HOUSE OF COMMONS

Scottish Affairs Committee

Oral evidence: Digital connectivity in Scotland, HC 654

Tuesday 23 January 2018

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Watch the meeting

Members present: Pete Wishart (Chair); Deidre Brock; David Duguid; Hugh Gaffney; Christine Jardine; Ged Killen; John Lamont; Paul Masterton; Ross Thomson.

Questions 1-103

Witnesses

I: Andrew Ferguson, Editor-in-Chief and Software Developer, ThinkBroadband, Brendan Gill, Chief Executive, OpenSignal and Pete Moorey, Director of Advocacy and Public Affairs, Which?

II: Professor Will Stewart, Optoelectronics Research Centre, University of Southampton and Chair of the Institution of Engineering and Technology's Communications Policy Panel, Ewan Sutherland, Independent Telecommunications Policy Analyst, and Professor Rahim Tafazolli, Director of Institute for Communication Systems and the 5G Innovation Centre at the University of Surrey.

III: Dr Gary Bosworth, Head of the Rural Research Group and Deputy Head of the School of Geography, University of Lincoln, Dr Lorna Philip, Senior Lecturer, Geography and Environment, and Deputy Head of School of Geosciences, University of Aberdeen, and Professor Sarah Skerratt, Professor of Rural Society and Policy, Fellow of the Royal Society of Arts, and Director, Rural Policy Centre, Scotland's Rural College.

Written evidence from witnesses:

- Thinkbroadband.com
- University of Lincoln

Examination of witnesses

Witnesses: Andrew Ferguson, Brendan Gill and Pete Moorey.

Q1 **Chair:** Thank you all very much for coming along this morning for our first session on connectivity in Scotland. For the record, please say who you are and anything by way of a very short introductory statement—we are very tight for time today—and we will start with you, Mr Moorey.

Pete Moorey: I am Pete Moorey. I am the Director of Advocacy and Public Affairs at Which?. By way of an opening statement, the important thing for us today is that broadband, in particular, is now increasingly an essential for consumers. Our own polling shows that. Nine in 10 people regard it as an essential, right up there with water, gas and electricity. Yet our research also shows that, all too often, people are having a lot of problems. More than half of people told us that they had a problem with their broadband provider in the last year. That particularly seems to be the case in particular parts of Scotland, where we can see people in certain constituencies and local authority areas struggling with their broadband speeds. Which? welcomes the ambition of the Scottish and UK Governments to address that, but there is a lot more to do to meet consumers' expectations.

Brendan Gill: I am Brendan Gill. I am the CEO of OpenSignal. We provide independent data on mobile connectivity around the UK and internationally. I would echo Pete's statements about the importance of connectivity and broadband for all of us. One comment I would add is that, if we are serious about the importance of broadband and connectivity, we need to understand the issue in the right terms. The way that we currently look at coverage has a lot of limitations. When we talk about 99% population coverage, it paints a very rosy picture of where we are today. We have to make sure that we have the right metrics to assess the problem so that we can talk about how we can fix it.

Andrew Ferguson: Andrew Ferguson, Editor of Think Broadband. We are some of the people doing the metrics. We also keep a very close eye on what the public has been saying about broadband and it has changed very much in the last few years. Whereas it was a nice-to-have, it is a must-have now. While decent broadband is lot more available, those who cannot get it are a lot more vocal about it because they desperately need it.

Q2 **Chair:** Thank you for that. We had a chat before you came in. A lot of this is very technical and we were getting our heads round all the different distinctions—what things are, your megabits per second, the different classifications of superfast, ultrafast, and what people would normally expect. As a first question: what broadband speeds should the people of Scotland expect and how many of them are getting it? We will start with you, Mr Gill.

Brendan Gill: Sure. To clarify the question, is that what are people getting today, or what should they be expecting to get?

Chair: What should they expect to get. We are all agreed that it is an essential service, in line with water and gas. What broadband speeds should the Scottish people normally expect?

Brendan Gill: I don't have any statistics on exactly what people are experiencing today. Potentially we could talk about what the target should be. It is worth saying that our position would be that it is important to get speed in services, but often there is a lot of hype around ultrafast broadband speeds and some very fast speeds. What I think a lot of people don't know is that the speeds required for a lot of the present day applications—things like browsing, using applications, e-mails—is not that fast. The actual speeds we need are not hundreds of megabits per second, or some of the figures that are sometimes thrown about. However, we do need access to those speeds all the time. That is something that is really important.

We feel very strongly that the availability of a decent mobile connectivity is extremely important compared to a rarely available ultrafast connectivity. What we have seen in terms of the overall availability of 4G services, for example, is that there is still a long way to go. The last time we looked at the UK as a whole, we saw the providers coming in at between 58% and 78% of the time. That leaves at least 20% of the time that you are without access to 4G services and are on a limited kind of connectivity. That leaves a lot of work to be done to get where we need to go.

Pete Moorey: Which? would generally agree with the work conducted by Ofcom, which considers that speeds of 10 Mbps should be sufficient for most households. Their assessment suggests that that should allow multiple users to use the internet, to do web browsing, to do video streaming, video calling, gaming, and so on. However, our view is that that should really be the bare minimum. We would certainly welcome steps by both the Scottish and UK Governments to go beyond that. Clearly, many households will need speeds that go beyond 10 Mbps.

The frustration for a lot of consumers is the gap between the package that they are paying for and what they are often getting. We have to be very careful about the way that we use different terminology and claims around speeds because, over the last five years or so, the claims around speeds have been undermined in many different ways. That was partly done through advertising, and the fact that the old ASA rules meant that the speed that was advertised was only available to 10% of people. Many people were signing up for those packages and not realising that. That should be changed with the new rules that the ASA are going to introduce, which means there will be an expectation around the speed that you should be getting at peak time. However, if we are going to say that people should be getting at least 10 Mbps as a bare minimum, then we need to make sure that that is the actual experience they are having

and that they are not paying for packages where they are actually getting 1 or 2 Mbps and, therefore, not being able to do many of the basic things that they need to do.

Q3 **Chair:** I was very interested in your evidence. This gap between what people are expecting to get and what they actually receive is quite vast. When I saw your evidence I checked my own broadband speed. It was nowhere close to the claim about what I was supposed to be getting. Why is that happening?

Pete Moorey: There are multiple reasons. It is not straightforward, sadly, and I wish there was a simple answer. Sometimes it is down to issues in your own home. There is a lot more that consumers could be doing to resolve those issues, to make sure that they have the latest technology that they need. Sometimes it is down to faults with the providers and providers could be doing a lot more to resolve them. Sometimes it is simply down to the fact that you are not on the best package for you and that you could be getting a much faster speed if you simply switched.

However, all of those pieces of information are not as clear to consumers as they should be, given that this is now an essential service. There is a lot more that both Governments and Ofcom could be doing to make sure that consumers have all that information so that they can make the right decision, whether around choosing a package or, when they have a package, where they are not getting the experience that they should be getting.

Q4 **Chair:** Mr Ferguson, what broadband speeds should we expect and how many Scots are getting it?

Andrew Ferguson: What you should expect: as things stand today the legal USO—Universal Service Obligation—is still only 28 kilobits. We are all talking about the 10 Mbps USO safety net, but that is not until 2020, so we have another two years of people saying, "When is it going to happen?".

As to what people can get today, Ofcom publish their data in December; that is data from the providers in around April/May time. Our data for Scotland lines up with theirs in terms of the numbers. To give you more up to date information, in December, with the April data, Ofcom announced 89% were able to get superfast. That means a connection of 30 Mbps or faster. As of today, we believe that that has risen to 93% of Scotland, so it is rising. Hopefully, when it comes out, the next Ofcom dataset should reflect that.

Scotland is very much changing. Unfortunately, if you are one of those 180,000 households in Scotland that is not seeing that speed, the projects—no matter where you are in the UK, not just Scotland—may as well just not have happened. That is why people are complaining that nothing has gone on, that it has been a waste of money, that nothing has

happened, because there are 180,000 households still stuck on old ADSL, 0.5/1 Mbps speeds.

Q5 **Chair:** In evidence that we have secured thus far, we are seeing vast improvements to the situation in Scotland, but there is still evidence that it does lag behind the rest of the UK. Is there any particularly good reason for that? We understand things like geography, topography, are challenges to delivering this infrastructure, but are there any other reasons we should be looking at in this Committee?

Andrew Ferguson: It is partly because it started off behind the rest of the UK. It is always very difficult. There are councils within England that are behind Scotland. It is very much that if you pick the right ones, you can make any particular case. However, overall, Scotland was behind the rest of the UK in terms of its superfast coverage. Back in 2012, it had only about 43% superfast coverage, so it has come on in leaps and bounds, but it needs to keep carrying on in leaps and bounds. We need to make sure we don't break what is happening.

Q6 **Chair:** We will come to the R100 and the current rollout in Phase 2 and Phase 3 later on. Mr Moorey?

Pete Moorey: The other issue, of course, is around uptake of packages. Which? has done research where we have looked at the data we have received from consumers conducting speed tests in their local area and, quite fairly, we have had pushback from both Governments and others to say, "That might be the experience the consumer is having, but the problem is that they are not taking up the faster packages where they could be getting improved speeds". From the data I have seen, it is around 30% to 35% of people taking up the faster-speed packages in many areas of Scotland. Clearly there is a lot more that we could all be doing, together to ensure that Scottish consumers have better understanding of what is available to them, and making sure that we are tailoring the right packages for what they need, because that data should be increasingly available to people so that, whatever their personal circumstances, they can get a package that is better for them.

Chair: Maybe this inquiry will help people with that.

Q7 **David Duguid:** A question to clarify something you said, Mr Ferguson. You said the improvement was from 89% to 93%. Was that for the UK as a whole?

Andrew Ferguson: That is for Scotland.

Q8 **David Duguid:** The 180,000 households?

Andrew Ferguson: That is Scotland.

Q9 **David Duguid:** That is Scotland as well?

Andrew Ferguson: Yes—in others words, households that cannot get superfast currently.

Q10 **David Duguid:** Your key point—and I recognise this; I have a very rural constituency—was that for those 180,000 households, it feels that nothing at all has changed for them. As everyone else is getting faster, 5% are left behind. I will come back to them later. Do I understand that correctly?

Andrew Ferguson: Yes. They feel they cannot enjoy the services. Teenagers cannot buy the games online; you cannot do your box set binging on a Friday night. It is those sorts of things that everyone is talking about.

Q11 **David Duguid:** That would go some way to explain why many of my constituents feel that nothing is happening. It is happening elsewhere. It is just that they happen to be in that—

Andrew Ferguson: The most frustrating of the cases—it is not just Scotland, but Scotland has more of these—is where you have a relatively small village, 400 to 500 premises. Openreach drop a cabinet in the middle of the village, usually right outside the exchange in the Scottish scenario. But you will have smaller clusters of 10 to 15 premises three or four kilometres from the cabinet that, while they are connected to a superfast-enabled cabinet, because of physics, cannot get superfast speeds. They may get speeds that are actually slower than their existing service. There is a crossover point between the new services and the old services over which is faster.

Q12 **Deidre Brock:** I want to continue on the point raised by the Chair about progress in Scotland being somewhat behind the rest of the UK. Obviously there have been big strides forward in recent years, but you did mention the difficulties faced in remote rural areas. One of the submissions to the Committee mentions that approximately 60% of the Scottish landmass is classified as remote rural and is home to approximately 10% of the population. Could you talk about the technical difficulties of getting broadband to these remote rural areas and how much of a challenge that is for whatever Government?

Pete Moorey: I am afraid that I cannot talk about the technical difficulties. I can talk more about the consumer experience and frustration around that. One thing to say on that is the important connection from this debate to other live debates about things like bank-branch closures. Increasingly people are expecting to bank online and want to bank online, and yet we are also seeing the issue with branches being closed across the country.

It is important to make that connection between what we do around those kinds of services and ensuring that there is availability of branches in local area, ATMs in local areas, again with the consultation currently from Link about what they do with the future of ATMs and broadband provision. Because, clearly, some of these areas that are not getting a satisfactory connection to broadband are the same communities that are suffering as a result of their local bank being closed down.

Q13 **Deidre Brock:** Continuing on with that point, you mentioned that sometimes there are issues in the consumers' own homes. Could you talk about those?

Pete Moorey: There are multiple reasons in your own home for why you may not be getting the speed that you are expecting. It might be because your broadband router is not the most up to date one. It might be about the positioning of the router within the home. There might be other reasons to do with WiFi in the home. As an organisation, we have tried to do a lot through our speed checker to make sure that, when people are checking their speed and finding problems, they are then provided with the information they need to be able to resolve it themselves. If they go through all of those processes and then cannot resolve it, they are then able to go on to their broadband provider and say, "I have gone through all those steps. What can you do about it now?"

The frustration we often have is that, once they have gone through that process of trying to tackle it themselves, frequently the experience they have from the broadband provider is poor. As an organisation, we see that general satisfaction with broadband providers is low, particularly with the larger ones. There is a general trend, which we have seen over the years, where the banking sector—for all the problems that it had 10 years ago—has gradually moved up in terms of consumer satisfaction. As I think we are all aware, energy companies suffer in terms of consumer satisfaction, which has stayed low, and telecoms companies are joining the energy companies, right at the bottom of some of our rankings. Trust levels have dropped. They are lower than banking, higher than energy and trains but still not as high as they should be. Therefore, there is a big challenge here for the industry to ensure that, as consumer expectations rise, as people increasingly see broadband as essential, they are doing the basics right.

Q14 **Deidre Brock:** You mentioned that consumers are sometimes not on the right package. I note from Ofcom's March 2017 survey, 46% of consumers did not feel the need to have the fastest speed available, and 15% felt superfast broadband was too expensive. How much of an issue is that?

Pete Moorey: It is an issue that consumers are not as able as they should be to find the right package for them. Last year the Competition and Markets Authority conducted a market study into price comparison websites, to look at the tools we all use to choose the best insurance company for us, the best energy company for us and so on. One of the key markets where they felt there was a particular issue was telecoms. They said that price comparison websites were not working as effectively as they should. That is particularly important in terms of those comparison websites providing you with the information you need to get the right package, the speed you should expect, the level of customer service and so on. That is another area for me where more needs to be done around the basics in the telecoms market to make sure that, when consumers are choosing the package for them or perhaps deciding to

switch, the right information is available so that they can tailor it to them. Because, you are right, not everyone will want the fastest package. It will not be right for them. Yet, I don't think there is the information properly in place in many places to help people make that right decision.

Q15 **Deidre Brock:** That is an interesting point. Mr Gill, Mr Ferguson, do you have anything to add to that, particularly with the technical challenges of getting to remote rural areas with broadband?

Andrew Ferguson: Once you get into the really remote rural areas—the Scottish definition is it is more than 60 minutes' drive to the next place of 10,000 or more people—the problem there is population density, where households are so spread out. Scotland has some interesting geographical challenges. Whereas in somewhere flat, like Norfolk, a church spire with a wireless antenna can cover quite a large area, in Scotland a wireless antenna may cover just 10 or 15 premises. That is part of the challenge. We know of locations in Scotland that are 15 or 20 kilometres away from the telephone exchange. You are getting that rural. How you solve their broadband issues to make sure they stay in line with the rest of the UK is very difficult.

