

Select Committee on Science and Technology

Corrected oral evidence: Autonomous Vehicles

Tuesday 15 November 2016

11.40 am

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Members present: Earl of Selborne (The Chairman); Lord Borwick; Lord Hennessy of Nympsfield; Lord Hunt of Chesterton; Lord Mair; Baroness Morgan of Huyton; Lord Oxburgh; Lord Vallance of Tummel; and Baroness Young of Old Scone.

Evidence Session No. 6

Heard in Public

Questions 48 - 54

Witnesses

[I](#): Mike Wilson, Chief Highways Engineer, Highways England; Steve Gooding, Director, RAC Foundation; and Charlie Henderson, Partner, PA Consulting Group.

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witnesses

Mike Wilson, Steve Gooding and Charlie Henderson.

Q48 The Chairman: Good morning, gentlemen. Thank you for joining us for this second session this morning. We are being broadcast so perhaps for the record you would like to introduce yourselves. Could we start with Mr Wilson?

Mike Wilson: Thank you. Good morning. My name is Mike Wilson. I am the chief engineer at Highways England.

The Chairman: If you would like to make an opening statement, by the way, please feel free to do so.

Mike Wilson: First, it is a pleasure to give evidence to the Committee. Highways England is the government-owned company responsible for the operation, maintenance and improvement of England's strategic road network, a network that is 4,300 miles long, carries about 85 billion vehicle miles a year, and so is an important part of the UK economy. Innovation is critical to the success of our business and for the safe, efficient and clean operation of the road network. Part of my role at Highways England is to ensure that innovation and technology are pulled through into our day-to-day operations but also into our longer-term strategic plans. Autonomous, connected vehicle-to-vehicle, and vehicle-to-infrastructure technology is developing rapidly and Highways England is actively engaging in this area, as we see potential benefits, particularly around safety, improved network utilisation and operation.

Steve Gooding: Good morning. Thank you, Mr Chairman. I am Steve Gooding. I am the director of the RAC Foundation, which is a small, independent research think-tank. We seek to represent the interests of the responsible motorist—and I would like to reassure Lord Hennessy that I am not carrying a tambourine.

I thought I would start with three observations, the first of which is, when I am thinking about the world of the full autonomous driverless vehicle, I sometimes find it helpful to distinguish between what government needs to do to foster the development of this technology as a matter of industrial policy, and what it needs to do to facilitate the introduction of the vehicles on to our roads as a matter of transport policy. One is about the ability to have a successful and thriving auto industry here, which is not the same as fostering the mobility that we all need. Secondly, we have talked quite a bit this morning about the incremental approach, the fact that the technology coming into our motor vehicles is becoming more and more sophisticated and taking more and more of the driving task away from the driver. The Foundation is rather concerned about this, because at some point it worries me particularly that the driver is not driving enough to be properly in control of the vehicle. I have a particular hang-up, as Professor Sampson knows, with level 3 of the infamous five levels of automation, where apparently the vehicle can hand control back to the driver, who, in my case, might well be asleep at the time, which does not strike me as a very sensible way to go about things.

Lastly, one of the key considerations which I think we are all struggling with when trying to think about the implications of this technology is that currently we do not know what it will cost, so when we think about how individuals might engage with autonomous vehicles and what it might do to the patterns of trips they make, one of the key considerations is whether they will be able to afford them, and we are not yet terribly clear on that.

Charlie Henderson: Good morning. My name is Charlie Henderson. I am a partner with PA Consulting Group, a global technology and innovation consultancy. I have worked in the field of transport for over 25 years, helping organisations adapt and take up the challenges of technology. Most recently I helped a European Government around the regulations associated with testing and piloting of autonomous vehicles.

I think this Committee is a great opportunity to provide scrutiny and challenge to the whole development of autonomous vehicles in the UK. I would like to put three issues on the table at the start. First, I am not a technologist, so I do not look at this from a technology perspective. A lot of the work I deal with with clients is around systems thinking, and this is a complex system that we are dealing with. While there is the vehicle technology, there is a whole bunch of other elements which are just as thorny and difficult, some of which the Committee has already picked up on. There is regulation, insurance, compliance and enforcement, and there is a huge chunk around public and political acceptability. I am definitely not an evangelist. I see big issues and challenges in this area.

