

Examination of Witness Dr Peter Cochrane OBE, former Chief Technological Officer, BT Q29 The Chairman: I welcome Peter Cochrane here. Thank you very much, and apologies for having kept you kicking your heels outside. We had a vote, and that got in the way of the timetable of the previous bit, so thank you very much. We have in front of us a brief CV of your background, which you have helped us by providing, so thank you. The meeting will be broadcast, so I hope that that will not pose any problems for you. When you start, will you briefly, for the benefit of all those listening, tell us who you are? Then, if you would like to make a brief opening statement, please feel free to do so. With your permission, I would like us to go on for about an hour.

Dr Cochrane: It is a pleasure to be here. I am rather pleased that you have invited me. I have been working in this area for a long, long time. My name is Peter Cochrane. I have two doctorates in technology and am also a visiting professor in the UK. I have spent all my life, from a being a young man, in telecommunications: and IT. To give you a perspective, I was at one point a line man, as a young man, so I used to climb and dig holes. I went into research and development and became head of research at BT, and ultimately CTO of the company. In 1979, my PhD was instrumental in BT making the decision to go fibre everywhere. In 1986 I got fibre into the home cheaper than copper at 2 Mbps. I left BT in 2000 and my company now is a consultancy. I travel the world continuously, so the evidence that I am going to give this afternoon is not based on the UK or Europe, but is a global perspective. To give you a rather interesting view, we completed a project recently in which the island of Jersey has installed fibre to every office and home at 1 Gbps; that is, 1,000 Mbps both ways. It is cheaper than copper, and it is there to enable a new economy. They have a 135 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) monoculture of banking, and they need to change the economy of the island. That has got to be founded on the ability to communicate globally. They have already completed all of the offices, and every company has access to 1,000 Mbps, and they are now rolling out the homes. I would like to position my afternoon with you along the following lines. Starting from the point of an ambition to give people 2 Mbps is like giving our population a Morse key. You might as well not bother. In Columbia recently, I was getting 100 Mbps both ways from my hotel. In America, I regularly get between 50 Mbps and 100 Mbps. If I go to Korea, China or Japan, I get above that level. For me, the starting point for this nation is 100 Mbps. Providing 20 to 50 Mbps will not give us the entry on which rests the next phase of industry, commerce and the generation of GDP. From a professional point of view I am quite relaxed. I have no axe to grind, and I have no vested interest. But as a citizen of this country, I really am quite worried as I watch the positioning of this nation on the back foot. To give you some perspective, on fibre to the home this nation is number 36 in the world league. When it comes to broadband in the EU, we are number 25. If we look at the UK on a global grid, we are number 33 in terms of broadband provision. That does not bode well for our population and our ability to compete in world markets, it really does not. When people use the word “superfast” about broadband in the UK, I have to smile. It is neither super, nor is it fast. One aspect of this is that it is asymmetric. The world is not an asymmetric place. If we are going to communicate, it tends to be rather symmetrical. If we are going to stop driving vehicles, travelling an awful lot and flying in aeroplanes, then videoconferencing is an obvious technology—which we cannot access because we do not have a symmetrical service. That is just one aspect. There are many others. I would like to see us with a programme that brings us up to a world standard in a reasonable time. I have some formulas and suggestions for doing just that. It means changing the way that we think about the problem and stepping outside of the shoes of a 200-year history that spans telegraphy and telephony. We need to think differently. Q30 The Chairman: Thank you. From what you have just told us, you have no equivocation in saying that internet access at a high speed is a sine qua non of success in the modern world. As such, you would argue that it was a strategic utility and an overriding economic requirement for the future well-being of this country. Is that correct? Dr Cochrane: Correct, probably even more so than road and rail. Q31 Lord Clement-Jones: Do you think that there is some complacency about adopting that view within government? Dr Cochrane: I think that there is a lack of

understanding. There is a perception afoot that has come out of industry and is in the interest of certain industries but not in the interests of the population at large. In my time in industry, I have seen phenomenal change in everything from honesty to ethics to positioning. I came into industry and it was clear cut. We were the servants of this society. Our job was to put into place products and services that actually satisfied the need of the developing nation. There seems to have been a swing of the pendulum away from that to, "I am here to benefit the company; I am here for the benefit of the shareholders". That loss of perspective, of a duty to society, is really quite damaging.

136 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) Q32 Earl of Selborne: You are very clear that superfast broadband is a strategic necessity. You said that Jersey was going to have 1 Gbps into business. That seems to me to make sense, but what are you expecting the benefits of that amount to be to a household unless they are running a business from it? What happens in societies where they already have large access to superfast broadband, in countries like Korea? Is it not the case that that is used for downloading films, very often illegally? What other benefit is there for the household?