Q16 **Deidre Brock:** I suppose it is all compounded by the lack of commitment to 3G and 4G coverage from telecoms providers for many years and I suppose that is a commercial—

Andrew Ferguson: The lack of 3G, 4G coverage goes hand in hand with the lack of fixed-line infrastructure that is up to date. As fibre is pushed further and further out—fibre to the cabinet, is the normal solution now, to the centre of the village or wherever—there is more scope for 4G to then appear or for people to have femtocells in their houses that perhaps could be open femtocells, so neighbours could also use them.

There is scope for things to improve, but it needs a lot of the fixed-line infrastructure to improve first, then you can improve the wireless infrastructure on top of it. That also means that people are not tied to just where the WiFi router is in their home, because 4G generally has a wider range than WiFi and they can now be using the 4G while they are out farming, working on the land, or just driving; the car can continue to pick up informatics.

Brendan Gill: To add to that, you have touched a moot point because a lot of the technical challenges are solvable but they come at a cost, so looking at the economic drivers is a fundamental part of that.

We submitted some evidence, I think, to the Committee, which quantified the extent of the challenge. Indeed, from our statistics, we were seeing that Scotland was seeing around 7% less time connected to 4G compared with the UK nationwide average. When we dug a bit deeper we did not see the same disparity when we looked at a comparison of urban areas, so it does seem as if it is the rural areas where the biggest differential is occurring, which plays into the conversation we have been having. If you

want to know if that is a significant amount of impact, will that be noticed? Well 7% of the time is potentially days per month when you are not connected to 4G whereas the UK-wide average is, so it is clearly a big impact.

Q17 **Deidre Brock:** The UK Government's future broadband investment seems dependent on private investment to an extent. Is that realistic, given the experience of the Highlands, for example, or indeed parts of the Lowlands?

Andrew Ferguson: It all depends on what they do. The private investors are going to go for where they can see a return on investment. Even if there are some incentives involved, they are going to look at the longer-term return on investment. That cluster of 20 houses, which is 10 miles away from a population centre of 3,000 to 4,000 people, is probably never going to provide a big return on investment. Companies like your Netflixes, on-demand TV, people who are selling the TVs that can use the faster broadband they may see more economic benefit. This is one of the unusual things. Rolling out the telecoms' infrastructure to give the benefits of the speeds does not always equate to the telecoms provider making more money but it may be that other things benefit, such as the banking industry. They can close branches. Local authorities can reduce manned-desk days to perhaps one afternoon a week for those who refuse to use the internet, so literally Thursday afternoon, if you don't like the internet, you have to go to council offices then. The side effects are more felt from local councils and business than the telecoms providers.

Deidre Brock: Then there is the difficulty of getting all those different organisations to contribute. Thank you very much.

Q18 **John Lamont:** I want to explore the difference between the percentage of premises that have access to superfast broadband compared to those that have an active connection. Mr Ferguson, you referred to Ofcom figures that showed that 93% of premises have access, but there is a much lower figure in terms of those that have an active connection.

The Committee has received evidence from Grace Ormiston from Eccles, in Berwickshire, which is in my constituency. She highlighted the issue that two years ago the community were told they were going to get access to superfast fibre broadband and the properties would be connected on a phased basis. The first property was eventually connected over several weeks, and the speeds they ended up getting were lower than what they were getting prior to the superfast fibre connection. Ultimately, Openreach had to take out the fibre connection and return it to the standard broadband connection, but the consequence was that the village lost their broadband connection, including a business employing 50 people. Eccles is still counted as being in reach of superfast fibre broadband; the cabinet is enabled. How much of a widespread problem is that? We have communities that technically have access to superfast fibre broadband, but the practical reality for those consumers is that they cannot actually access it.

Pete Moorey: I only have anecdotal evidence for that, but the story you are talking about is one that we have heard a lot, not necessarily in Scotland specifically. Last year, we conducted a roadshow in Wales and some rural parts of England, to try to help consumers with their broadband, and that experience was relayed to us on a number of occasions. Andrew gave an example of why that happens sometimes, where it is brought to a village and yet people in the remote parts of the village are unable to get a faster speed.

There is a critical issue here around communication to consumers because, as we have all said, expectation around broadband is now very high. Terms like superfast and ultrafast are not particularly well understood by consumers and, therefore, it is very easy for companies, or, indeed Governments and others, to state to local communities that they are going to get a faster speed, and then for them to find that that is not their lived experience. All that contributes to the low levels of trust that people have in the broadband sector, because their lived experience is not the same as the promises they often get, whether it is in advertising or in terms of the rollout. Everyone needs to be very careful around the promises they make, and should make sure that, when you are bringing faster speeds to a local community, it can be realised in a way that the majority of people can benefit from.

Q19 **John Lamont:** Again, on this example, that exchange is technically fibre-enabled, so the 200 or so properties that use that exchange could potentially be counted in that 90%-odd figure of people who have access—Mr Ferguson is making a face.

Andrew Ferguson: We have looked at the Ofcom data. We have talked to Ofcom, and we have our own data on this. To give you a sense of the difference, fibre—which is what a lot of the politicians and the projects will talk about—in Scotland is actually at 96.7%. That also includes people who are five or six kilometres from the cabinet, where they get nothing and people who may be at 1.8 kilometres, who might get 1 or 2 Mbps from the fibre upgrades. That is why we then come down from 96.7% to 93%. Ofcom do not publish a past figure for fibre, but their data will show it if you reverse engineer their numbers, so it is there.

A lot of the problem is that there is confusion. The projects will talk about a target figure for fibre, but they will not ever tell you what it means. Does that mean you can get something that is zero and higher? Does it mean you can get something that is 5 Mbps and faster, 10 Mbps or faster, 15 Mbps or faster? We need to spend a little more time being precise about what we say when we talk about broadband, and it is very difficult. When you talk on the radio, you do a two-minute slot and you have to abbreviate, talk very quickly, and use the buzz words that people understand. I would love there to be more time to say that when you are talking about fibre broadband, you mean they can get 15 Mbps or faster, or 10 Mbps or faster; if when you say "superfast", you actually say 24

Mbps, 30 Mbps; and if when you say "ultrafast", you actually say 100 Mbps, 300 Mbps, or whatever the number is.

Q20 **John Lamont:** That is an important point. The Scottish Government claim 95% access to fibre broadband and give the impression that that is access to superfast broadband. That is not necessarily the case.

Andrew Ferguson: It is definitely not the case.

Q21 **John Lamont:** It is misleading for them to say that.

Andrew Ferguson: If fibre broadband means a 10 Mbps or better, yes they are at that point. If it means 15 Mbps or better, they are almost at that point—only about 10,000 premises short. In other words, by the time they have done their tallying up for the end of the 2017 delivery, it is likely that they will be able to do that, so their March target of the 95% fibre is there.

This is one of the problems with vague definitions. You lose public trust because it looks as though you are moving the timetables. Then we have some politicians using one definition and some using another, companies using different definitions as well, and TV marketing. Everyone sees the superfast TV adverts, and the public, when they apply for it, get told, "You can only have 5 Mbps or 6 Mbps"; they are just told that is all they can have. It is not explained to them that it is because they are 1.3 kilometres from the cabinet. We try to do that for people online, but it is a very difficult job. A lot of the public have not had the years of knowledge around how telecoms work to completely grasp what the provider is trying to tell them or see through the cloak of the PR and sales techniques.

John Lamont: That is helpful.

Brendan Gill: To add to that, there is an analogue on the mobile side as well. Going back to a point I made at the beginning, we often talk about population coverage, which is typically looking at: is there is a signal at your doorstep? That would be great if we all used our mobile devices on our doorsteps, but the reality is that we go inside and there is a huge differential between what we can get outside and inside our homes—I am sure we have all experienced that kind of frustration—and the current metrics that we use to look at the problem fail to quantify what is really going on there.

In the same way as on the fixed-line side, there is a challenge around the connectivity of the last mile. From exchange to your house is a big challenge. We also think of it as connecting the last metre when it comes to getting connectivity inside your house. That is not something that we are currently equipped with the right metrics or tools to look at.

Q22 **John Lamont:** The Scottish Government do give the impression that this 95% to fibre broadband equates to superfast broadband. It is clearly not the case, and I am pleased you have confirmed that.

I went to Fergus Ewing about this, because initially the Scottish Government had a target of achieving their broadband delivery by the end of 2017. It has now been pushed back to the end of March 2018. I have written to Fergus, the Minister, to ascertain why that has changed. Are you aware of why the deadline has been pushed back?

Pete Moorey: I don't have any detail on why it has been pushed back. Clearly there are quite challenging targets for both the UK and Scottish Governments with regards to the USO and to the rollouts. That indicates that in general there is going to be a lot work to be done in the next year or two, to make sure that those targets are met. It also raises another important point around consumer expectation, because it is starting to become common knowledge that certain speeds should be expected by consumers, yet if we go on a year, two years, three years, and find that people are still not getting the bare minimum that has been set out—and beyond that some of the superfast promises—then that too is going to undermine consumer trust in the rollouts, in both the UK and Scotland specifically.

Q23 **David Duguid:** This is a supplementary to what Mr Lamont was talking about. It reminded me of a conversation I had, towards the end of last year, with Digital Scotland, in which they made clear to me the definitions of coverage versus access, which I was not aware of at the time. They explained to me—and I want to check this with your understanding—that coverage was: you lived in an area where there was fibre connected to the exchange, or a cabinet, so you were connected, but you may still be more than 1.2 km away, in which case you are not benefitting from the superfast speed. They used the definition of the word "access" as having access to superfast; greater than 24 Mbps, I think they used. Is that a consistent definition that is used across the industry? Or is that just Digital Scotland using that?

Andrew Ferguson: Your fibre figure will always be highest. Then you should have your 24 Mbps superfast definition, which originates from Westminster. Then there is the higher 30 Mbps definition—which I believe the whole of the UK is going to shift to—which is the EU-wide definition of what superfast is. Your best coverage is fibre, but that includes all those who can only get zero, 1, 2, 3, maybe 10 or 12 Mbps for some of them, and then you have superfast.

The problem is that fibre is a bigger area, superfast is a smaller area, then the 30 Mbps superfast is a slightly smaller area again. Also, it is not just a simple radius drawn around a telephone exchange. You can have premises that are 50 metres from the telephone exchange that, due to historical reasons, are connected direct to that exchange and don't go through a cabinet. Therefore, you have villages that are split down the middle, 30, 40 houses get proper superfast—30, 33, 34 Mbps-type speeds—and others that, for historical reasons, are just on a different set of wiring, are still stuck on maybe 1, 2, 3 Mbps, old fashioned ADSL. When you hear of villages complaining about being split, there is usually some historical reason behind it. Figuring that out is difficult. That is

where the money to rearrange and resolve all these old, historical problems needs to be spent to get rid of them so that they cease to be a problem.

Pete Moorey: It is an important point with regard to the Universal Service Obligation, because what we don't want is a commitment that the minimum should be 10 Mbps and then to find that the day-to-day experiences are that people are getting much lower than that. For me, 10 Mbps should be the actual speed that consumers are getting in their homes at peak time. That is quite a challenging target, given the experience that many consumers have today but, if we are saying that that is what people should be expecting, then we need to design the programme in a way that delivers that.

Q24 **David Duguid:** I think it was you, Mr Moorey, who started off by talking that the definitions and terminology being used by different providers, different Governments and by different people within the same Governments. I want to tie this down. I want to confirm one way or the other whether it was a consistent usage of the words, this difference between coverage—which seems to be essentially based on just being connected to the network—being different from the word "access", which means you are actually benefiting from those superfast speeds. Is that something that you recognise as a distinction?

Pete Moorey: I am perhaps as confused as you and other consumers are on that point. That is something we can take away and come back to you on.

David Duguid: Thank you.

Ross Thomson: Mr Moorey, you were saying that the targets set by both the Scottish and UK Governments are challenging. My question is: are they achievable, given some of the current levels of funding that we have? I also see that the UK Government have announced £190 million to go to local authorities this time to help with the rollout of fibre broadband. I would be interested in your thoughts on that, too.

Pete Moorey: I don't have an assessment of whether they will be achieved or not, but they are stretching targets and the dates of 2020 and 2021, while some way away, perhaps, in consumers' minds, all of us who work in this area know they are much more immediate than perhaps we would like, given how challenging they are. It is going to be a challenging issue for them to deliver on the targets. Therefore, it is important that the Committee speaks to Ofcom because they will be monitoring much of this. They will be publishing assessments around progress to date and they should have an assessment of whether both the USO and special Government targets can be met.

Q25 **Ross Thomson:** Do you think that policies provide sufficient support and funding for broadband rollout to the final 5%?

Pete Moorey: Clearly the intention of the USO, in particular, is that it will. We welcome the fact that the UK Government has come to a decision on the USO. In many respects, the decision to go ahead with a regulated USO is very positive.

There are a lot of details still to be gone through on that, particularly how much it is going to cost for consumers, which is going to be critically important, and the point I made around the actual experience of that final 5%: will the USO mean that the final 5% actually experiences speeds of 10 Mbps? I think that is what they would expect. Then there is the transparency around how it is delivered and that it delivers good value for money, and also the role around demand aggregation, which is so important.

We want a process that allows communities to work together to be able to get access to faster speeds as easily as they possibly can. There is a lot of detail that needs to be gone through, and I am sure it will be in the spring, as the Government and then Ofcom consult on the USO, but it is important for us that it meets all those requirements.

Q26 **Paul Masterton:** We have already touched on the new USO from the UK Government but I want to touch on one specific part of it, which is the cost threshold above which providers will not be required to meet a request, particularly when we are thinking about this final 5%, which are often the most rural, most remote and most expensive to connect to. Could you talk through what you think the implications of that threshold could be in practice?

Andrew Ferguson: The absolute implication might be that if a premise is told it will cost £10,000, we will meet £3,500 of that. If you want the USO minimum, you can pay the other £7,000. It will pretty much be that residential consumers will not pay that. A business may look at it quite differently, because there is the whole relocating of a business and if you are tied to particular land or a factory unit, or whatever, then it makes to perhaps spend that money.

The USO is so vague, still, in its definitions. We don't really know how it is going to work. It may be that you are offered what is called a full-fibre USO option—fibre to the premises—and it might be that you have to stump up £10,000 and we will pay £3,000. There might be lesser options of, say, fixed wireless, where we can meet that within budget, or satellite, which of course you can meet today, but then it might be that the USO means you don't pay the install fee for the person to come around and put the dish on the home.

I think satellite has a place to play in the USO but it should be an absolute last resort, simply because of the experiences we have seen to date from people. The USO—the 10 Mbps, as has been said—needs to feel like you are really getting that 10 Mbps. Also, it should be seen as a safety net, not 10, as in you will get 10 Mbps but as in: most of the people who get the USO are being delivered 25, 30, 40 Mbps; actually

are being delivered superfast. The ambition should be to go quite a way beyond that, so that you don't have to revisit USO2 in 2025, USO3 in 2030. Otherwise we are going to end up with these continual meetings for the next 30 or 40 years. It is nice to be kept busy by these meetings, but if you want the problem solved—

Q27 **Paul Masterton:** You would like to see the USO operate as a floor, rather than a minimum target?

Andrew Ferguson: Yes, as a safety net. 10 Mbps is fine as an absolute safety net for the premises where it is really, really difficult, but your ambition needs to be a lot more. For people on the outskirts of Glasgow and Edinburgh now, there are estates that have been built where the builders ignored broadband requirements two or three years ago, and they are looking at speeds of 1, 2, 3 Mbps, and the only prospect currently is either the R100 project in Scotland or, if you are anywhere else in the UK, it is the USO. There are a lot of people watching this and going, "What is actually going to happen to me?" and this is the problem: communicating what is going to happen to the individuals. That is what has failed in almost all of the projects so far—telling individuals what is going to happen to them, and the timeline.

