HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: UK telecommunications infrastructure and the UK's domestic capability, HC 450

Thursday 9 July 2020

Ordered by the House of Commons to be published on 9 July 2020.

Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Dawn Butler; Chris Clarkson; Katherine Fletcher; Mark Logan; Carol Monaghan; Graham Stringer.

Questions 61 - 206

Witnesses

I:Dr Yao Wenbing, Vice President, Business Development and Partnerships, Huawei UK; Mr Jeremy Thompson, Vice President, Huawei UK; and Victor Zhang, Vice President and Chief Representative, Huawei UK.

II: Woojune Kim, Executive Vice President, Samsung; Andrea Dona, Head of Networks, Vodafone; and Howard Watson, Chief Technology and Information Officer, BT Group.

Examination of witnesses

Witnesses: Dr Yao, Mr Thompson and Victor Zhang.

Chair: The Committee is conducting an inquiry into the UK telecoms infrastructure and our domestic capability, in particular with respect to 5G. This morning, we are hearing from network providers and some vendors. Before I introduce our first witnesses, can I ask members of the Committee whether they have any interests relevant to this session to declare?

Chris Clarkson: I put on record that I used to work for a telecoms provider, Virgin Media Business.

Q61 **Chair:** Thank you. We will start with our first panel of witnesses, all of whom come from Huawei. I am very glad to have you with us today. They are Dr Yao Wenbing, the vice president of business development and partnerships at Huawei UK; Mr Jeremy Thompson, also a vice president of Huawei UK; and Mr Victor Zhang, chief representative of Huawei in the UK. Thank you very much indeed for appearing before the Committee.

Perhaps I could start with some questions to Mr Zhang. Huawei has been listed as a high-risk vendor for many years. The Huawei Cyber Security Evaluation Centre was set up in 2010.

Victor Zhang: Chair, I cannot hear you.

Chair: We have a problem with the line. I do not know whether our other witnesses can hear me.

Mr Thompson: I can hear you perfectly.

Victor Zhang: Now it is okay.

Q62 **Chair:** Thank you. I was observing that for many years—over a decade—Huawei has been considered a high-risk vendor in the UK under three different Prime Ministers, all of whom had different relationships with China. Countries like the US, Australia and New Zealand have had concerns about Huawei as a security risk. What is your assessment of why that would be the case?

Victor Zhang: Thank you very much, Chairman. First, let me say something very quickly about myself. My name is Victor Zhang, vice president and chief representative in Huawei's London office. I worked in the UK for more than 10 years between 2004 and 2014 to oversee the programme journey in the UK from the early stages until 4G and 5G.

To answer your question, Huawei, working with the UK Government, at a very early stage was very open in addressing the security issue. I was CEO in 2010. We worked closely with the NCSC to establish the Cyber Security Evaluation Centre in Banbury. That was a very big move forward in showing you Huawei's transparency. We do not hide anything. We

provide all the software and hardware for the venture to be evaluated by British security experts at the highest level to evaluate Huawei's standards.

During the last 10 years, trust between Huawei, our operators and our customers has matured. This is very good practice. Even last year, the NSCS see this model still working very well and it is a good system to guarantee security.

Q63 **Chair:** Why was it necessary to set up a specific evaluation centre? We do not have that for other vendors or other countries. Why was it necessary to set up a Huawei cyber-security evaluation centre?

Victor Zhang: I was CEO at that time, in 2010. We had an opportunity to discuss it with the UK Government. The Government said, "Oh, cyber-security is a very big challenge at the moment." At that time, we understood the challenge and we said, "If there is a good measure, we can address the challenge." Then we came up with the solution, which was to set up the cyber-security centre in Banbury.

Q64 **Chair:** It was set up uniquely, but other countries have concerns about cyber-security in having Huawei as a vendor. New Zealand has recently said that it is regarded as a significant network security risk. There is now the very prominent example of US sanctions. What would be the effect of US sanctions on Huawei's ability to operate?

Victor Zhang: First, all of the security allegations by America and some other countries are totally untrue. We comply with the highest security standards, and during the past 30 years there has been no cyber-security risk from Huawei's network. We keep very strong checks and records globally, as we operate in more than 170 countries.

Regarding the new American sanctions, there was definitely an unjustified change by the Americans of foreign product laws. The impact is not clear. As I told the media yesterday, the impact will take quite a long time to evaluate because it is a complicated situation. It is related to the semi-conductor industry. We need to work with our customers and partners to evaluate the full impact. It is still too early to draw any conclusions, but what I can say is that Huawei has the capability to support the UK's gigabit broadband with a 5G and fibre solution; we are ready to support it and have been here in the UK for more than 20 years in the broadband economy.

Q65 **Chair:** The sanctions are already in force. Obviously, that has implications for countries and companies that rely on Huawei for their systems, so I would have thought you must be able to provide some advice or assurance to your customers as to what the implications are. They need to know now, surely.

Victor Zhang: You are right. We have already submitted our initial assessment to our customers and to NCSC. The initial solution is that in the short term there are no impacts on Huawei's supply capability to the

UK's 5G and fibre solution. We have already prepared for a five-year spares programme to make sure that the UK's existing network will not be impacted by the sanctions. That is the current and short-term situation. We are working closely with our customers and partners to evaluate the long-term impact. It takes time. We need to await confirmation of the full details of the sanctions and then we can come up with a solution with our suppliers and partners.

Q66 **Chair:** Can you explain why you do not think there will be a short-term impact?

Victor Zhang: I will give you an example. Huawei is a global business. We serve all the top telecom operators globally. We provide solutions that serve more than one third of the global population. With that volume, in China this year we are going to deliver 500,000 base stations for 5G. In the UK, because of that volume, the Government decision in January means that Huawei's 35% of the market share in 5G in the UK will result in a maximum of 20,000 base stations being deployed, so we have the capacity.

The telecoms business is not a supermarket business; we need long-term planning, so before we sign a contract we need to make sure that we can manage it for our customers and provide the solution. It is not something we install for just one week, like a supermarket; it is definitely a matter of planning, and we have the capacity to support the UK market.

Q67 **Chair:** The sanctions are already in operation; the question in many ways is whether they are going to be tightened further. In that event, even if you have a short-term ability to cope, what will you do in the next few weeks and months?

Victor Zhang: You are right; you make a very important point. As I said, we are working very hard with our partners to evaluate the full impact and the story for the long term. As a business, Huawei set up business continuity management 10 years ago. That was started from BT business. For all the components in Huawei's solution we do not allow only one source supplier, even for internal supply—for example, one chipset. If, globally, there is only one solution and one source of supply, we must choose a second one, or if there is not a second one we need to develop it. We have a very resilient supply chain because of our strong business continuity management over the last 10 years. We continue to enhance our business continuity management to make sure that for the long term we have a more resilient capability to support our global customers, which includes UK customers.

Q68 **Chair:** It seems surprising that a company as well resourced as Huawei, given that the prospect of the sanctions has been known for quite a considerable time, would not have more developed plans. Do you have those plans but do not want to disclose what the resilience of the company would be with respect to suppliers in the medium term? Do you have those plans, or are you saying that you have yet to work them up?

Victor Zhang: I mentioned that this is a very complex situation, and we are evaluating the whole impact and working on it. As you know, the Americans are going to confirm the detailed rules by the middle of this month. That is why we are working closely on it. If we have a plan—because we are very transparent and collaborative—we will show it to the UK Government and our customers.

Q69 **Chair:** Do you expect US policy to change if the Administration in the US were to change?

Victor Zhang: As I said, the US changing any rules is definitely unjustified. We do not know what is going on and what is going to happen in America. As a company, we need to make sure that we have resilience in the system to serve our customers with the best possible technologies.

Q70 **Chair:** Have you made an assessment as to whether you expect the sanctions regime to be permanent, or do you think it is contingent on the current Administration being in office?

Victor Zhang: As a company, we are not in a position to judge what America is going to do from now on.

Q71 **Graham Stringer:** Can I ask Mr Thompson what Huawei's response is to the report done by Christopher Steele?

Mr Thompson: We have not seen the report; we have seen the press coverage of that report, and we refute the content of what we have seen. Therefore, we have rejected the content of that report.

Q72 **Graham Stringer:** You have not seen it, but you reject the content.

Mr Thompson: We reject what we have seen in the press.

Victor Zhang: We see the report as untruthful, and we reserve the right to take legal action, if applicable, once we see the full story.

Q73 **Graham Stringer:** At the present time, I think there is consensus round the world that China is not a good global citizen. I can list all the problems with actions China has taken, from Hong Kong, to India and locking up more than 1 million Muslims. Do you think that morality and judgment about how China is behaving internationally should form part of anybody's assessment of whether to give Huawei a contract?

Mr Thompson: I feel that Huawei should be judged on what Huawei does. Huawei is a good global citizen, contributing to communications networks in 170 countries and providing communications to one third of the planet. I think we should be judged on how we behave, not how China behaves.

Victor Zhang: Huawei is an independent company; it is 100% owned by its employees. We are independent of any Government, which includes the Chinese Government. We are not in a position to judge the political decisions of any Government. We wish the world to have a stable

business environment. That is obviously what we want. We want a stable business environment in which we can do business with our customers.

Q74 **Graham Stringer:** You will forgive me for not accepting that. China is not a state like other states; it is very centrally controlled, and it simply is not credible that, if China wanted Huawei to do something, you would have the ability to resist it. China has broken an international treaty on Hong Kong. Perhaps you can respond to that. I simply do not accept that Huawei operates in China in the way Nokia operates in Finland. The relationship between the Chinese state and companies operating in China is completely different. I am afraid there is no credibility to that answer.

Mr Thompson: But Huawei operates in the UK as our competitors operate in the UK, under UK law. I have been in telecoms for over 25 years; I worked for BT as an incumbent UK telecoms provider. I have seen many different vendors, and what I see in the way Huawei behaves in the UK is consistent with UK laws and consistent with what you would expect of a company providing technology to the industry.

