective, the Committee should ensure Government's plans acknowledge this efficiency, and do not issue a single nationwide program, like it did with USO. This does not reward the ingenuity and local skills that can allow **local people to deliver connectivity to their local area at significantly better prices than national-scale operators.** If it saves public money at this time, it is worth doing.
- A "common sense" approach to connectivity would be beneficial – there are many situations where a small extension to an existing network's reach would help to bring users online with

Gigabit capable speeds. Government should seek to do this wherever possible, to **leverage the existing** assets and investment already in the ground. This would be an area where **detailed mapping data on access to existing assets would be beneficial.**

## Introduction

This response is being prepared at a time when the UK is making an unprecedented response to the Covid-19 pandemic. The importance of digital infrastructure has been seen with the requirement for everyone to work from home where possible. The significance of **digital communications for reaching the public, as well as delivery of services**, is now in the public eye. Work-from-home has highlighted the shortcomings in the UK's current digital connectivity. Many people have little or no mobile coverage in their own home – Ofcom's 2019 Connected Nations report<sup>1</sup> showed that **only 68% of rural homes are able to make mobile calls from all 4 UK operators**. This creates localised or regional scenarios where customers effectively lack competitive choice, and hinder our citizens' access to the full marketplace of different offerings.

Nonetheless, at this time, it is clear that there will be significant pressure on public finances, and this response outlines ways in which **Government can reach its ambition, on time or ahead of schedule**, by working with small businesses and innovative players in the telecoms market on a local basis, working in the areas with the communities they know best, to deliver **better value for money**, and get **Gigabit connectivity more rapidly to those who need and will benefit from it the most**.

At the same time, it is important to ensure that smaller players such as local ISPs are not left behind and forgotten about – there are thousands of kilometres of independently laid fibre in the UK, with hundreds more kilometres being installed per month. This fibre is being installed either in response to targeted interventions, or in some cases on a commercial basis, based upon demand from users and businesses.

## How realistic is the Government's ambition of nationwide gigabit-capable broadband by 2025, and what measures (regulatory, financial, technical, other) will be needed to achieve it?

When broadband is referred to as Gigabit-capable, the first thing to be taken into consideration is exactly what this means. A dedicated full-fibre connection to every premises (FTTP) is capable of delivering speeds well in excess of 1 Gbps per home. A Fibre to the Cabinet (FTTC) connection is also most likely going to be capable of 1 Gbps speeds per home, as long as the connection from the home to the cabinet is suitable – systems reliant on existing copper phone line from the cabinet will be unlikely to yield Gigabit-capable speeds. Some technologies will be limited by the **distance between the user and the telephone exchange**, which may be significant in rural communities. Therefore, such solutions as a blanket measure would not be suitable technically to deliver Gigabit speeds. These rural homes and businesses are the ones which are **most likely to be left behind** and not brought into the Gigabit-capable world, and it is therefore important not to overlook them.

Many have presented 5G as a solution to provide Gigabit connectivity to households where it is otherwise unaffordable to reach them. This is possible, and 5G has great potential to deliver

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<sup>1</sup> <https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-2019/main-report>

significantly improved speeds of connections to mobile devices, but **this expectation must be carefully managed.**

**5G alone will not yield Gigabit speeds to the household.** When using 4G and 5G technologies to deliver internet connectivity, the available capacity (i.e. speed) is shared by all users relying on that given mast. A base station capable of delivering Gigabit speeds will be at the top end of the price range of mobile base stations. Given that the mobile radio spectrum required to deliver 5G “Gigabit” speeds is in the 3.4 to 3.8 GHz range in the UK, and **higher frequency signals travel lower distances and are more easily interrupted by terrain and buildings**, 5G will not be a simple, definitive solution to rural connectivity. The **costs of delivering high speed 5G connections to rural areas will be higher**, as more masts will be needed, to account for the shorter range of each base station.