Q28 **Paul Masterton:** Do you have any visibility, or estimation, of how many premises are likely be caught by the thresholds, in terms of people who are likely to be excluded by the thresholds, or is it far too early to tell?

Pete Moorey: We don't, and clearly that is going to be a critical part of the USO consultation. We need to have that kind of information made available, so that we can start to consider what the right routes for those consumers are.

With other Universal Service Obligations—electricity for example—there will clearly be instances where households will have to meet some of the cost themselves, but those are pretty rare. It is important that we have an assessment around the different households that will be affected and how we are going to address that.

Q29 **Paul Masterton:** I represent East Renfrewshire, which is a pretty urban constituency, very high in the 90s in terms of coverage. But there are small pockets—mainly for the reasons you state, Mr Ferguson: either small rural pockets in the constituency or very large, new-scale developments where broadband simply was not considered as part of the infrastructure. Some of the individual residents coming to me are already being told, through discussions with Openreach, BT and so on, "We could do this, but it would be at your cost," and it would be exorbitant, so potentially these households are not going to benefit.

Pete Moorey: The issue of new-build properties seems to be a particularly significant one, not only in Scotland but right across the UK. Again anecdotally, we hear from a lot of people about problems with new developments, and we particularly hear it from Members of Parliament and Members of the Scottish Parliament. That is another issue where

greater consideration should be given to what should be done there. It seems absolutely ridiculous for consumers to be moving into new properties that have all the benefits they would expect from a 21st century home, but do not have a satisfactory broadband service.

Q30 **Paul Masterton:** Almost in the same way as developers have to look at roads, redoing traffic lights, doing new roundabouts, ensuring that new buildings are not going to impact on sewer coverage, they should be checking to ensure that the development plan covers broadband connectivity.

Pete Moorey: It is an essential product. That is how consumers treat it: just like water and electricity. They regard it in almost exactly the same kind of way, and it should be treated in that way.

Andrew Ferguson: It is worth adding something about the promises from providers about what they will offer. In the last year, Openreach have said that for developments of more than 30 homes they will offer to do full fibre. The builder can reject that offer. They don't have to take that offer, but there are competing providers that they could go to. Some close-gated communities, private estates, will go with different providers. There are three or four full-fibre providers. The problem is not with the new builds that have been granted planning permission that they are just about to break ground on now. It is new builds where planning permission was granted in maybe 2014, and they started building a few houses. The classic build is you build 10, sell a few, and that gives you the money to build the next 10. They are doing it in little steps so, when they approach Openreach with a development of 10 houses, Openreach will have said, "That is not worth us doing. You just stay on the standard copper infrastructure," and this would have been a decision made in 2014-15. Now, however, people are moving into the next 10 that have just been built in last October or November, moving in today. They are still stuck with those decisions that were made in 2014-15.

Our advice to people, if they have made the mistake of believing that there will be good infrastructure, is to stand outside the sales cabin and say, "This site does not have good broadband," to try to shame the developer into trying to co-operate with someone like Virgin Media, Openreach or someone like INFL, which is one of the independent fibre networks, to get one of those on board to put some decent future-proofed infrastructure into the estate. It has worked for some people. Some people have had builders reaching into their back pocket and taking what would have been some of the profits back out to retro-upgrade developments, particularly if it is an estate that they are planning to build over 10 or 15 years. Solving that problem for the first 100 homes means that sales then become easier.

Hyperoptic is a fibre-to-the-building provider. They say that they have seen a sea change in how apartment landlords behave with regard to broadband. They now see it as being crucial to being able to get long-

term renters or being able to sell apartments. If they cannot advertise good broadband, they will not sell anymore.

Brendan Gill: We would say the same consideration should be given to the mobile side. If we are treating connectivity as a right—and I think a lot of people would agree it is time that we did that—then, absolutely, when building developments, we should be treating it in the same way as we treat electricity and other utilities. Let's plan and make sure we have the best broadband and mobile coverage. There are things that can be done to ensure buildings have the best connectivity they could have.

Chair: We are coming towards the end of the session. We still have a number of questions to ask, so if I could ask colleagues to be brief with questions and also with replies, if that is all right. David, I think you have asked your question. Do you have anything else?

Q31 **David Duguid:** I was about to ask a question, which I think has been answered but, just in case, maybe just a one-word, or one-line answer, as to why you think consumers are not taking up faster-speed services when they do have access.

Pete Moorey: It is partly about awareness; it is partly about trust; it is partly about their lived experience.

Q32 **Ged Killen:** This has been touched on in places, but this is a question to Mr Moorey about misleading advertising. Some providers have been accused of advertising misleading broadband speeds. What extent of problem do you think that presents, particularly in rural areas, and what do you think can be done about it?

Pete Moorey: It has been a significant problem with the old Advertising Standards Authority rules, which allowed providers to advertise speeds that only 10% of customers could achieve. The ASA have announced that they are going to change that. We will see that change this year, which means that the advertised speed will be one that about 50% of people can get at peak time. That is very welcome, and that is a benefit to consumers, whether they live in urban or rural areas.

Andrew Ferguson: The problem with the speeds has been that Ofcom moved to have a broadband speeds code of practice a couple of years ago. A lot of the public see the nice, shiny adverts, see the nice price point with the £100 cash back offer or whatever, and go for that. But when they go through the process, they are missing what the code of practice obliges the large providers to tell you, which is: "For your line at your house, this is our range of speeds that we estimate you will get." That is most important. Forget the adverts. No matter what the adverts are saying, when you are going through the order process, the most important thing is to make sure of that. We say to people, "Screenshot that page. Take a photo with your phone, so when you have problems later, and you are phoning back to say your line is slow, you go, 'Look, you said I was going to get 15 to 25 Mbps and I am only getting 4 Mbps'". The advert is irrelevant at that point because even if it is a

median, 50% are faster, 50% are slower. It is making sure that the public knows.

Very much like when you are signing up credit cards, there are certain key points you have to be very aware of. It is the same with broadband. You have to be very aware of that speed estimate that the sign-up process includes.

Q33 **Christine Jardine:** I want to ask you about mobile coverage in rural areas, which has improved, but there are still problems. From what you are saying, it does sound as if we are deluding ourselves if we think that although there are problems in rural areas, it is confined to rural areas. In my constituency of Edinburgh West, we have large developments at the edge, and we could be looking at a significant problem for residents for the next five or 10 years.

Brendan Gill: I would say, absolutely, there is still a lot to be done to improve the access to mobile coverage. We are still far away from universal coverage, which is now almost talked about as if we were virtually there, whereas, when we look at the evidence, there is still a gap there.

I go back to my first point. For us to improve that problem we need to understand it, and talking about population coverage is a limited way to look at things. We are already talking about 99% population coverage, but that only looks at: do you have a signal on your doorstep? It is usually predictive models that are quite optimistically created, and they are not really capturing the accurate picture today.

Last year, the National Infrastructure Commission did a report. One of their recommendations was for Ofcom to create more meaningful measures of coverage that were based on real-world measurements of what people are actually receiving, in a way that is closer to the way people are experiencing coverage. At OpenSignal, we believe looking at the proportion of time you are connected is getting closer to the experience that you have of mobile coverage. When you look at those statistics, UK-wide we are talking about between 58% and 78%—and that is between the different providers—so you can see there is a big difference to this 99% population coverage figure that we like to use. It is by quantifying the problem that we start to solve it.

Andrew Ferguson: From our consumer speed testing, I cannot tell you about 3G and 4G speeds in Orkney and Shetland, because there seems to be no data. That suggests that those people just do not have it, or it is so slow, they know it is slow and they are not going to test it, whereas once you move into the central belt of Scotland—your Dundees—we have the data.

One of the other problems with the 99% for a lot of people, if you say "99%", they assume they are in that figure. But if you say that 99% of households in Scotland are covered, that still means there are 23,000 to

24,000 households that are not covered. When you talk about it in those terms, it does not look as good.

Q34 **Christine Jardine:** It does not look at the population spread.

Andrew Ferguson: We have to talk about households because we don't know how many people are living in each. We could guess, but why guess?

Q35 **Christine Jardine:** Not a good idea, no. Mr Moorey, you touched on the banking closures, rural closures, and how they are affecting the rural areas as much as the mobile problems. The areas that have been hit by the banking closures are also the areas that have been hit by lack of mobile coverage, broadband. There is a kind of double effect there. Would it be possible—maybe you are already doing this—for the internet providers, mobile services, and so on, to work with the banks to look at the areas where there are difficult problems with all sorts of services, health as well, and look at prioritising them in perhaps the next stage to make sure that those areas that have been badly affected this time—and some people would say ignored—are the ones that are given the first priority next time?

Pete Moorey: That is a very sensible point. As you are probably aware, there is the Access to Banking Protocol regarding bank branch closures and the steps that the banks are meant to go through when they are considering closing a branch, the range of stakeholders they are meant to talk to, clearly local communities and businesses, to think about that. Including telecoms providers in that conversation is a very good idea, given the fact that people, as you say, are often left without a bank branch and perhaps poor mobile and broadband coverage.

Q36 **Christine Jardine:** Is there a role there for something like Highland and Islands Enterprise?

Pete Moorey: Yes, whatever the construct is for this—local authorities, other bodies—indeed the role of Governments to convene, industries to come together, it is important. Originally the Access to Banking Protocol was something that the Secretary of State for Business at Westminster, along with the Treasury, brought the banks together to deliver and, therefore, I think more could be done to make sure that they are working with telecoms companies.

Chair: We are at the end of the session. We have two quick questions, hopefully, from Deidre Brock, then Hugh Gaffney.

Q37 **Deidre Brock:** There was a suggestion in some of the evidence we have received that there is a resistance from a lot of the mobile companies to joining forces on some sort of roaming arrangement, which is what was suggested by the Ofcom Advisory Committee. Is that your experience? Is there anything you think we can do to overcome that? It does seem to be one way of addressing the problems in rural areas.

Brendan Gill: I cannot speak to the specific problems. I know the providers talk about a lot of technical challenges in doing that. I cannot offer any insight on that. One thing we have looked at is: would that solve the problem entirely? I think we have to be realistic that that will not solve everything because there are many areas where no provider has coverage and, therefore, roaming will not address the situation.

Andrew Ferguson: People in rural areas learn to have two mobile phones with two different networks, so perhaps the roaming may not solve that problem because you have people who know they have the multiple networks and they still get nothing.

Q38 **Deidre Brock:** The Mobile Infrastructure Project, launched by the UK Government in 2013, was to build another 600 masts. Unfortunately it folded after investing in only 75. Do you think that if the 600 figure had been kept to, that would have made a huge difference? I am not sure if it was focused on rural areas or not, but presumably that could have made some considerable difference to the coverage.

Pete Moorey: That is not something we have looked at in any detail.

Andrew Ferguson: The Highlands alone could swallow 600 masts and there would probably still be gaps in coverage, so vast are the Highlands, compared with the population density.

Q39 **Hugh Gaffney:** I think you have just spoken about this, but you are basically saying there is no data on the Highlands but up to Dundee, you are saying, okay, we have plenty of data because of the density of the population and all the rest of it, so what are the challenges? Why do you not have any data for mobile phones above Dundee? How can we resolve this? What are the challenges in rural areas?

Andrew Ferguson: Do you have it split down?

Brendan Gill: It is not something we have taken a look at but we probably would have some data from those areas. Maybe it is a follow up that we could do. There is definitely a challenge in getting data. That is part of the problem. A lot of the ways we look at it, I mentioned that on the mobile side we use predictive models, which are inaccurate, but these days everyone has a smartphone or they have a way to connect to their broadband connection. That can also serve as a means of gathering more data. It is something we do but it is potentially something Ofcom or others could do more of.

Andrew Ferguson: Probably if I deep dive into the data there will be one or two people in Kirkwall with 3G speed tests and so on, but it is a problem of statistics. If we start talking about those when we have limited numbers—in places like Orkney, 12,000 households—the data set is already quite small so it becomes harder and harder. There is almost a need to gather more-specific data. We almost need someone slowly walking around, so they have enough time for all the devices to adapt, to properly map. We can crowd-source stuff, he can crowd-source stuff, but

actually someone investing the money and time to do it is really what is needed.

Pete Moorey: It is another important issue to raise with Ofcom because, under the Digital Economy Act that was passed last year, the regulator now has many more powers to source data directly from the telecoms companies themselves. There is a question about what data they could be getting access directly from the telecoms companies and then making it more readily available, because they now have those powers.

Chair: I am grateful. Thank you very much for getting this inquiry started off. As usual, if there is anything else that you notice in the course of this inquiry, please get back in touch with the Committee. I don't think there is anything outstanding that we require from any of our guests today, but please keep in touch with the Committee as the inquiry progresses. Thank you.

Examination of Witnesses

Witnesses: Professor Will Stewart, Ewan Sutherland and Professor Rahim Tafazolli.

Q40 **Chair:** Thank you very much, gentlemen. The usual protocol at the beginning of these sessions: who you are, who you represent, and anything by way of a very short statement. We will start with you, Professor Tafazolli.

Professor Tafazolli: I am Professor Rahim Tafazolli, Director of the Institute for Communication Systems, as well as Director of the first 5G Innovation Centre in the world, at the University of Surrey, of course.

Ewan Sutherland: I am Ewan Sutherland. I am an independent policy analyst. I suppose I have taken an interest in this area since 1990, when the Highlands and Islands Development Board launched HIE ISDN, and I think there was a previous initiative—I believe in the early 1950s—which was responsible for the rollout of a number of the smaller exchanges.

The first observation would be to say that one of the issues in Scotland is that investment is less attractive than some other places because of the lower levels of uptake. The other question is we are in a constitutionally complex area because the legal framework is a European Union framework. Then there is the United Kingdom legislation. Then there is action by Scottish Government and by local authorities. There is then the question: to what extent do we want to direct companies to do things? To what extent do we—as has been enacted—want the Universal Service Obligation, which is to be a safety net? Is it a safety net? Then there are issues of state aid. It is how you strike a balance between that to maximise what you can from the market.

Professor Stewart: My name is Will Stewart. I chair the IET's Communications Policy Panel, on which Rahim also sits, and William Webb, who is to do with OpenSignal, which you met last time. We have a finger in a lot of pies.

I want to say a few basic things to begin with. The first is to say something obvious, which I am sure everybody agrees with. This is by far the most cost-effective infrastructure in terms of wealth creation, social connectivity, and health support. Roads and railways are kind of nice, but they are ridiculously expensive. This is absolutely the right solution.

The second thing is that this is a communications network. There are a lot of technologies involved—wireless, fibre, a bit of copper still—but this is basically one network. The core of it is fibre. My project in Southampton has a petabit down of fibre, which is 1 million megabits. That will see us through until about 2030. The edge is almost always wireless. Even if your house has fibre, you will then turn it into wireless locally, so we are talking a fibre/wireless system.

Copper is increasingly irrelevant. There should not be any new copper going in, especially in rural areas. Not all of Scotland is rural, but especially in rural areas it is completely inappropriate. You cannot do any sort of real distance on copper. We are talking fibre/wireless. My village in Northamptonshire, which is not Scotland but is a little bit remote, has an all-wireless solution put in by a local community company, so that is something that can be done. Various places in Scotland are doing things like that. The technology is there and it is awfully cheap. It really is.