Q75 **Graham Stringer:** The question really is not about how Huawei has behaved in this country since it has had the contracts with the 2G, 3G and 4G networks. The question is whether, if the Chinese Government wanted it to behave differently in this country or elsewhere in the world, it would have the power to resist that. The evidence from looking at a very centralised country like China is that it would not.

Mr Thompson: Huawei has been here for 20 years.

Victor Zhang: You made a point about your understanding of China. As a company, as I said, we are independent of any Government, which includes our operations in China. We cannot judge and manage our company from any Government's perspective. What we do is comply with the laws and regulations in all the countries where we operate. If any Government wants to force Huawei to do something that harms and does not benefit our customers, we will say, "No." We would rather shut down our company.

Q76 **Graham Stringer:** Coming to my final point—I do not think this is controversial—the Chinese state has had a history of stealing intellectual property. Do you believe that, if we allow Huawei into 5G, this country will be more vulnerable to a cyber-attack?

Dr Yao: There is no evidence to support the claim that, if Huawei built 5G in this country, you would attract more cyber-attacks. That is absolutely not possible. Huawei has been leading in intellectual property in the area of 5G. By the end of 2019, Huawei held more than 85,000 active patents, of which 13,000 were granted in the US. Over 88,000 patent families were granted in Europe. We are leading in 5G technology. We do not see how cyber-attacks and intellectual property theft are linked together. We have the country's best interests at heart, and we could not possibly link the two together.

Q77 **Chair:** Mr Thompson, to pick up something you said to Graham Stringer, you said that in the UK Huawei operates as other companies do, and you cited your experience of BT. Are employees and directors of Huawei in the UK free to express their views?

Mr Thompson: Yes, very much so. We have a management team in the UK, like any other UK organisation, and we are free to express our views.

Q78 **Chair:** What is your view of the new security law in Hong Kong?

Mr Thompson: I am a telecoms executive. I have worked in telecoms all my life. My role is to enable our customers, who are the carriers, to provide communications faster and cheaper. I do not have a view on that.

Q79 **Chair:** You do not have a view. As you just said, you are free to express your views as any citizen in the UK would, but you do not have any view on something that I would have thought is quite germane to your commercial and international prospects. You have no view?

Mr Thompson: Chair, you have invited me here as a representative of Huawei. I am representing Huawei. Huawei does not get involved in judging the rules of different countries. We abide by the rules of this country.

Q80 **Chair:** But it is relevant, isn't it, Mr Thompson, in that you have said that the way Huawei operates conforms to the norms of the countries in which it operates? In this country, as you said yourself, people are able to express themselves, so you are able to give an opinion. Is it that you do not have one, or that it would not be consistent with your role in Huawei to make a statement about it?

Mr Thompson: I do not think it would be consistent with my role in Huawei in this forum.

Q81 **Chair:** Mr Zhang, do you have a view of the new security law in Hong Kong?

Victor Zhang: As Jeremy said, as a company we are not in a position to comment on the political agenda. As a company, what we want to do is work with our customers to make sure that the UK has the best digital network.

Q82 **Chair:** As an individual, are you able to comment on that?

Victor Zhang: Yes, I can, but not in this hearing because I am here as the vice president of Huawei. I could probably share my opinion with you after that.

Q83 **Chair:** Dr Yao?

Dr Yao: It is a similar situation. I do not think my personal view is of interest to this public hearing.

Chair: I think there would be great interest in it, but your response is

clear.

Q84 **Mark Logan:** My question follows up what my colleague Graham was asking. I think a better way to ask it is this. Western Governments often make a request to local tech companies for sensitive data or intelligence sharing. Would it not make Huawei's argument and credibility easier and stronger if you confirmed that there is a chance you would provide data when asked by the Chinese or, indeed, any other Government?

Mr Thompson: The first thing to say is that we are a telecoms equipment provider; we do not touch customer data. We do not run networks. We provide the equipment. To take the analogy of a house builder, we provide the plumbing; someone else builds the house and someone else lives in it. The plumbing is essential for the house to operate. It is not our role to operate the network or to touch customer data. We do not see that, but we have made it crystal clear that we would not interfere with data, even if we had the opportunity to do so.

Q85 **Mark Logan:** Why has the National Cyber Security Centre in the UK determined that Huawei is a high-risk vendor?

Mr Thompson: Huawei arrived in the UK 20 years ago. By the way, as you might expect, we do not like the expression "high-risk vendor", but because we had no market share and were not known outside China we were considered to be high risk at that time. Since then, we have contributed to the UK network and helped to increase the bandwidth available and the fixed line tenfold, and mobile twenty-sixfold, and we have reduced cost by a third. In fact, we are a third cheaper than the US and fivefold cheaper than 10 years ago. That is our contribution to the UK.

Q86 **Mark Logan:** Mr Zhang, if due to legislation and other constraints and advice by the NCSC, Huawei was in the short to medium term banished from the UK networks, how much of a failure or loss would Huawei see in being unable to access the UK market, or is the UK not even in the top 10 or top 20 markets globally for Huawei looking to the future?

Victor Zhang: We have been in the UK for 20 years. This year is Huawei's 20th year in the UK. We started with BT at a very early stage. With BT, we have built its fixed broadband since 2006 and deployed 70,000 street cabinets. We also started working with EE on 4G in 2012.

We have not done any evaluation of more restrictions by the UK Government on Huawei's role in the UK. What we can say is that Huawei is a great contributor to the UK. Based on the Oxford Economics report last year, in 2018 Huawei contributed £1.7 billion to the UK's GDP, and we created 26,000 job opportunities, both direct and indirect. We also procured investment in the UK between 2012 and 2018 of more than £3 billion. That is what we have done here. Apart from the network, we have invested, and procured and created job opportunities, in the UK. We hope that we will have the opportunity to work with operators to enhance

the UK's position for 5G broadband, which is very critical for the UK's economic recovery and for your innovation.

Q87 **Mark Logan:** That is the benefit for the UK, as you say, but for Huawei is the UK a top 10 market or, looking to the next 20 or 30 years, will the high-growth markets in south-east Asia, Africa, and even Latin America, be much more important to Huawei, and if you lose out in the UK it does not really matter in the end?

Victor Zhang: Let me give you an example, Mr Logan. The telecoms market is a population-related market. The greater the population, the bigger the market. That is why it is bigger in South Africa and other countries. It is definitely also dependent on the level of the economy, but quite importantly it is related to population.

The UK is a very critical market for Huawei, because UK telecom operators like BT and Vodafone always lead the industry and have the highest standards and strictest requirements for vendors to make sure the UK takes the leading position for serving the citizens of the UK. The size of market is not the only criterion for evaluating the importance of the market.

Q88 **Chair:** Mr Zhang, would you describe what would be the consequences felt by UK consumers if Huawei were to be removed from the UK network?

Victor Zhang: I do not have a detailed idea about that, if the UK Government came to that kind of conclusion. From what I have learned during my working experience in the UK of more than 10 years, I definitely believe the UK Government always take an evidence-based approach to decisions. Evidence-based decisions are very important. I believe that the UK Government will continue to do that for future decisions.

In the UK, we have worked with BT and Vodafone for 20 years to build the UK network. Until the year before last, the 2G network was still in place in the UK. It is not just a question of removing the technology from the network immediately, because it is a very complicated situation. It is not like a computer where you can replace it with another computer. It is a network, and there will be an impact on services, customers and investment for 10 years in the UK.

Q89 **Chair:** Would the person in the street notice the difference, or is that hidden from view? Is it an impact on the businesses that are your customers?

Victor Zhang: I can share with you a report from a third party. Mobile UK concluded last year that any partial or full restriction of Huawei's involvement in the UK's 5G would cause an 18 to 24-month delay of 5G deployment in the UK. Assembly, another organisation, concluded that a one-year delay in gigabit broadband would cost £9 billion in UK productivity benefits.

Q90 **Chair:** Is that also your view? That was a separate report, but does it conform with your assessment?

Victor Zhang: I am not good at economics. I trust the third-party evaluations.

Q91 **Chris Clarkson:** I want to pick up the comment made by Mr Thompson that Huawei is providing infrastructure rather than networks. You gave the analogy of plumbing. It is more accurate to say that you are providing doors, in particular back doors. I want you to explain for the panel the difference between the network topology with 4G and 5G, specifically how switching takes place within the network.

Mr Thompson: Let me first answer the question about doors, and then I will ask Dr Yao to comment on the topology because she is the expert on that.

We are probably the most inspected company in the world, certainly in the UK, from its products point of view. There is no evidence of malicious back doors in our products, despite years of true evaluation, so I would keep to the plumbing. We provide the pipes and the plumbing. Maybe Dr Yao could talk to the architectural discussion.

Dr Yao: At the moment, what we have seen in terms of cyber-security and the security level between 4G and 5G is that 5G provides at least the same level and is a safer and more secure network. That is defined by the international standards organisation 3GPP. It has been reiterated by 3GPP many times in the media and at conferences. Obviously, there is a lot of talk about back doors. It has already been clearly stated by NCSC, as Jeremy and Victor pointed out, that there is no evidence to the effect that it is linked to Chinese state interference.

When we build the 5G network, UK operators can choose to use the so-called non-stand-alone architecture to build 5G together with 4G. We do not see a material change in terms of the 5G network creating a greater cyber-security risk than 4G.

Q92 **Chris Clarkson:** In 2019, the Huawei Cyber Security Evaluation Centre oversight board found that there were "significant" technical issues around Huawei's engineering processes and that "no material progress had been made" in remediating some of the issues reported in the previous year. With that in mind, why have you failed to make any improvements? How genuinely secure is that network?

Mr Thompson: In 2018, Huawei announced a $2 billion investment in improving our software engineering capabilities. We fully accept that good security is built on good software engineering. As we move from a more hardware-defined world to a software-defined world, we as a business need to improve, as all providers do, our software and software engineering. That is a five-year project and programme. We expect to see some material improvements, probably next year. Some will be

coming through this year, but we expect to see some material improvements in our software engineering next year.

