Vodafone Technology Investor Briefing

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Introduction

Johan Wibergh

Chief Technology Officer, Vodafone

Welcome

Hello, everyone. I am Johan Wibergh, and I am the Chief Technology Officer at Vodafone. And I am very happy that you have taken your time to join us for this Q&A. And this Q&A is part of our Technology Investor Briefing.

So I hope you have had time to review the detailed presentations on the IR website that we released this morning. And also let me highlight then that there were five additional supporting mini brief technology details on that website on subjects such as Open RAN with a special appearance from Michael Dell.

We got a lot of interest earlier regarding the cable evolution DOCSIS, so we provide a specific deep dive on that. And we also are giving you a view on our supply chain sourcing model. So I would really encourage you to take a look at those presentations as well if you have not had the time to do that yet.

So before we open for questions today, let me provide a couple of key takeaways that I want to ensure we get across to you. I think all of us know that due to COVID-19 the pace of the digital transformation has really been speeding up. It is almost like a dramatic digital transformation that is ongoing for the last year. And I think we all understand that that would have been impossible to do without a well performing mobile and fixed connectivity from operators.

We think that Vodafone is well positioned to take advantage of this speed up in digital transformation. And I think there are specific three items I really want to list out as being important here. I mean, first of all, I think we are good on leveraging our group scale. And I think we can use that to further differentiate ourselves from competition and now really are thinking about ways of working scalable platforms, etc. And we are probably going to come into that several times during the Q&A.

Secondly, I think we are really good in driving relentless cost efficiencies, improved asset utilisation, at the same time driving up quality and customer satisfaction. And then, thirdly, I am fully convinced that all these changes we are going through is really creating a foundation and really enabling a revenue growth in new products and services. And I think we are really creating the capability in-house to make that happen. And that becomes a value-add on top of the core connectivity business we are doing today.

We placed a lot of focus in the video on our recent reorganisation as being taking the efficiency of our factory to the next level. And I think it really leverage our scale benefits both of doing things much more efficient but also then speeding up what we are doing to get to more revenue. And this will help us as we transition into a new generation connectivity and digital services provider.

For this Q&A, I am joined by two of my colleagues. First of all, Scott Petty, who leads our Digital and IT organisation in Europe, and also Alberto Ripepi, who leads Networks in Europe. And they both have a global responsibility in Vodafone when it comes to strategy and architecture.

And together, we will handle all the questions that you will be bringing up. I have to say I am very fortunate to have as good team members as Scott and Alberto. Both of them have been with Vodafone a long time. They are extremely capable and they are really good in making an organisation perform really well. It is really about getting things to work faster. It is really about getting things work better for our customers. And it is really about doing everything much more cost efficient. And I think both of them have a very big track record in achieving that.

We will do our best to answer all your questions. We will try to not get too technical and hopefully can get the message across well.

Q&A

Polo Tang (UBS): Firstly, thank you for all the videos today and all the presentations. It is very helpful, very informative. My one question is really about DOCSIS 4.0. I mean, you mentioned that broadband speeds with DOCSIS 4.0 could reach up to 10 gigabits per second. But what are the CapEx implications in terms of deploying 4.0? And would it require a big reengineering of the cable network and would it lead to a step-up in terms of CapEx?

Johan Wibergh: Thank you, Polo. It is a great question. So maybe if I start, and then I will ask Alberto to walk through is the evolutions to get into DOCSIS 4.0.

But if I take a market as an example, if you take Germany, because that is where the question comes after since Deutsche Telekom have made a lot of comments regarding their fibre build. I think overall we feel that we are in a starting point and a very strong strategic position in Germany. I mean, today our network reaches with gigabit speeds 22 million households while the market has around five million, the rest of the market.

If you look on the mobile network side, there are three mobile networks that are built. They have all got similar type of performance. Maybe one of the competitors is a little bit weaker in the countryside, but all three mobile networks in Germany have very similar type of performance. There is not really a big difference. We got a very strong IoT position in Germany and also on TV due to the cable TV positioning. So I think we are starting from a very good position meeting competition due to those acquisitions we have made.

Then, Alberto, maybe you can walk through the specific cable steps we would take.

Alberto Ripepi: Yes. Thank you, Johan, and thanks for the question. So as you mentioned, what is matter is the fact that we have 22 million households that are already gigabit capable. You need to keep in mind that we have a very flexible architecture. And this is the beauty of our architecture because we already fibreised our network.

The strategy that we have to evolve these hybrid fibre cable networks is in following different steps. First of all, during the pandemic, we saw growth of the demand in some specific areas and we are addressing and we addressed it through the, what we called, node-segmentation. So this is the way that we put the fibre very close to the customer to reduce the sharing of the common asset.

And then this is something that is for us BAU that we continue to do because we are doing the traffic modelling forecast to understand what is the evolution of our traffic, identifying the

areas where there is demand and investing in a cost-conscious way only where the demand is growing.

Then keep in mind that we already deployed almost in all markets the DOCSIS 3.1 and we are going to complete Germany at the beginning of the next calendar year. And this will bring us to 24 million households gigabit cable.

Then we have several areas that we can continue to invest to improve our performance. And are very, very cost conscious and focusing on where the demand is growing. And so we will go through, number one, the distributed cable architecture that would allow us to bring the modem closer to the households and so using again the sharing of the media.

Then we have the possibility and we already started to deploy in Spain of high split of full spectrum, where we can increase and we can modulate the bandwidth between downlink and upstream to increase the upstream capability. And this is something that we can do in a very reasonable way in a progressive way when the node-segmentation is happening. So it is not necessary to do nationwide tomorrow but where demand is growing to cope with the growth of the demand.

And then it will come to DOCSIS 4.0 that has been now released by the Cable Association from CableLabs. And we are starting to trial. It is too premature to say what are the CapEx required in the DOCSIS 4.0. But what I want to stress is the fact that our architecture can allow us to invest progressively where demand is growing and where capability. And we have a network that is already capable of much more than our competitors in the markets.

In the past, we suffered due to the shift of the usage pattern in some areas of capacity issues, but this is largely resolved and we have a very strong process now in place like what we have in the mobile to invest where it matters. I hope that we have answered your question.

Emmet Kelly (Morgan Stanley): So my question relates to 5G and which killer apps you see emerging for 5G and how you are preparing for that? If I look back at 3G, I think the killer app for 3G was probably the iPhone, which came a few years later after the 3G networks were launched. Now when you look at 4G, I would say video was probably the killer app for 4G. And again, that kind of manifested itself a few years after 4G was launched. So what are the killer apps you see for 5G? And in specific relating to network slicing or autonomous cars, is this something that you are already preparing for?

Johan Wibergh: Well, thanks, Emmet. That is a great question. So maybe if I start and say a few words and then maybe Scott seems to be involved in some of the business applications, if you want to add on a couple of examples there.

So as you said, I think, if you look on the business case for Vodafone in deploying 5G, it is mainly driven by all the cost savings we can do. The key thing for us when it looks on the data growth we are having and the cost per gigabyte that we need to have to make sure, because we always need to make sure that cost per gigabyte goes down faster than any possible data growth, because otherwise we will have a problem.