The second area picks up a point Steve made. I think it is interesting that the Science and Technology Committee is looking at this rather than a transport committee, because many of the issues and challenges we talked about with transport in a local environment and in the rural communities can be addressed by other problems. Autonomous and connected autonomous vehicles need to be thought of in a wider context of a transport policy.

The final point, again, picking up on a point that one of the other witnesses made earlier, is that the whole debate could be made a lot easier if we were more concise around our language. We talk about connected vehicles, autonomous vehicles and highly autonomous vehicles, and we have different levels. One of the challenges I have when speaking to clients and people in this sector is that the language is used loosely, and people do not really understand what levels of autonomy they are talking about, whether it is spatially fully autonomous or temporarily, or whether it is partially autonomous and at the end of the motorway will hand back control of the vehicle to a sleeping Steve Gooding.

- Q49 **The Chairman:** Thank you very much. That is three very helpful introductions, and it leads in very well to the opening question I was going to ask how you see the benefits and drawbacks. If I could take the observation from Mr Gooding that one of the drawbacks is level 3, where you are moving in transition, perhaps with mixed access to a roadway or other track system, and the alarming prospect of being told by the computer you are back in control as a bus hurtles towards you because the

computer cannot cope, we have already heard that in the air we have had automatic pilots. We are quite used to it and we are quite comfortable with it, but, again, there are occasions where the automatic pilot hands back. Air France had a famous case where this happened and the pilots were taken by surprise; they had all of two minutes to work out what was going wrong, but it ended in disaster. We have to recognise that transition is a very real issue here. That is a drawback. Perhaps you would like to elaborate on how you feel we can steer a way through—not meaning to be stupid about that—and how we can plan a way through this clear difficulty of transition. It surely has to be planned.

Secondly, following up on the issue of language, we are talking about these different levels of autonomy, and each of them has manageable, one hopes, steps where we have to understand what needs to be done by whom, not least by Parliament in the form of legislation. I wonder if you could take us through some of these stages—how you think we will need to react as a country as these technologies develop.

Mike Wilson: Those are two really interesting questions. The one on transition will be fundamental, because much of that technology already exists, and certainly as we are moving forward in Highways England, one of the objectives we have been set by Government is to have a trial of autonomous vehicles on our strategic road network by the end of next year. These are the sorts of questions we will have to have good answers to before those trials go live. There is work we will need to do on simulation and research and in the development of safety cases that will allow us to be confident that those trials will go live. The challenge in those trials will be that you will have professional people who are paid to be awake and responsive as part of those trials, and how you move from a trial environment into a real-world environment. That will have to be part of our development of the technology, to understand and give confidence to the public in the nature of the vehicles on the network. One of our challenges in and around safety is the mixed use of different types of vehicles on the network, operating perhaps in slightly different ways and how those vehicles will interact.

That is a significant challenge. I do not have an answer to that question but it is certainly a question we will need to answer before those go live.

As for the different levels, a number of those levels already exist on the network, in some of the adaptive technologies that are already available to many people. Be they adaptive cruise control, lane centering or emergency braking, those sorts of things are already in operation on the network and are helping to deliver safer roads. That sort of technology is available; the real challenge will be as you move into more and more automation, where the vehicle is more in control of what is happening. I am not an evangelist either; I see the benefits, but I see in the near term real benefits from connected vehicles and connected infrastructure. That is where we are investing and undertaking trials at the moment in understanding how connected vehicles and connected vehicle and infrastructure can deliver new services and improved mobility for users of the strategic road network, and other networks.

Steve Gooding: On the transition point, perhaps I should say that I see some of the problems here more as risks than downsides, but the risks can be managed. The risks inherent in that level 3, as described in the NHTSA guidelines, can be managed by simply not going there. I come back to a point I think Lord Hennessy made in the last session: who is liable? If I have handed over control to the vehicle, I am not expecting the vehicle to shrug and hand it back. The vehicle has to be capable, if I am to hand over control, of coping with the circumstances that the vehicle will encounter, and if that is not the case, that vehicle should not receive type approval and it should not be on the road.

