



- Patrick Moorhead: Niklas, it's great to see you. Thank you so much for inviting us to a factory here in the Dallas-Fort Worth area. This is incredible, the automation, the 5G connectivity, it's amazing.
- Niklas Heuvel dop: Isn't it? We're so proud of this site. We still haven't been able to host the grand opening because of COVID, and we've been in production for two years. It's pretty crazy.
- Patrick Moorhead: Well, here we are live, talking face-to-face. It's great to be here. I want to thank you for kicking off The Six Five Summit 2022. Really appreciate that.
- Niklas Heuvel dop: My privilege. Thanks for having me.
- Daniel Newman: It is great to have you here. It was a lot of fun to go out on the floor, put on our lab coats, put on our straps, it felt very official. Sometimes in the world we live in we spend a lot of time looking through the lens, through that macro lens. There's so many things happening. We talk semiconductors for instance, all the time. The actual process of spinning out one of these chips, it's almost like a miracle to watch the whole thing happen. Then you come in here and you see all the machinery, the components, the quality, the assurance, all that happens.
- Patrick Moorhead: I was surprised most of all that this is the longest SMT line in North America. And, in fact, we had talked about this before, the first time I've been to a U.S. Factory that actually did chip shooting since, gosh, 1999 was the last time I actually saw this. It's quite impressive.
- Daniel Newman: This is where I make a joke about being in high school.
- Patrick Moorhead: Exactly.
- Daniel Newman: I think this is that moment for me. But no, it was really fascinating.
- I think for this interview, what we really wanted to spend some time talking about is 5G.
- It's what's being built. There're components that make it happen, that super fast connection everybody's waiting on so they can get their Netflix and do their social media. And of course, factories and automobiles that want to talk to the cities. All these things have to happen, but it's not simple. It's not straightforward. It's taken decades of innovation, of intellectual property, companies like Ericsson and others that are here at our summit that have been participating in really meaningful ways. Let's start there. Where are we in this 5G race? Where do you say, as Ericsson, where are we at right now?
- Niklas Heuvel dop: We start looking at the global perspective. I would say we are tracking very well. We're two years faster in the 5G platform rollout than in the 4G platforms. You have over a thousand devices launched globally already today, commercial devices available, 200 plus networks up and running, we're on a path to surpass a billion 5G subscribers still this year. It's clearly ramping a lot faster across the globe than what we saw with any previous technology.



- Patrick Moorhead: Yeah. But, there is some differentiation between different regions. China seems to be doing really well, but where are we in the United States?
- Niklas Heuvel dop: That's a good question. We were out first. We launched 5G in the U.S. before any other country. As a matter of fact, six months ahead of any other country, in the low-band which gives you the big coverage, in the mid-band, and then in the millimeter wave which gives you the most extreme performance. The U.S. was first, but we had a blind spot. We didn't have a ton of mid-band spectrum, which as you all know, and we have seen that in China, South Korea and other places, is how you build out the network fast with really good performance. Then the mid-band we're somewhat behind in the U.S., but we're catching up fast. We have one network at 220 million PoP coverage, one at a hundred and the third one being built fast as the operators now get spectrum. Our customers have spent over \$200 billion on spectrum and building out the network, so it's not for lack of commitment. The networks are being built out fast.
- We have over 90 cities with millimeter wave spectrum in the U.S. and that you don't see anywhere else in the world. So yes, we can get depressed about other countries having nationwide coverage with meaningful performance, but we're firing on all cylinders and coming out fast and we have something other countries don't have that we need to bring together.
- Daniel Newman: I think in this era we live in the immediate gratification often works against us, I really do. I think even the way certain companies brought 5G to market, labeling something as 5G, that it created an interesting market perception when we had the first iterations that was really just advanced LTE, but people thought that was 5G, and that was years ago. So then what happens is when the real 5G started being implemented into markets, people were like, "Well, wait a minute. I thought I'd been on 5G." Then in some cases, in those mid-bands, it doesn't necessarily perform better than those well, long deployed, advanced LTE that's had a lot of tweaking, that's had applications built very specifically for it. People are like, "Oh, this works great. Now I'm on 5G and it's not working so great, what's going on?"
- Patrick Moorhead: Or as good as 4G. They expected better.
- Daniel Newman: Well, that's that gratification we all want, but at the same time, we do know how critical 5G is going to be to the future. So many different applications. I think a lot of people are waiting to feel that, waiting to experience that, which goes with what you said.
- What do you say when someone says, "What are those early success stories? What are those early use cases that you guys are really glomming onto when you're talking about your success?"
- Niklas Heuvel dop: That is really the question, right? It is about a differentiated experience and that's why we need the mid-band and the millimeter wave, because there is just no other way around it. That's when you can see real factory performance.
- I'm going to start by scooting over to South Korea, which was the first to get to nationwide coverage. They have really seen incredible success in the consumer space. So of course, think video, more video, high definition video. That's more for less. Three times the traffic on the