Dr Cochrane: Let me approach that from this direction. Very often the view is put in this country that if everybody cannot have something then no one can have it. If, for example, the company that produces my mobile phone had started with the question, "How do we make this so affordable that everybody in the country can have it?", they would have failed. All commercial products start at the top end of society. They start at a high price and low volume. The amortisation of R&D takes place at the cost of the people with money, the early adopters, and gradually the price comes down. We now have a situation, because of that effect, where there is no excuse for someone not being online. The cost of a mobile phone and a laptop is so low that, believe me, everyone can afford one. They may have to buy a second-hand one, but even the new devices are quite low in cost. So what are people going to do in the home with this broadband? In the United States, for example, they are rapidly adopting IBM Watson technology in medicine. Let me break that down. IBM Watson started off as a challenge. Deep Blue took on the human race and won: it became the chess champion. Watson took on all human players in a game show called "Jeopardy". It wiped out the human race. It is now wiping out human MDs—doctors—on diagnoses by a good measure. The reason is that it is able to analyse and put in perspective all the case histories that are available to it, whereas most MDs and most specialists in any topic, including my own, are really struggling to read the literature and keep up with the leading-edge technology. So when I go to see my specialist, I go to see him with the latest research papers because I have a vested interest in staying alive. He does not have the time to keep me alive. I have to look after myself. Let us run a scenario where you are ill. The doctor comes to visit you. Unfortunately, you do not have broadband so he cannot access the database. You are depleted of the very finest care, because the artificial intelligence is not there to help you. If you move on from entertainment and ask what is going to happen in education for our children, the model of education that we have right now is vested in an old industrial revolution which was about getting a population of people to read and write and know a little bit about geography pertinent to producing goods that we would ship worldwide. Nothing has changed, but education has to change. We are moving from a world of stovepipes, where we have physics, chemistry, biology, technology and engineering and history, to one where there is science. The interdisciplinary nature of industry means that we have to change the way that we educate our people. We are not going to do this in the future in the way that we have done with the sage on the stage and a whiteboard. We are going to have to do it much more on an individual basis. To do that, children will need access at speed to a machine that will help them learn and understand. On top of that, you have to recognise that understanding a lot of complex things is now also beyond the world of the mathematics that you and I enjoyed. It is inter-computer simulation. If you cannot get through on a broadband link to the computing power to allow you to do that simulation, then education is going to suffer. On the media side, you have to think in terms of television and radio being moribund. The notion that you will sit down with an

137 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) actual timetable and watch and listen to programmes at the behest of the broadcasters is nonsense. People are now time-shifting all of this content to when they can. However, there is an absolute desire to participate. I see the world moving from passive consumption to active participation. After World War Two, I was born in 1946. At 11 years old I got into electronics and drove my parents mad by doing electronics on the kitchen table. We now have a new genre, and they are doing bioengineering on the kitchen table. These are young people who are opting out of our universities because they are so dull. They are not getting the leadership and it is not adventurous enough. You can buy known genetic strings of material for \$5. They are doing experiments at

that level, and the only thing that worries me about this is what they are flushing down the sink. It turns out that things of that nature, including 3D printers, are giving rise to new industrial models. These are not the mighty workshops that we are used to today; they are dispersed. I know that it is a far stretch right now, but you have to think in terms of shipping designs and solutions instead of shipping product. That is the world that we are gearing up to. I do not want to engineer for today. I want to engineer for tomorrow with my sight on the future. There is a huge cost in getting this wrong. If we go fibre halfway, we will have to upgrade at some point. If we put 20 Mbps in, we will be re-engineering it within a couple of years.

Q33 Lord Gordon of Strathblane: I suspect that I know the answer from your previous sentence, but what sort of infrastructure would you put in place to deliver this? Dr Cochrane: I have no religious conviction here. I worked on optical fibre. I was responsible for the team that put the first fibre across the Atlantic. It was a terrific technology, but the reality is that you cannot always get fibre in. The mainstay of the future network has to be fibre. There will no doubt be some places where we will have to use a wireless drop to reach people. Let me give you a slightly bleak view. People are getting very excited about 4G. How would you feel about at least four or five times more towers around the countryside to service the nation with that technology? It makes no sense. On Jersey, when we put fibre into the home, the box that we put there has 3G in it and will be upgraded to 4G. Now we have automatic infill of the network. When we get a room like this, when we all suddenly want bandwidth, it can be serviced from a box in the corner, as opposed to a mast a 1-10 km away. The only way that we can engineer a network that allows for the clustering of people and things is to put bandwidth out there on the end of fibre.

Q34 Lord Gordon of Strathblane: But is it fibre to the cabinet or fibre to the home? Dr Cochrane: Fibre to the cabinet is one of the biggest mistakes humanity has made. It ties a knot in the cable in terms of bandwidth and imposes huge unreliability risks. Once the local bandits have recognised that there is a car battery in the bottom, you can bet your bottom dollar that a crowbar will be out and the battery will keep disappearing. It is a shame, but I understand why people have made that decision. They have made it worldwide, by the way.