And since 5G is up to five times more cost efficient if you use Massive MIMO technology, the business case on deploying 5G starts and builds upon really more on the cost savings you can get from it. So it is important to keep that in mind.

Then secondly when they look on the various use cases coming up, the first use case then is just to provide data for the smartphones, because as I said, due to the cost savings. From our perspective, we want to have as many customers as possible to buy 5G based smartphones and hence we would invest in less 4G technology. That will be more cost efficient for us from a network side.

Then we have seen shorter-term more examples on the business side and then more consumer to come. And I will ask Scott then to talk on the business side. We see things starting to come being talked upon, but we have very little on the consumer case in there. I think augmented reality will be an item that, on the consumer side I think we really believe big time in. But the first use cases has been on the business side.

So, Scott, can you cover a couple of cases you have been involved in?

Scott Petty: Sure. Thanks, Johan. And thanks for the question, Emmet. First of all, it is probably worth just reminding us where we are on the 5G journey. The networks we have deployed today are non-stand-alone 5G networks, which means we are using 5G radio access network but the core is still our LTE core. We will go live with stand-alone core over the coming months.

And that is important because it adds the speed improvements that we get with non-standalone that adds networks slicing, mobile edge computing. You may have seen our announcement yesterday with AWS, and ultra-low latency, which I think are important features and capabilities for applications.

So we have seen a couple of really good examples in the UK. We ran our first standalone core trial with Coventry University, which is one of the leading medical teaching universities in the UK. They have been using virtual and augmented reality in their teaching facilities, so students can actually travel through the anatomy of the body, look at the organs and understand what is happening as part of that teaching experience. And they are building that as a capability that they will launch into production next year.

We also did a partnership with Proximie in Wales. They have been running remote surgery applications between two hospitals, one in Cardiff and one in Llandough, where remote surgeons are able to offer expertise, follow the outcome of the surgery in the remote location, actually track all of the vitals and the machinery that is in that environment using 5G applications. And that is taking advantage of network slicing capability to be able to maintain the traffic.

I think we will see a lot in the mobile private network MEC space. We are really pleased with our partnership with AWS using AWS Wavelength that lets developers who are used to developing in AWS, take their applications and rather than just run them in a technology centre in AWS, push them to the edge of our network and really benefit from low latency. A great example is our partnership with Sports Ability. They are a sports tracking company. They provide trackers for players. They have just done a deal to insert sensors into the rugby ball to gather analytics and data about what is happening in contact sports.

They found that deploying MEC and 5G was cheaper than building a Wi-Fi LAN environment inside their stadium, gave them access to much greater speeds and much, much lower latency to create a new broadcasting experience for the capabilities that they are leveraging.

So I think we will see those will be the early consumer style applications leveraging MEC and low latency and wrapping that into a fan experience that people can leverage.

And then finally, a lots happening in the Industry 4.0 space. We have announced a number of projects in the mobile private network area. Probably the most visible is the Ford electric car factory in Essex. They are using a 5G MPN to build that factory and use it as a way to control the massive amounts of data, build virtualized applications, augmented and virtual reality for their engineers and tracking those capabilities. And that factory will go live next year as they start to build out the components.

So the early investments we made in our incubation centres to build, partnerships with different players is really starting to pay benefits that gave people early access to 5G technology, particularly standalone 5G technology, which is not yet live. They have been building platforms and code that will come into production next year.

Maurice Patrick (Barclays): If I could ask an ESG-related question, please. On slide 45, you show your energy consumption has been broadly flat over the past couple of years despite the increase in data traffic. Just curious to know where you see energy consumption going in the next few years? In the presentation, you talk about techniques such as Massive MIMO, which I believe has doubled the energy footprint compared to normal radio configurations. So I am guessing with the move to cloud and edge that might also bring increased energy consumption. So curious to understand where you see overall energy consumption going.

Johan Wibergh: Thank you, Maurice. Great question for that. Alberto, do you want to start from the network side?

Alberto Ripepi: Yes. So, as you say, over the last few years, we were able to maintain almost flat our energy consumption despite the dramatic and the significant traffic increase that we had to manage. We are doing several initiatives to cope with what you said. Number one, we are shutting down the 3G almost in all markets and moving the spectrum from 3G to 4G and 5G that is most efficient from the spectral efficiency perspective.

And it is correct that 5G will introduce incremental consumption in terms of Massive MIMO. On the other side, you need to keep in consideration that to download one gigabyte of traffic in 5G, the energy consumption is more or less 10 times lower than the energy consumption that we have in 3G and several times lower the energy consumption that we have in 4G.

So the combination of these in terms of downlink efficiency that we can have, it is an element. Then you need to keep in consideration that we are working with several vendors in parallel to reduce the consumption of 5G Massive MIMO to make more efficient. And we are confident that we can achieve it in the next timeframe.

And do not forget that we have also the programmes that are running in parallel that are all the sharing agreements that are making energy efficient. So it is one of the key pillars of the sharing both passive and active that we are doing in several markets.

We are optimising our core reducing the consumption, thanks to the cloudification both in network and IT. In network, we already reached 64% in the cloud. We aim in two years to reach more than 80%, 85%. And we are optimising all data centres and we plan to do and we have in the long range plan our cooling and infrastructure consumptions. And we are

starting to include the energy consumption in our consideration when we work on upgrading the network.

So it is one of the element that allow us to decide where we need to deploy additional spectrum to optimise the consumption. It is a matter of fact that the energy has an increased trend due to the 5G deployment, but we believe that with all the initiatives that we have in parallel, we can contain at a reasonable level this kind of impact.

Scott, over to you, if you want to –

Johan Wibergh: Scott, do you want to add on something?

Scott Petty: Just briefly to say, we have also been innovating in managing our energy consumption. We have been deploying our IoT smart metres to our radio access networks, leveraging lithium batteries to be able to turn off sectors and components during that period. And we have built a series of applications to optimise our power consumption across our network. And we are experimenting with onsite generation capabilities for both our data centres leveraging solar, but also at our radio base stations using wind and alternate energy sources to reduce our load on the grid.

Johan Wibergh: Thanks guys. And just to add on, so our models where we analyse investments also including buying from suppliers, it is based on the total cost of operation, total cost of ownership, i.e., we include energy consumption in the modelling when we decide how to do things and which means then that we favour solutions that are energy efficient. Okay. Thanks, Maurice. Operator, next question?

Matthijs van Leijenhorst (Kepler Cheuvreux): In the previous comments, you said you will see an impact from phasing out some of the legacy infrastructure like 3G. Could you quantify the impact for us?

Johan Wibergh: Do you want to comment on that, Alberto?

Alberto Ripepi: Yeah. I think that this is visible already in terms of energy savings where we did. In terms of efficiency in the deployment of the new capability, we did in Italy, Czech Republic and we will do in Germany by June and all the other markets will follow before the end of calendar year 2022.

The benefits are significant in terms of performance for the customers because with the spectrum that we free from the 3G, we can easily deploy on 4G and 5G because it is already there. We need just to do either a software activation or a small activity on the site.