network, and they're moving subscribers very fast to 5G. But what they've also come across now more recently is gaming, and cloud gaming. Gaming is a \$200 billion business globally. A hundred billion is mobile based. They have seen a willingness of their, call it, high end gamers to pay first the premium for a subscription which gives them that extreme performance, low latency responsiveness of the cloud platform, and then pay some for a set of gaming applications that are packaged up for mobile gaming. So they've clearly made some real progress in the consumer space.

But then we can actually also look at what's happening in the U.S., which we tend to overlook because we're very self critical; fixed wireless. That is really a net new business for our customers. Over 50% of the fixed broadband subscriptions sold in the first quarter of 2022 in the U.S. are fixed wireless. So fixed wireless has a massive role to play in addressing the digital divide, in getting that broadband connectivity delivered. That's something we don't talk a lot about.

Some of our customers have done some amazing things in private networks. Think of a venue, you have a limited footprint, you don't need that nationwide coverage to start trialing some really exciting stuff. The fan experience; now you're sitting in a stadium watching a football game, you can point your phone at your favorite player and you get all the stats overlaid. Or, you can pick a camera angle and you can follow your favorite player, or Formula 1 car that we just talked about, in a Formula 1 race. There is a lot of new immersive experiences in the entertainment business, which are being piloted in the U.S. as we speak. Those give us an idea of what could happen at scale.

And then of course, right behind me, this Mark Manufacturing use case where the U.S. is really at the forefront. I think we have a hundred proof of concepts across the U.S. where factories, mining applications and others are really being piloted stress testing the 5G networks. And that, I think, gives us pause to reflect about what's to come.

Patrick Moorhead:

I liked a lot about the factory floor tour, but the autorobots with LiDAR that were talking to each other via 5G, I thought was really cool. In fact, having the robots share information together so that it wasn't just some unilateral robot, it was sharing data from the robot that might be in proximity of it so that it doesn't run into people. I noticed it was waiting on us down there to get out of the way. It was trying to move equipment. I think that's a great example.

I spent my younger days in a few factories, and what I knew for sure was that the cost to set up and tear down a line was some of the biggest elements of cost. When I talk to a lot of manufacturers, this idea of being able to move the equipment around, ie: not plugged in all the time, and saving that time, saves them a ton of money and improves their time to market. Some great examples, we talked about South Korea, the fan experience and where we're sitting today. But is this it, are we here? Have we arrived? Is there more to this? I think I know the answer because we've talked about this, but I think it's important for the audience to really pay attention right now.



Niklas Heuvelodop: That's it. I think we're just scratching the surface. Some of what we do here, to be perfectly honest, is not on 5G yet because the device ecosystem is there, we haven't been successful as an industry exposing the capabilities. But it gives us an idea of the art of possible. By making these kinds of experiments visible, we're building an experience center in the corner where we're going to be piloting new stuff, bringing in developers, bringing in industrial partners like our component manufacturers here, the robot manufacturers, working together with them to stress test, what else could you do if...? Then you can borrow them, I mean, you have the AMR case here, but you have asset condition monitoring in the utility space. Well, how does something like that maybe help us improve our manufacturing on the shop floor.

