

Patrick Moorhead: Ulf, welcome to the Six Five Summit 2021. And I really appreciate you speaking here on day three.

Ulf Ewaldsson: Thank you very much, Patrick. It's my excitement and super excited to be here.

Patrick Moorhead: I know it's the second year, so it's super exciting for us. And boy, what a year it has been in 5G, and I'm thinking maybe the first place to start is I think most people watching this know what 5G is, but I still think there could be some confusion out there on what 5G is and what it isn't. Can you demystify this for some of us?

Ulf Ewaldsson: Well, I mean, 5G obviously is the next generation of the 4G, but otherwise having worked with 5G almost from day one and you know that I was part of the very initial discussions when I was CTO of Ericsson for what 5G was going to be about. And I can say from the beginning, we had the idea that the Internet of Thing or everything that is out there that can benefit from having a connection should really be part of what we call 5G in the next evolution of mobile networks. We realized with the success of 4G, that already then the smartphones was going to carry a big burden of what's the next generation on smartphone, but 5G is so much more than that. It's kind of the innovation platform for companies and enterprises to realize their connectivity dreams by having a macro network connected to the indoor networks or local networks in every possible way. That's what 5G is designed for. And we have just in the very beginning of seeing that being realized.

Patrick Moorhead: So I heard you use the word enterprise, yet here we are in 5G. People probably think it's more of a consumer thing. So how does 5G impact the commercial market for companies and even governments out there?

Ulf Ewaldsson: Well, it's very clear that the volume that we need in 5G, the volumes that are going to bring down the costs makes it affordable as well as tying smartphone users, even in enterprises, even tighter into the enterprise business models and what the enterprise are doing, that's where 5G plays such a big role. Or the beginning of the focus is absolutely right, Patrick, we are very, very consumer market-focused because the devices, the 5G devices, the first ones that come out from all the device suppliers and with the chip sets that are coming in from the chipset providers, all of that together is now building the beginning of the 5G ecosystem. Very soon, we will see applications on these devices, smartphones, et cetera, being oriented towards using much more of that 5G technology, both the security that's possible or one big drive is now very much around the image computing, image computing growing very, very fast, starting in the consumer market very much.

I mean, we have kids and children playing with TikTok and other augmented reality applications. That seems like a fun consumer proposal, but we all know that the commercial use of these kinds of augmented reality experiences or image processing, that's what's going to have a big, big enterprise use as we go down the road. We can then see that that puts demands on the networks, such

as T-Mobile's network, where we need to build up edge computing capabilities, possibilities to do image processing off the devices and actually in the network with the low latencies that 5G provide. That's just an example of where the boundaries between that consumer market and what becomes enterprise applications is getting more and more blur.

Patrick Moorhead: Yeah, it's interesting when I talk to CIOs of major enterprises during the pandemic, they were really looking for a solution that would, for remote work, not only be secure, but also have the bandwidth and separated from your kids doing Xbox in the back room. And I do like the way that you reacted, I actually tried out your internet hotspot here in Austin, and I have to tell you, it was one of the simplest experiences that I've had. And what I really like is that it melds with the conversations that I've had with CIOs and what they're looking for. Now, they're not sure if they want it in the hotspot or the PC or tethering off their phone, they want a separate line to be able to give higher quality of service and security to their workers.

Ulf Ewaldsson: Funny you say that because what we see is of course, the demand side of that, the demand for separate lines, we launched these enterprise applications a couple of months ago, it's just been a tremendous success in the market. Many people are thinking about multiple offices. You're no longer just thinking about one office, you have multiple offices. That demand is growing then for separate lines for that, as well as what we see as one of the big advantages. I mean, COVID for many of us was as tragic as it was, but it was a very big change in our network. We could see that all that frequency asset that we have at T-Mobile could skip to a very good use with our separate lanes for 5G, for example, which gives us the capability to actually have enough capacity to offer all these opportunities for enterprises and for people working in enterprises.

Patrick Moorhead: I hear this word being thrown around, edge computing, typically used with CTOs. And in fact, part of day three of the Six Five Summit is 5G edge and IoT. How does 5G enable computing at the edge?