Just to give you an example, we completed in March in Italy this reshuffle of the last five megahertz of 2100 spectrum on 3G and almost all sites already have activated these five megahertz on 4G. So it is capacity that is available for our customers. And you know that the spectral efficiency of 4G is much bigger than the spectral efficiency on 3G. And this is bringing significant energy savings, but at the same time this is a significant CapEx reduction because we should not deploy additional spectrum, but we can reduce what is already in the site.

And in all the markets, we are progressing quite speedy because we do believe that this is a very important factor for the efficiency, but also for the customer experience.

Johan Wibergh: And yes, you guys have an understanding on how we operate because many other things we invest in have a between three and seven years write-off cycle. So for everything we do, we think long-term we try to make sure we are cost efficient over a longer term horizon. So all of these things has been in our planning for a long time and it does not really change on our CapEx envelope. And we have already communicated to the market on how we see our CapEx envelope and our financial targets going forward.

Georgios Ierodiaconou (Citigroup): It is on network virtualisation and more specifically on Open RAN. I think during your presentation, one of the presentations discussed the importance of MIMO in delivering great experience and consistent service to the customers. But also you talked about your aspirations on Open RAN. And I know you have already contracts some of the less dense areas in Europe that you have allocated to Open RAN vendors. I am just curious as to where you think the ecosystem is when it comes to denser areas and solutions that are more equivalent to the Massive MIMO solutions you get from the established vendors? Where you are in terms of your collaboration with some of the other telcos that are working on this like Telefonica and Deutsche Telekom? And anything you could share in terms of the key milestones we have to focus on in the next 12 months just to track the progress.

Johan Wibergh: Yeah. So I will ask Alberto to talk about this. But I want to say a couple of things beforehand because he would not say it himself I think. And I think Alberto's team has been really leading and driving Open RAN since we start with this many years back. And we have been doing trials in many countries with different vendors starting back also at least 2016 when we started doing testing on different things.

His team is also having some of the important external appointments like chairmanship in the TIP as an example with 500 companies that are working heavily on getting Open RAN established via portal, board members with O-RAN Alliance. And Monday this week, we did a major press announcement on awarding the first European commercial deployment on Open RAN to a combination of vendors, which included Samsung, NEC and Dell.

And we try to explain how we see it in one of the deep dive videos. So I think Alberto's team has been really pushing the envelope here being really first out. And we have also then teamed up with the other large European operators to go down this path. But, Alberto, do you want to put some more colour on the situation on Open RAN?

Alberto Ripepi: Thanks, Johan. And thanks for the introduction. The team would be very proud for your works. Yes, it is correct. Since 2014, we are working on the Open RAN association to make sure that its reality happening. As you know, Open RAN, logically it is a separation from hardware from software. And this is key to the ability, will give us the ability to create an ecosystem that is more flexible than just telling a vendor that is providing the full stack. And this will drive in the future.

At this moment in time, not, it would be a cheaper solution. At this moment in time, it is not a cost strategy, but it is not a strategy to create diversity in the RAN environment and to create the possibility to innovate at better speed. And this will be possible once that you separate hardware from software and software in multiple components because you can have multiple new companies that will join this arena and we will compete and we will introduce innovation. We saw this in the past in the cloud architecture that was happening.

We have significant plans with Open RAN. We will deploy 2,600 sites in the UK. But as you mentioned, you were very correct, the first initial implementation will go in the rural areas where we need to have low spectrum capability and Massive MIMO will come later. We have plans that are very aggressive to deploy. So we are very serious on this technology because we do believe that the diversification in this arena is very, very important. And this will allow us to introduce faster innovation and reduce further the cost.

The performance that we are measuring in all the pilots that we are doing, we have three markets piloting the Open RAN, are very encouraging. In the 2G, 3G, 4G, we are start to see performance that are comparable with the traditional vendors. And we are working with very innovative vendors to evolve. We selected the vendors in all the stack for the UK where we are already serving with several sites and multiple customers, and we are happy with the progress so far. So we do believe that in the next couple of years the sites that we committed to deliver will materialise and these will improve significantly the ecosystem and speed over the innovation for the RAN world.

Johan Wibergh: Thank you, Alberto and Georgios. Next question, please.

Jakob Bluestone (Credit Suisse): So I wanted to follow up just on your overall sort of CapEx step-up starting from this year. I think John said in his presentation that a big part of it is clearly to the integration CapEx for the new partners that is sort of coming on board, but then that future CapEx would be lower. I am just trying to understand your thinking around the mix of CapEx and how you see your CapEx overall levels evolving longer term, particularly as you complete this integration CapEx. Do you think it sort of steps up and curves down? Or will you find other stuff and hence it sort of stays flattish overall in terms of your absolute CapEx levels?

Johan Wibergh: Thank you, Jakob. It is a great question. So let me talk a little bit briefly about the growth in CapEx. As Nick and Margherita talked about at the full year results, it is split more or less in three different buckets. One-third is going on network, and it is predominantly going to Germany.

The second part is going into new products and services, but there is a business case where return on capital is better than WACC. And that is mainly decided centrally by my two colleagues, Vinod for Vodafone Business and Alex for Consumer.

And then third is in Vantage Towers. And that is very much about where they have strategic growth opportunities, i.e., they get customers and hence they need to build out more sites or they need to do changes on the sites to allow for more customers on them. That is what that CapEx is being for. That is also been driven on business case analysis. So everything is driven from what investments that make sense. And it is not done by us in technology. We, of course, a key part in saying this is how we would execute. This is what it would cost. And then it is the various CEOs that are deciding upon to do that.

We have provided visibility on some of our key financial metrics going forward. And that is the granularity we can give you. We provided only EBITDA, free cash flow, etc. We have not said more on how CapEx would evolve, but this is how we think.

Our key job here is to make sure that every single euro is spent as efficiently as possible. And we are generally brutally chasing everything we can do in the organisation to continue to

drive down costs. You can see what we have done as a company on the OpEx side. And that is despite, as I said, growing energy costs, huge growth in data volumes, build out of the networks. And we have still been very effective in getting costs down and we continue to chase on doing things on that.

And the key part would be the new technology organisation that would enable us to take it to the next level because before even if we have been very efficient as a company, we may now create one organisation in Europe. It means basically that Scott and Alberto can drive this to the next level. Just a practical example. We have maybe a way of doing network operations today that is almost the same in every market, but is not exactly the same, and if we do it exactly the same you can cut away huge amount of the tools and then you can drive the digital automation. So there are lots of ways we can do to further drive efficiency. So that is what we are very much focused on.

Okay. Thanks, Jakob. Next question, please.

Robert Grindle (Deutsche Bank): You have highlighted that your cost per gigabyte will fall by 60% by full year 2025. Is that on all the traffic carried in the year, or is that the unit cost of incremental capacity added in the year effectively falling by 20% CAGR? I think you were trying to reassure us that the greater efficiency will offset the increase in volumes. Historically, mobile traffic growth rates in Europe and emerging markets at Vodafone have always been very similar within a few percentage points. Do you think that is because the increased capacity that becomes available in the two regions is driven by the stable capital intensity target and that the businesses basically sell what the factory makes for them rather than the capacity being scaled up and down quickly depending on the business need?