On regulation, there are various aspects. I know my former colleagues in the transport department and in CCAV are wrestling with those. I would probably pick out three things that spring to mind where national government will have to think very hard. One is about the type approval of the vehicle, which historically has been a mechanical issue. It is about how the vehicle functions when operated by a human driver. We are going to need a system that assesses the effectiveness of software, and that is a new thing for the type approval regime. Secondly—we have touched on this in the Committee already today—there are some big questions about data, partly about who owns data but largely about who has access to it and how much weight can be put on it. For example, even today in a modern car, if you are unfortunately involved in an accident, the car will know what happened; the information will be sitting there within the car's telematics system, but not to the point currently where it is court-admissible. It could tell you what it thought was happening. In future I suspect that will change. I suspect that in the unfortunate accident that you have contemplated all the vehicles involved will know exactly what happened. There needs to be regulation—a framework within which that data passes between different parties. Lastly, that question of liability, which is probably the most important near-term, is contemplated in the modern transport Bill to be introduced straight after Christmas. We will need to clarify who is liable for what during this trialling period that the department and the Government are supporting at the moment.

Charlie Henderson: Picking up on one of the words used there, “transition”, I firmly believe, as a very passionate country about motor vehicles, that there will be a large number of people who still want to drive a vehicle at some stage, so this idea that we transition to fully autonomous vehicles is one that I do not subscribe to. What I see happening is that we will have an increasingly mixed environment of vehicles, ranging from absolutely no autonomous elements at all, to some autonomous elements, such as lane change, assisted braking, or assisted parking, through to fully autonomous, and the question then becomes the take-up over time, which is more about demand and business model. As Steve hinted, the challenge around this will be the cost to users, how they will pay for it, who will own the vehicles, and how they will make their money. There are lots of unknowns, and this is why the complex system approach is quite interesting, because the technology is solvable, the risks are addressable, and the direction in which we move will depend on social, cultural, political and economic factors, such as what the driving public want, what

the politicians are prepared to put forward, and where we are as a country and where we see we are able to develop our economy.

The Chairman: Could I ask Mr Wilson this, in his capacity of speaking for the highways authority, clearly carrying a large amount of the UK freight traffic. You also have the infrastructure which could, without using the word “transition”, be used, one could see, very much more efficiently as further automation is brought into goods vehicles. Do you see further automation being of assistance in managing the quantity of traffic that you are likely to hold in the future?

Mike Wilson: Yes is the simple answer. The strategic network, in comparison to the networks we heard about from York and from London earlier, is much simpler from an automation perspective. There are very few pedestrians—there should be no pedestrians—no cyclists, traffic is moving in channels in the same direction, and it provides a much simpler environment for autonomous vehicles. We see there being benefits to greater levels of automation in all types of vehicles, potentially around utilisation vehicles travelling closer together, and narrower lanes. As Charlie has said, how will that work when you have a mixed fleet?

What we see, particularly around HGVs, is the potential for platoons of vehicles, and we will be undertaking a trial of platooning vehicles on part of the strategic road network again over the next year, only when we have a safety case and have done the research necessary to give us confidence that that will be a safe thing to do. Potentially it has significant benefits, not only in efficiently moving the lorries around the network—the trials that have been undertaken elsewhere have demonstrated efficiency with vehicles travelling closer together, they are more fuel-efficient because the wind resistance on the following vehicles is less—but there are also challenges, and one of them that we, as a road operator, will need to think about is: if all of these vehicles are travelling in a single wheel path, they could have a bigger impact on the integrity of the road pavement itself. If they are all travelling exactly the same path, you might argue about why you need the rest of the road, but that part of the road will suffer the greater loads and is likely to need maintenance first. There are opportunities and challenges, and part of the pilot we will be doing will be to really understand what they are.

Q50 **Lord Mair:** Do you think the biggest challenges are the rapidly changing technologies, or are they the social and behavioural issues that you, Mr Henderson, referred to and you, Mr Gooding, have in your evidence? That is, lots of people have said in your surveys that they are suspicious of autonomous vehicles and unwilling to adopt them? Do all three of you feel the real challenges are technological, or are they more social/behavioural?