Ulf Ewaldsson: Well, first of all, it's built into the idea and the architecture of 5G from the very beginning. Then I would say that it's probably the most jargon word if you are anyone in technology today, you have to have it somewhere, right? But actually doing it and building it means that we are moving the compute loads out of some very centralized data centers out further out in the network. At T-Mobile, we're optimizing that based on latency. We all know that 5G give very low latencies in the air interface, that's part of it. Then you need the optical connectivity and then you need to have an edge compute capability for as far out as you need that is driven by the applications that we see using offloading some of the computing from the devices into the network, that's where the edge computing comes in place.

It also has a very big role to play when we're thinking about enterprises workloads, one can of course choose to have your enterprise workloads on premise, you could choose to have it in an Amazon site environment, but at the

end of the day, you could also choose to have it in-between there or letting that Amazon work environment distribute the workload into T-Mobile's network to be able to compute at the edge and be able to get that performance that you need for your particular application in the enterprise.

Patrick Moorhead: Are there any use cases that you think look the most interesting que right now? You did talk about moving certain workloads, but are there any ones that kind of are rising to the top now?

Ulf Ewaldsson: I think everybody is looking at the same kind of stuff here. And first of all, we see an enormous takeout in all kinds of video and imaging. And that's happening, of course, predominantly in the consumer market. We have a very, very big percentage in our network that is pure video processing and video production. We could see that over time with augmented reality, that's just going to grow both from the entertainment side, but also now start to be driven by the enterprises as those applications come out. I read somewhere that last year, about \$4 billion were spent just on augmented reality applications. And this year that number is going to be even higher. So we can see that as one very exciting area that is growing very fast, the screens of the new smartphones are just getting higher and higher resolution.

You have more and more image processing power inside the devices, as well as then starting to make use of the network. So that's one area that is growing. The other one is what we're looking at, is IoT. IoT feel very limited to LTE because we know there are simply not enough chips or chip availability on IoT devices that has 5G built on it, but everybody's working on it, it's going to come very soon. And we can see that being part of remote controlling or logistics applications, automotive goes without saying, huge application in automotive. But all kinds of moving things around us that requires IoT. 5G IoT is just in its very infancy. What is important in the enterprise world is to start to already now think, "How can you make use of it? How can you actually start to use this in the applications that you use in the enterprise of various different kinds?" Already today, we see a very big growth in, for example, demand of logistics and fleet management.

Patrick Moorhead: I love it. It's interesting, I know some people are getting a little tired of talking about augmented reality, but here's the thing, there's only a few things about getting older-

Ulf Ewaldsson: I think it's just super cool.

Patrick Moorhead: Oh, listen, I'm with you. And also I'm patient, right? And I've watched how long it took for some technologies to take off. I mean, we reinvented the tablet computer three times before the volumes took off. We iterated on smartphones for years before we got to something that was just completely changing out there. And I fundamentally do believe that augmented reality is still one of the biggest things to do then. The only way to get that computing in that small little device on your face that nobody well wants to know that some special thing is by doing edge computing. So I'm still very bullish on that, but it's good to know

that there are at least five to 10 use cases that we're looking at. So we talked a little bit about work and the way that 5G is transforming work, a couple of use cases on collaboration, a couple of use cases on the internet, 5G capabilities for your own private line. Why should companies be thinking about 5G now and what should they be thinking about it?

Ulf Ewaldsson:

Well, I think first of all, I mean, mobile technology in general is moving now in the direction of everybody has a device. The device is so important now that leaving your house without the cell phone is much, much worse than leaving your house without your wallet or other assets, there's so much we're doing with our phones. That is becoming an increasingly blurry environment between your private life and your work life or enterprise life or entertainment life, all concentrates to the one device. That's one big aspect of it. Then with 5G comes now all of a sudden an architecture that is made for enterprise creation. It's a platform of innovative thinking around what the enterprise is going to look like. It's that digital relationship that is being formed in the enterprise through that device with the customers of that enterprise, that digital relationship can now be put on steroids because you could use the macro network for so much more.

And that has to do with traceability of deliveries or traceability of stuff that the company is selling, if it's selling stuff and so on. So 5G comes in as a technology by just being enabling so much more connectivity. At the end of the day, all those clouds, everything that's happening, all the applications that resides in the clouds, what really stops it from taking off is connectivity, so making sure that there is enough connectivity. And that's why for us at T-Mobile, our mission is to be leading that connectivity drive when it comes to 5G all across America. And we're doing it by building the largest 5G network in the nation, last year, we were able to launch the first nationwide network.