Johan Wibergh: Thanks, Robert. Great question. So what we are trying to tell you in the presentation is that there is going to be at least more than 60% cost savings and it is that you say you need to make sure that the cost to produce a gigabyte really goes down faster than an erosion on revenue, i.e., any growth of data means that we can do that with a similar cost as we have today.

And if you look back for I do not know how many years, we have always succeeded in doing that. And I feel very confident that we can do that going forward also. And that is why we are always chasing the latest technologies because it always will be, so the latest technologies will be more cost efficient per gigabyte.

If you then look on the data growth, okay, this is what the network can produce in capacity and that is what has been sold. It does not technically work like that. So it actually is the demand coming from customers. And there always are a few sites. It can be a beach in the summertime with a lot of tourists, but there is a limit on how much data that can be produced. But usually that is not the case. And the dynamics is really driven more from demand from customers, not what can be produced.

Nick Delfas (Redburn): Can you prove that the scale you have across markets is working? Are there any metrics that you can share, I do not know, from AT Kearney or from other studies that show that the group effect is working and helping you achieve these scale economies? And another quick question on the technology. Have you given us how many homes per node you have in Germany? And is Massive MIMO already working well? Are there any problems with it in terms of the weights or the EMF or local planning?

Johan Wibergh: Yeah. Thank you very much for your question. I will take the first one. And Alberto, if you can take number two. So as a company, we have been doing an external benchmarking. I think it is not confidential. It has been with AT Kearney that has been benchmarking many companies. And we are now up as a company up in the top quartile and on the way up.

Then as I have a passion for benchmarking and the way we think about this topic is a little bit like if you take the situation with our data centres, it used to be that they used to benchmark the cost to our data centres without the telecom companies. And we were not bad, but we maybe were not great either. We were doing well. We decided then to change the benchmark so who is best in the world of running data centres. That is the hyperscalers. Okay, so let us benchmark with hyperscalers. Let us understand who we really are.

So we did the benchmarking then. And then we said, okay, the cost position is not good enough. We need to do things. And then we could see also they were spending much more money on doing transformations versus what we were doing. Hence Alberto initiated several initiatives. And this is back to 2016 and 2017, where we were identify what are the key transformations we needed to do, how we were operating data centres.

And when we look at it now, we are really up where we need to be. We are very close to where the hyperscalers are on the things we are managing. We have done the same in different areas with network operation. We also have JVs that we operate as a group where we sell services. So Alberto is selling a network operational service to a JV. We have to compete on that in comparison with external companies. So we get to provide an offer and then they benchmark us. And in that work, we see that we are coming out and we are winning those deals on an independent basis, so to say, because the cost we are providing is lower than what they can buy from companies out in the market.

So I think we have come very, very far. I am also convinced that we can do much, much, much more. And that is what we are starting now in the reorganisation where we can take this to the next level. And there are so many more things we have identified that we will be working on the next coming years to take this to the next level. There is so much more cost savings to be done.

You can just imagine, even in our supply chain have reduced it to a certain amount of SKUs we are buying, stock keeping units. By reducing it even further by doing exactly the same things we are buying, we are going to be able to push prices down even a few more percentage points, which will make a huge importance to CapEx efficiency. So there's a lot more things to work upon.

Then, Alberto, sorry, over to you.

Alberto Ripepi: So, saying exactly the node per segment that we have, it is a more complicated because the node per segment is distribution that is depending on the areas of the geography. What I can tell you is that how we plan the limitation of number of customers that we have in each node in each segment to be sure that we do not get congestion. So we plan now with one year in advance in the worst and best scenario the traffic evolution.

We identify in this case the segment that will be highly loaded and the segment that will be congested to make proper investment in terms of fibre split and node split to put fibre close

and reducing the number of customers per node in the next 12 months. So we have a very, very accurate planning process now that we follow and also the CEO of Germany is following on a monthly basis.

And I think it is much better to talk how we manage the congestion rather the number of customers per segment because it is really distribution depending on rural, suburban and urban areas. Of course, in the urban areas, we are a very few customers per segment and in the rural areas we can have a more customer per segment depending on the kind of traffic that they are doing. And the real-time communication is changing, shifting a bit the way that the capacity is used because it is not more just busy hour peak in the evening with the people streaming in television, but it is becoming more a flat peak that we have on upstream to manage the real-time communication in the pandemic.

So we have now an accurate planning and the congestion is largely solved within Germany in terms of capacity and we continue to invest several thousands of node segment per year depending on the demand of the customer. So where traffic is demanded and growing by the customers. So it is not a massive deployment that we do spread, but we are very targeted and focused on the areas where customer are having higher demand.

Johan Wibergh: And then you asked your question there on Massive MIMO 3.5 gigahertz. It is actually working really well. It propagates better than 1,800 megahertz. The grid we have is to procure suitable for 1,800 and 2,100. It actually propagates better than expected. Still some improvements to get done in the algorithms. You can run 45 beams at the same time on a Massive MIMO base station.

There is still some improvements that we get done in the algorithms, but it is really getting there. And the rates have come down, but they are now into some of the suppliers getting to second or even third generation on Massive MIMO radios. So it's turning out quite well. And so they are somewhat more complex to install. In some countries, we have EMF regulations we need to consider and take care off. Sometimes there is some works due to that, but performance is good.

David Wright (Bank of America Merrill Lynch): My question is a little bit two-sided. First of all, you have talked about obviously the evolution of the cable networks and you have given us some visibility into that. What I was wondering is as you move up through these 3.1, 4.0 technology standards, do you get the step change in efficiency that the guys moving from copper to fibre get? What I mean by that is we are getting told by BT Openreach that the fault tolerance, the fault reporting falls by 50%, for example. So there is a very clear benefit feeding through to OpEx. Are you getting those kind of step changes here? Or is it much more gradual within the actual efficiency of return on capital on cable? And then if I could just ask, and I am not sure I saw this in the presentation. But on standalone 5G, do you guys give any basic rollout targets where you expect to be in terms of standalone 5G coverage by year X, year Y or year Z?

Johan Wibergh: Okay. So let me comment a little bit first on fibre versus cable and copper. And then maybe, Alberto, you can go a little bit more into depth on this. So I think, first of all, if we look on actual customer feedback we are having, there is somewhere between 30% and 50% that are related to Wi-Fi performance in people's home. And this whole debate about whether it is copper, fibre or cable is sometimes that discussions get left out. And I

mean, as an example, if you take on our fibre cable networks, we typically see like a gigabit speed going into the house.

And then that goes over to the local Wi-Fi and it drops to maybe 50 megabits, something like that. And also that is very common that there is Wi-Fi interference in the homes because many of the Wi-Fi routers are configured to be working on the same channels. So it may work really well one day, and then next day, your neighbour is home and it does not work because they are all operating on the same channel. And even if the CPEs are posted dynamically choose channel, often, there is a lot of problems around that.

Also there are many customers that sit with older CPs, with older Wi-Fi standards that actually do not perform that well. They may not even support five gigahertz, only be on 2.4 gigahertz. And there is still also very limited amount of customers within the meshed Wi-Fi solution. We call it Super Wi-Fi that gives really great experience.