Government should be more precise in its wording, and commit to high-quality, fixed-line connectivity, rather than wrongly assuming that wireless networks will address the costly and inconvenient “long tail”. Otherwise, the program **risks going significantly over budget or failing to deliver improvements for those in the hardest to reach areas.**

To **measure the realism** of Government’s proposal for Gigabit-capable broadband to every premises in the country, the universal service obligation (USO) program should first be considered – the aim of the broadband USO is to ensure every household can receive **10 Mbps speeds**, with a budget of £3400 per household available. There are currently **620,000 homes** unable to receive 10 Mbps broadband speeds, and thus eligible for the USO. 10 Mbps is **only sufficient for basic web browsing, email, and video streaming**. It is **considerably slower than most users will achieve from a 4G mobile phone in a city**. Therefore, Gigabit connections everywhere are a (positive) major step up from this, but the increase in ambition must be matched by a recognition of the commensurate increase in challenge, and cost.

Based on Ofcom’s Connected Nations 2019 data (September 2019 figures), 98% of UK households have access to speeds of 10 Mbps or greater. 95% have access to at least 30 Mbps, but only 53% have access to 300 Mbps. 10% have access to “full fibre” services, which will be capable of speeds exceeding 1 Gbps.

If we assume that 50% of premises with a 300 Mbps capable line are capable of 1 Gbps without a new line installation to the premises (this is likely relatively optimistic), this still leaves around 75% of the country needing a new connection in order to reach the promised universal speed of 1 Gbps.

Government should consider the costs and its ability to carry out an infrastructure project of this scale, reaching 75% of homes. Having a unified strategy for **communications infrastructure** would be key to making this financially effective – there are **already independent ISPs laying their own fibre infrastructure throughout the UK**, and doing so considerably cheaper than some of the national household names. Government should explore how these roll-outs could be converged with 5G roll-out, to avoid unnecessary over-building, since it is highly likely that **public money will be used for both Gigabit-capable broadband and mobile coverage roll-outs** (i.e. via the Shared Rural Network total not-spot program). To ensure efficient use of public funds, these programs should be aligned, and make use of the most cost effective means of deployment possible.

**Noting that the USO of 10 Mbps has only taken effect as of March 2020<sup>2</sup>, aspirations to raise this to 1 Gbps, while clearly hugely beneficial for rural communities and those struggling with poor connectivity, the aspiration is clearly going to be highly costly, and complex to plan and deliver.**

Given Government's goals of delivering Gigabit-capable broadband to everyone in what is effectively 4 years, it is important to ensure that suitable technical expertise is sought upon to lead this initiative, and that those advising and supervising the scheme have **broad experience in telecoms**, and indeed **broader than merely working in large national operators**. The nation-wide operators of mobile and fixed broadband infrastructure have **failed to demonstrate any ability to deliver a commercially viable service to rural communities**, at a time where local and regional independent network providers have done this highly successfully. To allow national operators to "mark their own homework", so to speak, would facilitate significant mismanagement of public funds. Technical oversight should be **independent**, expert-level, and empowered to scrutinise the technical and architecture decisions made by those deploying infrastructure using public money. They should be empowered to convene **"joined up thinking" between the Gigabit-capable scheme, and the Shared Rural Network**, and should prevent unnecessary duplication of effort, both between the two programs, as well as over the top of existing independent ISPs and alternative network providers.

Government should invite proposals from providers able to deliver on a local and regional basis, rather than national, for reasons of economy at a time of clear budget shortage in the years to come. Infrastructure investment like this will stimulate local economies, as well as allow communities to come together and deliver something that betters their own area. As outlined elsewhere in this response, we have personally witnessed the **ability of local communities to deliver in some of the most rural and challenging environments** (The Orkney Islands, and the Jurassic Coast in Dorset), including full "Fibre to the Home" services, on an affordable basis commercially. The best value to the public purse will come by **helping to scale up these initiatives**, rather than following the USO model of national, centralised delivery (which could cost as much as £527 million<sup>3</sup>, and only requires delivery of 10 Mbps). Work on USO should be contractually required to deliver Gigabit-capable, rather than 10 Mbps, where it is possible, in order to avoid public money being used twice to provide poor, and then better connectivity to the same premises.