Q93 **Chris Clarkson:** I think you are drilling down on the point I was trying to make, Mr Thompson. A 5G network is a lot more software reliant than hardware reliant. If that software does not pass rigour and has any kind of flaws, the network is not secure, is it?

Mr Thompson: Our software is evaluated by the evaluation centre in the UK and it is now in the network, so we believe it is secure. We need to continue to improve and produce patches for some of the older products we are maintaining in the network, but we are confident in the security of our 5G network. The overall architecture is in itself more secure than previous generations.

Dr Yao: In addition to what we have done on software engineering transformation programmes, our product line has actively sought international certificates, especially security certificates, for our product. We have obtained the world's first CC and EAL 4+ certificate. We are the first of all other vendors in the world. That proves that our 5G-RAN product is secure. Our core product code has been evaluated by a very well-known German company. It concludes that the code quality is very good.

We are also one of the first to pass the GSMA and NESAS audit process to prove that our product development process satisfies the 21 separate requirements of the GSMA security product development process. Our core product is going through the same sort of international security certification exercise. Concerns about Huawei product quality have been reported by the media, but internally Huawei believes its product security is very good, if not better than that of other vendors.

Q94 **Chris Clarkson:** Who issues those certificates? Which body issues these security certificates and international standards?

Dr Yao: It is a very well-known CC certificate. I will tell you the society's name. It is a top international body; it is a well-recognised international security society. I will give you the full name of the organisation. All the people in the cyber-security world recognise it and accept it.

Mr Thompson: The UK has its own processes and standards, which are arguably higher than those of any other country, and we are committed to the process that the UK has put in place for Huawei and for improving the standards of security across the whole industry, which are different from some other countries in Europe.

Q95 **Chris Clarkson:** Which do you place a premium on—cyber-security or commercial viability?

Mr Thompson: Cyber-security. We would not be viable without a secure product.

Dr Yao: My mind went blank just now about CC. I want to come back to you on that. CC stands for common criteria. It is an international standard for communications security certificates, so it meets that international standard, to answer your earlier question.

Q96 **Chair:** Thank you, Dr Yao. We would be grateful if you would drop us a line with the details of that certification.

Dr Yao: Of course.

Q97 **Carol Monaghan:** What sort of customer or consumer information is a mobile phone provider able to collect about their customers?

Mr Thompson: I think we have to recognise that we have two distinct businesses here. One is supplying the carriers and the other is providing the mobile handsets that you would buy in the high street, typically through a carrier. We have no access to customer data from the carrier business; we do not run the networks. I think that should be clear; we have said it a few times.

The mobile phone business, which is the handset or smartphone business that we also operate in the UK, would have access to some customer data. That is managed very carefully, but it is a completely separate business and so is its consumer data.

Q98 **Carol Monaghan:** What sort of data would that be? Would it be buying patterns, Google searches and stuff like that?

Mr Thompson: No. If the customer signs up to a Huawei application store, we would have basic data on the customer for them to make consumer purchases.

Q99 **Carol Monaghan:** Surely, you would have basic data, for example, on customers' movements.

Mr Thompson: No. That data would be held by the carriers, because the carrier runs the network. We would not know the location of the customer.

Q100 **Carol Monaghan:** The question of human rights was touched on by my colleague Graham Stringer. The UK has a very strong record on human rights, and it is very difficult for us to operate when we know we are working with somebody who has a less robust record on human rights. There have been very serious allegations made regarding Huawei, particularly in Xinjiang province, and the Uyghur population. In that situation, I understand that the allegation is that Huawei was providing a lot of data about customers and their actions, movements and activities on 4G and potentially 5G. Should we be concerned about that?

Victor Zhang: As we have mentioned to you many times, Huawei provides telecom infrastructure equipment to our customers, the telecoms operators, either in China or in other countries. Once we deliver the equipment to a customer, the customer will own the network and will

operate and control the network. Huawei does not own any customer information from those networks. It is the same in any country where we provide telecom equipment; it is the pipe equivalent. There is no data stored in the equipment. We do not have access to the data; we do not run the network. It is the same in China and in the UK.

Q101 **Carol Monaghan:** If there was some sort of conflict of interest between the UK customer and the Chinese state, where would Huawei's loyalties lie?

Victor Zhang: If we operate in the UK, we comply 100% with UK law and regulations.

Q102 **Carol Monaghan:** I am asking about loyalties. Where would Huawei's loyalties lie?

Victor Zhang: To our customers—always. That is where we begin.

Q103 **Carol Monaghan:** Is Huawei's equipment interoperable with other organisations that would be hoping to operate within OpenRAN?

Victor Zhang: I will start, and then Jeremy and Dr Yao can add their comments. The telecommunications industry is a very standard-based industry. That is why we have multi-vendor integration in all countries. In one network there will be equivalents that can work together based on the international standard. That is where we are in the telecom industry.

OpenRAN is one of the masters for 5G. Huawei is technologically neutral on implementing 5G. Currently, OpenRAN, compared with SingleRAN, is far behind in performance. OpenRAN has high power consumption, and its performance is far behind SingleRAN; it is about three to five years behind SingleRAN. That is why we are looking at OpenRAN as one of the choices. Once OpenRAN arrives and has comparable performance with SingleRAN, we believe Huawei will be one of the best suppliers of OpenRAN as well.

Q104 **Carol Monaghan:** But at the moment it cannot deal with OpenRAN; its equipment is not interoperable.

Victor Zhang: As I mentioned, telecommunications is very standards-based. SingleRAN is based on a series of standards. Currently, OpenRAN does not have those standards. If there are no standards, no one can guarantee interoperability.

Mr Thompson: We interoperate. We have protocols that allow us to work with other vendors. The nature of a telecommunications network is that it is a team game with multiple vendors, and that is evidenced by the fact that our radio access network, which we operate here in the UK, inter-works with other core networks, so we interoperate. We interoperate with the way the standards were set up. OpenRAN is new. We are neutral to it, but how we interoperate further depends on how it develops.

Q105 **Aaron Bell:** Mr Zhang, following the recent US sanctions, who will Huawei be using to supply its chip technology in future?

Victor Zhang: As I told the Chairman earlier, we are working on the long-term impact of the new restrictions. We are not in a position to have a full plan. Once we have that plan, we will share with you the solution for replying to the new restrictions from America.

Q106 **Aaron Bell:** But there isn't a company that can supply leading-edge chips, apart from using American technology, is there?

Victor Zhang: I do not have that information at the moment. It is still too early to draw any conclusions because America will not formally confirm it until the middle of this month.

Q107 **Aaron Bell:** You say it is too early, but, unfortunately for you perhaps, Britain and other countries will have to make decisions very soon about the future. Unless we have confidence in your supply chain, and the quality assurance of that supply chain and the security checks you are able to perform on it, we are not going to be able to proceed with using your company as a supplier for 5G, are we?

Victor Zhang: We definitely understand that the UK is reviewing the impact. We are working closely with them and our customers to address it. As I mentioned, there is no impact on Huawei in supplying the UK's 5G and fibre solution. For the long-term solution, as I said, we will definitely work with them to provide a solution. Once the situation is clear and we confirm all the details, we will take the next step.

Dr Yao: The FDPR is targeting Huawei's own chipset design capability, but the company also has the capability to use other companies' chipsets, such as Corcom and MediaTek. I saw in the media yesterday market anticipation that the price of Corcom's and MediaTek's chipsets will go up because of Huawei. Its high silicon chipset supply will have some impact on that. On the other hand, taking Huawei out of the market will have a detrimental impact on fair competition and will be detrimental to consumers' advantage.

Q108 **Aaron Bell:** That is the argument that I think was accepted in January, but the US sanctions fundamentally have changed that. New Street Research said: "Without leading-edge chips, Huawei cannot sell competitive networking equipment, and there is no alternative to fabricators powered by U.S. technology to manufacture such chips."

Aren't the US sanctions fundamentally game-changing for you as a company, potentially worldwide, if you are not able to provide a competitive product, but specifically in terms of our security concerns in the UK?

Mr Thompson: They are certainly not helpful. We were put on the entity list last May. We communicated with our customers and the UK Government, saying, "Give us a few weeks and we will work out what this means, but we feel confident we will find mitigations for that." After six

months or so, we were able to confirm that mitigations were in place, and here we are 12 months later and there has not been an interruption in supply.

As you say, this is very different; it goes to the heart of the chip design and some of the competitive advantages that Huawei has, but we have resilience in our supply chain. We feel confident that we will have mitigations, maybe not all the mitigations, in place later this year. We just ask for time to respond, in the same way as we did last year, to do the analysis, understand the supply chain, identify the mitigations and share them with the UK Government.

In the short term, we can supply our customers; 5G is not an issue in the short term, and the existing network is not an issue. We need time to evaluate what the rules mean, given that they have not even been published or finalised. When they are finalised, we will be able to assess what it means and come back to you as quickly as possible.

Q109 **Aaron Bell:** You obviously do not have a preferred supplier sorted out, but, if you do, how will we and other countries be able to examine that supply chain in the way we can at present, which is what has given us confidence at the moment? If your supplier is potentially a Chinese firm, for example, how will we be able to trust the quality assurance and security checks in the manufacture of those chips?

Mr Thompson: We appreciate that. As for transparency in terms of who the alternatives are, they are not just Chinese; there are also European companies in that space. We will be able to share those with you, but it will take a few more weeks.

Q110 **Aaron Bell:** You will have read that it has been reported that the National Cyber Security Centre is likely to recommend, on the basis of the American sanctions, that its assessment of Huawei's future viability in the UK has changed and that Huawei products will not be secure enough. You have asked for more time, but what is your response if that is the conclusion we see from the NCSC?

Mr Thompson: When the rules are finalised, we will have a better view of their implications. Clearly, we have been working on this since the draft rules were published, but we just ask for more time. We have been here for 20 years; we have been a key contributor to the UK. We buy more from the UK than we sell to the UK. The components that go into our products come from the UK. We ask for more time to be able to make that assessment. If our mitigations are not satisfactory, fine, but there isn't a burning bridge. We can supply our customers with their orders and support the existing network with spares.