So this is actually the biggest problem. And that often gets overlooked in this whole debate regarding which technology. This is really the number one issue to get resolved to get happier customers and get better performance. Then it is still, of course, that copper cables has a lot of problems, often being there for a long time in the ground. If it rains, you can have issues, etc. So of course getting away from copper is a major thing, because that is not the same with coax but with the copper there is.

But Alberto, do you want to build on this?

Alberto Ripepi: I think that you are saying right. If I look to the tickets that we are able to manage, the vast majority are linked with the CP (consumer premises) Wi-Fi and topics like this one. It is not really issue that we have in the building with the coax. And this is an analysis that we do on a weekly basis and we control. When it comes to the cost, you need to look these in an holistic way not only the OpEx that you can have at the end of the journey, but also the total cost that you need to sustain in terms of investment.

And our cost to upgrade our network is one order of magnitude lower than another company that need to be at the FTTH. And this is the reason why we continue to do this evolution of our very flexible network and very good network that we have step-by-step where it matters.

When it comes to the second question that you raised on the 5G, we have, of course, plans for the next three years in all the markets. We aim to deploy 5G right, first of all, that means with a dedicated spectrum on 3.5 gigahertz where we can experience, our customers can experience the real 5G with regard to the throughput and latency. We acquired this spectrum in nine European markets. And this is something that is ranging between 80 and 100 megahertz that we book and deploy it through Massive MIMO where we know that the efficiency of one gigabyte is a four, five times the 4G.

We currently have a plan to deploy 5G. Of course, there is also an initiative that is used by many competitors that is the Dynamic Spectrum Sharing that is giving you the icon, but is not giving you the experience of 5G. The sharing of the spectrum with the 4G, you have a more or less the same experience that you can have on 4G, in some cases, significantly worse because you can have interference.

So we do deploy build right where it matters, so where customers have high demand, like cities, ports, airports and industrial districts. Overall, we plan in several markets an

acceleration in this in the next financial year and this is already in the long-range plan. We plan to have something in the order of magnitude of 50% population coverage in some markets like Germany, UK. Ireland is 60%. So we have a significant plan that we will upgrade year-by-year. And this is the technology that we want to push in the markets because it is much more efficient and give a better experience to our customers.

David Wright: That is standalone 5G, just to be clear.

Alberto Ripepi: We have partnered with non-standalone and we are migrating to standalone. Do not forget that we are the first operator deploying 5G standalone. UK and Germany are the markets where we are launching and then the next countries will come. And once that we launch 5G standalone, we will migrate the traffic on this because this give also the experience of a very low latency and allow us to integrate with the MEC and AWS, that is something that is we believe as a business case, as mentioned by Scott.

Johan Wibergh: So there is a limit on phones that is supporting 5G standalone. There are very, very few phones that do that. So we always need to make sure we time it when phones becomes available. Okay. Thank you, David. Operator, next question?

Sam McHugh (Exane BNP Paribas): I just want to just ask about mobile network sharing. So you have several agreements obviously in Europe, the active network sharing. And they quite often include carve-outs in urban areas. I am just wondering what kind of tech was on those carve-outs. Are they carve-outs for commercial reasons or technical reasons? And does 5G and Massive MIMO change your ability to do more network sharing in cities? And if I can just ask a cheeky clarification? On the 5G coverage, what proportion of that do you think you will do with Massive MIMO within the 60% coverage target?

Johan Wibergh: So if we do like this, just to get Scott the chance to talk also. I think, we are going to have Scott answer the first just on doing the network sharing active carve-outs in the cities, etc., because Scott's previous job to be CTO in Vodafone UK. So he has gone through all of that. And then in think, the remaining questions, Alberto, if you could help just to fill on with those. Is that okay, Scott?

Scott Petty: Yeah. Sure. Thanks, Johan. So our strategy for active sharing is to active share in rural and suburban areas where traffic density is lower and our ability to differentiate our network performance is lower. The cost benefits of active sharing outweigh any potential differentiation that we could create. That is not true in dense urban areas, and particularly in cities, where engineering acumen and build strategies, the way we build 5G give us a differentiation and ability to compete and win customers based on the network quality and capabilities that we use there. And there, we use passive sharing as our primary sharing mechanism.

We have learned these lessons, I guess, over years. And we have reversed some of our original decisions to do active sharing in cities and reverted back to a passive sharing model to get that control and ability to compete in the marketplace.

5G gives us an incremental opportunity for differentiation. And therefore, we have been using carving out to passive sharing in dense urban areas through 5G to allow us to launch applications and new services more quickly than with our partners.

In an active sharing agreement, it is more difficult to execute in an engineering sense, in dense urban if the two sharing partners are not perfectly aligned on their strategies and their spectrum holdings. And we found certainly as our growth in IoT, a new business services that having flexibility in dense urban areas enabled us to compete and would outweigh any efficiency savings that we lost in only using passive sharing.

Johan Wibergh: Thanks, Scott. Alberto, over to you.

Alberto Ripepi: Yes. As said by Scott, the importance of the sharing in the big urban areas, it is less relevant because the benefits that we can get is limited. On the contrary, in the big urban areas, so in the cities with a population higher than 100,000 inhabitants, it is there where we accelerate and we push with Massive MIMO. There is more capacity demand and also typically the more demand also from the business perspective.

So our plan is to differentiate the rollout in the urban areas and in the rural areas and to adopt 3.5 gigahertz and Massive MIMO more in the big urban areas. Where we are already deploying, we are more or less aligning it with our competitors in all the markets. UK is leading in terms of market, the Massive MIMO. And as you now in London, we got also the best 5G network, thanks to our deployment on Massive MIMO. And the Massive MIMO deployment, as probably you know, is a bit more complex than the normal deployment, because you need to raise a bit the pole. It is something that is not preventing us to accelerate the deployment. So it is something that is in our capabilities and we are deploying at the speed that we believe is linked with the demand of the customers.

Adam Fox-Rumley (HSBC): I had a question on MEC please. I was interested in the scale of the build that is required to make MEC work. So to take maybe the UK as an example, do you need 10 sites? Do you need 100 sites, 1,000, 10,000? I am getting different answers from different people. So I would be very interested on your perspective there. And I guess practically, does Vodafone need to buy equipment for each of those sites? And then a short second question, if I may. Johan, I think five years ago, you probably would have been in charge mostly of network engineers. Now software is a much bigger piece. You referenced the change of culture that is required in your presentation. And I wondered how you are tracking that change of culture internally.

Johan Wibergh: Okay. So if I ask you, Scott, to talk about the UK, then specifically on MEC even if it is Alberto's area, if you cover it since you know it well.

Scott Petty: Sure, no problem. So our MEC deployment in the UK, you really need to separate MEC used for the public macro network, and in that case we are deploying MEC into our technology centres, so between four and eight technology centres for a country the size of the UK enables us to offer MEC services across the macro network with the low latency capabilities.

However, MEC is also applicable to mobile private networks, like the Ford example that I gave you earlier. And in that case, you will see MEC actually deployed inside the factory of the very edge of the mobile private network. And that is where people get confused with the numbers. I think in a macro network sense, probably four to eight technology centres for a reasonable sized country will deliver the services you want. But in our case, we have 10 MPN projects in the UK, and if I will use MEC, then that is another 10 MEC deployments to support those. So if you separate the two, it is a fairly small number though for the macro now.