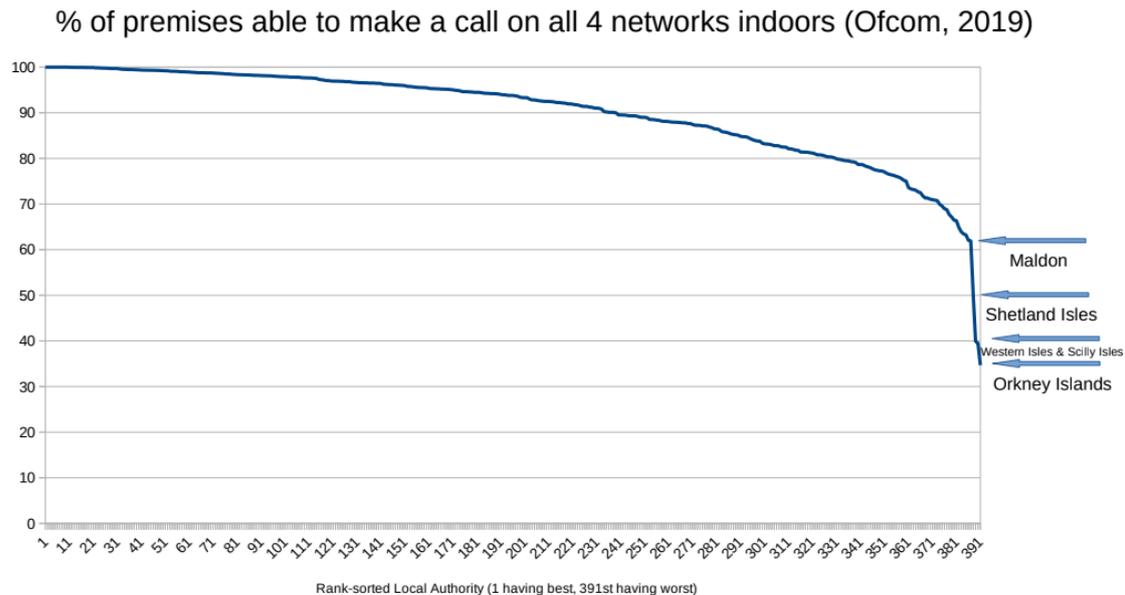
The Gigabit-capable program should strongly consider a provider's ability to leverage existing fibre infrastructure in the area, and the ability to deliver value for money for the public purse, as well as the homes and businesses wanting to use the broadband service.

One key aspect for the Committee to consider is the extent to which the Government's proposals are **grounded in the realities of bringing connectivity to rural communities**. Attempts to design a single national strategy will likely prove incredibly expensive, and reward inefficiency. We would implore the committee **to seek the guidance of those who have experience** in the realities of **delivering connectivity in rural and challenging areas**.

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<sup>2</sup> <https://www.ofcom.org.uk/phones-telecoms-and-internet/advice-for-consumers/broadband-uso-need-to-know>

<sup>3</sup> <https://commonslibrary.parliament.uk/research-briefings/cbp-8146/>



The above diagram shows the picture of mobile connectivity for people of the UK today – rank sorting local authorities, and comparing the percentage of premises estimated by Ofcom to be able to make a call on all 4 networks indoors. These figures are likely generous estimates, and show the extreme drop-off seen by some rural island communities. Delivering better broadband will be appreciated by these communities, but they really require a **joined-up approach** to delivering better fixed and mobile connectivity. This could all happen at once – the fibre needed to deliver Gigabit for broadband **can and should be used to deliver mobile operator-independent capacity for cellular networks**. It simply makes sense to do so, and improve this situation simultaneously.