That period is intensifying and that's where we are right now. So we are at the cusp of exponential innovation. When you see 5G AI machine learning, mobile edge computing, nanotech 3D printing all come together at the same time. It's the combinatorial effects that I'm super excited about. But yes, we've just scratched the surface.

Daniel Newman: It's interesting because as you see some of these use cases, and you even alluded to not everything being on 5G, I think sometimes when you hear us we're going on all great, and then you're like, "Well, we're not even actually using the technology for everything just yet.". And, by the way, when you were talking about the fan experience, Niklas, I'm thinking to myself, gosh, it must have been the World Cup, not the last one, I think I had a pair of Samsung Gear VR and they sent me an app and it was supposed to do with this fan experience where I was able to put on a VR and stand on the sidelines and watch the games. I was standing at the rail, watching the game. And it kind of worked, if you don't mind wearing like five pounds on your head and sitting there for 90 minutes and being a little disoriented. These are early days though, but that was obviously not on 5G, and by the way it worked okay.

I think this is where we almost get ourselves in trouble because we introduce concepts to the world and then people just expect everything to work right away. People don't remember the five or six years that Facebook didn't work particularly well, or the five or six years that Search never returned what you were actually looking for. Innovation takes time. In the beginning though, Niklas, you said something along the lines of, "We're two years ahead from an implementation standpoint.", but are we? In terms of where you expect to be, where the world expects 5G, do you think we're there? Do you think we've met the expectations?

Niklas Heuvelodop: That's a very good question. We are there when it comes to the networks, but the 5G networks are just a piece of the equation, foundational, nevertheless, but still only one piece of the equation. So we may have all of the 5G networks built out across the entire world. If we're not able to expose the unique capabilities that would allow you to take that compute capability on a robot and put it on a cloud instantly available to you with high integrity, security, instant responsiveness, the network will be no good for you. So how do we take this network platform and expose it to developers in an open, intuitive, and programmable way? Allow them to build and execute applications on that network, that's what we call network slices, not to get very technical, then you're not going to get the developers excited. Right?



You heard me push to the folks on the floor here and say, "So where do you bring in 5G now to allow us to scale that use case on this factory floor?". We're dragging device manufacturers in here, we're dragging developers in here, and that's the ecosystem portion that we haven't really solved yet. A lot of it is on us, the technology suppliers, the operators, but we need to get the devices. The U.S., unfortunately, only 20% of the devices that are commercially available globally work in the U.S. Device ecosystem is a key portion of that. That's where you hear our team down here being a bit frustrated. They want more chips, more devices, so they can test even more use case into it.

Daniel Newman: Just to follow on, because I know we're going to want to start talking about the future, but how important are the developers? How important does Ericsson see that? Because all of the things we've talked about, we need developers building 4/5G, right? The apps have to be different and better.

Patrick Moorhead: Well, it has to be... you can't have to write to three or four manufacturer APIs. That's super inefficient.

Niklas Heuvel dop: If you think of the network platform being there, we're not talking about getting the unique capabilities that we know the 5G network has. That's the kind of stuff we're testing here. So we know that. But those, to your point, need to be exposed to developers in an open, intuitive and programmable way so they can make sense of it. That's where we have failures in industry at this point. Not surprising maybe, it takes time. But getting those APIs standardized across networks, the Ericsson network, the Nokia, the Samsung networks, across multiple service providers, it can't be only one of them, because developers care about scale. Those capabilities need to be exposed to all developers. Then they will come and they will build great applications, and the device ecosystem will of course flourish once there is a scale game. It's a bit of a virtuous cycle that we're trying to get in to.

This type of experiment, some of the other examples I mentioned, are all about getting developers intrigued, excited, device manufacturers to their betting and making the investments up front. Intel used to spend a lot of money on early market making, we're trying to do some of that. Most of our partners are right. We really need to find a way to ignite that ecosystem, because otherwise developers won't know what applications to build.