Johan Wibergh: Thanks, Scott. Then if we talk about the important change overall on the engineering etc. So this is really a journey that started before my time, started really back in 2014 and starting to build. And this started originally in India and in Egypt and starting to create a shared service organisation. And that was initially more operational items, but also some maintenance and simple engineering topics.

We decided then that it is really key to become big in software engineering for many reasons. I mean, first of all, we have found out it is actually more efficient to in-source versus buying from suppliers. Every time we in-source, we save 20%-plus, plus we also get people that are incentivized of doing what is best for us and not the supplier long-term.

Then we realised we also need it because typically the business model operators are being that you buy everything from suppliers. If you do that, how do you then differentiate? Because the suppliers will sell it to everyone else. And part of the industry problem we are having is, of course, that there is not enough differentiation in the customers' eye.

Now you cannot be naïve and think you can create differentiation overnight. But we said we need to start adding on and building differentiation. We need to start creating add-on products that has more value and add more differentiation. And if you do not have that it is hard. And as I said in the videos, I mean, software is eating the world. So we need strategic to be in the software engineering capability.

So now we have about 7,000 people. So it is a sizable chunk of the technology organisation. The target is to grow that. It is, as I said, put a stake in the ground. So it is about 15,000 people in 2025. Always if and buts depending on how we succeed with things etc. And we also have a balance between what is in-house and what we buy from suppliers. They want to make sure that is balanced, because could not bring everything in-house.

Then we are working really hard on changing the culture of Vodafone. So when we started with the Tech 2025 work back in January 2019, part of the work was to really talk to a lot of other companies. And we have been working one with the advantage of having the scale of Vodafone is that we get to deal with some of the best companies in the world and some of the best people in the world.

And I am super grateful for the, I mean, the Head of Engineering for Facebook, Jay Parikh. He has been a great guy. He helped us so much in the culture change. The Chief Architect of AWS has also been a great helper. And they have talked to us. They have shared information. We talked about the journey to do. And we have been changing the culture in Vodafone. And if you look at on our internal presentations on Tech 2025, it talks about three key pillars: culture, platforms and software engineering.

And we are on the way of getting there and we are by no far excellent. But we are on the way, we are getting there. And we gave some proof points on digital, on the pace in the presentation. I talked about what Scott has achieved in the UK. That is done with our own teams. That is the Vodafone employees achieving those results. So we are really starting to get there. We are again winning. One of our great guys won an award in the UK.

And so we are really starting to build an engineering culture in Vodafone. Now we would also need to be realistic that we are not where we want to be and we cannot really compete with the best companies in the world. But it is known that Vodafone has in the network space,

world-class experience and we are working really hard to get there overall in software engineering.

The interesting thing there is when we went down this path and Alberto's team, his network engineers people, they said, this is really interesting. So we have a scale platform for data in Vodafone, which is built on Google Cloud. And it used to be that we were doing a lot of drive testing on our networks, cars going around testing the performance. So what they have done is that we are getting performance data back from our customers' smartphones. It goes into GCP Google Cloud.

Then they are running very smart algorithms to analyse the performance of all the various places to come up with where they need to be tuning. So we are actually now starting to reduce drive testing because it is not needed anymore. So they both have the ESG benefit. They have a cost reduction benefit. We are fast to getting the data. And you can see the excitement in our people when they are working with these things.

So I think we have really turned the corner. Now having said that there is still so much left to get done. But I am very pleased with the progress, Adam. So thank you for asking that question because this is something I am very passionate about when it comes to Vodafone's future.

I think it is so important in evolving and changing the company long-term. I think it will differentiate us from companies that are telcos. You do not see it today, but it will really change us. It will make us another company in the future. I am so convinced about that. Thank you. Operator, next question?

Carl Murdock-Smith (Berenberg): It is kind of following on slightly from Adam's question and following on slightly from Jakob's question actually. If I look at slide 56 of the presentation, it says that your share of technology employees in software development will increase from 23% today to 50% by 2025. Am I right to think of that as your number of software engineers kind of slightly more than doubling from 7,000 today? Or is it that rather than it being that your technology group itself could shrink substantially in headcount over that timeframe? And then kind of a bit following on from Adam and Jakob's is in terms of that cultural piece and hiring piece and HR piece, how do you attract and retain top talent in an area like this where there's obviously lots of demand? And I suppose a bit from Jakob's question that sticks in my mind because in your answer to him you were kind of talking about technology is a ruthlessly efficient cost centre effectively. How do you attract people to come work for you as a cost centre rather than maybe going to other companies where technology is viewed as profit centre and potentially therefore more attractive?

Johan Wibergh: Great question, Carl. Really good question. Scott, do you want to give a try on that one?

Scott Petty: Sure. Look, I think we have real opportunities in the technologies that we are developing for and we find attracting software engineering talent actually reasonably easy to do. And we have been investing in resources both in our offshore centres and our onshore centres to support our digital initiatives and capability.

We focus our measurement of our people on velocity. And let me try and explain that to you as a concept, because this is what really gets software developers excited. If you have a

squad of 10 to 12 developers, they work in two weekly sprints to develop story points or features that we deploy in the market. We challenge those teams to be as efficient as they possibly can to get as much throughput through that sprint as we possibly can.

And we achieve that by building common standard platforms, reusing code, working in an open-source mindset where we share and we leverage off each other. And we challenge our teams to focus on velocity as their primary measure of productivity and the way that they deliver. And then balance that with the quality metrics, how many defects per release? How many issues do we have from a customer point of view?

And that is build a really strong engineering culture in software development that's got teams very focused on performance and velocity, not cost. So we do not talk about cost per engineer or cost per feature point. We talk about velocity and throughput and speed. Ultimately, they have reduced the cost per unit that you are producing. But more importantly, you can decide whether you want to produce more units or you can put it somewhere else.

So the culture of the engineering team is all about how can I go faster, how can I reuse more? How can I leverage technology more effectively? That may result in lower cost, but that is not how we manage them or focus them in our culture.

Johan Wibergh: Also, just to add on, I think in the new organisation, we are creating a European scale. There are actually not that many companies in Europe that have the engineering scale as we are having. And there are some really interesting technical challenges for people. If you consider the amount of data we are having, they are pretty advanced technical systems. I mean, both the fixed and mobile networks is really, really advanced technology.

On top of that, we are running a huge amount of servers both on-prem and in AWS and Google. There is some pretty advanced technology available in Google Cloud. And indeed with the best people. We are doing co-development with Google. We get to meet some of their best people doing things together. That really stimulates people. So I think we have a very, very strong employee value proposition.

I have actually been worried because we have been losing some people actually to both Google and AWS, because we have been starting to get really, really good people into our group. We need to make sure we retain people. So I think we are on our way. We have a lot more to do. But I think we are getting there.

Now, this capability we can use it in two ways. One is to drive very, very efficient things. But also we need to create to make sure we have enough innovative things when it comes to new product development to make sure we really generate new value-add there. So, of course, there will be different teams that are focused on different things. But it is very similar capability. Thanks, Carl, for that. Really like that. Operator, next question?