We are then bringing that to the next level. We're close to 300 million pops coverage almost on our low-band 5G, Mid-band 5G, about 140 million population. That's out of the entire population of the nation. So we want to make sure that that coverage is everywhere and that's the changing factor, it's not a hotspot, it's not just one area, it's wherever you are, it's that continuous customer relationship that enterprises can have with wherever their consumers, wherever their application is. And that's the mission of our company. And I think that's what we see the potential in 5G. And that's what we're working on.

Patrick Moorhead:

There was a lot of talk in the 4G days about 4G potentially being your corporate network. So instead of companies managing their own corporate networks, they could leverage a carrier to deliver that. And didn't go to many places for various reasons, are you more optimistic on this with 5G or has that ship sailed already?

Ulf Ewaldsson:

Somewhat. There is a lot of buzz around 4G still when it comes to private networks and that's what's available there, 5G is slowly coming. I have ever think that the 5G architecture allows you to not differ so much between the private network and the macro network, and actually allows data and connectivity to flow in between the two. So we are as excited in T-Mobile about the opportunity

of private networks, but we're using them commercial frequencies, for example, or specific frequencies that are public or using the macro network and trying to make sure we have an offering that comprehends and brings both of those benefits to any enterprise working with us.

Patrick Moorhead: Yeah, it's interesting, even factory, the future seems interesting. Most of the money a manufacturer spends at each new product that goes down a line, they're resetting up tooling, they're moving equipment around and they have wired networks that are very low latency. And I see a lot of interest because the cost of moving the equipment around with all the cables and interest in 5G enabling a digital factory to move, why would that be a smart thing to do? I mean, or is this demos and not reality?

Ulf Ewaldsson: I think we're on that trajectory of being able to work with a complete wireless manufacturing environment. There are already today proprietary solutions, for example, from the manufacturers of those equipments that are used in manufacturing that provide this kind of functionality. With 5G, though, you get a standard that is built with this low latency that is ready for anyone to use. I think we're going to see a broader use of the standard. The same time, there is the opportunity to also use operator frequencies, for example, in shielded indoor environments with private networks that then cooperates with the macro network, allowing you to do much more than just looking inside that factory room with your applications. That, I think, it's kind of letting all the manufacturing possibilities free, moving much more freely. And I think that's what 5G can do. And I think the standard is very comprehensive. It's built both for that environment, but also built for the macro environment.

Patrick Moorhead: My company does forecasts, we're an analyst company, it's not the biggest thing we do, but it's one of the things we do. And as an analyst, when you're looking five years out, it's easy to make mistakes and it's easy to throw numbers out there, but we could easily see a trillion devices out there within the next five to seven years, and part of that is very tiny devices, every 10 feet on an oil pipeline or on an electrical grid, the amount of sensors that can be out there. What is it about 5G that makes this more exciting? Because in the 4G, 3G, 2G world, using a lower G wasn't necessarily lower cost on a variable basis, there was fixed cost and it was good, but what is it about 5G and 5G technology that makes it more suitable for those? And whether we want to call it 100 billion devices or a trillion, a lot more devices than we're having out there now.

Ulf Ewaldsson: It's funny you say it, Patrick, because I must laugh a little extra because in 2010, I coined a phrase. We were looking for something to say in the Mobile World Congress in Barcelona from Ericsson. And I went out and said, maybe there would be 50 billion connected devices by 2020, which was bold at the time. And it opened a lot of eyes and thinking about, "Wow, that's really the future of mobile connectivity." Today we sit here and I don't know how many there are, nobody knows, but you're right, there's going to be lots. And what in the technology that makes it possible is really that 5G was designed with two extremes.

One was what we called massive machine type communication, which is really having a lot more devices per sector or cell. And that had to do with reworking schedulers and other things to make that happen. Then on the other dimension was this critical machine type communication. The latency, the optic feeling, how messages are being sent and resent to the different devices in the cells. Those two were the working hypothesis of 5G that became the standard, and because of that, we get this broad spectrum of opportunity when it comes to use 5G for machine type communication.

Patrick Moorhead: How far are we away from being able to have services that started a one, okay, low speed, high latency, and then going all the way to 11, low latency and crazy speed with of course, shorter distance. How far are we away from that?