**What are the challenges to the roll-out of 5G and gigabit-capable networks? To what extent do existing legislative, regulatory and spending plans address them?**

The biggest challenge to the roll-out of improved connectivity in the UK is the mind-set with which we approach the challenge. Until March 2020, connectivity has mostly been delivered based on a commercially-driven approach; **connectivity would not be made available unless there was a commercial basis** upon which a provider would do so. There have been some market interventions, such as broadband voucher schemes, but nothing on the same scale of a full Gigabit-capable roll-out. As of March 2020, the Broadband Universal Service Obligation took effect, allowing those who do not receive 10 Mbps from existing commercial operators to request a connection under the USO program, at a capped price, which will deliver a speed in excess of that.

One issue with the USO model is that it can facilitate the designated USO operators to use **public subsidy to over-build independent commercial network providers** – since the process of approving premises for USO does not take into account the planned works of an ISP (unless part of a state-sponsored roll-out), and completed works are only notified to Ofcom quarterly, this creates a gap of potentially 6 months where an over-build scenario can occur.

Over-build is a challenge, since it results in the **inefficient allocation of public money**. It also can reduce the confidence that smaller private providers have to commercially invest, if they can face a Government-funded roll-out over-building their private investment. This may be an issue for

Government's plans, since, as outlined elsewhere in this response, **these smaller providers are able to deliver connectivity on a significantly lower cost basis** using local knowledge and strong community ties.

This matters because to achieve Gigabit-capable networks nationwide, with a robust and diverse supply chain, we must ensure that public money is not used to build new capacity in areas the market has already managed to provide such connectivity. **Public money in interventions should be spent in a transparent manner, with advanced notification of plans to other network providers, to prevent intentional or unintentional over-building from taking place.** Where other providers are able to cover premises on a commercial basis, without requiring USO or "Gigabit capable" money to be spent, these providers should be given the opportunity to do so, as it reduces the impact to the public purse in a time where savings are essential!

While Ofcom and Government's approach to USO to date is understandable – they want to keep the process simple and leave one party accountable for delivery of USO for almost all of the country, it is critical that in this time of increased pressures on budgets that we do not spend public money unnecessarily when there are other ways to deliver, especially when we raise the speeds to Gigabit, and thus the complexity and potential outlay.

#### **What should happen to ensure the "outside-in" approach delivers value for money, and successfully delivers value for money**

For any intervention to be successful, it **must** learn from previous government-funded interventions on connectivity throughout the UK – The Mobile Infrastructure Project, the Scottish 4G Infill program, and the various broadband voucher schemes run by DCMS under the BDUK scheme.

MIP ultimately delivered mobile base station sites at a cost of **£477,000 per site**, which is a very high figure. This is partly due to inefficiencies in how national operators work (i.e. adhering to national procedures, rather than adapting their processes based on the locale of the build), and partly due to the high prices of Tier-1 operator equipment. Government must ensure there is **competitive pressure to encourage innovation and help to drive down prices** – otherwise, further roll-outs will be costly to the taxpayer, and ultimately not support the UK's innovative telecoms companies.

To put it plainly, these **prices are reflective of the challenges faced by relying on the traditional mobile networks to roll out coverage in the most rural areas.** One way to reduce these is to try to build infrastructure in a "joined up" manner – broadband and mobile connectivity should benefit from the same underlying infrastructure investments, as part of a single network.

The 5G RuralFirst project (successful project funded by DCMS under the 5G Testbed & Trials program) demonstrated that it is possible **to decimate traditional cost barriers** in rural deployments of both fixed and mobile connectivity. The learnings from this project should be reviewed by Government before committing to significant expenditure on connectivity, in order to **prevent unnecessary expenditure at a time when we can least afford it.**

A mind-set change would significantly increase the prospects of successful deliver of a program for everyone to have Gigabit connectivity – **connectivity is now critical infrastructure**, and effectively is a utility. We have seen the importance of good internet connectivity rapidly become a national priority as a result of Covid-19.