Q111 **Dawn Butler:** Mr Zhang, I want to go back to something you said earlier about the evaluation process and Huawei being highly evaluated. Do you agree that when it comes to software and programming it is nigh impossible to identify any form of rogue coding or Trojan software?

Victor Zhang: In the UK, we worked closely with the NCSC to set up the evaluation centre in Banbury, which has highly experienced British personnel at every level. They have evaluated Huawei's solutions for the past 10 years. As Jeremy mentioned, we started our transformation programme in 2018, to invest $2 billion in improving the software capability end of the architecture to address that challenge.

Q112 **Dawn Butler:** Let me put it another way. Using Jeremy's analogy in regard to infrastructure and plumbing, most people are just concerned with turning on the tap and getting water. You are the person who is putting in the plumbing, the pipes and the infrastructure. You could connect the plumbing to next door and I would not know about it, unless my water meter reading went through the roof, or you could put in plumbing for future homes that I would not know about until those homes were built. Is that not correct?

Mr Thompson: The UK has the best view of Huawei's software and hardware and has confirmed that there is no evidence of Chinese Government malfeasance. We would say you know us really well. You know what our pipes look like. That is why I think you have reassurance from HCSEC and the experts there that it is a secure network. We accept that it needs to improve in terms of its software engineering and we have a programme to address that, but we are safe to do business with.

Q113 **Dawn Butler:** Huawei is 99% owned by a trade union committee. Who sits on that committee, and how are they chosen and selected?

Victor Zhang: I will give you a very quick update about Huawei's governance structure, as you have touched on that point. As I mentioned before, Huawei is a private company, 100% owned by employees. How many shareholders in the company? Currently, there are 104,572 shareholders in the company. In total, we have 190,000 employees globally in more than 170 countries and nearly half of them have shares in the company. Our founder, Mr Ren, has only 1.04% of the shares of the company.

You mentioned the trade union. That is just a name. The structure is that the shareholding employees have the right to vote for the representative commission, which consists of 115 representatives. They have the right to vote for the directors and the supervisory board in the management team. That is our ownership structure. No third parties or any other people who do not work at Huawei have shares in the company.

Q114 **Dawn Butler:** All of the employees own the company.

Victor Zhang: One hundred per cent.

Q115 **Chair:** Mr Thompson, are you one of the employee owners?

Mr Thompson: No, I am not. The 100,000 or so owners are Chinese. There is a scheme for non-Chinese people who participate. We do not have voting rights, but I have to say there is more democracy in Huawei

than in any company where I have ever worked in terms of voting for the leadership team. Unfortunately, I do not participate in that.

Q116 **Chair:** No one in the overseas operation does so. Is that right?

Mr Thompson: No one outside China.

Q117 **Chair:** Why would that be, Mr Zhang?

Victor Zhang: Company law in China has limitations on shareholders in terms of citizenship in China. We came up with a solution for incentives for our overseas employees. We call it the TUP programme and it has an incentive mechanism similar to our internal shareholder programme.

Q118 **Chair:** But not contributing to democracy in decision making.

Victor Zhang: Not voting in the shareholding system.

Q119 **Chair:** We are almost out of time. We are grateful for the time you have spent with us. I have a couple of final questions.

Australia has been interpreted as having a de facto ban on Huawei and other Chinese suppliers. Mr Zhang, I think you yourself told the previous emanation of this Committee in the previous Parliament that Huawei "remains a major network equipment provider" in Australia. Is that still the case?

Victor Zhang: Australia decided not to allow Huawei to participate in what is called its MBA programme—its national broadband network. I cannot give you the exact year, but it was many years ago. After that decision, the MBA took about 10 years, having started and finished that programme. That is what we know from the very beginning. We still have a team in Australia to support customers in their existing 4G and 3G networks.

Q120 **Chair:** But that is declining. Do you expect that it will be removed at some point? Is that the trajectory taking place in Australia?

Victor Zhang: I do not have that detail. I am not sure if Jeremy has that detail. What I know is that we are supporting our customers there.

Mr Thompson: I do not have the detail on Australia, but we have a customer base there that we support. Telecommunications infrastructure is put in typically for a decade or so, and we will support our customers in 3G, 4G and 2G and whatever fixed network we have in Australia.

Q121 **Chair:** In terms of your knowledge of the Chinese market, what is the extent of participation by overseas vendors in China?

Victor Zhang: The Chinese telecoms market is a very open one, with free and fair competition. There are the same players in China as in the UK: Huawei, Ericsson, Nokia, Cisco and other players. They are all in China to build our telecoms infrastructure based on fair, commercial competition.

Chair: We have overstayed our time with you. We are very grateful for your evidence. We need to turn to our next panel.

Thank you for giving evidence to the Committee today. The Committee is considering Britain's future capability in telecommunications, of which 5G is an important part. There are some imminent decisions that we know will be taken. Our inquiry is for the longer term as well as the short term, and we are very grateful for the information you have supplied today. Thank you very much indeed.

Examination of witnesses

Witnesses: Woojune Kim, Andrea Dona and Howard Watson.

Q122 **Chair:** I am very pleased to welcome our second panel of witnesses. Mr Woojune Kim is the executive vice president of Samsung. You are very welcome. Mr Andrea Dona is the head of networks at Vodafone and Mr Howard Watson is the chief technology and information officer of the BT Group. Thank you very much indeed for joining us.

I will start with some questions to Mr Kim on Samsung. Samsung is a very famous and renowned telecoms and technology company, but it has a limited presence in the network discussions that we have been having in the UK so far. Is it too late for Samsung to enter the UK and European markets substantially?

Woojune Kim: Thank you for the opportunity to address the Committee. First, I would like to change your question. You asked whether it was too late to enter. We are actually part of the UK network right now, as part of Hutchison 3G UK. We have supplied them with over 12,000 base stations over the last five years, building up their LG network. I do not think it is a question of whether we can enter; we are already in that market. We are trying to expand the market as we get into 5G. We would not say it was the easiest thing in the world, but nothing in life is easy. We are working on it.

Q123 **Chair:** To put it a different way, you have a relatively small presence in the market compared with some of the majors. Is it possible for you to get to the scale that some of the major players have?

Woojune Kim: Yes. There are some questions about our scale right now. We have about 10% of the radio market worldwide. I think we have shown our operational capability, as you have said. The question is whether you can get the right products. Everyone agrees, at least those in the industry who are well aware, that our products are top-class. We have already shown our phones to be top-class. We have taken that knowledge base to create software chip manufacturing capabilities and added them to our 4G and 5G R&D capabilities to create what we think are market-leading products.

The next part is commercial discussions. That is also something we are very active in with a lot of operators. The one thing that is a challenge for

Samsung entering the UK or European market is related to the request for SingleRAN technology. I would say it is more like 2G or 3G technology—the legacy technology. That is a burden that we, as a company with responsibilities to our shareholders, have decided not to take. It is a lot of investment in creating a technology that is basically a dying technology.

We prefer to invest our money in creating forward-looking technology such as 4G, 5G and now 6G. That has resonated a lot with our current customers and has been very helpful for us in gaining our market share in the last couple of years, and hopefully in the future.

Q124 **Chair:** Do you think it is the wrong regime, if I can put it that way, to have a non-stand-alone network, rather than regarding 5G and its successors as a fresh start?

Woojune Kim: Whenever you get new technology, you always have an opportunity to refresh the network, or not. Various operators in the world have taken different paths. The Korean, Japanese and US operators, for example, have been very clear. They tried to go for the new technology and invest there. They invest less in legacy technology. The reason is very clear. Basically, that is where the market is and where they believe they can maximise their revenue. That is the difference between those markets and what has happened in Europe and the UK.

Q125 **Chair:** If it continues to be the case in the UK that it will require, as it were, an entry or a capability and legacy systems, is that something that Samsung is willing and capable of developing in order to access the forward opportunity?

Woojune Kim: That is a very interesting question. We have been talking a lot about OpenRAN. OpenRAN can be interpreted in a lot of ways, but one of the key technologies besides OpenRAN that is coming to the fore is virtualised RAN—vRAN—a software-based solution. We are finding a lot of opportunities to partner with smaller companies or other companies so that they can bring in 2G and 3G solutions that they have already developed and merge them with our solutions. That is one way where, if the operator still requires 2G or 3G, we could enter the market.

There is another somewhat easier way. You can separate the 2G and 3G network from the 4G and 5G network. You do not have to have them all from one vendor. If the operators or our customers agree that you can create a 4G/5G overlay on top of the current network, that is more than a good enough way for us to enter the market. It has been done already in many places throughout the world.

In Korea, for example, we showed last year that you could put a 5G network on top of another vendor's 4G network and it works perfectly well. Unfortunately, that was not possible in the old days with 2G and 3G. That is why the whole SingleRAN concept came about. People believed that you could not mix and match, but as the technology has evolved, we

have come to a stage today where you can mix other vendors' equipment much more easily.

If you extend that a bit further, that is where you get the whole concept of OpenRAN. We are on that path. We had some of it in 4G, and a lot more is coming in 5G. It opens up a lot of doors for us. It is not something that is going to block us in the future. It is going to be more the mindset of countries and operators, but, as I said, we have already shown, in Korea, Japan, the US, Canada, and so on, that it is possible to swap the vendors.

Q126 **Chair:** That is helpful; thank you. We will go into a bit more detail on that through my colleagues. If we were to follow that route, does it have an implication for the speed of roll-out or the cost of roll-out? In other words, is it slower and more expensive?

Woojune Kim: Overall, speedwise it is much faster. Say you have to do SingleRAN and you have to bring in new vendors. Basically, you take apart your whole network. It is as if you want to add a kitchen and you tear down your house and rebuild the whole house because you want the same fixtures everywhere. But if you do 4G or 5G with an overlay, as we were saying, you can concentrate on building that network out as soon as possible, as quickly as possible. You can just add the kitchen or add the garage to your house, and that is usually much faster. That will help you do it much faster.