Ulf Ewaldsson: Well, I think, I mean, already today, it's in the standard. Then there are things that needs to be realized. You have to have a core network if you're an operator like us, which is a standalone core network to be able to use a lot of this, including what is called network slicing, which is another term that was coined in the development of this, which has to do with the connectivity between a cloud and a device that is secure and has certain attributes to it, those attributes that you point to there, Patrick, those attributes that has to do with very low speeds, but very safe communication for example, or those that are very, very fast and has different set of attributes to them.

That those developments, I think, is already there, needs the steps, it needs a standalone core, which we already have at T-Mobile. It needs also a radio network that has enough capabilities to cater for it, which needs a lot of frequency, a lot of capacity, if you will, and stuff that is dedicated to 5G, not blended in with 4G, which we also have at T-Mobile, but those are steps. That thing is already happening today. We can see it happening gradually, but it will take time. I would say a good guess that many of these services will be starting to take up next year and the year after.

Patrick Moorhead: That's super exciting, it really is. And that's where I think, listen, I love incredible smartphone enabled devices, who doesn't? Right? Faster is better. I live 30 plus stories up, and I was able to put your 5G internet device right in the middle of it. I live in a metal box and it took me seven minutes to set this up and boom, I was there getting decent performance and decent latency, but I'm really excited though, about the ability for businesses to enable. So for instance, I have a thermometer on my wall, right? It's a digital thermometer and it uses Wi-Fi today, but you know what? Half the time I can't get into it when I'm outside, I would like a better network to be able to do that.

And it doesn't have to be a high bandwidth, very low bandwidth and very high latency, it just doesn't matter. And for those billions of devices or trillions of devices in 10 years, I really think that that's the right answer out there. You're the expert at this, so what is T-Mobile's long-term view on 5G and how are you enabling the adoption of that? I mean, you talked about, you've already got the

standalone network, I mean, are you done? I know you're not, but I have to ask it in a provocative way.

Ulf Ewaldsson: I love it, Patrick. First of all, the examples that you gave on 5G and how you use it is the perfect examples of how important coverage is in 5G. Coverage is basically everything. One thing, you need the capacity and the speed, but coverage is really... As a consumer, there's no way, or an enterprise, that you are going to have to keep track of where the towers are. I mean, you have to rely on having those speeds wherever you are. I'm very proud to say that with our launch of nationwide 5G in December in 2019, and then all the journey, we have up 1.6 million square miles covered, how is that? That's pretty good, and a lot of towers. Now, we're running at a pace here of about 1,000 upgrades per week.

So we're upgrading the network very, very fast to build that coverage. Today, we stand at about 295 million population covered with our low-band 5G. Low-band 5G only gives about twice the speed of LTE, but still it's cool, right? We're up to almost 100 megabits per second in speed. Then we have ultra capacity. Ultra capacity is that use of the mid-band, what came with the merger with Sprint, where we're able to get speeds now that are way North of 300 megabits per second, and giving that on a consistent, broad, broad, broad scale, 140 million population covered with that today, aiming at about 200 million population covered by the end of this year, aiming to get to 300 million with a low-band and just continue on that journey, we're never going to get done. And then we're going to make sure that we have the in-building experience and all the other experience. Our goal is of course, to make the most consistent experience all across, from enterprises to consumers out there over total 5G network, we call it 5G for all, and that's our [inaudible].

Patrick Moorhead: So let me just end, we're at the end of our time here, but first of all, I want to thank you and 5G for making my company look really smart because we chose you as the 5G leader over two years ago, caused a lot of heartache in the industry, but we saw the writing on the wall, we saw with the merger of Sprint, this was right in the early days, of what you could do with mid-band when connected with low-band and a high-band. And when I look at the moves of some other people who were jettisoning entertainment properties and news properties, I think we see the writing on the wall. And so thank you. And with that, I just wanted to thank you all for coming on here and making day three just so much better.

Ulf Ewaldsson: Thank you, Patrick. And we are so excited about this 5G future that we're now leading.

Patrick Moorhead: Yeah. Thanks again. And this is Pat Moorhead with Moor Insights and Strategy. Hope you're enjoying your day three of the Six Five Summit, have a wonderful remainder of your day.