To ensure outside-in works and delivers, it is important to **genuinely begin at the outside**, and to **work with existing local and regional independent network providers**, to firstly avoid over-building their commercial networks with public money, and secondly to ensure more **cost effective means of**

**deployment can be leveraged.** Applying a “one size fits all” approach to Gigabit-capable connectivity, in the same way the USO contract was awarded to one company nationally, will demonstrably not yield a cost-effective outcome. Government does not need to look far to see evidence of this – Wessex Internet, a small independent network operator, has **laid over 1350km of fibre in the rural South Coast of England, providing a full-fibre service into premises deemed commercially unsustainable by others.** Yet they are doing this successfully commercially. The Committee should use innovative players like this as a benchmark for future roll-out programs.

### **What does uptake of broadband and mobile services show about attitudes to connectivity? What needs to be learned?**

One of the key take-homes from attitudes to connectivity is that **consumers are primarily price-driven.** Surveys of users carried out in the run-up to the launch of 5G highlighted that people **wanted better speeds, but were not willing to pay more** for it. This can be explained either that network operators have successfully identified the optimum maximum price that the majority of users are willing to pay, or a consumer unwillingness to pay more for what they perceive to be a fundamental and basic utility service.

In government, communications have historically been seen a second-tier utility service, rather than a first-tier utility (power, gas, water). In the emerging Covid-19 pandemic, it is clear that **good communications are critical** both for **working from home**, but more importantly for ensuring ability to **convey urgent information to the public.** This has been recognised by Government when determining key sectors and workers, which includes telecommunications workers.

In the past, we have seen disjointed interventions based on numerical criteria or similar – the **USO only covers premises unable to achieve 10 Mbps.** There are people living in suburbs and urban areas of major cities, in housing developments, where typical speeds sit below this figure, yet are unable to access improved internet through the USO scheme, as **BT is reporting their connection speeds as being from 10 to 30 Mbps.** This is not reflective of their **typical user experience**, yet leaves them sat on the unhelpful side of the fringe of an intervention. These premises sit only a few metres from slightly older houses, served by Virgin Media. There is a clear simple approach to resolving this issue – Virgin Media could extend coverage down this street, and gain new customers.

The challenge is that we need to **encourage and reward a “common sense” approach** – Government should **empower local communities** and give them the means to resolve the situation where possible, in order to **simplify the process.** The alternative is a large, unwieldy, centrally managed scheme requiring significant Civil Service administrative staffing on it (and thus cost, at a time when Government needs these people working on Covid-19 pandemic response) – Government should **benchmark itself by the percentage of allocated funds which can be actually spent on the delivery of connectivity**, rather than on overhead costs for the administration of the scheme, or the business overheads of large providers.

Where people already have what they perceive to be “good enough” speeds, they are unlikely to want to spend more to get better speeds. The “willingness to pay” is a useful initial starting point in determining those who will benefit the most from Gigabit-capable connections. This would likely emphasise the importance of a true “outside-in” approach, starting at the genuine long-tail of connectivity in the most rural areas. By **combining this work with the mobile SRN, the costs can be shared between the two programs**, since fibre to rural areas will be needed for SRN’s total not-spot coverage infill anyway.

### **Impact on Individuals and Communities with Poor Connectivity (next 10 years)**

The national vision of where value is generated (and thus where good coverage and connectivity is viable) is changing – the UK is currently in a state of lockdown with people working from home where possible. This has the effect of turning most residences into a productive location requiring connectivity. Given the likely duration of current “stay at home at all times unless essential to leave” guidance, there is clear potential that **home and remote working as a “business-as-usual” practice could increase during the recovery from Covid-19 restrictions**. It may well be needed for the most vulnerable, such as the elderly and those with pre-existing health conditions. **These people are economically active, and unless Government wants to continue paying furloughed wages** (both of these people, as well as the businesses they cannot effectively interact with and buy from due to poor connectivity), it will be **imperative to ensure they are able to access high performance Gigabit-capable connections sooner rather than later**.