Operator: We had a couple of questions on the webcast around Open RAN. So I am just going to tie these together into a single question. What new vendors are you seeing enter the Open RAN software space? What innovations do you expect? And what is their business model? And secondly, are there any downsides from Open RAN? And how can you mitigate them?

Johan Wibergh: You want to take that, Alberto?

Alberto Ripepi: So the vendors that we see are not the traditional vendors, because I think that they would like to push as much as they can the traditional business. And we are entering a lot of newcomers that are bringing the innovation and the business model. Of course, for them is to introduce innovation that can be very easy to be deployed. And in the software side, it is something that we can achieve because of the separation from the hardware, otherwise we have a much more complexity to do.

So with regards to the negative side effects, of course, it is something that we are mitigating, in particular, the maturity of the technology. And so we are working exactly on this point on the maturity having the right PoP in the right trials and the right testing, and we created an organisation that is managing the integration. So you have two different low side that we need to consider. One is the maturity; and the second is that, of course, there is an integration complexity that is increasing. For this reason we are having the lab to manage this kind of integration.

So we are mitigating with the right test, right PoPs for one side. And the second one, creating a centre that is managing properly the integration to make sure that we take the best value from the technology.

Ottavio Adorisio (Société Générale): So first of all, thanks for organising the call. It is very informative. You provided a lot of details about all the developments you are making on the coverage and the capacity. And you say that effectively there is a massive shift also in terms of the culture. My question is a bit broader. It is what is different from the past? Because effectively, for us, analysts, it is very difficult to grasp, because what is going on in network, it is invisible to us. What is visible to us is the financials that the company delivered. The financial has been no great in terms of how to monetise all the capacity, all the good things you are doing in technology. So the question is, what you reckon could be different over the next three years to five years? I know that you are talking about a bit lengthier amount of time. In terms of the efficiency, the company can achieve both on the mobile and on the fixed, thanks to the technology you are rolling out, like you said, in terms of the cable in Germany in terms of the mobile with 5G, Massive MIMO and so on and so forth, because so far it is not been visible the numbers. So the question is that, when all these changes you are talking today would be more visible and we can actually see either on the margins on the P&Ls or on the capital intensity?

Johan Wibergh: Ottavio, great question and a very difficult question also. So I can give you the way I think about this and I have it in my head. So I think, first of all, I share your frustration that if you look on the revenue development for us and I guess the whole sector, it is not really impressive at all. And we can all agree on that. If you look on the core business we are having as Vodafone, the pure connectivity business, it is a very flattish business outlook, how it has been up until now. And it is a very challenging business.

And we have been doing maybe slightly better in recent terms, but still it is very challenging on the revenue. And it is not really where you want to be. And since I deal with so many of our partners and vendors, many of them have that double-digit revenue growth and you are sitting there and be feeling very jealous on what they have been able to achieve.

Now, to be realistic around the core connectivity business, that has something between a flattish to a low single-digit revenue growth outlook probably if we look on the total part of it.

If you then look on the Vodafone business piece and their presentation back in March on how Vinod is seeing the market and his ambition, you are seeing that he has a higher growth rate opportunity. And we start looking at those add-on things. We talked several about them here. We had MPN, where we have a very, very strong foundation. We got SaaS-based services, etc.

And all of these are things that are sitting in the extractive chart on the six strategic areas how we want to compete. So we see a somewhat better revenue outlook possibility on the Vodafone business side. And the technology is really key to make those things achievable. And so if you think about the core business, it has a certain outlook and we are doing the best to really optimise that. And in the best case, it is probably a low-single-digit.

Then there are some other areas around that that is a somewhat of a better outlook, and we highlight that on one of the slides in the pack. It is slide 58 in the pack, where we try to show the connectivity growth area, where they could be a somewhat of a better growth rate where we have certain items, so highlight things like consumer IoT. We have SD-WAN, security that we are doing there. There are a few different areas. Some that Vinod highlighted in March and Alex will have, for consumer, an Investor Day going forward, where he will talk about the growth possibilities.

And then further out, we have an emerging growth areas where financial services is strong for us in Africa with a double-digit revenue growth rate. We have a really strong position on IoT. So we need to make sure we utilise the skills and create those added values around the core connectivity that either just adds revenue per customer. And then gradually, I hope you are able to create things that are actually differentiating.

If you look on our IoT platform, it actually is differentiating versus competition. And we need to be able to create more value on that. Now, I do not think we have done a good enough job on it as an industry in creating differentiating adding value on things. And the core connectivity is a challenging business that maybe it is low single-digit, I do not know. And then, it is the other things we can add on top of it and around it. And that is what we are working on. And that is my way of explaining the next-generation connectivity and digital services provider strategy. And that is our ambition to execute on.

Ottavio Adorisio: Yeah. And if I can follow up, Vodafone has been basically born as a mobile company and it has been transforming over the last few years into convergent. And, of course, you have been growing mostly inorganically by integrating the business inorganically in place like Portugal. But in the mobile, you effectively control the end-to-end because effectively it is your network. Most of the times, you want to use it. In fixed, you have to rely a lot on your competitor/partners. And, of course, the technology you have in fixed varies according to the geographies where you got cables in Germany, you got fibre in Italy and you got a mix and hybrids in Spain. So my question is that, what is the difference of managing a network when you have the end-to-end control, like you do in mobile, while you have to rely on a part in that in most of the times, tend to be also your competitor on the retail market. In terms of how you are managing the visibility you have direct on all in the

network like you have in Germany makes a huge difference vis-à-vis places like Spain, UK or Italy.

Johan Wibergh: Alberto, do you want to cover the differentiation between wholesale and our own network?

Alberto Ripepi: Yeah, of course. You are right. You are perfectly right, because when it comes to the control on the mobile network or on a full omni-network, we have a full control and we can guarantee the end-to-end performance. In some other cases, we are relying on the third-party.

But in this case, what we need to put in place is very strong agreement with an SLA with the other vendor where we control effectively with the clients and the application of this. And as already said by Johan, do not forget that the vast majority of the tickets and incidents that we are getting on the fixed network is not driven by the pure infrastructure, even in the access.

Yes, we can have some problematics copper areas access, but the vast majority is always coming from CP and Wi-Fi, where we have room for improvement and we are deploying it. We have a very good control in UK, in Italy and in Spain where we rely on partners. And we have also agreement in terms of resolution of the access problems, relying on the same third-party vendor to make repair. In such a way, we can directly contact the third-party that is doing the repair in the access. But as I said, it is not the most painful point that we have in the end-to-end process.

Johan Wibergh: Okay. Thank you, Alberto and Ottavio. Operator, I think we are ready for the next question.

Andrew Lee (Goldman Sachs): I had two questions, I am afraid. The first one was just, I wonder if you can just explain in your digital transformation efforts, why are digital sales still such a low percentage of total sales? One of the technological obstacles to not being high. It is not just you guys. BT also targeted 30% of its total sales being digital by 2024 at its recent CMD. And just wondering why in this business it is like that? And then the second question is just how do you now decide what you are going to do in-house versus what Vantage does is doing for you? And just specifically maybe you can comment on, if fibre backhauling going to be done by Vodafone or Vantage? And is Vantage going to manage your Open RAN sharing like Cellnex started to do? Or do you think you have got more expertise in that area?