Q35 Lord Gordon of Strathblane: I imagine that cost plays a large part. My understanding is that it is about a quarter or fifth of the cost of fibre to the home. Dr Cochrane: Let me give you an alternative view. I live out in the country. We have 420 households and I am trying to get fibre into the village. All I am asking a company to do is put a fibre into the middle of the village and walk away. I know that it is going to work because on the island of Jersey we have taken housing developments where there is an 138 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) underground or on-surface garage with six or 12 apartments above. We put a box with a fibre in it into the basement. We open up the wi-fi and 3G. We leave all the Cat 5 sockets—the RJ45s—open, go away, come back a month later and the apartment block is wired up. What a miracle. Think about it. You buy a washing machine, a television, a hi-fi or a computer and you install it yourself. What is the magic about this fibre to the home? Answer: none. You can put copper cable, Cat 5—LAN cable, if you will—in yourself. If you cannot—

Q36 Lord Gordon of Strathblane: Forgive me, are you allowed to? Dr Cochrane: I always take the view, in everything, that I will beg forgiveness later. In my previous home, when I worked for BT, I asked them to put fibre to my home and they would not. I arranged for a drum of cable to be dropped off one night, and my sons and I pulled the cable in ourselves using my car instead of a winch. Some friends spliced it in and I had eight fibres into my home. That is an alternate model. Just a month ago, I was in Munich giving the opening address to the fibre-to-the-home conference. I stood and watched in amazement a gentleman from 3M joining single-mode optical fibre with snap connectors in less than two minutes. The last time that I did that in the laboratory it was taking half an hour; it was a precision job. I looked at that and thought, “I think that I could find geeks in just about every housing development and village in the land who would take about an hour to train in doing that, and then they would do it”. In my community, I have a farmer with a plough and a JCB, and he is happy to cut me a trench. When I go to BT, they say, “We need £140,000 to put the fibre in”, and you can bet your bottom dollar that that is £130,000 for the trench. But they will not accept my trench. I am looking for a company with the imagination to say, “Dig me a hole, I’ll put it in, you cover it up and we’ll take it from there”.

Q37 Lord Gordon of Strathblane: Just so that I am absolutely clear, you would go for fibre to the home? Dr Cochrane: Yes, wherever possible, without a shadow of a doubt.

Q38 Lord Gordon of Strathblane: At the moment we have a lot of copper, in which BT possibly wishes to recoup its investment. Is there any future for copper in even the medium term? Dr Cochrane: Let me give you an interesting statistic. Even when I was in the company, 85% of all homes were within one kilometre of a BT fibre that was dark; it was not being used. From my home to the nearest fibre is 500 metres to the

east and 500 metres to the west. I can get access to neither. The easterly fibre belongs to the railway, and the westerly fibre belongs to BT. The whole village is surrounded by fibre, but we are not allowed to drink.

Q39 The Chairman: Is your point that across the UK there is a considerable amount of fibre that is either dark or used in private networks that could, and you would perhaps argue should, be deployed more generally with other people tapping into it? Dr Cochrane: Correct. I have a line I have tried on Ofcom from time to time, which goes like this. If they are powerful enough to regulate the air we breathe—by which I mean the radio spectrum—surely they are powerful enough to regulate the wavelengths on the optical fibre. A single fibre can carry all the conversations of humanity at the same time twice over. It is an immense amount of bandwidth. Their ability to carry data is a lot less, of course, but there is quite a lot of space on the fibres that are in the ground now that could be accessed.

139 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) As we go along, liberating and unbundling the duct network, there is a case for unbundling optical fibre and the wavelengths.

Q40 Earl of Selborne: It is clear that you wish to see every household connected to optical fibre, and that the cost at the moment, if you get a quote from the operators to install it, as I would—like you, I live in a remote, rural community—is fairly staggering. What is the cost of the cable itself, if I were to buy it? Dr Cochrane: The cable is trivial. The fibre costs pence, the plastic that goes around it costs pence. It is a very low cost. The fantastic costings that you get are entirely due to civil engineering. It is always the civil engineering that gets you.

Q41 Earl of Selborne: I have got a JCB, so that is not a problem. What problem am I going to have getting somebody to accept that work? They are not, are they? Dr Cochrane: In BT's case, it is not in their business model to do that. Before they can do it, they have to modify their business model. However, I was with a company this morning which is coming to have a look. Right now, for my village I have two contenders who want to come into the village with wireless from the church tower, and one contender who wants to bring in optical fibre. My solution for my particular village is that there are quite a lot of houses side by side. That makes it relatively easy to dig a trench right across the gardens if people want to join. The get-out is to have small antennas on the church tower to beam into people's homes. I can get about 100 Mbps to people's homes within reasonable range doing that.