Where you might have questions is that some people will say it will be more expensive. That is a point of view. It may or may not be. There are a lot of commercial aspects that play into that. There is also the aspect that if you are a legacy vendor you can always argue, "Oh, I can make it much cheaper for you if you just add on 5G." As I say, that is more of a commercial thing than a technological issue.

Q127 **Chair:** You may have heard some of our previous discussion with executives from Huawei. Clearly in this country, and globally, there is much consideration of its future role in 5G. Is that something Samsung is considering at board level in its strategy? In other words, if a hole opens up that was previously occupied by Huawei, is Samsung looking to fill that hole?

Woojune Kim: We always look for commercial opportunities. Wherever there is an opportunity, we will go there with our products. Samsung as a company has a very firm belief that things can change very rapidly in the market, but the only thing that does not change is having the best product. Our view will always be to make the best product that we can and be the best partner to the customers, and everything else solves itself.

I know there is a lot of discussion of the political winds, but political winds can shift and things can happen differently, so we do not base our strategy on those aspects.

Q128 **Mark Logan:** Mr Kim, good morning, or it might be good evening. In 2018, the head of Samsung Electronics network business division, Kim Young-Ki, stated that Samsung aimed to capture more than 20% of the global 5G equipment market by 2020. What share of the global 5G equipment market does Samsung now have? What does that mean for the UK?

Woojune Kim: He is actually my old boss. At the end of last year, Dell'Oro placed us at 34%, or something like that, of the global 5G market. This year, it has gone down a bit. I think we are anywhere from 14% to 20% depending on how you count the revenue or the base stations. We were roughly on track for the 5G market.

More importantly, if you look less at market share but more at mind share and how industry views our leadership in 5G, we are viewed as one of the clear leaders in 5G technology and products. We are very happy with our progress, but we want to go to the next stage.

Q129 **Mark Logan:** Is your approach to supplying markets like South Korea applicable to the UK?

Woojune Kim: That is a very interesting question. Frankly, every market has its characteristics. First, we have to make great product and great software, and have great services. Then each market has its differences. For example, if you compare Korea and the UK, the biggest difference is that Korea is a super-dense country. The UK has maybe a maximum of 18,000 to 20,000 base stations per operator to cover 60 million people. We have maybe 100,000 base stations or sites—sites is the correct term—to cover a population of roughly 50 million.

Korea has come to a stage where people talk less and do more text messaging, chatting and internet browsing. Our network is more focused on that sort of optimisation. The UK is less dense. The UK population still talks a lot more on the phone. It is friendlier, I guess. There are some differences like that.

We have noticed that as we go to different markets there are differences. India has a market that is very text crazy. The US uses voice minutes much more than others. Every market has its characteristics, but, as I said earlier, our key point is that if you make the right products, and have the right technology, good software and the right people, it always fits.

Q130 **Mark Logan:** Is developing the radio access network equipment for telecoms networks that we touched on earlier a new venture for Samsung?

Woojune Kim: No. We have been in the networks business since the 1970s or 1980s. We created the first CDMA wireless base stations in the mid-1990s, so we have been in the business for roughly 25 years-plus.

You could say that we placed our bet on the wrong horse, in that we bet on CDMA and WiMAX for example. They were old technologies that were laid aside by GSM technology and later by LTE. Although we developed a lot of technology that was used in later generations of wireless, we placed the wrong bet. It was very technology intensive. From LTE and 5G, we have been right in the forefront of technological development, and our products reflect that right now.

Q131 **Mark Logan:** Very briefly, how does the product produced by Samsung compare to your competitors such as Ericsson and Nokia?

Woojune Kim: The best proof is in the pudding. Korea, where we have more than 50% of the market, is ranked as the best wireless network in the world by many people who do that sort of stuff. That is a reflection not only of our operators but also our products.

Q132 **Graham Stringer:** Mr Kim, to follow up Mark's question, could you quantify how much investment you are putting into the radio access network? We know that your competitors have invested very heavily. Can you put any figures on your investment?

Woojune Kim: It is hard to put a direct figure on it because, as a rule, we do not break down our multiple business use in Samsung. Samsung invests over $19 billion in R&D per year. For some of our competitors that is actually their revenue, in some ways. You could say that the $19 billion is spread across multiple things, but I would say that all of them are relevant to 5G. In our chipset division, we create the chips. We create a secure supply chain there. We have a lot in pure research, in AI. That is also helping as we go to software-oriented networking. We have a lot in our own division as well. Investment-wise, in R&D, we are more than capable of matching everyone else in the world. We are investing more than others in many ways.

Q133 **Graham Stringer:** Mr Kim, $19 billion is a very impressive figure, but how much of it is going into work on the radio access network?

Woojune Kim: We cannot break that down, as I said, Mr Stringer. We are part of one of the seven major business units in Samsung Electronics. The seven major business units divide up the $19 billion in R&D.

Q134 **Graham Stringer:** You have partially answered these questions previously, but I want to be clear, so that we are not left with any ambiguity. Can you supply a new stand-alone 5G network to the United Kingdom?

Woojune Kim: Yes, we can; definitely.

Q135 **Graham Stringer:** Would OpenRAN technologies allow Samsung to supply non-stand-alone technologies in time for the 5G roll-out?

Woojune Kim: We do not think we need OpenRAN to supply non-stand-alone 5G. As I said last year, we have already proved it in Korea. In the standards, you can mix and match 5G equipment from different vendors

with a 4G vendor and supply non-stand-alone. It depends on your definition of OpenRAN, but that is an OpenRAN solution.

Q136 **Graham Stringer:** Finally, if Samsung was to enter the network in a big way, is there a commercial risk for other network operators?

Woojune Kim: We de-risk it quite a bit for other operators. In today's world, operators are looking for vendor diversification. That is one thing. It is not vendor diversification for vendor diversification's sake. You also want a financially stable vendor. Frankly, over the last 20 years the industry has been pretty brutal to the vendors. We have gone down, I would say, from 10-plus to maybe three or four who could stay viable. For any operator going forward we, as a $200 billion company that has over $100 billion in cash, are a vendor you can believe will still be around in 10 years, so, for operators, we heavily de-risk their future.

Q137 **Graham Stringer:** I thought that was my final question, but you said an interesting thing about the reduction in the number of players in the field. Has that reduction in numbers been brought about by unfair competition in some cases, effectively by state subsidy?

Woojune Kim: I cannot say if that is a direct cause, but over the last 10 or 15 years there has been brutal competition in the market. You could say that in some cases the prices did not make sense. That has been proven. A lot of companies went into the red; they were not able to sustain their business and had to go under. You can argue about the root causes, but that is what I think has happened in our industry in the last 20 years.

Q138 **Graham Stringer:** Is one of the players in that field whose bids do not make sense Huawei?

Woojune Kim: It has been one of the most aggressive vendors in the industry. I cannot really comment on their situation, but they have been a very aggressive competitor. They have been a very tough competitor.

Graham Stringer: Thank you very much. You have been admirably clear.

Q139 **Chair:** Thank you, Mr Kim, for your evidence. We are fortunate to have with us two of the UK mobile network providers. Perhaps I could ask you to start by describing which vendors you have contracted with to supply both the core and the radio access network components of the 5G network.

Andrea Dona: The Vodafone UK network uses Ericsson and Huawei in the RAN part of the network—the radio access part of the network. That is the infrastructure, the antennae and the radio base stations near the site. We use Huawei and Ericsson in the 2G, 3G and 4G parts of the network, including the 5G part of the network.

Q140 **Chair:** In what proportions?

Andrea Dona: Roughly a third of our network—2G, 3G and 4G—is with Huawei. The rest of 2G, 3G and 4G is with Ericsson. We also use Huawei and Ericsson in the 5G part of the network. The split is commercially sensitive at this moment in time so I will be unable to divulge those numbers, but what I can say is that Huawei is not used in the core part of the network, which is the brains of the network where the aggregation of data occurs.

Q141 **Chair:** Why are the figures commercially sensitive for 5G, but not for 4G?

Andrea Dona: We recently launched 5G, a year ago, in a very competitive environment. By divulging the numbers, we would give our competitive advantage away.

Q142 **Chair:** Mr Watson, I have the same question for BT. Who do you use in your 5G network? Do you want to say something about your legacy network as well?

Howard Watson: Similarly to Vodafone, we have two vendors in our radio access network: Huawei and Nokia. We use Huawei for 2G, 4G and 5G. We use Nokia for all of 2G, 3G, 4G and 5G today. On the split, leaving 3G to one side because that is exclusively Nokia, we use the SingleRAN as described by Mr Kim for 2G and 4G, and that is two thirds Huawei and one third Nokia. We, too, launched 5G a year ago, and have tended to use Huawei in the more urban areas of the UK where we tended to launch 5G initially. The majority of our current 5G deployment is on the Huawei network.

In the core, we use both Ericsson and Huawei. We are currently removing Huawei from the core of our mobile network in line with Government policy. Would you like me to speak to the fixed network, or do you just want to concentrate on mobile?

Q143 **Chair:** We will keep our focus on mobile if that is okay. Having heard the evidence from Mr Kim, why don't you have Samsung in your mix, Mr Watson?

Howard Watson: The key point that Mr Kim makes is about the SingleRAN concept and the 2G/3G legacy. Right now today, 50% of my voice calls still use the 2G/3G network. The 4G element of that has increased significantly over the last few years, but there is still a not insignificant number of customers—high single millions—who have devices, phones, that can only use 2G/3G in the UK. A lot of the early deployment of devices that we use—sensors—relies heavily on the 2G network. My view right now is that for a replacement technology today 2G has to be a critical part of the solution.

Andrea Dona: We have a very similar situation. We cannot ignore the fact that a lot of our customers are businesses that rely on 2G/3G technology. Their devices are 2G/3G-only enabled. The transition to fully-blown 4G/5G has to go hand in glove with our commercial colleagues to replace the devices on the ground and ensure that only 4G/5G enabled

are present before we can completely move away from 2G and 3G technology.