Steve Gooding: I would keep those two side by side. I think they relate to each other. There are still some technological challenges to sort out. How we react to them as a society will partly depend on how they then play out. For example, if I pick up on the point about platooning on motorways, there is a challenge in making that work—in getting the lorries to line up and follow each other. There is a challenge to the highway because the inside lane of motorways is often quite

severely rutted already, and if you ride a motorcycle, as I do, that is quite an exciting experience. There is also the issue that if you are in your current motor car, driving in the middle lane, and you find you are on the outside of 17 18-wheeler trucks and you think you would like to pull off soon and they are thundering on through the night, you will have a particular view of whether you like platoons or not. The more we start seeing real examples, and come to understand both what the challenge is and what the upsides are, the more we will start to be comfortable with the idea, and I suspect that is the way it will go.

Charlie Henderson: Picking up on the trialling of goods vehicle platooning, that is very interesting from a technology perspective. The business model is, as a fleet operator, you still have a driver sitting in the vehicle, so you are still paying for the driver. Do you pay them less because they are not driving a chunk? I would worry that there may be fewer collisions on the Highways England network but, because the drivers are not as experienced and do not drive as much, the minute they come off the network, regardless of the handover issues that Steve was talking about, they are not as experienced. There are business model challenges there as well.

One of the pieces of work we did earlier this year was thinking about the capabilities needed to deliver fully autonomous vehicles on our roads, not just technology but regulatory, insurance and public acceptability. We ran an exercise where we spoke to a number of esteemed and informed people across the industry and affected sectors—not a survey as such but we sought views and opinions to try to understand this timescale issue you were talking about earlier. The consensus view was that it would be about 30 years before fully autonomous vehicles are operating on our roads in any mass form, but within that consensus view there was a huge divergence of opinion between those who were extremely optimistic and said three years as a result of some major disruptor coming along, to those who were slightly more black-hat and thought 30 years was probably about the scale.

Interestingly, across the seven areas we looked at—you asked which is more important: technology or culture?—technology was one area highlighted as difficult, but equally difficult was enforcement. How are we going to deal with compliance and enforcement issues for these vehicles from a policing perspective and make sure they behave and they operate correctly? How will we check the code within the systems and ensure that is appropriate? That touches on a point Steve talked about earlier around regulation and our traditional approach to type approval for vehicles, which up to last year we all thought was perfect. As a result of an issue around vehicle emissions testing last year, we are perhaps not as confident in it.

The challenge around autonomous vehicles is that the complexity of the systems is significantly greater than in current vehicles. The space shuttle had about 500,000 lines of code in it. Windows 10 has 60 million lines of code in it. A production vehicle such as the Ford 150 truck has over 100 million lines of code, and the challenge as a regulator is how you look at this code and decide whether it is appropriate or not. We need to move away from looking at individual elements to thinking about overall outcomes and outputs of vehicles, a bit like how they test medicines. They do not look at the medicine under the microscope and decide whether it is

appropriate; they do testing in a real-life environment and look at the impacts of that. You could see an environment where we have ratings of autonomous vehicles, how many crashes they have over 1 million miles or something like that.

Mike Wilson: I want to reiterate the importance of changing attitudes. Trials will be really important, letting people touch, feel and understand how these vehicles will work. How people will feel will largely drive the take-up of these vehicles. We talk about timescales, and I think attitudes of motorists will be key in the penetration of these vehicles into the market.

Lord Mair: These trials will have to be quite carefully evolved, will they not, because you can do perfect trials and then you can do trials in the real world and there are big differences?

Mike Wilson: We have two of those trials on our books at the moment. There are those I have mentioned already around autonomous vehicles and for platoons, and we will be doing very detailed safety cases.

Lord Hunt of Chesterton: Will the trials involve pedestrians?

Mike Wilson: No, they will not. Sorry, I say they will not because we have not yet designed them, but I would suggest they will be on motorways, where the network is, as I said, much more controlled. We will be doing detailed safety cases, looking at the changes of hazards for a variety of populations.

One of the things I would like to mention is road workers, which I do not think has come up yet, and improved safety for road workers. One of the challenges we have as an operator is the segregation of traffic and those who are maintaining and building new roads. I believe that, first, the autonomous vehicles need to be capable of negotiating all environments, so that will include roadwork layouts as well as ordinary roads, but also ensuring segregation of vehicles and road workers is a key opportunity that autonomous vehicles might present.