Patrick Moorhead: Yeah. The common APIs. I am super excited. I think we're going to see some real magic happen once even the mid-band gets worked out. I think a lot of them are waiting for this nationwide coverage, high speed, low latency. You put on top of that massive, massive MIMO, a lot of the industrial folks are excited about that. They want one frequency inside of their oil refinery operations, and it really simplifies it for them, but the carriers could never offer the right ARPU to manage and have those 5,000 gas line sensors connected. We talked a little bit about where we came from, where we are now, what we need to do to be better at rolling out 5G, but let's talk a little bit about the future. Maybe some use cases that aren't necessarily in POC, but theoretically they would make sense and 5G adds value to it.



Niklas Heuvel dop:

Well, to be honest, a lot of the use cases we talked about to our tech to fan experience, or even the smart manufacturing mining cases, they are not in scaled industrial production. We haven't industrialized them so they are still proof of concepts. I think the first big hurdle for us to cross, horizon too, is to figure out how we industrialize that. That's where we get this exposed to developers, where we get the devices, and that is going to take off. That is going to be the horizon too, in my mind, the period where we will see industrial, digital transformation happening for real. I mean with 4G, the consumer experience was digitized. We don't think about that today but banking, everything you do, is digitized as a consumer. That is going to happen now in the industrial context. What we're also seeing with some of these use cases, we're talking about holographic interviews, we were looking at the AR mixed reality demo on the floor, this is now a smart factory.

We have the two bay stations. You can see them here. So we can control the radio environment and we can build something like this in no time. But if you take this now onto a nationwide network, when you start thinking about having these kinds of mobile edge compute capabilities, an instant responsive cloud gaming application, or an instant VR application available to you, that doesn't have to have the compute capabilities in the goggles, you can now start imagining glasses that look like glasses, but with AR capabilities. The compute happens in the cloud. The access is instant. For that to be a good consumer experience, it can't be available every now and then, best effort. We talk a lot about peak rates and we talk about the millisecond latency that we can get to. That is great in theory, until you can industrialize it in a way where you can deliver that as a consistent, predictable consumer experience. Basically, against an SLA.

Think: the Metaverse. We talk a lot about that. We can see applications of the Metaverse in a private network setting like this one. The Metaverse of course is taking this now into the wide area for consumers to benefit in an augmented retail shopping experience, the virtual participation, I mean, me sitting here as a hologram. That we can demonstrate in controlled environments like this one today, but to take that on the streets in the macro network takes quite some work to do. We're super excited about the work we're doing with Meta and several of our customers. What does that network have to look like two, three years from now to have that mobile edge compute capability so you can basically put any of those applications on a cloud, instant? So the devices can be ultra slim and not consume a lot of energy either. You made the comment about the backpack.

Daniel Newman:

Well, you could never imagine doing it all day. I've actually heard certain organizations that have maybe turned on the quote, unquote Meta, having people wearing their VR all day in meetings. I can't actually imagine it yet. But, I could imagine if it was as light as my readers, for instance, being able to throw them on and engage with the Metaverse having data in your periphery. Like I said, and have said for a long time, I truly do believe, you look at the evolution, you show an evolution of man and writing, we get vertical. And now with the phone, we're starting to go horizontal again. What I'm saying is that the whole idea of technology is getting us back up, get our heads up again. Get the data in front of us, but allow us to be more engaged with the physical world.



That's one of the biggest opportunities the Metaverse, or next generation of augmented reality can solve. This tech has been here a while, this really to me seems like the big opportunity. Of course, you're going to need the developers, the apps, you're going to have more streamlined platforms, they're not building for too many different devices concurrently. But at the same time, we've been talking about VR for a decade. We've been experiencing it for probably just as many years. Things like autonomous simulation of industrial environments, of buildings, being able to build and fly a plane, but not actually fly the plane so it can get millions of hours of simulation data so that you can build the safest assets, or truly engineering cities to create traffic patterns that are going to improve our world experience.

This is where I think that 5G really has a big opportunity to play a part. We're doing this in microcosms. We're doing this in little pieces right now. Like you said, proofs of concept. As we start to bring this to conclusion, what concerns you about this? What are the potential pitfalls? You guys have to be thinking about this all the time, where what I just described sounds extremely exciting, but again, four or five years ago when I was putting on those goggles and watching the World Cup, I would've thought maybe we're a year or two away. It's been five more years, and the experience is only a little better.

Patrick Moorhead: What's holding us back?