Q42 Earl of Selborne: What should the Government do to break what appears to be something of a cartel which allows these massive costs to be foisted on the consumer? Dr Cochrane: My recommendation would be to put some money into an investment called "The New Players". The £560 million that is being talked about, I have to tell you, is petty cash in this game. For getting the country up to fibre to the home for everyone, we are probably talking something in the range of £10 billion to £15 billion. If we want to leverage for the nation the best we can out of that £560 million, I would invest it in the small players so that there is a third force. In all successful commercial markets there is a rule of three, possibly four. Right now we have a rule of two. We do not have enough competition, and we need more competition in the market. If we were to bring in new players with new business models, with the flexibility to come to you and me and say, "You dig the trench and we will provide the terminal equipment and the fibre", that would transform it. It would also change the attitude and the approach of the incumbents. That is what it is going to take. Why would you change if you control the market?

Q43 Lord Clement-Jones: I do not think that I am digressing, but are these new players, particularly one of the two that you were talking about—you dig the trench, they lay the fibre—not still going to have the issue of connecting to the BT fibre? How do you regulate that? Are you saying that that is what Ofcom should be specifying and so on? Dr Cochrane: In a lot of cases, that is the problem. The charges are entirely commercial; by which I mean "for business". There is no breaking up of the charges for domestic use, or even SME use. It becomes prohibitive. But there are cases where a number of companies have actually got their own fibre. It will need the will of government and probably a change in regulation and operating licences to make sure that that national investment in fibre, which has been amortised this past 20 years, should be accessible to other players. We need a little bit more of a level playing field. The worst thing that I see is start-up companies that

140 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) get into this space to service people like you and me, which are then observed making a success and purposefully wiped out by the incumbents. I do not think that that is a healthy marketplace. It is unbalanced. We need three strong players and, probably, one or two boutique players. That is the sort of market mix you usually get.

Q44 The Chairman: You make a point there about small companies growing and then being wiped out. Do you have any evidence on that for us? It is difficult, and I am not pressing on it. Dr Cochrane: Yes. If you look at Cambridge, for example, there have been several start-up companies, like Cambridge Wireless, which set up purposefully to serve the villages in

Cambridgeshire. The inhabitants went to the incumbents and said, "We would like broadband" and were told that it was not cost-effective. Cambridge Wireless went out there to put in wireless broadband. As soon as they went out to the households, there was an announcement by the incumbent: "We are coming". Once that happens, people say, "Oh, we will wait for the incumbent, then". Then the market is taken away. You do not need too much of that to destroy a small start-up. The Chairman: When did this happen? Dr Cochrane: This has happened within the past five years. It is repeated behaviour. Q45 Lord St John of Bletso: You mentioned in your opening remarks the UK falling woefully short of the world standard for superfast broadband. Could you define that world standard? What criteria would we need to satisfy in order to have the best superfast broadband in Europe? I think that we are 25th in Europe. Dr Cochrane: Yes. What are the leaders doing? There is Sweden in greater Europe, and in the Far East you have Korea, Japan and China. They have a minimum level of 100 Mbps. That is where they start. They are rolling out 1 Gbps, but they are planning for the next phase of 10 Gbps. To return to an earlier point, if you have got fibre to the cabinet and you are relying on copper, I can tell you that the network is going to collapse on copper when you get to 1 Gbps. It will collapse much earlier. You may do 200 to 300 Mbps over a very short distance, but you are not going to do anything with a reasonable reach over 1 Gbps, and you are certainly not going anywhere at 10 Gbps. So you have immediately got this knot in the bandwidth. The only question is how fast all this occurred. That is almost entirely down to the rate of industrialisation and growth. A lot of people see Japan as something of an economic basket case in south-east Asia. I do not. It has been a roaring success. They have done rather well at fending off the Chinese and have held on to the high-tech ground. Compared to the Western economies they have done quite well. They are investing in the next round of supercomputers and robotics, and the next round of industries that will be based on nanotechnology and biotechnology. I sometimes have this dream: if I could go back to being 20 years old, where would I go? What would I target as an industry? It would be at the cusp of nano, bio, ICT and artificial intelligence. That is where the action is for the coming 50 years. That is very much a bandwidth-hungry sector. If we do not invest in those areas, we are going to lose out significantly. Q46 The Chairman: In the case of these south-east Asian countries, where did they get the money from in order to do what you have described? Dr Cochrane: Well, there are several models. One of them is, of course, government intervention. Another is much lighter taxation. They see fibre to the home or bandwidth 141 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) rollout as much of an infrastructure as water, sewerage, electricity, gas, road, rail and air. It is a necessary infrastructure, and if you have not got it, then your economy suffers in the same way that the British economy suffers because of the road network. They see the next phase being heavily dependent on the transport of bits—period. Q47 Lord St John of Bletso: Within that context, you were saying that the amount that the Government have set aside, £560 million, is petty cash. Dr Cochrane: Correct. There is a zero missing off the end. Q48 Lord St John of Bletso: Are you then suggesting tax breaks to smaller operators who can fill that third space which you talk about? Dr Cochrane: Here is the problem. I work in the start-up sector here and in the United States. It is quite upsetting. If you go for funding in the UK, people start talking about £50,000 or £100,000, possibly £1 million. You go to the United States, and they start with \$10 million, or \$100 million to \$200 million. Ask this question: what contribution has Europe made to internet technology? What revolutionary technology and industry came out of the internet for Europe? There is only one. It was Skype, and that was bought by the Americans. All of the innovative technologies in the internet came out of the United States. We do not have an Intel, an Apple, a Microsoft or a Cisco. We do not have anything remotely close to those industries. Why? We have spent an awful lot of money in R&D in Europe, mainly funding academic exercises. They have not resulted in big industry. Where we were really good in manufacturing was in things like aerospace and pharmaceuticals. That is where we have scored. But there is nothing coming out of Europe that would excite you about the internet. That is not where the innovation is. Partly, that is due to the fact that you cannot get funding—period. I listen to government Ministers and I watch the market. I watch people trying to change the funding regime, but it is extremely difficult to get funding for anything innovative in Europe. If you fail in the United States, someone will immediately ring you up and offer you a job; you must have learnt something. In the UK, if you fail, you will not be given a job. If you fail in Europe, it is a real black mark, a social disgrace. If you fail in south-east Asia, loss of face will probably mean that you will commit suicide. Those are the social inhibitors. In this country, we have got some super people and really good start-up companies. But they cannot get the money to succeed. If you are up against someone who is not as clever