Lord Hennessy of Nympsfield: Very quickly, do you think the human factor we have been touching on has the central place in this great debate that it should have? It is extraordinary when you look back how the car reflected human temperaments. A great sense of status comes into it: the boy racer phenomenon; the Mr Toad phenomenon; and the people who set up the RAC, these enormous men in great leather coats and goggles. I must admit, I can never see a Royal Autonomous Vehicle Club being set up.

The Chairman: This is a question only for Mr Gooding.

Lord Hennessy of Nympsfield: There is no poetry in this at all but do you not think the human factor really should be at the centre of this debate?

Steve Gooding: Personally, I agree with both points there. I doubt very much whether I could interest my landlord—since we rent a room there—in setting up an autonomous branch of the Royal Automobile Club. By and large, the members there like driving; it is one of the things they do.

In much of this debate I am invited to other events to talk about driverless cars when, frankly, the motorist is written out of the script, because motoring for me involves doing something. What I would say is this, and it harks back a bit to the earlier question of how people will engage with this and how the trials will go. We tend to talk about driverless cars as if they are a homogeneous thing, but we will see many different permutations coming through. For example, the trials that Lord Borwick is involved in in Greenwich will have a relatively low-speed pod trundling around, delivering people a bit like a tube carriage but on the road and occasionally on the footway, and I suspect that people around and about that will become used to it quite quickly, and so long as nothing terrible happens, it will carry on trundling, which is very different from the sense I have walking down Pall Mall and seeing the occasional Ferrari or Aston Martin. I somehow doubt whether in the world we are describing Ferrari will go autonomous. Like Charlie, I fear the world where Ferrari has gone autonomous and therefore has ceased to be; I quite like a world with Ferrari.

- Q51 **Baroness Morgan of Huyton:** Can we move on to timeframe? I know it is an impossible question in a sense, but we are interested to get an idea from all our witnesses of the timeframe we are talking about, and in particular the factors that you think will significantly either speed things up or slow things down, particularly in different categories, as we are talking about that.

Charlie Henderson: As I have already mentioned, we have done some research in this area. We think the area that is probably easiest to solve is insurance. A number of insurance companies already have products that they offer for semi-autonomous vehicles. The financial markets are quite good at responding to the opportunities in this area. There is a lot to be done to understand liabilities associated with insurance. Insurers may be willing to take on the risk but there is the question of understanding in courts who is liable, and indeed from a policing perspective, if there is a criminal case to answer. The challenge with regulation is that we continue with an incremental approach. I think we need a drastic change in how we think about regulating the autonomous vehicle. It does not mean we throw out the regulation we have for existing vehicles; it means I do not believe we will reach an end point by incremental additions.

Clearly, there is a lot to be done around the technology and, picking up your earlier point about the public view, having three middle-aged men talking about the love of motoring here is one thing. My daughter is 17 today and has no interest in driving. We need to think about the social changes that are happening. That is not happening at a UK level but at an international level. We have relatively little control over that. We need to understand the implications for transport systems.

Lord Hennessy of Nympsfield: I have a question for Mike. I think you said you have 4,300 miles of strategic road network. Are the infrastructure structure implications enormous for your bit, putting aside everything else, to making this work—there is the level of investment that you will need for alterations—given that it is a national thing? We obsess, quite rightly, about the cost of and need for HS2 and all the rest of it but this, in a quiet way, is possibly comparable is it not?

Mike Wilson: I suppose the challenge at the moment is really understanding what the implications on the infrastructure will be. You have heard already about better white lines, and we have seen organisations publish reports about roads that cars can read. It might be there is a scenario where no changes to the infrastructure are necessary to facilitate autonomous vehicles. For connected vehicles there is potential for additional changes to the infrastructure. I have mentioned this UK CITE project we are doing with Jaguar Land Rover, Coventry, Siemens and other organisations that is going at the moment, which is looking at the technology necessary to facilitate connected vehicles and vehicle infrastructure, and we are looking at what those infrastructure needs might be. That will help us look at the M2/A2 corridor project, which is another connected vehicle project that we are committed to delivering. In those scenarios we are looking at hybrids of technology. Sometimes we have wi-fi connectivity or other physical infrastructure on the network, and other times we are relying on mobile technology to provide the connectivity that we need.