Johan Wibergh: Thank you very much, Andrew. So I think Scott if you take first and then Alberto take the second one.

Scott Petty: Sure. Andrew, a great question. Our digital sales have been growing steadily and actually quite strongly through the pandemic. And in some markets, we are quite close to digital being our biggest channel from a sales perspective. Not universal, but I think you will see these differences in cultures between particular markets.

What has been driving those increase is really improvements in the journeys and the capabilities we offer in our digital tools. So for instance, in the UK last year, we launched an upgrade guarantee tool that ran from the My Vodafone app. So as you are in the upgrade journey, you were offered a price to upgrade. You ran the diagnostics on your phone and it gave you a guaranteed price for your trading of that particular phone.

And we saw that resulting almost a third of our customers that went through the upgrade process in the app, also traded in their phone. That is more than double from what we saw the year before. So part of it is very much capability-driven, making sure you have all of the journeys that are required for the upgrade process. Simplification of our tariff models and our structures has helped dramatically our move to unlimited tariffs. And a simplification of the framework has made it easier for customers to make their own choices through digital journeys.

And a little bit is re-education of the market, a perception that is growing in many of our markets that you can negotiate deals. If you talk to our contact centre staff or if you go into our retail stores, you can get a different pricing. Steady consistent commercial rules across our digital platforms and our retail and contact centre sales platforms has also helped us drive up our percentage of digital sales. So I think we are making good progress on our capability. And we are seeing that the reshaping of our tariff models, that will see us have digital as our largest channel over the next couple of years.

Johan Wibergh: Alberto?

Alberto Ripepi: Yes. Thank you. Thanks for the question. So I know very well the Vantage set up since I was part of the core team. I was leading the core team of the set up of Vantage. So Vantage is focusing on the passive infrastructure. So everything that is linked with the passive infrastructure, so the location, tower and so on, air-conditioning, power, but is not linked with anything that is active.

So they don't provide us neither Open RAN, nor the 5G, nor the connectivity in the calling. We can agree with them in some specific cases when they are digging, for example, to bring the power to do in a synergic way to optimise the cost, the build of the fibre to connect to that site. And so, in this case, we can ask them to provide also the fibre, but we will remain the owner, and they would work on our behalf.

But only in the case that new sites have the opportunity to create synergies, deploying for power and fibre, or there is a demand that is coming from multiple operators that will be served in the passive infrastructure. And in this case, they can build in an optimal way sharing the cost with multiple operators. Otherwise, the FTTS, fibre-to-the-sites or the microwaves are completely managed by the operators. And how we manage it, that was the first part of your questions.

Vantage is part of our processes. We work in strictly contact with them our deployment team and we monitor the performance. Just for you to know, in one hour, I have a meeting with Vivek and the German team to see the progress of the German rollout in terms of new sites that they need to build to allow us to deploy the active part in the 'white spot' areas.

Johan Wibergh: Thank you very much, Alberto. And Andrew, thanks for the question. Operator, next question, please?

James Ratzer (New Street Research): Question I really had to start with was just around your cable upgrade path, please. I mean, I think, you set out a pretty clear path around the DOCSIS upgrade. But then in Gavin's presentation, he seemed to hint at the end that you left the possibility open that there might be an FTTP overlay option. So I suppose I just kind of going to question, in what situations would you consider this? If you did, what might the

CapEx implications be, in particular, also with cable, is N plus zero part of your planned upgrade? And if you move to DOCSIS 4.0, can we then start to move to this nirvana that is being talked about in cable where we can see set-top box costs coming down and there is more intelligence centralised in the network? And if am the last question, maybe just a follow-up, if possible, I think to one of the questions earlier from Nick Delfas around spectral efficiency and the propagation of Massive MIMO. I think in your presentation, Johan, you were showing that there is three times to four times uplift on spectral efficiency with 5G. But could you talk about how you see that uplift across the radius of the cell? And I am particularly interested in what uplift you are seeing in spectral efficiency at the edge of the cell. Are you still seeing the same uplift there? And if you are, then presumably there is no real need to have to densify the existing mobile grid.

Johan Wibergh: Okay. Thank you very much, James. If I start with the second question, I will take that one. And then Alberto, you get the cable upgrade part.

And I know you are quite knowledgeable in these areas also, James. I think what you do on the cell site when you have various frequency bands is that you try to optimise in the cell on how you use the various frequency bands. So you may have hundreds of customers in a cell and you try to make sure that the customer that is far away gets served by the lower frequency band, 700, 800, 900MHz, and customers that are close served by the larger frequency, that is the higher up.

It depends on how far the customer is and what the need is. But the cell is trying to optimise. The schedule is trying to optimise how this is being served. And, of course, the further away you are from the radio base station, you will have a weaker signal because there will be more interference and the signal will get weak. And hence, you will not have the same modulation on the signal and you will lose some of the spectral efficiency in that. And that is why it is.

But the radio base stations really drill down on analysing each individual customer where they are? What are the signal to noise ratios? What is the need? And then try to optimise. You can serve different customers on the different spectrum bands at the same time. So it end up in a very, very complex algorithm. And that is also part of how you really drive high performance there. And that is also one of the key things. And I think that is where we had a really good engineering skill set on how to configure and tune these things.

This is also one very interesting area in Open RAN, where you have a special controller where you can actually do more tuning and optimisation from this side. And we put out a press release on this a couple of weeks back on some of the improvements we could achieve by using that RIC as its called.

So sorry, if I did not give exact numbers but there are so many it depends on. But all of these things actually drives the cost efficiency. Getting all of these things work together is how you get more data through in that same cell by combining all these different things. Alberto, over to you.

Alberto Ripepi: Yes. Thanks, Johan. Thanks, James, for the question. So as we mentioned already, we have a very flexible architecture that we had deployed in the markets and we are continuing to deploy with the node split. Of course, we have an evolution over the coax in the access, but this opportunistically does not prevent us to deploy fibre where there is the

economic return that is good for us. And we can do this with the consortium or joint venture, depending on the commercial and the economics of the case.

The fact that we have a network that is already fibreised up to a certain point, make this decision really very easy depending on the economics that are in front of us.

Johan Wibergh: Thank you, Alberto. Thank you very much, James.

James Ratzer: Can I just follow-up on that Alberto, if possible, just on the kind of cable upgrade path? I mean, is N plus zero part of the plan and you see it evolve where cable set-top box CapEx can start to come down off you have then completed though or made inroads into the DOCSIS 4.0 rollout?

Alberto Ripepi: The set-top box CapEx, it is something that we are working in terms of designing of the set-top box in a way that will reduce the cost. And I do believe that it is a matter of time, but this will happen. But then, we will need to see and to combine with all the other features that are going to be deployed in the cable network.

Johan Wibergh: Okay. So I just want to say once again thank you for taking time to listen to us. I hope it provided some value and insights in how we are thinking and working with things. And, yeah, maybe then say thank you to you Alberto and Scott for also helping me out. And then I wish you all a nice day. Thank you.

Alberto Ripepi: Thank you very much, Johan.

[END OF TRANSCRIPT]