Q41 **Chair:** We are all grateful for that enthusiastic note. I want to ask about the technologies, as we have you here as experts on these very issues. We are hearing that copper has had its day, and that it is all fibre. What are the limitations of this? What are the particular challenges in terms of the technologies that are being used to apply them to rural areas that a number of us represent? Let me start with you, Professor Stewart.

Professor Stewart: The reason the copper is there is that it was put in to provide traditional telephone coverage. Those are traditional paired wires. You can put broadband on that. That was an incredibly successful technique in the early days. You provide megabits on it. You cannot go very far at reasonable data rates. Roughly speaking, more than a kilometre, and the data rate is hardly worth having. It is almost negligible. That is fine. These things were put in up to 100 years ago to carry a telephone, and they still do that.

If you want to go further than that, which in many rural areas you do, the most cost-effective way of doing it is almost certainly wireless, but you can put in full fibre. To say something obvious, it is not the fibre cost that is the problem. Fibre is incredibly cheap. It is the cost of putting it in. It is no more expensive to put in fibre than it was to put in copper originally. The core problem here is civil engineering, and we could discuss productivity. Productivity in telecoms has gone up 10^8 times in the last 30

years. That is 100 million times. This was covered in the *FT* and on Radio 4's "Today" last week, you may have heard. That was my panel.

Productivity in civil engineering has not improved at all. That is the problem. It is the installation that is the problem. If you are installing certainly the new build, which was talked about earlier, there is no way you should be putting in copper. You should be putting in fibre or wireless, depending on the situation. Does that answer your question at all?

Q42 **Chair:** I think so. I look at probably the furthest community in my constituency, Bridge of Gaur at the top of Glen Lyon.

Professor Stewart: I have been there.

Chair: I hope you enjoyed it.

Professor Stewart: I did.

Chair: To get a connection, you physically have to get that fibre all the way up the Glen, which is about 20 miles long, before you get to Bridge of Gaur. That is massively disruptive, isn't it, particularly to people in rural communities? Are there any issues about the laying of the infrastructure that is particularly unusual or troublesome when it comes to getting things like that?

Professor Stewart: Yes, there are issues with existing infrastructure: poles, which I think are used up there, aren't they?

Chair: Yes.

Professor Stewart: And ducts and so on. There are issues with sharing. If you search 5G IET—which Rahim will talk about in a minute—on the IET website, you will find a report that tells you what you need to do to get 5G in, and 5G is just capacity in this context. Sharing existing infrastructure for installation is a crucial point, and overhead poles for cables and that sort of thing. In many cases, this is restrained by regulation in ways it need not have been. That is certainly something where something can be done.

Basically, if you can get electricity to this place, you can get fibre. The cost is no more than the cost of installing electricity. It is just that we have got used to electricity. I agree with the previous speakers. This is absolutely essential, more essential than we realise. I don't know whether you use Amazon Echo or Apple Siri to call things. You can call 999 with this now, and it saves lives. That involves communications. You go to this unit. It comes up as text from this unit, but it has been done by communicating with an Apple server in Cupertino, which does the actual speech interpretation.

Universally available coverage is very important, not just megabits, which is what was said before. Coverage is very important. Latency, which we

have not mentioned so far, is also important. I will not go into that unless you ask me to. This can all be done. It is all perfectly possible.

Q43 **Chair:** Is it not the case that most of the broadband delivery is dependent upon Openreach's infrastructure when it comes to this?

Ewan Sutherland: Yes, very much, for reasons that are quite historic. The Communications Act in 2003 came into effect. One of the first things that Ofcom did was to do a strategic review. It found that, although we had been regulating telecommunications since 1984, remarkably little progress had been made in introducing local competition. The conclusion from a long and not very pleasant process was that they would create something called Openreach. That then resulted in not yet 20 but soon 20 years of litigation and lobbying and difficult processes. The question becomes: can you create the incentives for Openreach to build a cable out along Glen Lyon? That has not been achieved. Openreach has an economic incentive to build out its network, but it does not see the economics of that particular valley.

The alternative argument—or supplementary, because it is not necessarily an alternative—would be to have said, "What we want is to create community opportunities for broadband and we want to have people maybe who are local farmers, who are not necessarily terribly skilled in telecommunications but do know how to use a backhoe and can dig you a trench and put the fibre in themselves". What they now have is quite an effective network, relatively cheaply installed. People were doing this certainly 10 or 15 years ago in Sweden. The catch is you need to backhaul. You need to be able to connect on to some sort of network because you have gone from the village down to the end of the glen, "Right, what do I connect to?" The answer is BT will say, "We will connect you to links on a leased line", which will be so hideously expensive that you will not do it.

Professor Stewart: Yes, I half agree with that; meaning BT Openreach's backhaul is very important. It is also important for mobile cost. Most of that is provided by BT as well. But there are other people than BT and you can get around the BT restriction. Regulators are not necessarily as sympathetic as they were to BT being difficult. In our village locally we have a wireless provider system. We got around it. It can be done. It is also not obvious that you should run a cable down Glen Lyon at all. It may well be that point to point wireless is a better solution. It is certainly much cheaper to install if you do not have anything to start with.

Chair: I am grateful, thank you.

Q44 **David Duguid:** All that said, I have heard a lot of the technological challenges already. One of the things I read in the papers that were provided for this meeting surprised me, which was that Openreach continues to invest in copper-based technology to supposedly deliver superfast broadband. Do any of you know why they would have made this decision? Is it, indeed, a sensible commercial response to the costs of

deploying fibre cable in rural areas?

Ewan Sutherland: I believe the technical term is sweating the asset. The other technical term is something called G.fast, which my former colleagues in ITU developed, which does pump somewhat more data down the copper wire. The question is: is there sufficient economic incentive for Openreach to put fibre in or to try to get more capacity on the copper? There is a G.fast technology that BT has trialled and appears to think is quite useful.

Professor Stewart: G.fast is also short for range. You can get more and more capacity on to two wires if you go shorter and shorter distances. You go to the cabinet, you go to the cabinet closer to people, and so on. Why does BT do it? Because they own the copper network already. Would it be a sensible way to do it if you were starting from scratch? No, it would not. You would not be putting any copper in at all if you were starting from scratch. I don't think BT's behaviour is unreasonable. I don't think it is necessarily in the interests of the consumer. Is that a fair answer to your question?

David Duguid: I think so, yes. Thanks.

Q45 **Christine Jardine:** It is very interesting what you have been saying. One of the things that Ofcom has said is that infrastructure sharing could be a solution to improving the network, and it would encourage investment. Not many people take it up at the moment. Why do you think that is and how can we improve the situation?

Professor Tafazolli: Infrastructure sharing solves one part of the overall cost. If you look at the cost elements, it is the cost of developing the technology, the cost of buying the asset, the cost of deploying the technology, and the cost of operating it. Infrastructure sharing is just the cost of the asset, the capital, that you are sharing, but the cost of operation needs to be sorted out. That is the biggest element of the overall cost, which influences the return on the investment side for each player involved.

All this spectrum sharing, radio sharing, infrastructure sharing, mast sharing, or the lease of the sites—for example, the Government intervention that provides the sites at reasonable cost and so on—if you manage all of this, at the end of the day we need to develop the technology, especially for the rural areas, so that it travels much longer distances than the current technology can do. I think that is one of the issues with this.

It was mentioned by the first panel that, for example, in Scotland the user density is very low. The reason that technology is not taken up is because when we look at South Korea, you see high-rise buildings with 10 times higher people density in the high-rise blocks. That makes the deployment of broadband much quicker and the take-up much faster. The cost of infrastructure sharing, the point I want to clarify is the cost of equipment is not the big factor because telecom systems are

international standards. The market is as big as a globe, so economies of scale reduce the cost of the equipment substantially much faster than any other system. The other cost elements, especially the operational costs, I think need to be reduced.

Ewan Sutherland: I was slightly surprised by the DCMS report on the mobile infrastructure programme. Clearly, it was a disaster in the sense that it delivered 70 masts instead of 600, but to my mind it does not really explain why it was a problem. It does say that the response of Government is that what they will do in future is—rather than get the operators to share masts and collaborate—they will impose coverage obligations. It is not immediately clear because in other countries mast sharing is not uncommon. It is not uncommon to find a third party does large numbers of the masts. Yes, you may be a Vodafone customer somewhere, but the reality is that somebody else is managing the network, somebody else is managing the masts, and that is a fairly typical commercial model in other places. There is no reason why it should not work. Something clearly went wrong here and it seems to be problematic.

Q46 **Christine Jardine:** In the previous session we heard that in areas like Orkney there is very little data. I know that the Government are proposing that the next round of rollout in Scotland should be done by the local authorities. Is there an advantage to decentralisation in the provision of broadband and mobile or is there an advantage to centralisation? Which would you say? Is there an ideal model?

Ewan Sutherland: You would have to look at the experience across the European Union, but the general experience would be that local authorities have been heavily involved. There are crucial issues about creating a forum where the local authorities can meet and can discuss their experiences. I don't think we have a post-mortem yet on Broadband Delivery UK work with the English local authorities.

I don't think it is fair to suddenly turn round to a local authority and give it a lot of work in an area that it is not familiar with, when it has lots of other things to do, but these are people who are involved in the planning. They are also people who should not have been allowing people to build houses without ducts for optical fibre to them. Somebody should answer for that. It is a very common model in many countries and it has been made very successful.

Professor Stewart: Can I come back on the local authority one?

Christine Jardine: Yes.

Professor Stewart: A local authority is not necessarily local. Speaking for Northamptonshire—which I know isn't Scotland—Northamptonshire Council did a deal for Superfast Northamptonshire and they said, "There is only really BT"—have a look at the minutes of the meeting; that is exactly what they said—"so we had better do a deal with BT". The result

is, when we wanted the money for our village, BT got it, because they were going to do it eventually. They actually have done it, even though we have already fitted a wireless system.

That isn't really local. If you want it to work locally, I think you have to have control down to the users, to the individual villages, to the clusters of houses, the end of Glen Lyon, so that people who care need to be involved. There are companies that will then support them—Gigaclear and so on. There are people that will then do that. The reason it became a BT monopoly is the local authority said, "Help, I don't understand this. I will go to somebody. BT is safest".

Q47 **Christine Jardine:** One last thing: originally, at the start of the round before, Highlands and Islands Enterprise had a proposal—which Mr Sutherland especially may know about—that they should handle a lot of it through their communities arm. Would that be—

Ewan Sutherland: It is a question of granularity of how you want to deliver this, and where you think there is sufficient expertise or you can support that expertise. If it is a question of just being able to go out to tender for something, then that is a different matter. I forget how many square kilometres the Highlands region is. It is a vast area. It does not give much sense of being a community. It is a question of how different they are, but then it also comes back to economic issues about how many potential suppliers there are in the market for that, how much capacity the suppliers have, and whether you are simply replicating the same basic model several hundred times, or whether you are doing something that is genuinely customised for that geographic setting.

Q48 **Chair:** We have a couple of supplementary questions, but before we move on, there was something that Mr Tafazolli said that piqued my interest. You mentioned Korea, and obviously there are very attractive propositions and options that are available with high-rise buildings. I was recently in Iceland and they had superb coverage by broadband and 4G. There was not an issue. In terms of the Highlands of Scotland, it is less inhabited than they are. They seemed to be able to do this without any great concern or issue and they have amazing services, so it is possible in lesser densities.

Professor Tafazolli: I think it is a combination of not only just the population density, which impacts the economics of the return on the investment, which is very important—

Q49 **Chair:** It is all about investment and giving the resource to deliver it—is that what you are basically saying?

Ewan Sutherland: I think at one point Iceland had the only state-owned branch of Vodafone, after the banks that owned Vodafone Iceland collapsed and it was taken over by the state. There may be more complicated issues here.

Q50 **Chair:** I think what we are getting at here is it is all about resourcing. We

are hearing from you guys about some of the challenges of the geography and getting it up to Glen Lyon. There are all these difficulties, but if there is enough of a resource made available, we could have Iceland levels of interconnectivity.

Professor Tafazolli: At the moment, most of the local authorities come to me—obviously they don't know the technology—and say, "We want to be the first to deploy 5G". That is all they say they want. My advice to them is, "Make your local authority, your location, 5G ready". They say, "What does that mean?" It means deploy the right fibre and make the right sites available, so the service providers, when they want to deploy 5G, have all this foundation in place. They can do the rollout, reduce the cost of initial investment and then speed up the deployment. That is something that Iceland has done as a small country, but we can do this and replicate the same thing in the local authorities and local councils as well.

We should not leave all the burden of deployment and operation of the network to the service providers. Local authorities, as well as Ofcom, have a big responsibility. It has to set the spectrum licensing auction requirements. The population density and coverage and 99.5%, this is the wrong metric. It is a metric we use for GSM, which is a second generation system that uses only one type of service, which is a telephony service. Now we are taking on broadband, so we need to look at a different metric that is reflected in the spectrum auction licence and commitment as well.

Chair: Thank you.

Q51 **David Duguid:** Professor Stewart, going back to something you said in your introduction about the relative cheapness of full fibre everywhere compared to its benefits to society and to the economy and, Mr Sullivan, you mentioned looking at other examples and models across the EU. I think it was Germany, if I am not mistaken, that decided that the focus had to be on what we are calling the final 5%, the difficult-to-reach areas, rather than making everyone else, who already have broadband, faster and faster and faster. Do you think there might be a case for a shift in focus by either Government—be it the UK Government or the Scottish Government—to at least close that final 5% gap before we try to make everyone else faster?

Professor Stewart: I don't think the right approach is to close the 5% and then do the rest. You need to push everything, and you will end up with the final 5% probably having less capacity measured in megabits than the 95%.

I also think the comments that were made earlier about coverage geographically are much more important than people realise. It is very hard if you are a supplier—particularly of 5G or 4G, but any sort of supplier—to be told that you are not doing the coverage when the coverage is really good. 4G has much better coverage than 3G, but the

expectation has risen much faster than that. People are now angry when they cannot get a signal, when they cannot get connected, when they cannot get broadband, and they are quite right to be.

That tells you the absolute coverage is absolutely important, and it is not just important for the 5% of people who live in the 5% place. It is important for all of us when we go on holiday to Glen Lyon. It is important for everybody to have continuous coverage all the time, which I think the OpenSignal person said last time. I think you have to push on all those fronts. I don't think you can choose to do one or the other. I think the solutions for the 5% are not as difficult as people will tell you they are. They are expensive, but they are not technologically difficult and they are not expensive compared to providing that 5% with electricity, for example.

David Duguid: Or water or sewerage.

Professor Stewart: Which is just as essential, yes.

Professor Tafazolli: What probably needs to be done to reduce the economics of that 5% in rural areas is the law of physics says that the lower the frequency band, the frequency to transmit, it will travel longer distances. We need to provide adequate frequency of spectrum in much lower frequency bands below one gigahertz, below 700 megahertz, and then develop the technology around these radio spectrums in order to cover much larger areas more cost effectively. I think that is the role—

Q52 **Chair:** We are getting into megahertz here. The frequencies may be beyond the technical ability of this Committee.

Professor Stewart: 5G has a 700 megahertz band, which can be used to provide coverage everywhere. It is roughly like TV spectrum, for instance. The tens of gigahertz, which is the millimetre wave bands, is very short range for coverage inside this room—coverage in local settings.

Ewan Sutherland: The important point to understand with 700 megahertz is you are familiar with it because it is already being used for radio and television services.