I suppose the answer to your question is that I do not know. There is a potential to have some impact on the infrastructure but the scale of that at the moment is uncertain.

Steve Gooding: May I add a couple of points to Mike's answer? The question that sits behind it is: is the advent of the autonomous vehicle going to materially affect the levels of traffic? That is one way of thinking about it. If there were much less traffic because the system is running a lot more efficiently, maybe we would not need the programme that Highways England is taking forward to widen our motorways, but we would have to depart quite a long way from the existing levels of traffic to get into the future and look back and think we should not have gone that way, we should not have needed that extra capacity, because we already have significant congestion over a lot of the network that Mike tries to run.

The second thing is I certainly tend to think of the infrastructure in a traditional way. It is the pavement that we drive on. It might be the lighting columns that light the way, but we have to think of the data infrastructure and the data handling infrastructure and, as Mike hinted, that is probably the area where we will need most change, depending on how the system architecture develops. Some vehicles will be more reading the road than trying to download data from elsewhere; others will have a higher requirement for connectivity, a far higher requirement than we have ever had before.

The third point is, we have heard this phrase a number of times today, about "the rubber hitting the road"; we are still going to need the road to be there, and one of the key things I feel obliged to say from the Foundation's perspective is, apart from Mike's network, a lot of the roads in this country are falling apart. We have a big maintenance backlog and one of the things we must not lose sight of is that all these many advantages of enhanced mobility will not materialise if we have not maintained the roads for the vehicles to run on.

Q52 Lord Vallance of Tummel: On the communications technology requirements, we

have heard different things from different witnesses. Obviously, there is a satellite requirement; you have talked about wi-fi and cellular of one kind or another, and the European Union is looking at 5G—how is this being dealt with? Do you know? Do you have any input into it? Ideally, one wants international standards in this area. Do you think there is any chance of that happening?

Mike Wilson: I think the standards associated with the variety of technologies are well established. It is the availability of that service—this is perhaps where some of the cities have an advantage—where you have greater coverage of mobile data service and you might need less technology from a data collection and facilitation perspective than on, say, the M6 in Cumbria. I think the RAC Foundation did a survey that said that less than 50% of the road network has a full 3G service, so we are some way from 4G or even 5G connectivity. We will have to look at the network and determine what the appropriate service is. We have though a backbone of fibre connectivity that we can use as an organisation that will enable the transfer of this data to facilitate the wi-fi or the short wave technology that might be utilised. I think the standards exist; it is the availability and predicting the uptake of that technology which will be a real challenge. We do not want to put technology on the network that becomes surplus to requirements a short time afterwards. That is where one of the challenges in this will be.

Q53 Lord Mair: Can I come back to a question you have already touched on, this question of the mixed fleet, that, in practice whatever happens, on the highways and on local roads there will be a mixture of autonomous vehicles and less autonomous or non-autonomous vehicles? How is the prospect of what will certainly be a mixed fleet being considered by your organisations? Is that being modelled? Is that being thought about carefully?

Mike Wilson: Is it being modelled? Not at the moment, as far as I am aware. I know there are some trials the Transport Research Laboratory are doing that we are engaged with. It is clearly somewhere we have to understand the interaction, not only for ensuring safety but delivery of the benefits we have talked about that greater levels of autonomy might deliver.

To come back on a question that Steve answered earlier about mixed fleet, the challenge for us is, I agree, that there will be people driving Ferraris who will want to drive them, but there are many people who use the network every day for whom driving is a chore, and who might see autonomous vehicles as a way of using their time more productively. Yes, we need to do the modelling and understand the challenges associated with the mixed fleet, but we also need to recognise that people use the road for a variety of different purposes and in different contexts, and I hope there will be an opportunity for people to enjoy driving, because there are many people who enjoy the act of driving.