Q144 **Chair:** What would the consequences at Vodafone be, Mr Dona, of the requirement to remove Huawei, not just from the core but from the periphery of the network?

Andrea Dona: If we follow the current guidelines—the ones that are in force now; the 35% RAN cap and the ban on the core—because we in Vodafone do not have Huawei in the core, there is no effect on that. We believe that the steps taken by the telecoms supply chain review that led to the high-risk vendor report strikes the right balance between securing the telecoms networks and giving us stability to keep investing in the networks.

According to the current Government's position, we do not expect a material financial impact or operational impact in the UK on the basis of the current guidance. Should that guidance change and become stricter, it will have an effect. It will delay the roll-out of our 5G. It will have cost implications, because it will focus our investment on the removal of the existing equipment to replace it with new.

Q145 **Chair:** What sort of time and how much capital would that consume?

Andrea Dona: If the current guidance were to be tightened, and further restrictions were to be imposed, we would need to spend in the order of billions to change our current infrastructure.

Q146 **Chair:** If Huawei was required to be removed, how much would you have to spend over and above what you would ordinarily spend?

Andrea Dona: Of the order of billions.

Q147 **Chair:** Single figure billions.

Andrea Dona: Single figure billions.

Q148 **Chair:** Between one and 10 billion.

Andrea Dona: Yes.

Q149 **Chair:** Towards the bottom or the top of that range.

Andrea Dona: Towards the bottom.

Q150 **Chair:** Is there a trade-off on the time for the deployment of 5G? If you commit the right amount of money, can you do it sooner, or is there an inevitable length of time by which it would slow down 5G deployment?

Andrea Dona: When considering further restrictions, we need to look at a sensible and practically feasible timescale over several years to minimise the disruption that it will have on our business and customers. Infrastructure deployment, by its very nature, requires multiple years. A quick U-turn or change in decisions would undermine the resilience of the network. We would be looking, if there were to be further restrictions, to

have a realistic timeframe for us to be able to minimise the impact that a very challenging rip and replace of the existing Huawei equipment would have on the network. We have an existing installed base of 2G, 3G and 4G—

Q151 **Chair:** How long would that take? If you had to do it quickly, how long would it take?

Andrea Dona: In my experience, these are multiple-year programmes. The replacement does not happen overnight. We would have to manage the impact that ripping out the equipment had on our consumers and businesses. In the current guidelines, the imposition from the Government is for a 2023 timescale. We would look at having to extend that considerably if we were to consider replacing Huawei in the network.

Q152 **Chair:** If the Government said you had to do it in two years, are you saying that you could not do that?

Andrea Dona: It would be highly disruptive for our customers and businesses, especially at a time when we are so reliant on technology.

Q153 **Chair:** How would it be disruptive? Describe what the impact would be on your customers.

Andrea Dona: The swap involves going to a base station or a site—a mast—and taking out the equipment at the base of that mast. That means switching off the signal, disconnecting the electronics from the cables of the antennae and replacing them, so there is downtime. Service-affecting work is being carried out. It needs to be replaced with new equipment. There is also planning—

Q154 **Chair:** That is what needs to happen, but what is the effect on your customers? Are they going to be without service?

Andrea Dona: The customers would lose their signal.

Q155 **Chair:** For how long?

Andrea Dona: Sometimes a couple of days, depending on how big and how intrusive the work to be carried out is.

Q156 **Chair:** What length of time do you need to avoid the loss of signal for customers? What length of time would you need to replace that equipment and to be able to guarantee—

Andrea Dona: A swap needs to be planned over multiple years. The existing coverage needs to be evaluated, and the sequencing of events for how the equipment gets changed needs to be thought through very carefully.

Q157 **Chair:** What is the minimum period that could avoid disruption to customers?

Andrea Dona: A five-year transition plan would be the minimum.

Q158 **Chair:** Mr Watson, the same question to you.

Howard Watson: The ban on using our core networks and the 35% limit in the access networks over three years is hugely challenging and costly to BT; you will note that at the time we announced a £500 million impact. But we think it is ultimately manageable. We can meet it with minimal major network disruption. However, we recognise that the latest movements, with the US sanctions and the review that the Government have requested the NCSC to carry out, are important. Clearly, we will abide by whatever direction comes out of that.

Like Andrea, I believe it is logistically impossible to get to zero in a three-year period. That would literally mean blackouts throughout the country for customers on 4G and 2G, as well as 5G, as we were building it in. We would definitely not recommend that we go down that route.

Q159 **Chair:** Would you agree with Mr Dona that the blackouts would be for a number of days or over a different period?

Howard Watson: Think of it this way. Our mobile network today has multiple overlapping cells. With your device, you are typically in the range of multiple masts or rooftops. We can probably manage changing one out, where you lose a bit of capacity but you do not lose signal. That is why over the three-year period, we think we can get to 35% without causing significant disruption.

To take the whole network out, the two thirds, would require multiple sites to be switched off at the same time for at least a day, or, as Andrea says, for two days. London is mainly served through equipment on rooftops. We would need to close streets, bring cranes in, lift new equipment up to the top of rooftops, replace it, put the old equipment back down on the street and then reopen the streets. That is logistically not practical in the timeframe of three years that has been discussed, or the two and a half years now remaining.

Q160 **Chair:** What would be the minimum period to do it without that disruption?

Howard Watson: We believe we need a minimum of five years, and ideally seven.

Q161 **Chair:** What is the answer for BT, and EE in particular, in terms of the cost? Mr Dona said the low billions. Is that something you would agree with?

Howard Watson: We have already stated half a billion as part of the implication.

Q162 **Chair:** Is that for the 35%?

Howard Watson: That is for the 35%. Correct.

Q163 **Chair:** If it were to be totally removed, what would it be?

Howard Watson: Again, it depends on the timing. The key issue is the life of the 4G equipment. If five years is logistically appropriate timing, between that five, six, seven or eight-year period, I would be out there anyway replacing 4G equipment that was starting to get towards end of life. In our view, the increment on top of the 500 is not double that; it is in tens to a hundred million rather than significantly double what we stated previously.

Q164 **Carol Monaghan:** Can I ask you a bit more about that, Mr Watson? Back in 2018, BT stated that it intended to remove Huawei from the core of the EE network anyway. First, could you tell me if any progress has been made on that?

Howard Watson: Yes, we have made significant progress. We have been through a period of selecting which vendor to use. We selected Ericsson and announced that. We have been trialling the Ericsson equipment in our network and through pilots. We have now approved that. We are now building that capability.

We are ensuring that we focus on 5G customers first, in line with the guidance issued in January, and then follow that by migrating the 4G customers. The guidance in January set the 2023 timeline as the requirement for that.

Q165 **Carol Monaghan:** There is a bit of an issue. In 2018, you said you would have it done by 2020. Now in 2020, you are saying it is going to be a further three years. Why has it not been a major priority of BT?

Howard Watson: It is a priority of BT. Over that period, the focus shifted from removing the core from the 4G network to focusing on 5G, as has been discussed more broadly. We focused on ensuring that what we replaced it with was capable of both 4G and 5G. To replace the 4G core and then to have to do something again for 5G did not make any sense as an engineering project. In essence, through that period, we decided to focus on both 4G and 5G together, hence the extended timeframes.

Q166 **Carol Monaghan:** So for the next three years, assuming that you meet your 2023 target for the removal of Huawei, we have a high-risk vendor in the core of the 4G and 5G network.

Howard Watson: In the core of the 4G network and for the initial 5G deployment. We will meet that date by January 2026.

Q167 **Carol Monaghan:** You are currently putting in 5G equipment with Huawei at the core.

Howard Watson: There is a key distinction. The 5G radio equipment currently runs on the 4G core. The 5G core that we will introduce will be from Ericsson.

Q168 **Carol Monaghan:** How are you mitigating the risk that Huawei poses at the moment for the 4G that still has Huawei at the core?

Howard Watson: We are strongly aligned with HCSEC. Both we and HCSEC work closely on ensuring that the hardware and software that we deploy in our network does not have vulnerabilities associated with the definition of a high-risk vendor.

Q169 **Carol Monaghan:** Why then do Government want to remove Huawei from the core if you are saying it is okay?

Howard Watson: No, I am not saying it is okay. I am saying it is mitigated. We agree that the long-term trajectory—by January 2023—is that it should be removed from the core.

Q170 **Carol Monaghan:** My other question is about the consequences of the radio access market share. You spoke about that a bit earlier to the Chair. We now have a market cap share on high-risk vendors. How will that hit you? What will be the consequences?

Howard Watson: Right now, we are going through the commercial and technical evaluation of whether we use more and more of our second source vendor today, which is Nokia, to in essence shrink down the Huawei footprint to 35%, or whether we introduce a third vendor that is capable of the 2G, 4G, 5G SingleRAN that was described earlier. We are finalising that process as we speak.

We have already trialled migration. We have taken a Huawei location and migrated it from Huawei to Nokia. We have also taken a similar site and migrated it from Huawei to Ericsson.

Q171 **Carol Monaghan:** Thank you, Mr Watson. I will ask Mr Dona the same question. How is the market cap share affecting Vodafone?

Andrea Dona: The Government's current position on the 35% RAN cap does not affect us materially. We will, according to our current plans, be able to satisfy the 35% RAN cap without material financial impact in the UK, and with a clear programme to deliver on that.

Q172 **Carol Monaghan:** Is that because you are using less of the high-risk vendor in the core at the moment—sorry, not in the core, but using less of it at the edge?

Andrea Dona: I do not know the BT figures. I am not privy to those. What I do know is that I believe we have struck the correct balance with our other vendor, Ericsson, to ensure that we have enough security and enough certainty to be able to develop our new technology and introduce 5G at the rate that we need to introduce it, remaining competitive in the market while maintaining the balance of vendor split.