or smart as you are, but they have got \$200 million and you have got £1 million, guess who is going to win.

Q49 Lord St John of Bletso: On the current model in the United Kingdom, the strategy for superfast broadband, you mentioned the rollout of 4G. Are you saying that that is not going to be a viable rollout? Dr Cochrane: I am saying that it will not do what it says on the tin. One of the things that amuses me greatly is “up to 20Mbps”. It is like “up to 5,000 cornflakes” in my box, but there are three. It does not help. It is an absurd product description. If anything needs deleting from the English language, it is “up to”. If 4G is rolled out, for sure, if you are close to the base station, you will get bandwidth. The further away you go, the less bandwidth you will get. That is a function of physics; you cannot beat that. The only way to get a lot of bandwidth everywhere is to have more and more and smaller cells. That is really what the wireless future is about. To do that, you need more fibre.

Q50 Baroness Fookes: Dr Cochrane, I was going to ask you if you thought that the Government could deliver on their campaign and effort to have the best superfast 142 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) broadband network in Europe. I get the impression from your previous answers that you do not think so on present policy. Dr Cochrane: Correct – there is not a chance. The Chairman: I am told that we have a Division in three minutes, so do not think that it is discourteous when the Bell goes off. We will either finish or not within three minutes.

Q51 Baroness Fookes: So, if you had to give advice to the Government—maybe you have—what three things, or even one thing, would you say that they should be doing? Dr Cochrane: Funnily enough, I have got three things on my list here. First, pursue the unbundling of the duct network. Secondly, unbundle the dark fibre and make capacity available. Thirdly, empower Ofcom to regulate the wavelengths on fibre as they do the frequencies in the radio spectrum. If I can have a fourth, please push some money towards the start-up companies that have a new and refreshing business model that will allow us to do something in the rural areas as well as in the cities. In the village where I live, the number of creative people is quite phenomenal and the number of businesses that have failed is also quite phenomenal. The Chairman: Can we temporarily retire and come back and listen to the rest? [Meeting suspended for a Division in the House.]

Q52 Baroness Fookes: What you are really saying is that we are dealing with a monopoly which has to be broken. Dr Cochrane: Yes. “Monopoly” or “cartel”, it is a protected market. Q53 Baroness Fookes: What would be the best way of bringing about the four good things that you thought should be done? Does it need a lot of legislation? Could it be done by regulation? Would the forthcoming communications Bill—we understand that there will be one—be a suitable vehicle? Dr Cochrane: Yes to all of the above. I am great believer in the light hand of management. I never saw a bureaucracy problem solved by even more bureaucracy. I suggest that it is the Government’s role to present a playing field on which the players can play an even game, and the nation can benefit. Baroness Fookes: They can be a facilitator. Dr Cochrane: Absolutely. The Government’s role is to be the guardians of the society, in my view, to protect the citizens in every sense of the word. We need to have in place laws, regulation and investment that bring about a levelling of the playing field so that the nation can get broadband at a reasonable speed. I am also very much in favour of self-help. Being identifiably from BT can be quite alarming sometimes. Everybody in my village knows that I am from BT, ergo I have suddenly had the finger pointed at me and they say, “Why can’t you fix it?”. So I am suddenly the man in the chair for my village and am doing everything that I can. What I have been entrusted with doing there, by the way, is creating a new model and then advertising that model as an exemplar to say, “This is the way that it can work”. Let me give you an idea of a similar community in the United States. Occasionally, I go to a geeky conference in Woods Hole on the east coast of the United States. Verizon said that it was not cost effective to put broadband into this small village, so the community started a company, raised \$30 million and put up broadband themselves. Every home in that village now has 100+ Mbps and the wi-fi has to be left open so that everybody can use it. You can 143 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) walk down the street and pick up a huge amount of bandwidth for free all over the village. It has the advantage of being a rather hi-tech community because there is an oceanographic institute there. They have 53 Nobel prize-winners living there, or whatever. However, it is an exemplar which says that if citizens take, if you wish, the law into their own hands and form a company or corporation, things can change. I am willing, where I live, to go that far if I can muster the support. I cannot afford to do it on my own, but I am willing to chip in my time and some money to create a smaller model of that exemplar. Baroness Fookes: Sounds like a lucky village. Dr Cochrane: Well, I am not the only one. Everywhere I go in this country, I find remarkable people living in the rural areas, such as the farming community. Where I live, there are people who are world famous for restoring vintage cars, yacht