Steve Gooding: I am going to be uncharacteristically optimistic for a moment. What we know of the way the auto companies are developing their systems is that they are putting lots of sensors in vehicles that are on the road now—not to do what Tesla has done and enable autonomous operation, but to track how the vehicle is

being driven. Their objective in designing the autonomous system is that the autonomous car will drive as well as the best possible human driver, perhaps even slightly better; so they will drive more smoothly; they will not be braking dramatically, because they will have sensed the road ahead; they will, ideally, be better. We can get hung up on how the interaction between the autonomous and non-autonomous could be problematic. One way of thinking about it is, as the autonomous vehicles penetrate the system and are driving in a better-behaved manner, they might have a calming effect on the rest of the traffic, because if the laws are not changed, these vehicles are not going to go at more than 70 mph, because we are not allowed to, to pick one example.

- Q54 **Lord Hunt of Chesterton:** Can I pick up on that? You talked about driving better. In France on the motorways they say if you drive more slowly it is safer and you produce fewer carbon emissions. In Britain we do not tell people that information, and with PQ after PQ I have put down on that, the Department for Transport always says, "We are not going to use our road signs to tell people about the benefits of driving more cautiously". There is not a unique best, is there? That is the point.

The question more broadly is about data. We are already generating data with new cars, and, as we go further into an autonomous system, data will be very important. The question is how this will be managed and what uses can be made of it. We discussed in the previous session the question of simulations, and there is obviously potential for doing it well and enabling the designs of systems. We also talked about rural areas. I go down to Devon quite often, and there are all these country lanes. How do you think we will deal with that, where you have a lot of the accidents? Motorways are one side of it but most of the accidents that happen are happening on quite small roads.

Charlie Henderson: To start with the data side, it is useful to break the data down into a number of elements. Rather than just say data as a whole, if we think about real-time information on where vehicles are, it is in manufacturers' interests to share that with the highways authorities so they can make better decisions and help inform the movement of that vehicle. In the sharing of that information, as an individual, as a vehicle manufacturer, as a highways authority, there is some common element to that.

Where it becomes more complex is around the movement of those vehicles: where they start, where they are going, how they are travelling, whether their autonomous systems are switched on and how they are behaving. It is a bit about performance. Different manufacturers might be able to work out who is performing better or worse. You start to understand where their customers are based, so you can target marketing at these sorts of people. The overall movement is a really thorny issue, and there is a lot of intellectual property around the ownership of that.

The location data at any particular point is something that can be shared. The overall performance of the vehicle cannot be shared. The final bit is post-incident investigation, where a vehicle has been involved in a collision and there is a bunch

of data on the machine. Police already have the powers to be able to seize that data to aid a criminal investigation. The challenge is whether they have the capacity and capability to analyse the 100-plus million lines of code, the huge terabytes of data stored there, and work out who is at fault, who is to blame. We need to break the data problem up into a number of bite-sized chunks and, rather than try to eat the elephant all in one go, slice it up and have a go at each relevant bit.

Steve Gooding: I agree. There is a key thing here about the architecture through which data is shared in a way that balances the commercial sensitivity of some of that data, the personal privacy angle, which you touched on with the earlier witnesses, with the benefits of sharing that data, for example, with satnav companies, with companies that can assist you in making your own journey safer and more efficient.

Secondly, I would echo the point Charlie made about the police but draw it more widely. There is having a lot of data and there is being an intelligent client for drawing the knowledge out of the data. I think the witness from York would admit that this needs developing. Thirdly, to pick up your rural road safety point, at some point in this future that we are contemplating, it is entirely possible that I will be in an autonomous vehicle that will know whether there is another car just around the corner that I cannot spot because I cannot see around corners. I do not know whether it will spot a bicycle or a horse, therefore the system which operates it will be a lot more cautious about approaching the corner than perhaps many motorists are today, because they do not know what they will find around the other side.

Mike Wilson: I agree with my two colleagues. There are a couple of points I would make. First, there is the importance of data in managing people's movements around the network. At the moment the motorway network is highly instrumented. We understand traffic flows and speeds and journey times. Greater connectivity with vehicles will allow us to understand much more about that is happening on local road networks and all-purpose trunk roads, which have less instrumentation on them at the moment, and we will be able to provide better journey times and better journey information to road users.