Q173 **Dawn Butler:** I have a couple of quick questions. Picking up on what my colleague Carol just said, can we have a percentage from Mr Watson of how much you have a high-risk vendor at the core of BT's operations?

Howard Watson: A percentage does not really apply in the core. Today, we use Huawei as the 4G core for our mobile network. That is what we

are replacing. As we start to introduce a 5G core, it will not be with Huawei.

Q174 **Dawn Butler:** When you talk about disruption with regard to replacing 4G and the masts, would that not occur anyway when you were implementing 5G?

Howard Watson: No, because in most cases you can add 5G by small changes to what we call the passives on the antennae on the site. You just plug new electronics into the existing cabinets and the electronics inside them. Swapping the vendor out is a significantly much greater undertaking, where you are essentially stripping most of the site and replacing it.

Q175 **Dawn Butler:** Mr Kim, you spoke about some of the aggressive and tough competitiveness of Huawei. Could you expand on that a little bit and maybe highlight the issues around it, and how that is different from how vendors would normally operate?

Woojune Kim: They are just a very tough competitor. When you go into bids, we have frequently seen bids that do not seem to make sense in the pricing. We think that a company that was beholden to shareholders and had to make profits could not offer that sort of bid. The industry electronics are pretty well known. If you look at a product, everyone can guess how much it is going to cost in raw materials and so on. Based on that, we frequently see bids that do not make sense.

You could say that the company takes a long-term view. That is fine as well. It is just that as a public company with shareholders it is difficult for us to take a long-term view that stretches out 20 years or something like that. That is, for us, the difficulty that tough competition brings. It is open to interpretation as to how that is possible.

Q176 **Dawn Butler:** It is, essentially, undercutting the market so that it is not viable for any normal business to operate.

Woojune Kim: For us, at least there have been a lot of price points that we felt were unviable.

Q177 **Dawn Butler:** How would something like that normally be viable? How would an organisation be able to operate without shareholders?

Woojune Kim: That is what we do not know. To be frank, Samsung is a $200 billion company. In some ways, we are the largest electronic manufacturer in the world. We create over 500 million things per year, so we are pretty well versed in what it takes to make products and what they cost. It is not that we are not able to complete; it is just that we were very surprised to find that it was very difficult.

Q178 **Dawn Butler:** If you were to compete on that price range, how long would it take before you would go bust?

Woojune Kim: My father used to say that in accounting when you go bust depends on what the accountant thinks. I do not know how I would answer that, but it would not be sustainable for us. Our shareholders would not be happy.

Q179 **Dawn Butler:** Mr Dona, I was going to say that you seemed quite distressed, but that is probably not the right word. With regard to ripping out your core, you seemed more concerned than BT. It confused me because you said that you did not have any high-risk vendors at your core, just on the edge. You seemed more concerned about how you would make it all work in removing high-risk vendors. I wondered whether I got that feeling right or wrong.

Andrea Dona: Let me provide some clarity. We are able to adhere to the current guidelines and rules without major disruptions to our customers and our business. If that policy were to change, depending on the timelines of the policy imposition, I would be raising concerns about the element of disruption it will have for our customers and businesses. It will all depend on how much time we have to work the plan through, and to be able to introduce an alternative to the current vendor that we have.

It is not distress. I am highlighting that it highly impacts customer and business experience if the imposition of a change in policy is too steep from a timeline perspective. If the timelines are reasonable and practically feasible, we can work on a plan that does not impact on our customers. If it is very aggressive and very tight, there will inevitably be a very high cost and a very high impact for our customers. At a time when, in the Covid crisis, we see the reliance of our customers, our society and our economy on trying to gain a kickstart from telecoms, I am concerned that the ultra-aggressive imposition of a change in policy could hamper our economic recovery in the UK and not bring the full benefit of 5G to the economy.

That is not distress but a realistic and practical articulation of what it would take to meet very tight timescales. Hopefully, that clarifies my position.

Dawn Butler: As I say, I do not think distress was the right word, but I completely understand. Thank you very much for responding.

Q180 **Chair:** Do you want to come in briefly, Mr Watson?

Howard Watson: I want to ensure that Ms Butler does not have the impression that I am sitting here thinking it is no problem at all. It is indeed a significant change, which will require significant work. I completely agree with what my colleague has just said. It is the last thing we want to be doing in a hurry as we are ever more dependent on our telecommunications network.

Chair: You have clearly expressed a joint view, albeit independently arrived at.

Q181 **Katherine Fletcher:** Gentlemen, thank you so much for the candid and very wise insights that you have given us today. I want to almost stop and step back. In the UK, we are in a position where we have an exciting new technology, 5G, that can provide huge benefits. We want to get it as quickly as possible, but we have some concerns about the tiny pool of vendors we have at the moment, overlaid with the other things we examined earlier.

How do we get more people in that field? That is the essence of my questions. I want to understand what the commercial barriers are from BT and Vodafone business practices. I also want to understand what we can all collectively do and recommend to the Government as this Committee to be able to bring more diversification to the market.

Mr Kim, while I am going to address my questions to the providers, if you think, as a potential provider of equipment, that there is something relevant, I would like you to give us a wave and butt in at any point.

Mr Watson, are your commercial practices selecting existing vendors and making it really hard for new entrants?

Howard Watson: It is not purely down to commercial practices in any way, shape or form. One of the challenges is that to introduce a new vendor to the UK telecommunications network is probably a two-year undertaking by the time that you have worked through the technology, the specification and the specifics of the UK market.

We have to be very careful. The one commercial reality is that, as I deploy equipment, I need to get the useful life out of that technology, which is typically seven or eight years. A practical example right now is that, as I am replacing some equipment to get to the 35%, it is going in brand-new. I need that equipment to be what is available to me right now. There are really only two other choices: Nokia or Ericsson. Having deployed it, I need to get the economic life of that equipment.

As we look to diversify the supply chain, and we work on medium to longer-term solutions like OpenRAN, there is a bit of unintended consequence. If we take too much urgent action now and replace all our equipment with the small choice that we have today, it potentially delays when we can start adopting some of that diversified solution.

I am in favour of leaning heavily in, as the UK, to what OpenRAN has as an opportunity for us, with a sense of realism around how quickly we will be able to deploy it.

Chair: Thank you. We need short answers, if you wouldn't mind, because we are running out of time.

Q182 **Katherine Fletcher:** The same question to Mr Dona.

Andrea Dona: We are very much on the same page as BT when it comes to OpenRAN. We are leading the way in the UK and globally with OpenRAN. OpenRAN gives us a great opportunity for diversity. Through

very sophisticated technical mechanisms, you are breaking the monolithic end-to-end chain of your technology into smaller chunks. The smaller chunks enable new entrants to come in at a lower entry point. It also promotes innovation because those entrants are specific and are best in class in those particular areas. It fuels innovation; it lowers the barriers for entry; it creates diversity because the monolithic end-to-end—

Q183 **Katherine Fletcher:** It is at such huge scale that it breaks it down. When is that going to come in? When can some clever person in central Manchester say, "I know how to do this better"?

Andrea Dona: We are currently testing OpenRAN with the vendors available today. It is not yet mature to replace, scale and provide the efficiencies that the legacy—

Q184 **Katherine Fletcher:** When is it going to be? I am sorry, I am conscious of the time so I am just trying to get it down.

Andrea Dona: It will depend on support from Government on accelerating the research and development. It will be directly dependent on co-funding a centre of excellence in the UK. It is a difficult question to answer because, if we let market forces take their course, it could take a very long time. However, with a concerted effort, with Government, to fund R&D, to pilot and facilitate the deployment and to stimulate the entry of new players and support their scalability, those timescales could be reduced.

Q185 **Katherine Fletcher:** Let me put that in Lancashire. You want the Government to fund a test bed site that allows us to show all of this working in practice with the new vendors, and that will give you the confidence to take those vendors into your network.

Andrea Dona: Yes; we need to test those. Absolutely, yes.

Q186 **Katherine Fletcher:** Mr Kim, if the geniuses at Samsung produce something, do you think it is commercially viable for you to have to wait two years before you can access a product?

Woojune Kim: We actually have OpenRAN products that we are developing right now. Some of them have been tested in the field. For the UK, the faster way to get 5G quickly is to rely on what is already doable. As I said earlier, you can take 5G equipment from Vendor A and overlay it on 4G networks run by Vendor B. That technology is proven. It works for NSA. If you go for a stand-alone, it is more than easy to do that.

Before you even go for the idealistic world of pure OpenRAN, and I agree with Mr Dona and Mr Watson that there are a lot of benefits, you can actually start introducing the best 5G technology today by the overlaying method.

Q187 **Katherine Fletcher:** Mr Watson and Mr Dona, you have a genius here who wants to say something. Why can we not just take that?

Andrea Dona: We need to remember that it is very important, without getting too technical, that 5G networks are based on our evolution of 4G. If I were to take a 5G overlay to the existing 4G, it would not be an immediate process. I need to build 5G coherently with the 4G stack I have to maintain customer experience.

Q188 **Katherine Fletcher:** Is this about the fact that the way we have chopped up the bandwidths looks like a bar code rather than in chunks? I hear what Mr Kim is saying, but how do I explain to the man on the street why we cannot buy an overlay and get on with it?

Andrea Dona: Let me try this. With 5G today, in the current non-stand-alone architecture, a normal consumer with a Vodafone phone, with a 5G symbol and signal, would get the maximum experience if that user could also rely on the addition of the underlying 4G at the same time as having 5G. If you remove the option to also have the full benefit of the 4G stack—all the frequencies, all the carriers and all the capacity—the 5G experience will deteriorate. Rather than being an add-on to the 4G, it will be a replacement that is lower than adding 5G on top of 4G.

Q189 **Katherine Fletcher:** Let me play that back. What you are effectively saying is this. I am a small business with no fibre broadband and I cannot get a 5G overlay on this phone, when this phone is my personal phone, because you are worried about the fact that I might not get signal. Surely, there is an appetite for 5G and we could just have two different streams of devices. Do we have to have them working in concert if speed and security concerns are so manifold?