Q53 **David Duguid:** Sorry to stick on this technological point of the megahertz and gigahertz, but isn't it the case that when you extend the range in such a way, it actually weakens the signal, so when it hits a building, it does not get inside the building so easily? Or am I misunderstanding that?

Professor Stewart: It is the other way round. The high frequency does not go through buildings; the low frequency does.

David Duguid: I just wanted to clarify that.

Q54 **Chair:** We will need a briefing on some of the frequencies to help us with that. Maybe you guys could help us with some of these issues.

Professor Stewart: If your walls are thick stone like mine are, then the 700 megahertz still will not go through. The lower the frequency you go, the more penetration you will get.

Chair: We will just leave it at that. Thank you.

Q55 **Deidre Brock:** Mr Sutherland, in your very interesting contribution in your written evidence, you were talking about a decision in England to pass funding directly to local authorities. You described that as a risky approach, given that they had no experience in broadband. What piqued my interest—and has caused me to ask this question—was you saying again that there has been no published analysis anyway of the lessons learned.

Ewan Sutherland: As far as I am aware, no. I think it came to many people as a surprise when it happened. It was not clear to me that there was much support for the local authorities. The Public Accounts Committee went through this in some considerable detail, but the criticism that was made of them was that they tended to defer to BT, that they could not even share the contracts between local authorities, so they could not see what was being paid or offered in other authorities. There were non-disclosure agreements being signed. It was a rather unusual way to do state-aid public procurement. Your Public Accounts Committee was quite detailed and I think had them back a couple of times.

Deidre Brock: Right. I will have a look at that. Thank you.

Ewan Sutherland: You come down to two questions: one is whether you do it through local authorities and some sort of mechanism like that, as a state-aid measure, or whether you are encouraging communities and you are providing them with technical back-up and commercial suppliers. Ardgay and Rannoch Moor both complained about broadband relatively recently. If you say to them, "All right, do it yourself", there needs to be some significant amount of information provided to them on how to do it and who the suppliers are for that, so that they can then do it.

Q56 **Deidre Brock:** The investment also has to include a considerable amount of technical advisers, as support for them to be able to create something?

Ewan Sutherland: Yes.

Professor Stewart: Or communities of mutual support. Many communities around the country have already done this. For new communities who want to do, it is important to be able to go to somebody who can help them, who is in their position. That is certainly possible to do. It does happen a bit. It could happen a little bit more.

Chair: The thing with these community ventures—because I have seen a couple in my constituency—is they are very fragile and they need lots of support. What we see so often is that, for a number of issues, they get set up and they cannot progress this and then they get into all sorts of difficulties. We will get into some of these programmes that are coming

forward that might be more enabling to ensure that happens, but we will leave that there just now. We will come to Paul Masterton.

Q57 **Paul Masterton:** My question around some of the infrastructure sharing has been covered by you guys before, so I would like to shift on to mobile if that is okay. Even my constituency of East Renfrewshire, which is an urban constituency on the outside of Glasgow, has really significant issues with mobile black spots where for next to absolutely no reason suddenly mobile coverage completely disappears. In terms of the national picture on mobile coverage, is Scotland where it should be in terms of people being able to get on their phone and easily connect to make calls or are we still suffering from really big disparities?

Professor Tafazolli: I have recently seen some statistics: a drive test in Edinburgh and Glasgow and then that compared with the drive test in London and Bournemouth. In terms of the urban areas, I think coverage of broadband in Scotland and England is the same. The problem comes when it is suburban and rural areas. That is the big difference. That comes back to the fact that, because of the law, user density is not big enough to provide a good return on the investment and deployment of technology. Therefore, there is no incentive for the mobile service providers to deploy the coverage in those sorts of areas.

Ewan Sutherland: I would not have thought that applied to Newton Mearns. It is not even that topographically challenging. There is no immediately obvious reason for that, though I know one of the criticisms that came out of the mobile infrastructure programme was that people wanted mobile coverage but they did not want masts. Masts would spoil the landscape.

Q58 **Chair:** That has sort of disappeared now, though, hasn't it? There is not the same resistance to masts that we had five or 10 years ago.

Ewan Sutherland: I don't think so, but I think there were still complaints in that programme.

Professor Stewart: It depends who you ask. The IET: in about October we did a press conference where we talked about deployment of 5G and the *Daily Mail*—who was not there, obviously—misreported it. There were some in *The Telegraph* who were reporting accurately. The *Daily Mail* said, "They are going to put 75-foot-high masts, 30,000 of them", something like that. People are worried about masts.

Having said that, living in a village myself, we had a request recently for an O2 mast—which is not 75 metres tall; it is about 10 metres tall—and it had 100% support. I suspect that it is different people objecting to the masts to those people living there who want the coverage. If I am very cynical I would suspect it is the visitors who do not like the masts and the locals who do. The clear solution is to ask the locals.

I don't know that masts are really the problem in terms of providing mobile coverage. As Rahim said, the problem is there has to be enough

money to make it work. The irony is I suspect the amount of money slopping around for support from local authorities for broadband is enough to pay for all this. It just somehow does not seem to get through to buying the base stations and the masts. The point about sharing has been made several times. It is part of that. Maybe authorities should buy base station locations and start renting them out. There is a way of putting money straight into the system and, if the regulation gets in the way of that, we may need to shift the regulation.

Ewan Sutherland: The other issue is I am not sure the mobile phone companies have been quite as enthusiastic as they should have been about giving you, in addition to your WiFi router at home, a mobile router that allows you to go straight on to the wireless network in your house. Some of the houses in Mearns might be problematic in that sense.

Professor Stewart: It is relatively easy to do that. The femtocells mentioned earlier are obsolescent technology. One of the points my panel has also made is about inside-out coverage. That is, coverage that is provided by broadband as far as you are concerned to your WiFi router but then the WiFi is available for other people around. That is an increasingly important way for people to connect.

Q59 **Paul Masterton:** I want to follow up on that, and this links back to the discussion we had with the first panel where these are often relating to developments that are newish, in the sense of 15 to 20 years ago, whereby this kind of connectivity was not featured in the plans. Are you now seeing that local authorities—when they are looking at local development plans and so on—are ensuring that when developers come forward, that mobile and broadband connectivity is baked into the infrastructure requirements, alongside roads and access to the telephone network?

Ewan Sutherland: I am struggling to remember. I think there was a European Commission recommendation on that, certainly 15 years ago. The view was that, because it is infrastructure, when you are building new housing estates, you should put ducts in that would allow subsequent upgrades. Whatever wiring you put in at that time, you could then cheaply put in fibre as a replacement if that was the appropriate measure. The additional cost of putting a duct in when you are building the housing is not great, despite the failure of the civil engineering profession to increase its productivity.

Q60 **Hugh Gaffney:** Moving on to mobile phones, we want to alter the ground structure. In Scotland, what is the current technology used for mobile phones? How do we cover mobile phones? Is it still a ground structure? Is it on the airwaves? Can you explain? I don't know the graphics and all the rest of it. How do mobile phones work?

Professor Stewart: Mobile phone technology in Scotland is the same as it is globally, essentially. A long time ago there were different standards in different places. The US tried that. It was a disaster. There is now a

global standard for all of this access, and this is 2G, 3G, 4G and 5G, as you have heard about, 5G being the upcoming technology. Scotland uses the same. At the moment that would be 4G if it was a new deployment.

The backhaul, which is the connection from the base station to the network, is more or less always fibre, although you can do it in other ways. That is the technology everywhere. The fact that it is Scotland and more remote does not really change the base technology.

At 5G, it may. This is the 700 megahertz point. We may be able to use lower-frequency bands to cover a bigger area, on the basis that you will not have as many people within that area. Therefore the megabits per second per user will be the same but the megabits per second per base station will be lower because of the bigger areas. That is the difference with rural areas generally, including Scotland.

Ewan Sutherland: My very clever smartphone here does very discreetly tell me which technology I am using but it is relatively promiscuous. It will find WiFi networks. It will find 4G networks, and if it cannot find 4G it will then gradually go down in technologies. Occasionally, I will get 2.5G.

Professor Stewart: That is agreed between you and the base station. That is what will happen. If there is an awful lot of traffic in the base station, it will downgrade the technology. Those are just protocols. More significantly, it will also move between WiFi and mobile according to where you happen to be. If there is WiFi coverage where you are, my phone—and presumably your phone—will automatically use that for telephone calls. That is completely transparent to the user, which is exactly how it should be. This is one network providing one capacity for everybody, for all purposes, and it will opportunistically use whatever it can get.

However, it must be able to get something. If you are on the back end of Glen Lyon, your problem is getting anything. That is the problem we need to solve. I know I keep saying this, but it is not that expensive. If you had a whip-round among the locals you could cover it, I suggest. We tried that in our village. The guy said, "We need £100,000 to do this village," and we raised £10,000 in the room, just, "I'll put in a few". People will. It is not that the money is the problem. It is that the money does not flow through correctly. You also hit regulatory difficulties, which is true. If you ask people what they would like to spend their local council money on they would almost certainly put this high on the list. It is not that the money isn't there. It is that it somehow does not get through to the right place.

Q61 **Christine Jardine:** Some small villages in the Highlands of Scotland might find it a bit more difficult to raise that sort of cash, because there are maybe only half a dozen houses and two or three farmers. It is not realistic to expect that they will all be able to raise that amount of money. They may not even have that amount of money.

Professor Stewart: You should at least ask. You may find it is easier than you think.

Ewan Sutherland: You then come back to the fact—as somebody earlier commented—that the Chancellor has produced some more money for new networks. He is saying that, for reasons of national competitiveness, the United Kingdom needs to have the most advanced networks. We are doing that at the same time as we are still trying to get the networks out to rural and remote areas. To try to do all of that at once is quite challenging. Part of the answer to the question is that some of the links to the base stations may not have the capacity to provide very much 4G. They are going to have to be upgraded.

Q62 **Hugh Gaffney:** The question I am going to pose is on the challenge of the technology and the postcode lottery. I give your village the money; how do you improve the technology then? That is the question.

Professor Stewart: It depends which area you are talking about. We are talking about low density and high density, but there is a lot more to it than that. It is a question of how they are clustered. A low density of villages isn't really a problem. You just provide fibre between the villages. That costs a bit more if they are further apart, but not all that much more. Coverage in the village can be done on wireless. That is fairly straightforward.

Five or six houses, with 50 kilometres to the next population, are more of a problem economically. It is more of a problem if you are putting in water. It is more of a problem if you are putting in electricity. These are not different just because it is comms. If you rate comms at the same level as other utilities—which I think all of us think you should be doing—then this is not more of a problem than any other utility. It is just a question of finding out how to do it.

Professor Tafazolli: We don't need capacity everywhere because the user density is not high everywhere. If you look at the UK-wide coverage, I think less than 10% of the locations need high capacity, but most of the areas need coverage with moderate capacity to serve them. You mention 10 or 12 farmers in that location. They don't need huge capacity. If you give them 10 Mbps each—so 12 families will be 120 Mbps—that can easily be done with 4G.

Going back to what I said previously, 5G or 4G, now we have realised, compared to the rest of the world, we should do mainly high capacity and higher speed in the UK and Europe. We have said that 5G needs to address, technology-wise, the problem of cost effective coverage, not just capacity. For this, one of the pioneer frequency bands is identified as 700 megahertz. Unfortunately, most of the equipment manufacturers are not in the UK—Ericsson is not here, Huawei and so on—and it is less of a priority for them to work at 700 megahertz, to develop the technology that provides long-range coverage at the same capacity. I think it is an opportunity for the UK to invest more R&D funding in 700 megahertz,

and lower-frequency bands, to develop long-range broadband communication infrastructure.

Q63 **Chair:** What is coming from you gentlemen, right now, is that all this is relatively straightforward and not all that expensive. I am getting thoughts coming to me saying, "Why on earth are we not doing it? Why are we not making more progress if it is relatively cheap, and if a few farmers can get together and all of a sudden you have the network that you require?"

Professor Stewart: Since this is my fault a bit, can I answer your question? Why is it a problem? Because the money does not flow to the right people. These things cost £1,000 each and they are selling like hotcakes. That is more than the cost of putting fibre into your home. The difficulty is that the money does not flow to the person putting fibre into your home. If you are talking about 5G coverage, the problem is that the person providing the network does not get enough money back from it. I have to say that I think the solution is to look very directly at how to get the money in and, also, at how to share base stations and other capacities.

I would also slightly take issue with the point about farmers. I am sorry, Rahim. I know a lot of farmers locally. They do need very high capacity broadband. If you look at a modern farm and how it is run, it is a very data-intensive business. These people don't need less. It is less per square kilometre, but it is not less on an individual basis.

Q64 **Hugh Gaffney:** To finish off, you mentioned that this is infrastructure. Gas and electricity go to these places. Therefore, can we tap into that channel and use it?

Professor Stewart: Do you mean, "Can you run fibre down a water pipe?". It has been looked at. On the whole, it is not a cost-effective way to do it. It is not an impossible thing to do. If you were putting in water new, you could run the fibre cable through it, and that would save you most of the installation costs, but if you are talking about running it through an existing water pipe, it is not normally a cost-effective thing to do.

Ewan Sutherland: There is a technology around that allows you to do broadband over electric power lines, but that has failed.

Professor Stewart: That is the same as copper. It does not work.

Ewan Sutherland: To be fair, it was bought by the telephone companies. They did not want competing infrastructure.

Q65 **Ged Killen:** Professor Tafazolli, we have already touched on the opportunity for 5G technology to provide a wider geographical coverage. Will it be an expensive option for consumers and when do you expect 5G to be widely available to the average mobile phone user?

Professor Tafazolli: 5G cannot be more expensive than the 4G offering because people will not adopt it. The whole idea is that the industry is trying to make 5G technology as expensive as 4G initially was at the beginning of 5G deployment. As I said, this is an industry, because of the economy of scale, in which the return on investment in R&D, equipment and so on is the fastest so it is not going to be a big problem.

What is important to note is that three pioneer frequency bands have been identified for 5G to address the problem of capacity as well as coverage. As Will mentioned, one is a very high frequency band. That is going to be in football stadiums. We cannot deploy it nationwide. That is in millimetric bands. That is going to be very expensive but usage of that will be in hotspots.

The frequency band that is going to be deployed initially for 5G is very close to the 4G frequency band. Sorry to talk hertz but it is about 3.5 GHz. From the cost point of view, there is not going to be a big difference between 4G and 5G. The main cost will be the extra space that you need to put up a mast for 5G and sharing the sites with 4G systems. Initially, most of the 5G networks will be co-located with a 4G system and will work with 4G systems.

To address the problem of coverage the 700 megahertz, then we will need to have an economy of scale there so that manufacturers develop 700 megahertz, produce it and sell it to the global market. That is the area where more work needs to be done to provide cost-effective coverage. Overall, 5G initially has to be the same cost as 4G was when it was initially deployed.

Q66 **Ged Killen:** When do you think we would expect to see that technology for the average user?

Professor Tafazolli: The first version of 5G will be deployed at a mobile broadband site in 2019, so next year.

Q67 **Ged Killen:** When I come to renew my phone contract next year, you are saying that there is no excuse for my provider to tell me that my price has gone up because I have 5G now?

Professor Tafazolli: No, it should not be. Initially it will be deployed in a high-density population, like London, Birmingham or Manchester and initially the speed will be 10 times faster than 4G mobile broadband. It will not be that much different. Probably the 5G-enabled mobile phones will be more expensive.

Ewan Sutherland: It is perhaps worth pointing out that, in every previous generation, the handsets have been months and years later than the services.