designers, sail designers, and people who work for the BBC and the media. We even have an exgovernment diplomat in the village. These are smart people. It is up to them to lead the rest and solve the problem. Q54 Lord Clement-Jones: I will pursue that a little. It seems to me that you are not saying that there should be government money. That is the sine qua non of this. If you opened it up and allowed investment to take place, obviously subject to that predatory competition point that you mentioned earlier, that could do the trick. Dr Cochrane: Yes. There are two dangers with government investment. It is either spread too thin and has no effect or it just impacts one place. The trick is to do exactly what you said: to put in place a legal and regulatory situation whereby small start-up companies that are willing to raise investment and move into this area stand a reasonable chance of survival. If they do not, investors will not put their money into the pot. So we need a situation where, clearly, these new companies stand a fighting change of survival. That is what I would like to see. Q55 The Chairman: Can we move on before we go back to the Bishop of Norwich? When you talked about the three measures, one of those you recommended was that dark fibre should be unbundled. Was that a shorthand way of saying, "Obviously, active fibre networks would equally be unbundled and people given access to them"? Dr Cochrane: Yes. While you were out in the Division, we had a short discussion about the parallel situation with mobile. What happened in the UK was that five mobile operators each put up 30,000 towers costing £2 billion for each operator, so £10 billion was spent when they could have all shared the same tower. The country could have spent £2 billion. The competition was not about towers and coverage, it was about services. Only now, as competition and costs are really biting, do we see the mobile operators coming together. I am always interested in the way that we leverage technology to the benefit of humanity; that is, this society. That parallels exactly what you said. Q56 Bishop of Norwich: Before I get on to my main question, I am interested in your comments about towers. I have about 648 of them in my diocese and you mentioned them in relation to your village. You have focused quite a lot on fibre, but do you think that wireless has enormous capacity for meeting some of the challenges about which we have been talking? Dr Cochrane: Yes, but it depends on a number of things such as the geography and density of the population. Something as simple as a wet tree between you and the antenna can wipe out a signal. You have to remember that the laws of physics cannot be got around. The 144 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) distance from the antenna is critical. Any obstructions in the way are quite critical. You are quite right that we can do a lot with wireless, but if we are going to get 100 Mbps then the wireless is going to be a relatively short distance. You are not going to be doing 100 Mbps over 10 kilometres; you really are not. Q57 Bishop of Norwich: Going back to some of the things that you said earlier, you described what sounds like a combination of market failure and political failure. Do you think that the political failure is more to do with a lack of understanding of what the potential of superfast, or super-superfast, broadband is? How is it that other countries have not experienced the same combination of market and political failure? Dr Cochrane: Let me relate to you a very sad story from my past. In 1986, I got fibre to the home. By 1990, BT, with DuPont, had built two factories, one in Ipswich and one in Birmingham. The Ipswich factory employed nearly 1,000 people manufacturing the components. The Birmingham factory was manufacturing the systems. We were rolling out fibre to the home as an active programme. It was stopped by a little problem called the Thatcher Government and Sir Keith Joseph. They wanted the American cable companies in. The programme was stopped, and who was right behind us? Who were we working with? The Japanese and the Koreans. They looked on aghast as we stopped and they carried on. They have had the benefit of a lead since about 1991, where they have rolled out fibre to the home and we went backwards in time. That is the political failure. This could also be a commercial and an engineering failure. Technologists have a wonderful habit of rolling out technology without telling society what it means and what the implications are. I have fought all my engineering life to try to explain to lay people that the implications of the technology are very important. To my mind, that failure was, first, catastrophic; secondly, it was partially political; and, thirdly, it was an industrial failure: a failure to come to the Government and explain the implications and why that investment should not have been stopped. It could be that bringing in more competition was the right thing to do, but it could have been done without forestalling the fibre rollout at that time. That happens all the time, by the way. Q58 The Chairman: Can I just get back to the point about the business that was stopped in 1986—was it called BT then? Dr Cochrane: It was BT engaged in manufacturing. Right up until that period, we had been manufacturing for undersea cable systems, so we had an established manufacturing arm. By the way, in its GPO past, it used to be called the factories department and refurbish