Niklas Heuvelodop: It's a good question, I think of it in kind of three layers. First, the network. We need the network to be built out. In an environment like this we can do it really fast. If it's a nationwide consumer experience, it takes more time. That network build needs to continue in the U.S. and spend a lot of time in Washington. Spectrum, zoning permitting, and the tower crews are kind of the big bottlenecks. Policy. There are risks on the horizon where there are discussions about more regulation on our customers. That could hold back their appetite to invest. So, there is some hinders, blocking and tackling on the network layer. I think we'll solve that. Then, the next part is something where we as an industry, if we're a bit self critical, haven't been brilliant on collaborating among ourselves, between OEMs, between service providers.

Because you made the point: It's all about the APIs, and standardized APIs that work across networks, across our customers, the operators, so that developers can benefit from hyperscale across all operators, all technologies. Here we have a lot of work to do between us in the industry, to come together and standardize on the APIs. Then the rest, the developer ecosystem, I'm not so worried about because if there is something we have plenty of in the U.S., it's venture capital, it's developers, a good risk appetite and a good ecosystem. If we can put the first two layers together, I think this is going to really start accelerating.

It's going to come down to form factors and devices. What gives me a lot of confidence is yes, they are bulky, they're geeky, you need to be a nerd to play around with some of this technology, but it shows you the art of possible. With 5G, and a lot of the other technologies around 5G, you can shrink the form factors. We know it's possible, but it takes scale. It's a scale game at the end of the day. So we need to get into this virtuous cycle where the innovation starts taking off at a much higher pace.



Patrick Moorhead: Is there anything specifically that the U.S. needs to do to be able to lead in this? And, and I think many smart people in the U.S. do see a correlation between leading in a certain wave of G, 5G, and the ability to create jobs, to be able to lock in and create the next wave of global IP. But I think even more importantly, when it comes to innovation, remaking these brownfield industrial IOT with digital transformation, what does the U.S. have to do?

Niklas Heuvelodop: Accelerate, is where we're on. It comes back to the same things. I think we were caught a little bit with our pants down when the world started building out 5G at pace in the mid-band.

We need to learn from that. We need to make sure there is more mid-band spectrum put in the hands of the service providers in the U.S. They have a third of what's available to some of the leading nations globally. So more mid-band spectrum, because that's where you get the best kind of performance coverage trade off. We need to think ahead. 6G is many years down the road, but we need to make sure that we get on mainstream spectrum, which we didn't in 5G. This is just hard work, blocking and tackling. We need to get those networks built out. We need to make sure that policy makers, regulators, local jurisdictions, there's 3,500 jurisdictions that our customers have to work with.

Patrick Moorhead: And how many does China have to go through? One versus 3000.

Daniel Newman: 3,535

Patrick Moorhead: But who's counting, right?

Daniel Newman: Yeah, exactly.

Niklas Heuvelodop: So it is a lot of hard work, but the commitment is there, the money is being spent, I think policy makers are on board. We just want to make sure we don't create more hurdles, but less for the service providers to build out and for industry to do their thing and to innovate. Then the big part is on us. Get that network exposed, agree on those APIs across countries, across operators, and then the developers will come into devices. It could be one thing where the U.S. could actually maybe learn from what we see elsewhere around the world, but also from earlier generations. Not necessarily wireless, seed money, jumpstart the device ecosystem. You need to see more devices for developers to get crazy. They could talk to our people here on the floor. They can see a lot more things they could do if they had different form factors of devices.

Daniel Newman: Yeah. We need to continue the investment, totally agree with that. I couldn't agree more with what Niklas just said about the policy. I think our regulators and policy makers can be the gateway for innovation, and they can also completely block or slow, so that's going to be really important here. Niklas, I think this is a great way to start off our day here at the Six Five Summit. I really appreciate you sitting down with us. We can't wait to see what you guys do. Continue to build. 5G is an exciting topic with so much potential, and the world is waiting with interest.

Niklas Heuvelodop: Thanks Daniel. Thanks Pat.



Daniel Newman: Thank you. Appreciate it.

Niklas Heuvellop: Enjoy the rest of the show.