Professor Stewart: Is it worth pointing out, Rahim, that the reason that the millimetre is more expensive is nothing to do with the equipment? This is not about the terminal equipment. Even though it carries more

megabits all together, that is not the point. The point is that there is more equipment. The point is that, to provide coverage at 5G with short range, you need a lot more small base stations all over the place. Whereas, with 4G and 5G at 700 megahertz at longer ranges you need fewer bigger base stations that are much cheaper to provide. It is all about installation cost. It is not about the cost of the equipment or the cost of these.

Q68 **John Lamont:** My question is about rural coverage for mobile phone signals. You have spoken already about the challenges that exist in remote and rural communities, like my own in the Scottish borders. Now, mobile providers have signed up to a deal—I think brokered by the UK Government—that 90% of the UK will get a basic signal, and Ofcom are now reviewing the success of that. How successful do you think that has been and how effective do you think Ofcom are in terms of enforcing it?

Ewan Sutherland: It is a slightly odd deal because DCMS launched a consultation of what it might do in several options and, before the consultation had been analysed and published, the deal was done and the operators had committed to this. It again reflected the failure of the mobile infrastructure programme. These are a nightmare to assess. I remember talking years and years ago to the regulator in Switzerland. He was saying, "No, we have no idea what the operators are doing. It is far too expensive". He skied in glaciers, so he was in quite out-of-the-way places and he could check the coverage personally in some areas. It is very, very difficult.

A question was raised earlier about national roaming. All I can say on that is that national roaming is something that is likely to result in very long and quite litigious processes. Certainly the experience, in some European countries and in the US, is it is an absolute nightmare, so you are stuck. How do you get the coverage? We will have to wait and see whether Ofcom can measure it properly. They are not easy to measure.

Q69 **John Lamont:** That is the role that Ofcom has to measure it, but have Ofcom fulfilled their duties in terms of enforcement?

Ewan Sutherland: I think so. The catch is that it is not an easy obligation to enforce. If you are imposing an obligation on an operator, you want something that is self-reporting and self-reinforcing, rather than something where you have to send people around to measure signals in country areas and so on.

Professor Stewart: Metrics is another real issue, measurement. Ofcom does not ask all the questions it could ask. Even information that the operator has, Ofcom does not often ask for. We have found issues with that. You can pool things, though. France has recently announced—if I understand the details of this, because this is today—that it will have a coverage obligation in return for easy spectrum licensing. I don't know how that is going to work, but it is the right kind of incentive.

Ewan Sutherland: This was last week. The French regulatory authority would appear to have agreed to waive auctions for spectrum, in return for fairly substantial territorial coverage. It is worth saying that one of the first differences in auctions is that, since the famous 3G auction, there is really no prospect of anybody entering the market. The last real entrant into the mobile market in the UK was Three. BT was there, was out and was back in.

Professor Tafazolli: If I could add one more thing, the metric set at the spectrum auction by Ofcom is very easy to justify that they meet that. Why is that? Because they said 95% of the population, so that will be the combination of 3G, 4G and WiFi and most of the service providers can easily justify that or are on their way to meet that. But it is not only about the coverage, unfortunately. For example, when we talk about broadband we say, "You have the coverage with this minimum speed we can provide for 95% or 99%". Those metrics were not in place for the vendor at the spectrum auction. That is why we are pushing. We say that for 5G, for the next generation, for the next round of the auction, we need to get the metrics right because the metrics were loosely defined and it can be easily done.

Chair: We are approaching the end of this session.

Q70 **John Lamont:** Lastly, as part of that 5G spectrum auction, do you think that if the conditions are tougher on the licensees it will potentially ensure better coverage?

Ewan Sutherland: It is a trade-off. The operator can look at a license and say, "Do we want to provide 96% coverage and pay a certain amount of money?" If you raise that to 98% coverage you get a different number. It is also worth flagging up that there was a hearing in front of this Committee a number of years ago, which raised the question of resilience. That was not just whether the network covered an area but what happened if anything broke down. In one case there was a mobile base station that could only be reached by helicopter.

Professor Stewart: We can discuss resilience another time.

Q71 **Chair:** To wind things up, I am looking at some of the things that the National Infrastructure Commission have suggested about how things could be improved in some of the rural areas. You have suggested very strongly that the idea of roaming is pretty much a non-starter with all the difficulties that you have highlighted from other countries. There are other things like mobile mast-sharing, which I think you are a little dubious about too. The last thing that they suggested was perhaps using a new spectrum, which may be able to improve things significantly. Is there any relief with that, given that the other ones are ruled out by the three of you?

Ewan Sutherland: No, I would not rule anything out. The question is whether you can sufficiently understand what happened in the mobile infrastructure programme, for example, to understand that, yes,

enforcing mast-sharing would be the answer. It worked very, very well in France.

Q72 **Chair:** It seems like such an obvious thing to do. One mobile mast in a rural area and all the other companies want to provide the service.

Professor Stewart: Many mast sites are shared. It does happen. You need to ask very carefully why the companies don't always do it, and there are regulatory issues as well. Spectrum-sharing is not done and could be. That is you offer bits of spectrum around.

Q73 **Chair:** How about this one then? It is from the Ofcom Advisory Committee, which has suggested that in future the mobile spectrum should be allocated to community groups and projects of public benefit instead of the major networks. Is that a starter?

Professor Stewart: Yes.

Professor Tafazolli: I advocate a neutral host operate it.

Q74 **Christine Jardine:** Can I ask a question about the spectrum? If there were to be an expansion of the spectrum, would that mean a loss of spectrum elsewhere for the likes of venues using mobile microphones? There is no clash with any existing usage?

Ewan Sutherland: The 700 megahertz spectrum requires clearing. That was a very unusual ITU decision. They are not supposed to do that but they made a very quick change in use of spectrum, but that does require clearing some existing services. The catch with the Advisory Committee's suggestion is that spectrum is normally issued on a United Kingdom basis and it is very difficult to see how you could construct a license that said, "The whole of the United Kingdom, with the exception of the following 25 small communities". That is not to say you cannot, in the totality of the spectrum, find bits of spectrum that you could use in out-of-the-way places that would not cause interference.

Q75 **Chair:** If you are out of the way and you are not going to be clashing with any other operator, surely, it would be perfectly feasible to do that.

Professor Stewart: I was on Ofcom's Spectrum Advisory Board—not when they made this statement but previously—and it is absolutely true, especially in rural areas where there is much less pressure, that there should be much more wireless usage, both 5G and other things, because the spectrum is there.

But to answer your basic point, spectrum can only be used once. That is correct. A lot of spectrum is freed up by not doing old-fashioned terrestrial TV broadcasting. There is still MOD that could be released. Ultimately, broadcasting is going away. It is a silly thing to broadcast to everybody all the time. The users don't want it and it uses a lot of spectrum. That will not make a spectacular difference. It is not really the problem here. It is an issue in rural areas because you need these low

frequencies—hence the 700 megahertz band—in order to find the breadth of coverage. The 700 megahertz band will be enough.

Earlier I think you said 10 megabits was enough and I was thinking, "You are kidding". It would not be enough today and, if we are talking about what will happen by 2025, it is nowhere near enough. This will go on going up. That will mean spectrum is an issue.

Having said that, something we published before—which I think Rahim will support—is that, if you are trying to give more mobile coverage, you have three things. You have better use of the spectrum, getting more data down a given spectrum. You get a bit from that. You have more spectrum. You get rather more from that, which is quite good. Overwhelmingly, you need geography. That is you need either smaller base stations covering smaller areas or you need beaming, which will also do, or some emergent technology or something like that. None of this is a problem rurally. Rurally, you are absolutely right, there is plenty of spectrum and there is plenty of space. It is not a problem. You have an economic problem. You do not have a technical problem.

Professor Tafazolli: I will just add to what Will said. If you want to address the rural areas, as we said, we have to lower frequency bands. On the point you mentioned: if we release the frequency bands will it affect other frequency bands? There is not a huge amount of spectrum available unallocated. It can be used for other lower frequency bands. What should be done in rural areas: it is a limited spectrum. Don't divide it between different service providers. Share it with one neutral host to manage that limit of the spectrum.

Christine Jardine: Thank you very much. That clarifies what I was concerned about. The one sentence you said, which was that other services would have to be cleared—"What other services would have to be cleared to make this happen?"—was actually what I was thinking.

Q76 **Chair:** We will leave that one hanging there, if we can. Thank you very much. As I said to the previous panel, if there is anything else that you can help the Committee with—I think you are hearing some of the issues we might have with spectrum and understanding how that all operates—or if somebody has a very concise guide, it would be very helpful to the Committee.

Professor Stewart: We will do a written submission afterwards.

Chair: You could not get more helpful than that. Thank you, gentlemen.

Examination of Witnesses

Witnesses: Dr Gary Bosworth, Dr Lorna Philip and Professor Sarah Skerratt.

Q77 **Chair:** Good morning, everybody. Are we all settled? Water? Notes at the ready? Just for the record: who you are, who you represent and anything by way of a short statement. We will start with you, Dr Philip.

Dr Philip: Hello, I am Lorna Philip. I am Senior Lecturer in Human Geography at the University of Aberdeen. I have been involved in rural research since I started my doctorate 25-odd years ago, and I have been involved in research that has been looking at issues around digital economy, digital society, for about seven or eight years, largely through the Research Councils UK grant to the University of Aberdeen, the dot.rural research programme. I worked on three separate projects as part of that—my own research—and I also supervised three doctoral students whose work is potentially relevant to this Committee as well.

Q78 **Chair:** Excellent. Professor Skerratt?

Professor Skerratt: Hello. Thank you very much for the invitation to come to the Committee today. Not wishing to compete, I have been involved in rural research for 30-plus years. I started researching rural broadband around 2000, because that was when a lot of communities started setting up community websites, and I have been monitoring it since.

As an opening comment, I would like to comment on how research has changed over that time. Back then we were looking at the haves and the have-nots, who had broadband and who did not, who was still on dial-up and so on. To me, where this Committee could really add value in its inquiry is to throw light on assumptions around the connections between broadband and other needs and other issues in rural areas. We have already heard about the withdrawal of banking services, which you have been looking at, but also depopulation, fuel poverty, affordable housing and health services. How does broadband availability connect with these? How does broadband availability connect with resilience of rural communities? What does that actually mean? I hope we will have a bit of time to look at that, and also—now that we have this timeframe—to look at the sustainability of initiatives.

Very often, we can focus on the digging of the channels, the getting of the broadband, but we need to be looking longer-term at what has happened five years on, 10 years on, 15 years on, particularly at community initiatives, but also at other broadband rollout initiatives. I would say that this inquiry is exciting, because it has the potential to look back and to look across at how broadband connects in other ways to what is happening in rural Scotland.

Q79 **Chair:** Excellent. Thank you. Dr Bosworth?

Dr Bosworth: Thank you again for the invitation. My background starts more from a rural business perspective and the role that rural businesses, small businesses, play in creating sustainable rural places to live, viable communities and so on. As part of that, having access to better broadband has been a key element. My personal research also—as Professor Skerratt was saying—links into the broader digital divide at a community level, which I have looked at.

One thing we have looked at in Lincolnshire—I am sorry, I am at the University of Lincoln; I should have said that at the start—is not just, "Can we provide broadband to these rural places?" but, "How do you engage SMEs in understanding the potential that this provides in a competitive marketplace?". There is a lot more work that needs to be done in that area.

I would also like to contribute to the discussion around the role that communities can play in bringing broadband to their rural areas, and reflect on some work with colleagues in the Netherlands that is a little bit more innovative, I think, in bringing the public sector, the private sector and the communities together to create solutions to community broadband.

Finally, I ought to flag up that colleagues in Lincoln Business School are part of a North Sea region project called CORA—check the long acronym—connecting rural areas with digital infrastructure and services. That is looking partly at, "Can we join up the provision of utilities?" which you have heard about already this morning but, also, we are about to do quite a large-scale survey across rural parts of the North Sea region of Europe. We would be very happy to share the findings of that on the CORA website. If we can extend it to the non-North Sea bit of Scotland, do come and talk to me and my colleagues in that project.

Q80 **Chair:** Thank you. I don't know how much of the earlier sessions you heard. You heard most of it, I presume. Some of it was fascinating, very interesting to the Committee. There were some things I was learning for the first time, but the issue that we seem to have is the difficulty with rural areas, notwithstanding some of the issues with new developments around Newton Mearns or wherever. The problem, the difficulty and the issue is the rural communities. Is there anything that you could add about why we have distinct, particular issues in rural areas, which may have been missed in some of the earlier panels, from the work that you have done?

Dr Philip: The previous speakers have outlined a lot of the technical challenges and the 'final mile' issue, which has affected almost every rural community with the exception of the people who live in the population centres across rural Scotland. All the tracking that bodies like Ofcom have done recently, in the last five years or so, has shown improvements but we still have a problem—as you know so well—that rural areas and the more remote rural areas, in particular, have not benefited from those upgrades.

It is very difficult for non-telecomms engineers and others with that type of expertise to explain exactly why, but I think it is an issue of consumer base, where the commercial priorities are, the effectiveness of the business community and local communities themselves in making a case for infrastructure improvements, money and time.

Q81 **Chair:** In the evidence there was a phrase that was "accessible rural and

remote rural areas". I don't know if it was one of you three who gave us that evidence. I want to know what that means. You are shaking your head there, Professor Skerratt.

Professor Skerratt: Yes. I should have said at the beginning that my affiliation is Director of the Rural Policy Centre at Scotland's Rural College. Every two years we produce "Rural Scotland in Focus", a biennial report, which takes the temperature of rural Scotland. In that we use the Scottish Government's sixfold classification of remote rural through to urban Scotland. It is a very useful system for us. There are marked differences around broadband, services and a number of markers comparing accessible and remote rural. I can furnish the Committee with the specific definitions, if you would find that useful, because they are different from the definitions in England. They focus around drive times and settlement size.

What I would say is that we must not assume that if you live in accessible rural you have access to broadband, given that is what we are talking about today. Simply because we look at coverage and it looks better in accessible rural areas, that does not mean you have access. Professor John Farrington, from Aberdeen University—who we have all worked with—has written about the difference between access and accessibility. If you live in accessible rural you have to think, "What are you accessible to?" We have to be careful not to be carried away with the maps and dig a bit deeper below that.

Q82 **Chair:** In your evidence, Dr Philip, you referred to an accessible/remote divide as well as an urban/rural divide. Could you help us a little bit more with that?

Dr Philip: Perhaps it would be useful to think about how the Scottish Government's urban/rural classification distinguishes between small towns in an accessible and a remote rural context, and the more dispersed communities. If we are thinking about remoteness, of course it is always relative. For people who live in remote small towns in rural Scotland, which are the population centres in which most of the services that support remote rural communities are concentrated, their experiences are no doubt different to the experiences of people who live in more dispersed areas. Likewise in accessible rural Scotland, because that is to do with drive times to our large centres, you have people living in all types of settlements. They can equally be remote to the digital infrastructure. Over the piece—and this is based on the geography at which data are available for us—it is the more remote areas of Scotland who are still the most underserved. That is partly how we define the variables we are using and partly because of the difficulties of the data that we have available. We cannot say anything in more detail.

Chair: Very interesting and helpful.

Dr Bosworth: If I may add something: a brief anecdote from one of the projects in Lincolnshire is that one of the SMEs, right in the centre of

Lincoln, was unable to access decent broadband speeds to do their business and they were on an industrial estate in the centre of the city. So, yes, it is not as clear-cut as drawing lines on maps.