Howard Watson: Andrea, maybe I will have a go at that one. Right now, the standards for 5G started with what was called non-stand-alone. That implies that you use your 4G network to carry the signalling information for your 5G service. Both co-exist, and it is by far the best way for us to give you, as a small business, the best experience.

In the future, as standards mature, building an overlay 5G network may indeed be possible. We then need to solve the second problem that you described as the bar code of spectrum, because you need a large chunk of contiguous spectrum to be able to do that effectively.

Q190 **Katherine Fletcher:** There are standards that have been agreed by the industry and the Government that are currently incentivising integration with 2G to 5G rather than creating a stand-alone 5G overlay, and you guys believe those standards to be correct. I am doing a little bit of the, "Oh, what if" to say that that sounds like a decision that was taken a long time ago. Is it still the right decision?

Andrea Dona: There is a natural evolution to stand-alone. There are steps that you take to go from a non-stand-alone architecture and evolve to fully-fledged stand-alone 5G architecture. It is a natural evolution in the standards.

Q191 **Katherine Fletcher:** I am after speed of access and security. I am a

biologist, as you can see, so I know evolution takes a long time.

Howard Watson: I would say that we have given you that. We were the second country in Europe to launch 5G after Switzerland.

Q192 **Katherine Fletcher:** Yes, but we face a situation where we may have to risk turning some of it off due to data security concerns. That is back to the diversification in the market.

Mr Kim, please tell me what three stupid things I have just said. I am sure there are a lot of them.

Woojune Kim: No, I think you have made some very valid points, Ms Fletcher. On the diversification of the market, I think the vendor is a very important goal for all operators. For the market as well, it will benefit a lot of people. Having a lot of people with new ideas always benefits the market. We are very supportive of it. As I said, a lot of things have to happen in the industry for that to occur. We support all of them, including OpenRAN technology and the overlay technology. We will do whatever it takes to help the diversification of vendors.

Q193 **Katherine Fletcher:** Can you clarify why we did not opt to build 5G as a stand-alone? I hear you say that the standards suggest it is integrated, but can we understand why we did not? The analogy is when you have an evolving technology for movement. The first car still had wooden wheels that were bound with steel. Then there was a point when we said, "No, we cannot evolve that technology any more, so we are going to put vulcanised rubber on the wheels." Why is it still a transition from 2G through to 5G? Why can we not just stop it and make it stand-alone?

Howard Watson: We would have had to launch at least two years later, and we would need more contiguous spectrum to get it to work, otherwise you run the risk that the 5G service would not be much better than the 4G service.

Q194 **Katherine Fletcher:** Because the radio masts, the kit and the signal amplification would not be there.

Howard Watson: The spectrum would not be there.

Q195 **Katherine Fletcher:** It is the practical need to use the existing kit on the ground for speed of delivery that has made it a non-stand-alone system.

Howard Watson: And the standards were issued for that first, because that is a consistent approach that was taken by most operators on the globe.

Q196 **Katherine Fletcher:** Has the UK taken a different approach? Is there anybody that has gone stand-alone?

Howard Watson: As Mr Kim said earlier, China is probably going to launch stand-alone. There are some countries that have gone down that route. They have gone a bit later, and they have significantly more spectrum.

Andrea Dona: The answer to your question lies in the historical evolution of the standards. If someone looks at what happened 3G to 4G—4G is also known as long-term evolution—the bases of 5G were laid when defining 4G. The concept of 5G being born on the back end of 4G was laid many years ago when the LTE standards were prescribed and the road map was defined.

The vendors have followed that standard road map. The big vendors will provide non-stand-alone features, availing themselves of 4G existing features, adding functionalities to them and making them, previous to 5G launch, pseudo-5G or 4G-plus. As those features develop, consistently with the underlying protocols and standards, that is how 5G develops.

As we said earlier, 5G stand-alone will come to fruition. As Howard rightly points out, if we were to decide to do 5G, we would have to wait. We would have to wait for those standards to develop and the vendors to be ready to bring those standards to life through their equipment, and that would cause delay.

Strategically, Vodafone has decided not to repeat the errors we believe we committed in waiting too long to launch 4G, and to be the front-runners of introducing 5G technology. Yes, it will be non-stand-alone, to stimulate the need for 5G, and to stimulate the creation of industry use cases that can unleash the full potential of 5G. If we were to wait, we would have lost two years of trialling the technology, using the technology and pushing the technology.

Q197 **Katherine Fletcher:** That is a very helpful explanation. You have basically said that we need an ecosystem out there: let's get it done and then we can start to add other vendors. Can I ask this quickly of all three of you? I appreciate I have said this already, but if we were to do one thing to get more diversification in the market, what should we ask the Government to do?

Howard Watson: The one thing I would suggest we do is be cautious about how quickly we make changes, to give us time on the research to find the diversification alternatives.

Andrea Dona: Lower the barriers to fuel innovation. We need to lower the barriers and support innovation with clear funding.

Q198 **Katherine Fletcher:** The barriers being the test bed site that you talked about.

Andrea Dona: As an example, yes.

Q199 **Katherine Fletcher:** Give me one more.

Andrea Dona: Planning permissions to trial and test some of the new technologies.

Q200 **Katherine Fletcher:** Mr Kim, what one thing would you do to diversify the market in the UK?

Woojune Kim: I would like to clarify one thing about an earlier statement you made on non-stand-alone. When you do non-stand-alone, the only technology you need to support 5G is 4G. The 2G and 3G are not really tied to non-stand-alone. That is one thing I would clarify.

I think the Government have to incentivise the industry in the UK to be more forward looking, to be more 4G and 5G oriented and to try to find a lot of use cases for that. If customers request 5G and the fancy stuff that it is able to do, everyone else—operators and vendors—will follow. What that takes I am not sure, but in all cases it has to be market-driven. That is what will make things move faster.

Q201 **Katherine Fletcher:** Feed the market's appetite.

Woojune Kim: Yes.

Katherine Fletcher: Gentlemen, thank you very much.

Q202 **Chair:** This has been a fascinating session. We are very grateful for your evidence. There are just a couple of final clarifications. You emphasised that to rip out Huawei very quickly could involve blackouts for customers and would cost billions, and you would need five years to do it properly. Would the work to take out the Huawei equipment be at the expense of installing 5G equipment, or would that proceed at the same pace?

Howard Watson: There would inevitably be an impact on that. It is hard to quantify, because again it comes down to the timeframe. If it is five years-plus, I think we can minimise that and still keep building 5G for Britain, but anything less than that and we would have to stop doing 5G.

Q203 **Chair:** You would have to stop doing 5G in order to do the remedial work.

Howard Watson: If we were to be asked to swap out all of Huawei in a period of less than five years, we would have to stop.

Andrea Dona: We would have to slow down our 5G deployment. The reality on the ground is that there is only so much physical capability that we can draw on in the UK in terms of how much of this work can be done. If all the operators were to be asked to swap out in very tight timescales, it would put enormous pressure on the workforce that is available in the UK. We would need to see how we could augment that workforce with apprenticeships, to add more labour and more capability to do that. That is why we are talking about, at the very minimum, five years. I would say seven years for something that did not impact our consumers and our businesses.

Q204 **Chair:** What do you say to those who might be watching this session and hearing about the prospects of blackouts, that it is going to cost billions and that it would delay the roll-out of 5G? They may observe, "Well, you would say that because you would rather not take Huawei out." They might even say that you might want to exaggerate the prospective consequences. How can what you have described be understood as likely

and credible by outside observers?

Andrea Dona: We put customer experience at the heart of everything we do. We want to be able to service our customers during this. We need to do it with the right processes, with the right sequence of events and with the right alternatives and capability. That will require time.

What I am saying is that, if we are given, should the decision change, sufficient time to do it properly, we will support the UK Government decision. We will abide by it, and at the same time we will help the UK economy restart after Covid and ensure the minimum disruption to our customers while we do so. If the timescales are too short, the impact will be inevitable, and the cost will be higher.

Q205 **Chair:** Mr Watson, these bleak prospects are not an exaggeration and you can document them. They are objective facts that ought to be taken into account. Is that right?

Howard Watson: Yes, Chair, and we did indeed document them in our contribution to the DCMS supply chain review.

Q206 **Chair:** One final question. Is it not the case for BT and Vodafone that you have contributed to the problem that we face by choosing two partners in the roll-out of 5G to your networks? The problem is lack of diversity. Is it not due to your procurement practices? Could you not have anticipated the public interest concerns that are now being crystallised? As a country, we are now having to contemplate acting, essentially, to correct some of your procurement decisions.

Howard Watson: One of the things I would like to be clear on is that from the perspective of operating a network, having more than two suppliers across the 19,000 cell sites that I have—we are now considering introducing a third to manage this through—is quite an operational burden on our ability to maintain that network. It means that three lots of kit need to accompany every engineer as they maintain the network.

Diversity of choice is really important, and making the right operational decisions, to have limited deployment, is also critical. That is the balance that we always face.

Andrea Dona: We consult closely with NCSC on the supplier choices we make. We seek advice on network architecture. We have actively engaged with HCSEC. Our procurement process strikes a balance between technological advancement, the road map that the vendor brings and the future capabilities that benefit our customers.

Huawei has been a partner of ours over the years because of the technological road map it has delivered and because of the technological advancement it brings. In all the benchmarks that have been conducted internationally, Huawei has fared very well on those technology benchmarks compared with other vendors. That is the reason why we chose it. We chose Huawei because it brings good technology that has

benefited our customers and the UK economy so far. It has also provided good value for money and a good customer experience.

Our procurement processes base their decisions on a variety of aspects. That is why we have found ourselves in this situation. It is a position that has been supported by NCSC, who closely advise us on it.

Chair: Thank you. We are very grateful to all three witnesses for their evidence today. It has been a fascinating session. It will be very useful to us as we reflect on our conclusions for our report. That concludes this meeting of the Committee.