telephones, switching equipment and things like that. What actually happened was that Hewlett Packard bought the Ipswich plant, and that was then dismantled and sold into southeast Asia; this was all the clean rooms and the fabrication equipment. Fujitsu purchased the plant in Birmingham, and that is still in operation. Q59 The Chairman: Do you think it is a general proposition, therefore, that where there is fibre, there should be open access? Dr Cochrane: Yes. Q60 The Chairman: Presumably, the same basically will follow with mobile and satellite. So the key to it is open access to whatever infrastructural means of delivery. Dr Cochrane: Yes. One of the things that I have engendered in Jersey is that 3G, which is built into everybody's home, should be operator agnostic. The incumbent, Jersey Telecom, 145 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) which is providing the 3G service, can carry a competitor's mobile signals and make a little money out of that. Q61 The Chairman: So it is a bit like the railways. Providing that you can buy a ticket, you can get on the train. Dr Cochrane: Yes. That is exactly right. But it is difficult sometimes to convince people that this is a sensible argument and a sensible way to operate. In my past, when competition came up against BT in the UK, I argued strongly for opening up the ducts and cables and using our strategic resources, which were things like buildings, telephone exchanges and computer stations to house the equipment of the internet service providers and the competition. We could provide them with power because we had diesel generators and batteries and all the people. We could sell that as a service. But that was not seen as a good business plan. Q62 The Chairman: The idea was to squeeze the other guys out rather than to make a profit. Dr Cochrane: That was the alternative, but that does not play to the benefit of the nation. To my mind, it is not a very clever business model. Q63 The Chairman: But then, if you have fibre trailing across the countryside in various ducts, is it difficult where there is no access point to make an access point to tap into it? Dr Cochrane: If it is dark fibre it is extremely simple. You and I could go and do it one afternoon with a pen knife and a few bits and pieces. Q64 The Chairman: You speak for yourself: I am pretty cack-handed. To go back to the point that you are making about self-help, if you could get access to the nearest piece of fibre, whoever it happened to be owned by, that obviously makes self-help easier and more attractive. Dr Cochrane: Correct. Q65 The Chairman: If you have dark fibre or private intranet stuff nearby, if you could get in, would it transform it or is it just at the margins? Dr Cochrane: No, it would be absolutely transformative. By the way, this is exactly the history of the cable TV industry in the United States, the telegraph industry way back and the telecom system way back in the United Kingdom. In the United States, on the prairies, people could not get a television signal. It was not cost-effective to build more transmitters so the community banded together and put up a 300-foot tower with a huge antenna and an amplifier and then wired up the community for what was called community antenna TV. That later became an industry called cable TV. In my mind, this self-help ultimately will become another industry. Believe me, the last thing that any of us want to do is to run a network. But once the network is established, players will come in and say, "We will manage it for you". The key thing is getting that network installed. That is where all the cost is. The running cost after that is relatively low. In our communities—believe me, the farming community is wonderful—if you mention that you need a trench, someone will turn up with a huge tractor, a plough and a JCB and that will be that. It will be done. Q66 The Chairman: In my experience, they normally dig up the water main at the same time. 146 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) Dr Cochrane: They certainly do in the towns. In the villages, they tend to be a bit more careful. The sorts of problems that a large corporation would have are with wayleave, and that sort of thing. And yet there are vested interests here, because the landowners want broadband—and if you want broadband, you have to let us put a trench across your property. Q67 The Chairman: Are there potential difficulties with calculating the costs of carriage in respect of the inputted wireless network? Somehow or other, you have got to agree a price and, if you cannot do so, you need a regulation to set it. Dr Cochrane: A long time ago, I came to the conclusion, which by and large is true, that the delivery of bandwidth is independent of both the bandwidth and the distance. That is the reason why your telephone call to North America is worth relatively nothing. It is just the sheer quantity of calls that makes it a viable business. Let me give you a couple of figures that pop into my mind. When I came into this business, it was with the old analogue cables across the Atlantic, which used thermionic valves. A system would be put in which would cost about \$300 million and would take something like five to seven years to pay back. When the first optical system was put in, it was filled inside about six months and paid back in less than 18 months. Today those systems cost \$350 million and the cost of the installation and the project pays in in a matter of months, not years. So the money to be made in that provision is huge. In terms of talking about