To your initial question, there is this chicken and egg situation. Yes, it costs more to deliver faster broadband speeds and technology to the very rural areas, but we also heard this morning that these companies are saying, "There is less demand. There is less uptake in these areas". There is a big communication issue, both to the SMEs and to the communities. You don't just want a little bit of broadband. You don't want to make do with broadband. Once you get this better, faster broadband, this will make a difference to your business opportunities, to your community life, to your children's education and to older people keeping in touch with relatives. That message has to get out there first to rebuild the groundswell of demand. Then the private sector companies might see there is a little bit more potential for them to go and serve it. I think it is two ways.

Professor Skerratt: This may be an issue we come back to in the next few minutes, but there is also a myth and a reality about communities doing it for themselves, particularly in remote rural areas. They do and they will. Some are not able to because of variations in capacity and, certainly, some don't have the £10,000 sitting around that we heard about previously. That can excuse certain providers, because there is this belief that communities will do it for themselves because they need to. Great care needs to be taken around that, but we need to have that in mind as well.

Q83 **David Duguid:** Finally, on this definition of accessible rural and remote rural, did I hear you correctly, Professor Skerratt, when you said there was a different definition between Scotland and England?

Professor Skerratt: Yes.

Q84 **David Duguid:** That must be confusing. Also, as you were talking there and describing the difference between accessible and remote, and the rural/urban divide, it occurred to me that I try to avoid using the word "remote" when I am talking about my rural community, because I find it is when you remove services, when you have long drive times between towns, for example, that is what makes a community remote. Is it not the case that if we don't have decent broadband in these communities, that in effect makes them remote? It is a bit of a cyclical argument.

Professor Skerratt: I agree. Also, we did some research last year on mental wellbeing in rural areas at SRUC with Support in Mind Scotland, and we found that those who were self-reporting mental ill health reported remoteness in different ways too, as with the general population in rural Scotland. We found remoteness was not always correlated with geographical remoteness. There wasn't a straight link between whether you were geographically remote, according to the Scottish Government's classification, and whether you reported experiencing geographical and

socioeconomic remoteness, according to whether you could afford a car, what public transport was like and what broadband was like.

A bit like one of the previous speakers said, we can focus on population coverage or we can focus on how people experience broadband. It is a similar thing: we can focus on remoteness geographically or we can focus on how people experience it. Some people will be very connected and they will not mind where they live and they will enjoy the physical remoteness. Others will find that very distressing and will feel that remoteness in very negative ways. It has a subjective and objective element to it, and we have to be careful how we use that language, as you rightly say.

Q85 **Christine Jardine:** I am very interested in what you are saying on the remoteness. From what we hear, the capability of broadband and the internet increases all the time, as does the difficulty of providing it. Is it becoming as much of a problem now with speeds as access to the internet itself?

Dr Philip: The speed issue is absolutely critical because, for example, software developers develop their applications assuming that those who are going to use that software have good connections, and it is not just speed, it is reliable connections that don't buffer and don't drop out as well. Work that one of my PhD students was doing with small businesses in Moray and Aberdeenshire found that those businesses that needed to use complex data management systems, complex software, who needed to be in regular touch with other businesses and potential customers at a distance to them, assumed that they had the type of broadband infrastructure that somebody sitting in central London would have. Particularly for people who then resorted to satellite as a solution to poor fixed broadband connectivity, the big challenge for them is to do with latency. I am not a technical expert, but my understanding of the challenges with latency is that, for example, if you want to send a large file to somebody, if there's a dropout in the sending of that signal, it might mean that file does not send and you might not know that. We have huge problems for businesses, but also for ordinary users.

Q86 **Christine Jardine:** Is there a danger in this situation you are describing with software not suiting specific areas, in that a problem we have had with rural areas in Scotland for generations could continue and be exacerbated, and for people to be able to work effectively, they will have to move? Whereas, we have always been told that superfast broadband would allow companies and people to stay within rural areas. It would allow remote working and Telehealth programmes to work when, in actual fact, we could be facing the opposite situation.

Dr Philip: I have two examples from work that would speak to this. The first is on the e-health system. There are various applications, for example, for patients to monitor blood pressure at home. Most of these applications work in the home. They do not require you to be connected to the internet. For these data to be usable by healthcare providers, they

need to be sent from the home to a central point, for example, to a consultant. The work that colleagues at the Centre for Rural Health at Aberdeen—which is based out of Inverness—were doing a number of years ago, showed that the big challenge in some remote communities, where patients were using a home monitoring kit, was that they could not then transfer the data to allow effective monitoring.

At a time when many remote communities across Scotland are finding it difficult to recruit healthcare professionals, this mismatch becomes very difficult. A second example would be from work that I was involved with in a very remote upland community in Shropshire. One of our participants worked for a national utilities company and was on call. Where he lived there was no mobile phone signal, so the mobile phone was run off the home WiFi. The home broadband was very poor, dropped out a lot, had huge problems, and it was getting to the stage that he could not be in touch with work in the way they wanted and expected him to be. If he had not got a better solution to the home broadband, not only the individual but the household and the other business they ran would have had to leave as well. What you have raised is going to be a problem that is seen throughout many rural communities.

Professor Skerratt: When broadband was first coming in, in the millennium, the phrases that were used were, "The death of distance" and, "The end of geography" and it was really exciting and, 18 years on, we have not seen either of those happening. There are multiple examples. You have given two, and I am sure, Gary, you have some coming.

Dr Bosworth: I have some comments, yes.

Professor Skerratt: You will have examples from your constituents also. Those things have not happened and they won't without intervention.

Dr Bosworth: It is an irony, isn't it, that whole, "Death of distance" and what it has become? Yes, just two comments and examples. Again, both of these are from Lincolnshire. We found that in subsidising broadband connections through a project called Onlincolnshire—which the RDF funded through Lincolnshire County Council—originally more businesses saw taking up of funding for lower speeds. They got on board, "Yes, we can do this. This is affordable. This is incrementally doing something new". Once it got to the higher speed, bigger transition, we saw a fall off in businesses taking it up. More recently that has moved around, and there is a much greater appetite for faster speeds. It is the faster internet speeds that are the prerequisites for more innovative companies. That is the key message that has come out of Lincolnshire: those that are taking on board new technologies—3D printing and all of those sorts of things—are the ones that are driving forward the need for faster speeds.

Echoing Dr Philip's point, the second one is this whole perception of a region, and yet we have had exactly the same thing: retaining graduates in Lincolnshire, keeping skilled workers, employers reporting that they

cannot recruit the right-skilled workers because, yes, they can come into the office and get the high-speed internet to do their jobs but, as soon as they get home they cannot, and it does not fit their lifestyles or it does not allow them to do their homework. You have to address those problems.

Q87 **Christine Jardine:** I wish I could remember Willie Ross's exact quote, but what would you think of the suggestion that in future we should take that example of the glens of Scotland, and that the remote areas should be given priority, as they are further behind and in the greatest need, and the only way to close this divide is to provide the next upgrade to those areas first, rather than to the city centres?

Dr Bosworth: That is the only way you will close the divide. Economically, commercially, what is going to stop the big telecoms companies delivering 5G, 6G—whatever next—to the cities first, or at least as quickly as anyone else can encourage it into the rural? I don't see the answer to that.

Dr Philip: It is not just about closing the divide; it is about an element of future-proofing, because if all we do is allow underserved areas to catch up to even just the Scottish national average now, technologies are moving at such a fast pace. Does that mean that in five years' time we are going to have exactly the same challenges on our hands? In effect, it is: how do you future-proof? Perhaps what was said in the previous panel about fibre connections to the home, although logistically challenging and perhaps not as cheap an option as people might like, might in the longer term be the most cost-effective, because that is the most up to date technology for serving individual households we have at the moment.

Q88 **John Lamont:** Have you done any analysis to ascertain whether poor broadband coverage affects people or, indeed, businesses' willingness to move or remain in those areas that have poor service? I am thinking particularly of Chris Strickland, who gave evidence to the Committee. He is a photographer in Jedburgh and he highlighted that he has to pay £120 a month for 4G WiFi devices because his broadband landline service is so poor. He stays in that area because of family connections; but for that, he may well move to some other part of Scotland where the broadband speeds are much better. Have you done any analysis of that type of impact?

Dr Philip: I have; it is a paper that was submitted to a journal just before Christmas. We were looking, again, from the Shropshire-based work, at home-based businesses and whether these businesses were what we called, "Embedded in place". A classic example would be a farm: that business exists because it is located in a particular place. For other businesses, people who run or work in that business might feel attached to a particular place but the business would not be compromised if they relocated. Then you have other businesses that could operate from anywhere.

The businesses that could operate from anywhere are perhaps the ones that we are most at risk of losing from areas that do not have the infrastructure upgrades, but there are many businesses that are rooted in place and they play a fundamental role in keeping a community economically vibrant. We need to make sure that we cater to their needs as well. Then the case you cite, somebody maybe sitting in the middle who wants to be somewhere. What I don't have any evidence of is what the trigger point for somebody choosing to move is.

On the other side, we have issues of connectivity that influence people's decisions to move to an area. Looking at demographically fragile areas, if they don't have decent infrastructure, in terms of broadband and mobile phone coverage, for a large proportion of potential in-comers that could be a negative aspect when they are weighing up decisions about whether or not to move there.

Professor Skerratt: This is not a recent phenomenon: I was doing research back in 2003 in the Republic of Ireland, looking at the difference between west and east Ireland and the lack of investment in the west compared with the east. Back then, it was evident that people were, "Following the bandwidth" was the phrase that came through. That was 15 years ago. The imperative to follow that bandwidth is still there. There are multiple examples of not only businesses but also householders checking the broadband speeds and those are on Rightmove. They are an integral part of the search and the criteria that people use for moving home and for establishing businesses, and that imperative is even greater, particularly, given the speed demands that businesses now need.

Dr Bosworth: I am sure there is a project somewhere to look at the specific internet speed versus house price variation that is emerging now that data is more available.

Q89 **Chair:** Is there any evidence for that to say that people are—

Dr Bosworth: Anecdotally, I have seen it written in papers; I have not seen a statistically rigorously carried out survey.

Q90 **Chair:** In Scotland we have the home report. That is a report done on behalf of the seller that has to be made available. It is not included in that, is it?

Dr Philip: I don't think broadband is included in the seller's pack.

Professor Skerratt: No, not in the home report".

Dr Philip: You would be able to take data from the sales scene, and look at the movement in house prices against small geographies in terms of the speed data, but, as we heard in an earlier session today, taking the units that data reported for is not perhaps the most accurate way of doing it.

Professor Skerratt: You would also have to establish cause and effect because there could be other causes for those variations in house prices.

Q91 **John Lamont:** The bigger and more important question is not the impact it has on house values but it is the economic value that is taken away from that rural economy, as a result of businesses either refusing to move to that area or moving themselves because of the poor broadband.

Dr Bosworth: It was Leanne Townsend—one of Lorna's colleagues, who I have worked with—who did some work on one of the Scottish Islands. I forget which it was now, which of the islands. For one family who moved because of the bad internet connection, their children were the tipping point for the viability of that school. If you take one business out of even a market town, let alone a city, there is negligible impact; you take that one small business out of a precarious rural village, we know the implication of that.

Professor Skerratt: A colleague of mine, Dr Jane Atterton of the Rural Policy Centre, has researched rural businesses and looked at home-working as well, and the extent to which broadband enables home-working is a critical element too. The diversity of the rural economy is something we need to be aware of and how broadband enables that diversity to take place. It is not only bricks and mortar businesses but also the home-working.

Q92 **David Duguid:** Following on from Mr Lamont's line of questioning, I think we have all heard of issues anecdotally. For example, my constituency of Banff and Buchan is quite rural but there are quite a few large employers. Fortunately, we have quite low unemployment. However, if you are an employer and you are looking to attract an employee from further afield, I have heard from employers anecdotally that they have had people turn down jobs because, "The house prices are fine and other services are great, but broadband is not good so I cannot keep my job". How does poor digital connectivity affect the competitiveness of businesses in rural economies in other ways?

Dr Bosworth: Examples that we come across: obviously skilled labour is a key one. Working with collaborators, particularly the higher education sector, to drive innovation, which is increasingly a network-oriented process now. You have University of the Highlands and Islands, with multiple campuses, with the opportunity to link with small businesses and get innovation from the big cities out into the smaller towns. That needs people to be joined up; maybe they are Skyping internationally as well as within those regional networks. Innovation is a key thing in terms of people networks, as well as in that so many new technologies rely on high speed or connectivity. Whether that is—as I have mentioned already—the 3D printing, the 3D scanners that we have had in hubs in Lincolnshire, businesses are not going to buy those without having any idea what they can do. If we can showcase them in the hubs, as we did in Lincolnshire, businesses get to see what innovation potential is out there

if they have the faster broadband. Then that snowballs into, "Well, we could do this and we could do that".

Without the connectivity at all, or with the very low speed connectivity, these things are a different world, so it is opening their eyes to innovation potential. Maybe they are not going to buy that equipment. Maybe they suddenly realise that their suppliers or competitors are doing that, and they have to then realise where they sit in this new competitive world.

The final thought on that is the whole emergence of the gig economy, or Industry 4.0—all these terms that are being bandied around—if you are going to go on Airbnb rather than using your local tourist office to promote your accommodation, any little steps like that, you would probably want to upload a video to see what your accommodation can offer. Upload speeds are probably more critical to a lot of these businesses than download speeds. Again anecdotally, some of the actual evaluations in Lincolnshire, businesses were setting uploads at 3.00 am because that was the only time they could reliably get these things through. There are a lot of day to day practicalities but, also, there is the bigger question of exposure to innovation, which is something that fast internet can really drive.

Dr Philip: When we think about businesses in rural areas, it is very easy to overlook the fact that the majority of them are small, if not microbusinesses, and their turnovers are comparatively low. Earlier this morning, when we were hearing some discussion about the Universal Service Obligation, and who is going to pay to ensure that people or businesses have the 10 Mbps, there is this uncertainty as to what the consumer will have to pay and what might be available through public subsidy.

For some businesses, £7,000, £8,000, £9,000 to improve their connectivity might not be a lot of money but for a lot of microbusinesses—especially in their early years when they are at their most vulnerable financially—that might just not be possible. We have an issue of making sure that the environment for existing businesses is preserved but also, in order to retain vibrant rural communities in the future, we need to ensure that they have the opportunity to have new business start-ups and the issues to do with connectivity don't prove a barrier for certain parts of the country having that level of innovation and economic development.

Professor Skerratt: To come back to an earlier point about being aware of what the availability of broadband links to—and that includes housing and affordable housing—business growth also links to housing for a workforce. There is a connection there, even though it might be tangential, between broadband and housing and recruiting labour into that business sector. These connections are there; broadband does not

sit alone as a piece of infrastructure. It enables and disables progression within the economy.

Q93 **Ross Thomson:** Understandably, there has been a focus on the impact of rural communities. However, as Dr Philip will no doubt be well aware, Aberdeen City still remains poorly served when it comes to broadband infrastructure. It is 61 out of 63 regions in the UK for superfast broadband coverage. As everyone around this panel will know, Aberdeen is home to the oil and gas industry, which is a global industry. In terms of its rankings there, a worldwide study showed, out of all the oil and gas cities, Aberdeen recorded the second-slowest connectivity speeds of all of those cities. When we are trying to compete with them to attract investment, what sort of impact does this kind of poor level of connectivity have on that wider economy, the regional economy and also, given the impact of industry, Scotland and the UK's economy too?