Otherwise, we will see an even **greater social and economic divide**, with those in areas lacking good connectivity facing economic deprivation compared to those in better connected areas, who will be better able to work remotely, and thus be efficient and economically active.

As people “cord cut” conventional TV<sup>4</sup> there is a social and cultural imperative to improve connectivity – for a cohesive society, people need to have access to the same shared cultural experiences. As **broadcast TV loses out to modern internet-based streaming platforms**, and these platforms move to produce and show **content “exclusively” on their internet –based platforms**, the cultural exclusion and isolation for communities and individuals with poor connectivity will only get worse.

Ofcom’s Media Nations 2019 report<sup>5</sup> has confirmed that **more than half of UK households have their TV connected to the internet**, and around **half of UK households now subscribe to at least 1 “Subscription Video on Demand” service** (i.e. Netflix, Prime Video, etc.) **Broadcast TV viewing has fallen by 49 minutes per day** (on average), since 2012, with those **under 24 watching less than 85 minutes of broadcast TV per day**. People’s habits are changing, and online video services will only become more popular and more important to people.

In a time of what is fundamentally a national crisis, however, **access to high quality news and broadcast media is an area the Committee should carefully consider**, particularly a time of increasing challenges due to deliberate disinformation and media manipulation. Already there is evidence from the US that cord cutting is likely to grow, due to a reduction in TV content production due to Covid-19 lockdown measures<sup>6</sup>. This could serve to **increase the gap between the high-speed “haves” and “have-nots”**, as those with better internet are able to access and enjoy Video on Demand services, and the remainder are left with a significantly reduced output and selection of content on broadcast TV.

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<sup>4</sup> <https://www.ofcom.org.uk/about-ofcom/latest/media/speeches/2018/british-tv-stronger-together>

<sup>5</sup> <https://www.ofcom.org.uk/research-and-data/tv-radio-and-on-demand/media-nations-2019>

<sup>6</sup> <https://www.marketwatch.com/story/comcast-faces-big-cord-cutting-risk-as-covid-19-limits-new-tv-content-analyst-cautions-2020-04-17>

## **How effectively stakeholders work together? And how these relationships might be improved?**

Currently, we have a number of different approaches being taken at multiple levels of local, devolved and national Government, and ideally this would be harmonised into a **single, simpler, strategy for improving connectivity**, and levelling everyone up to being Gigabit capable.

National Government clearly has a series of different challenges to address, and openly embracing these and working with industry and other stakeholders, including local government and devolved administrations, will be key to this.

It is important to understand what people and businesses want and need, and look at whether it has been delivered to them. The **forecast costs of the USO program (solely reaching homes lacking access to 10 Mbps) are concerning**, and this should give food for thought to Government. Some early estimates analysing the proposal are available<sup>7</sup>, and the Committee should have access to more recent estimates from Ofcom.

**Government should engage with those working on the 5G RuralFirst and 5G RuralDorset DCMS-funded testbed and trial projects**, which are demonstrating how **cost barriers** to roll-out of infrastructure (both fixed and mobile) **can be decimated**. I am happy to facilitate this. There are strong learnings around how to roll out fibre without incurring large wayleave costs, cheaper than national providers can do, which Government should take on-board **before spending significant amounts of public money on national-scale connectivity** programs.

Local and regional internet providers are trusted, known to their own communities, and **create skilled, well-paid, valuable employment for people in their local areas**. In rural communities, **this employment could become a lifeline** for areas which have suffered from a massive reduction in tourism (often their main industry) due to Covid-19 movement restrictions.

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<sup>7</sup> [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0027/95580/annex6.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0027/95580/annex6.pdf)