thousands of circuits across the Atlantic, we are now talking about 2.5 million speech circuits across the Atlantic, because the majority of communicators on this planet now are machines, not human beings. Q68 The Chairman: If that analysis is basically correct, why is it that people who have either dark cable or exclusively use cable are not falling over themselves to encourage other people to tap in? Dr Cochrane: Because they are hanging on to grim death, to old thinking and to an old business model—period. They have to think again. My analogy would be something like the old steel industry as against the new steel industry. If you have bought all the old infrastructure and have thousands of people running it, it is very difficult to say that you have to get rid of all that. Let me just recall some numbers. When I was in BT there were 7,600 telephone exchanges—small buildings in villages all over the land. We came to the conclusion that with optical fibre, because of the greater reach than copper, we could get well below 100, or something like 60 buildings. Now 60 buildings versus 7,600 is an awful lot of reduction. There was also the possibility of going down from 10,000 or more “man in van” crews to fewer than 1,000. The number one fault problem with copper is water ingress. Fibre does not care about water. There is not a lot that you can do about the JCB driver who hooks a cable and rips it up—but that is the minimal case. The fault level in an optical network goes down very low. You can reduce manning, buildings, power consumption and everything. Q69 Baroness Fookes: When you speak about trenches, forgive me but I am not really familiar with trenches. What depth are you going down to, and what is the size of the trench into which all this is laid? Dr Cochrane: The trick in digging a trench is not how much earth you take out, it is how much earth you do not take out. Let me give you a couple of examples. In Scotland and Wales, for example, rock saws are used, with a trench about 2 inches wide—this is done in Sweden also—and about a foot deep. The cable is put in and then they put cement in back further, so you just get a line in the rock. Where I live, in a sandy location, the cables are 147 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) typically 1 metre or possibly 2 metres down, depending on the other services there. You have to imagine in 3-D that services are layered, and you try to avoid things like power cables, for example. So if it was a trunk cable between London and Birmingham, the answer to your question is that it is about 3 metres deep, the duct is taller than me and about 1 metre wide, it has a lot of holes in it, and it is earthenware all the way. It is set in reinforced concrete and covered in shale and sand, and occasionally a JCB digger will hit it and keep going, despite all the indications that there is something valuable there. So it depends. The big infrastructure between major cities is buried very deep. It is a lot closer to the surface when you go between town and village, and when you get to your home, it can be a foot or two feet down, depending on the terrain. Q70 The Chairman: As we are getting to the end of the session, I would ask you, first of all, whether there is anywhere you think it is particularly beneficial for us to have a look at around the globe. You have a very wide global experience in these matters. If you are interested in the topic that we are talking about, where should we look to see what you think is as good an example as there is? Dr Cochrane: I think you should go to Scandinavia, because there are a lot of self-help examples there. I think if you went to south-east Asia, you would be both surprised and shocked. Germany is another good example. Q71 The Chairman: When you say surprised and shocked, can you elaborate? Dr Cochrane: It goes like this. The engineering is neither elegant nor particularly secure. I always describe it to students that, if there is a tree or anything standing vertical, they just nail the cable to it and continue. It is extremely crude but very low-cost. So if you go to the United States, one of the things that immediately strikes you is the amount of cable that is in the air. This country is wonderfully clean by comparison. Any town, any village, relatively speaking, is free of cable in the air. In the United States, major cities have huge cables dragged on poles right into the centre, which is always a bit of a shock. The Japanese do the same thing. I believe that the Germans are much more tidy-minded, as are the Scandinavians. The Germans have an incredible social pride about their towns. They do not have them cluttered; they engineer well. A lot of people would say that they engineer to the extreme. Another place is Singapore, which is also engineered well. So on my list would be a few extremes, and I think Japan and Korea are at one end and— Lord Gordon of Strathblane: The Baltic states? Dr Cochrane: There are a few places there, yes. But from an engineering point of view, the costs, roughly speaking, if you dig a trench and it is at all hard work, like you are putting through Tarmac, concrete or any kind of stones inclusions, are about £80 a metre or thereabouts. If you are in sand, you can get down to about £15 or £10 a metre. It is of that order. So if it is 100 metres to your home, you are talking the top side of £1,000 just for the hole. So that is the order of the problem. However, very often you are not coming to one property; you can fan out to several. If you can get to one place, you can get to several others and

share that cost. Q72 The Chairman: That is interesting. Finally, if you were in charge of writing a national superfast broadband strategy, what would be its core principle? Dr Cochrane: The core principles would be founded on access for all companies and all people at a rate of 100 Mbps and above, with an eye on fair competition and an economic 148 Dr Peter Cochrane OBE – oral evidence (QQ 29-74) framework and a regulatory framework that encourage people to help themselves and encourage start-up companies to provide the competition that is necessary. Q73 The Chairman: Thank you. And if you were starting today, when do think it would be realistic to suppose that you might have managed to have achieved what you just described? Dr Cochrane: If we put everything in place, you have to be thinking in terms of a 10-year programme. It has to be of that order. One of the most significant difficulties now is the lack of physical skills. Getting enough people to actually go out there and do this is a problem for the established industry, let alone the new. So part of this has to be training up people with sufficient dexterity and technical skills to do this work. But I do think those people are there. It is a question of identifying them and getting on with the job. Q74 The Chairman: Thank you very much indeed, unless there is anything more you wish to say to us. Dr Cochrane: I wish you luck in your endeavour, and I look forward to reading your report. Should you require any more information or any help, if you cannot find it on my homepage, which is [cochrane.org.uk](http://cochrane.org.uk), just e-mail me or call, and I will help you all I can. The Chairman: You have been very generous. Thank you very much.