Dr Philip: Sitting within the University of Aberdeen campus we have been buffered from a lot of these problems, because the university community for a long time has been part of pretty good connectivity networks. My understanding is that a lot of the large companies operating out of Aberdeen had their own infrastructure pretty early on, which allowed them to transcend some of the more local problems.

When you think about the distribution of where oil-related companies are, it is not just in the centre of Aberdeen, as you will know, especially when you move out of the boundaries of the city into Aberdeenshire where there has been a huge amount of new development. If those companies have not put in the good infrastructure to start with, they are potentially at a disadvantage.

Relating to the comments about home-working, I personally know people who live out in Aberdeenshire who are constantly complaining about their really poor connectivity, despite only being 15 miles from the centre of town. A lot of companies are trying to promote flexible working arrangements and allow their staff to work from home; if people cannot locate themselves in a property where they can use all their corporate software, they cannot do that. As we all know, Aberdeen is a very expensive place to live anyway so at the moment, unless there are whole-scale improvements to the infrastructure—not just in Aberdeen City but probably in the entire Aberdeen housing market area—that problem is not going to be overcome.

For a global industry, you absolutely need to be at the cutting edge of technology. Aberdeen has recently been announced as a candidate for the Gigabyte City initiative so, hopefully, that will have huge improvements but I don't know what the geographical extent of that initiative is going to be. If it does not include all the major new industrial developments on the fringes of the city, which are outwith the city boundaries, we might not see the improvements that the scheme would hope us to achieve.

Q94 **Ross Thomson:** You have pre-empted my next question, which was: anecdotally, I am aware exactly that people who, because of flexible working and a lot of changes a number of the larger companies have made in the city, those who are seeking to work from home can really struggle because of poor connectivity. It is to do with the size of data as well that they are using, and I know that, given the nature of the industry, it can be large pieces of data they have to send, and that can be inhibiting. Do you have any evidence or data—other than anything that is anecdotal—about the impact that would have for home working on the amount of people who would-

Dr Philip: I am not aware of any research that has looked at that specifically and, from discussions with engineering colleagues when I was trying to pin down ideas a number of years ago about, "What is an acceptable minimum speed?" they would always prevaricate and say, "It depends on this. It depends on that".

I do know that with the move to more and more Cloud-based services, they do expect not only a fast connection but a very reliable connection. If we are talking about some of the data-heavy applications that, say, some of my petroleum geology colleagues will use in my own academic unit, they are massive data files. If you don't have a reliable connection to allow you to download that you are not going to be able to work from home.

Ross Thomson: You are right. It is not just oil and gas. I know with the council as well, looking for more people to do flexible working, work from home, that it can be difficult sometimes to get hold of council officers by e-mail if they have a really poor connection. Thank you very much, Chair. That is all.

Q95 **Deidre Brock:** Dr Philip, you mentioned in your work on the digital divide, "In Government policy, the focus on speed for the majority detracts from universal access across all of the UK". Does that USO of 10 Mbps—I am no technical expert but that does not sound like very much to me—address that criticism?

Dr Philip: It addresses it in terms of it is a huge improvement on what the BDUK programme initially set out to do, which was to bring 2 Mbps broadband for all. If I recall correctly, it was a Royal Society of Edinburgh publication a few years ago that was saying that for Scotland to be competitive by—and I think the date for this has now past—last year, they said everybody should have 16 or 17 Mbps.

The USO is a really good move forward because it is saying that we need to provide better speeds in order to allow people to engage in activities but, as mentioned earlier, the problem is going to be if technology continues to develop fast. We don't know what the demands on speed are going to be even two, three, four years into the future, so it was mentioned earlier that we might have to have USO 2, 3, 4. Maybe that is not too far off the mark but, at least if we try to get people to the 10

Mbps now, we might get around some of the problems that many people in rural areas, but also elsewhere, are currently seeing.

In terms of the headlines, what is going to be commercially viable, it is this push for speed, "Get faster. Get faster. Get faster". That is laudable, but we also need to turn our attention to the people who are not achieving speeds anywhere near these advertised headlines at the moment. These final few are hard to reach: 5% of the population is an awful lot of people.

Dr Bosworth: We don't use the word "few" anymore.

Dr Philip: It is hundreds and thousands of people.

Q96 **Deidre Brock:** There is some criticism that the Government is yet to provide any clarity about how they are going to achieve that 10 Mbps. Are you aware from your work of any concrete proposals as to how the UK Government will address that?

Dr Philip: There has been all the money that has gone into pilot projects for the alternative solutions, mainly based on wireless technology. I have never been involved in investigating any of them specifically, but it seems from news reports that some of them have been very successful. Perhaps that is one of the ways forward.

I also know that the Welsh Government had a subsidy scheme running to help people who were not going to be able to get fixed broadband to defray the costs of installing a satellite service because, not only do you have to have the contact with a satellite provider, you need to install the kit to allow you to use the satellite service. Those could be examples to look into in more detail.

Deidre Brock: The Scottish Government is putting £600 million into its broadband rollout as well. Thank you.

Q97 **Chair:** On the USO, I know there has been a consultation and we will see the responses and the feedback, but it seems it is more a right than an absolute requirement. What I am struggling with is, just say you want to exercise your universal seller's obligation and say, "I want my broadband", is it necessarily going to appear? Where does the right start and the requirement end, or the other way round?

Professor Skerratt: There is a philosophical debate there as well as a practical debate, isn't there? I don't know. It could be my ignorance about how you would exercise your Right, with a capital "R". I don't know the procedures for that. We have information that has recently been published about the three lots and how they will be put into place. How you would then exercise your right within that, if you are not satisfied at a certain point in time, I am not sure what the procedure is.

The issue around it being a human right: certain countries, such as Finland, have said it is a basic human right. There is another debate that

says it is a right that enables human rights to be delivered. Whichever way you look at it, it is a basic right now so I don't think anyone would debate that compared with, as I say, back in 2000.

Q98 **Chair:** There is an obligation to build on all reasonable requests. Obviously there is the cap that is in place, which they have listed as one request that might be unreasonable. Do we have any right to expect that there will be other unreasonable requests in terms of exercising your USO?

Dr Philip: I wonder if, for the general public, they understand the idea of a Universal Service Obligation in the way that it has been framed in this current policy. If we think about, say, USO for the post service, everybody gets their post physically delivered to where they live, no matter where they live. The cost of a second-class stamp is the same to send something within Aberdeen as it is to send it from Aberdeen to Land's End. That is what I think people understand a USO to be, which means it is for everybody irrespective of where they are, how much it might cost. That is not my understanding of the framing of this particular initiative.

Q99 **Chair:** Yes. That is what I am trying to get you to help me with, just to be clear where it begins and ends and what does the right expect?

Dr Philip: Personally, I don't think it should just stop at a right to request. If, as a society, we think that digital connectivity is essential, whether we can enact that within the constraints of public finances, and so on, is a secondary but closely aligned, issue.

Q100 **Chair:** Scotland is a UK Government and obviously, broadband being reserved as it is, this will apply across the United Kingdom. How does that fit in with the R100 programme from the Scottish Government, for example, which seems to suggest that every home will secure superfast broadband? Are there any tensions in both those commitments that are being delivered by the different Governments?

Dr Philip: The fact that the Scottish Government wanted universal coverage is a good aspiration, because the BDUK programme only ever said that it would deal with 95% of the population. To move from "most people" to "everybody" as an exhortation is good, but the practicalities of doing it are different. Although, if we are thinking about superfast broadband as 24 Mbps, technically, satellite could support that; whether, in fact, it does, is a different matter.

Maybe we need to think about the Scottish Government's aspiration as being mixed methods of delivering that coverage and not just through fixed broadband. That then means that we need to be, perhaps, putting more effort into the alternative non-fixed broadband solutions, and the practicalities of that I honestly don't know.

Chair: I am just trying to get what the general public have a right to expect with these various commitments, and we might need to explore

this a little bit further with respective Governments to see what they mean by that. I was just interested in your views. That was all.

Q101 **Ged Killen:** There have been a considerable number of community broadband projects in Scotland in the past few years. The Committee have had written evidence to say that there is too much red tape, too many hoops to jump through, to get this set up. Do you think it is an effective way of delivering broadband in rural areas? What challenges do you think there are? Is that a challenge about the red tape?

Dr Bosworth: Red tape is certainly one of the issues. The way I think about it is that it is hard enough for a community to get together and perhaps take over a village pub or a village shop. That requires a number of people to buy in; some volunteers to put a lot of time into it and some cash, but at least you can see the asset, the tangible service. We all know how to run a shop or a pub, in our heads; realistically, it is more difficult.

When it comes to a community broadband provision, the first thought is, "That is very technical. I don't understand." Some of your questions earlier, "How does the cable work? How does my mobile smartphone get that?" It is so far removed from perhaps what we understand in our day-to-day lives. You have the bureaucracy on the one hand but you also have this technocracy—if that is the right word—that can put people off. You need the experts. In Lincolnshire, we found a lack of the right mix of experience and skills was a problem for rolling out funding that was available to support rural broadband initiatives. They said, "Well, BT will come eventually anyway so why do we put all this effort in when eventually they will serve us?"

With the work in the Netherlands there were some similar issues where you had to bridge the gap between private sector providers and the people; yes, there are some rural bits of the Netherlands, it surprises people, but "demand bundling" was the term we come up with. You need to bring together these diverse hamlets or small settlements that have been left out by the rollout to the larger villages and towns; you have to get them together in a way that they could then liaise with the service providers, with the public sector enabling body so that the villagers, the people in the hamlets, are empowered to say, "Look, we are willing to sign up now to subscribe to your service. We do have some money to help get the cable in the ground. We will make a commitment".

As a group of villagers, to be able to go and say that to Openreach, or whoever, feels a long way away. If you have a public local authority group in the middle that can help that negotiation, help that conversation, that is what we found was quite powerful in making things happen.

Professor Skerratt: It is very possible, and there is evidence of communities providing their own broadband; whether they should have to is another question. I will come back to those who have in a moment.

Last summer, I remember on BBC Scotland there was a front page on their website showing a picture of people digging their own broadband cables in Sutherland, and this was seen as fantastic. Whether that should be seen as fantastic is something we need to reflect on: if communities should be expected to prepare and dig their own infrastructure. Would we expect that of mains electricity and mains sewerage in the same way for a community?

Again, reflecting on my comments right at the beginning, we need to look at it over time. I was doing a quick check on a piece of research we published in our biennial report back in 2012 looking at some of the community broadband projects that had set up then and looking at did they still exist; some do, some don't. Does that matter? I imagine the impact on the communities could be quite significant where community broadband projects have ceased to exist, for different reasons.

Some of that will be because of burnout in communities—volunteer burnout is a well-known phenomenon—some of it will be because of technical failure. None of this is a fault of the communities; it is a considerable technical strain on communities. In one case that is in the public domain the provider of the kit went into administration, so there are sustainability issues as well.

On top of that, you have the issue of capacity of communities: some can do this, some cannot. Some have the individuals within their communities who can deliver. If you pull all that expertise together within a community that can navigate all the red tape and the legal speak, the technical speak, go through the procurement process, the registering of interest—all these different stages—and can last the course, then they can do that.

Others don't have that capacity within the community; again, that is not a criticism. My concern is—and our research evidence supports this—what happens in those cases? There is this mixed-methods approach that you have talked about. If there is a continuing reliance on that, what then happens in those communities where there is not the capacity? They are not even on the radar, necessarily, because they are not articulating that they don't have coverage because they are not part of that conversation yet. What about those?

It then becomes a human rights and social justice issue, so it is a much bigger topic that we start talking about, rather than the plumbing. It is enabling or disabling all these other elements as well, so it is one part of the solution. We have to be very careful in not saying communities will sort this last bit because that is then assuming that it is right that they do that and everyone has the competencies and capacity to do that.

Q102 **Ged Killen:** On your point there about whether they should do this or not, it depends on whether or not there is any benefit to doing it. All things being equal, if we could get the services there, is there any benefit or unique opportunity that comes out of communities doing this for

themselves, as opposed to it being provided?

Professor Skerratt: Research by a colleague, Fiona Ashmore, who worked on the dot.rural project, shows that there are benefits around communities pulling together and having this strong community identity of working together, so it is a triumph of putting this in.

As you would expect, there are also disadvantages with that; it is not all rosy, it can lead to tensions within communities as well. There will be pluses and minuses. Of course, the product then enables the community to get broadband and they probably would not have otherwise, however, coming back to Lorna's point, it depends on how future-proof that technology is, whether there is technical expertise in that community. As my colleague, Fiona Ashmore, was saying from one of her interviewees, "If somebody cuts through that cable, who is there then to provide the technical backup and support?" That is a simplistic comment, but if something goes wrong with the system three years down the line, whose problem is it?

It is thinking long term, both in terms of future-proofing the technology, and the technical support that is needed to keep that show on the road. There are advantages but I think they need to be seen in this bigger context of the reality of how it is experienced for communities.

Dr Bosworth: This is where bringing the public sector and the communities together, you can try to generate the positives of the community pulling together, doing something that might then be a springboard to them doing other community activities: launches of the community website and social activities locally, but given that protection of a bigger voice navigating them through the difficult bureaucracy.

Professor Skerratt: One PS, if I could, Chair? When I was looking very quickly at comparing 2012 to now, those that seemed to have blossomed are those exactly where the community initiative is embedded in a community development trust or another initiative where the capacity is built around several activities, strategies and programmes, so it does not sit alone as one single technical project, but there is that capacity.

Research also shows that links outside the community, drawing in resources and specialist skills, are really important to the resilience of the community. It has to be seen in that mix rather than just a technical project.

Q103 **David Duguid:** A very quick question on the whole question around community projects: are you aware of any examples in your research where a community has invested in a project only to find out a few years later that they were going to get connected anyway? What happens in that situation? Do they get some kind of rebate?

Dr Philip: I don't know about a rebate, but Fiona Ashmore—whose PhD we both supervised—was working with a community in South Lanarkshire that faced numerous barriers and setbacks in getting their community

initiative off the ground. One of the difficulties was getting accurate data from Openreach, about which exchanges in the locality were on the radar for improvements, never managing to get a concrete answer and constantly feeling that the goalposts were being changed, which made it very difficult for them to finalise their technical plans. Without the technical plans, they then could not apply for further funding.

They would have dearly loved to have been told early on, "This is the schedule. We don't know exact dates but we know that exchanges A, B and C are all going to be upgraded so we are going to take them out". Their response was largely from a community that was so frustrated at having to wait. There needs to be a better dialogue between the companies that are doing the upgrading, the mediators in the public sector and communities themselves, because communities don't know. I would be loath to say games were being played, but certainly there was not as much transparency as there could have been if community solutions were really being seen as a way forward in that particular case.

Professor Skerratt: That is not an isolated case.

Dr Bosworth: There was certainly one in the Lincolnshire area where a larger provider realised the community was looking to take steps to go with a smaller provider, leaflet dropped residents to say, "We will be providing it in a year to 18 months' time, trust us" which rather scuppered the momentum that the local group had. You have to be careful of the tactics of the more influential companies.

David Duguid: Thank you.

Chair: Great. Thank you. It has been a bit of a mammoth session this morning, but it has been very helpful for the Committee. Again, like all the other previous guests we have had, if there is anything else that you would want to add, just send it on and then we will be able to consider it. Thank you very much for coming along this morning.