We have talked about some of the complexities. We heard from Michael Hurwitz earlier about the importance of fog lights and windscreen wipers. All of those things have an impact on the capacity of the network, and a rich source of information is important to us as a network operator. There is also the point around use of that data to enable us to understand the performance of the infrastructure itself. We heard earlier about potholes, but measuring changes in the longitudinal profile of the road over a period of time will enable us to make better decisions about maintenance. There are some real opportunities in that data, but as for the other parts, I think my colleagues covered that pretty well.

The Chairman: If we accept for the moment that there are indeed opportunities to share data, equally, there are cases where commercial confidentiality will be inevitable. Can I go back to the issue which Mr Gooding raised earlier and Mr Henderson has just raised of being able to interrogate data after an accident, for example? The point has been made on the practicalities that 100 million lines of

code may be beyond the capacity of anyone to interrogate.

We have a Modern Transport Bill coming up. It is not unknown for legislation to make provision for future advances in technology. It has happened very often. If it appears that advances in technology make this more practical, there could be a regulation implemented on the back of the Bill. It seems to be absolutely unanswerable that, if there is information which helps identify liability, there should be no question of commercial confidentiality; it is information which should be accessible. Would either Mr Henderson or Mr Gooding like to comment on that?

Steve Gooding: Yes, you are right; it should be, and I do not think at the moment there is any question that, if the police requested the information, individual manufacturers would say no. At the moment what I have called the information architecture is at such an immature state that I am not sure the relevant police force would know exactly where to go, and if they went there, it is not absolutely clear that the system would be able to answer the specific questions they had. Although Charlie is absolutely right; there are 150 million lines of code and I could not possibly interrogate that, what I want to ask the system is: how fast were you going? What direction were you headed in? As a non-engineer and a non-software engineer—but I have met such folk—I do not think it is beyond the wit of them to devise something that would allow me to ask the sorts of questions that a police investigating officer would be asking here and now.

Lord Oxburgh: Initially, I take it you would want to know who made the decision to go in a particular direction at a particular speed, whether it was the driver or the system.

Steve Gooding: Indeed, in the future autonomous or partially autonomous world, where the vehicle can be run in autonomous or non-autonomous mode, that distinction, which is one that Charlie mentioned earlier, needs to be absolutely clear for the enforcement authorities.

The Chairman: Can we move on then to Lord Borwick?

Lord Borwick: We have talked about the police and what their powers would be, and you mentioned that the police should have the ability to require cars to get out of autonomous mode in the event of an accident, or a new contraflow, or a blocked road, or something of that sort. I could also imagine that they could require that a car should go into autonomous mode and stop safely. That Ferrari that you mentioned in Pall Mall—if it is a stolen Ferrari, it would be an enormous advantage if it had an autonomous mode that could be controlled externally.

Charlie Henderson: Certain vehicle tracking systems already have that capability.

Lord Borwick: To be remotely controlled now?

Charlie Henderson: To be remotely controlled now.

Lord Borwick: Really?

Charlie Henderson: They have had it for about 10 years. It is not one that the manufacturers widely broadcast but some of the high-end vehicles have that capability.

I think your point about how to direct an autonomous vehicle in a complex incident—you can imagine—it has happened to me sometimes; I have been directed by a policeman to go the wrong way up a one-way road because there is a diversion, and practically he wants to move the traffic. If you tell an autonomous vehicle to go the wrong way up a one way road, first of all, how do you tell it to do that? There might not be anyone in the car. Secondly, its systems will say, “I can’t do that because...” There are all sorts of complex interactions there: the police need to radio back to base to speak to the data providers or whatever, to get that to be permitted in case a further incident happens. Those are the sorts of complexities that I think are quite interesting, the thorny issues that we need to think through. Yes, the pilots, the testing being done at the moment is interesting, but how will it work in reality?

Lord Borwick: Are the police thinking about this already, do you think?

Charlie Henderson: Yes. The police are involved in a number of the pilot exercises.

The Chairman: Unless any of my colleagues have a burning question they wish to address to you, we will bring this session to a conclusion, with very many thanks for what I found very informative. If there is any follow-up you wish to make to submit anything further in the light of your answers, feel free to do so. As I said to the earlier witnesses, the transcript will be sent to you for correction of minor errors and the like. On behalf of the Committee, thank you to Mr Wilson, Mr Gooding and Mr Henderson for helping us this morning.