



# USER FRIENDLY

## New wireless technology and 5G trends

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**Hanish:**

New wireless technologies, such as 5G, are an essential link between billions of devices, machines, people, and a promise of performance improvements. Faster speeds, increased data capacity, lower latency, greater device density, and location sensing are just a few of the things that make wireless an attractive option.

As many organizations shift to 5G, networking executives view the technology as critical to enterprise success, with

business leaders joining in to drive adoption. And joining me today to discuss new wireless technology and 5G trends are Jakob Bluestone, head of European Telecom's Equity Research at Credit Suisse, and Paul Lee, partner at Deloitte UK. Jakob, Paul, welcome to the show.

**Paul Lee:**

Thanks, Hanish.

**Jakob Bluestone:**

Thank you for having us.

**Hanish:**

All right then, gents, let's dive straight in. As you guys know, on User Friendly, I really like to break down the topic into something digestible. Now, most of our listeners will be aware of 5G, but for those who are not so familiar with it, can you explain what 5G is and your perspective on the current state it's in?

**Jakob Bluestone:**

Absolutely. Maybe I'll kick off and, Paul, maybe you can jump in. I mean, roughly

speaking, mobile technologies follow sort of 10-year cycles, and this is the fifth one coming around. With each cycle, you basically get the ability to handle data better than previous generations. It involves ripping out most of the kit, replacing the handsets, using new spectrum. In practical terms, what consumers will see is mobile data which will be a lot faster, so up to 10 times faster, and also with lower latency. So that's the delay that you get when transmitting data.

In theory, the latency should be as low as about a millisecond versus 4G latency, which is about 30 to 50 milliseconds, so a lot lower latency, which will enable all sorts of things that I'm sure we can get on to. With 5G, as well, comes a lot more capacity. So, in most countries, the amount of spectrum being dedicated to mobile will roughly double. And then also, there's a lot more flexibility that comes as well with 5G and particularly how you use that additional spectrum, so you can start being able to do all sorts of cool things like what's called network slicing and beamforming and all sorts of other cool, modern things that weren't necessarily possible with earlier generations.

**Hanish:**

One of the things that I do want to ask is you mentioned a couple of things and I would love for our listeners to kind of get the breakdown on, you mentioned, spectrum, network slicing, and beamforming. If you could just spend a few minutes on those just to help our listeners with those terms as well, that would be great.

**Jakob Bluestone:**

Absolutely. So, spectrum is the amount of capacity that is dedicated to mobile. The simplest way of thinking about it is if you think back to old radios, which operated at 88 to 108 megahertz for FM. It's the exact same idea with mobile, it's basically a two-way radio with a certain range of frequencies that have been allocated for them. So the more spectrum you have, the more traffic you can handle. If you don't have any spectrum, you won't have any data going through the network. In most markets, you typically have sort of around 500-ish megahertz of spectrum available. And with 5G, that amount is being roughly doubled

in sort of more usable bands. There is also some very, very high band spectrum, which is much harder to use, whether there's a lot more of it available, but essentially spectrum, it's the sort of raw material that you need for mobile.

On the other bits, so spectrum sharing or dynamic spectrum sharing is something that's currently being launched by a lot of operators. That's where they combine 4G and 5G spectrum. And what that basically allows operators to do is to use that spectrum that they have more effectively, so they're not tying it all up with one technology or another, but they can use it across different technologies. From a consumer point of view, you don't really notice the difference, whereas from an operator point of view, it is a much more efficient use of the spectrum that they have. And then, beamforming is a way of basically using that spectrum in a much more effective way, so rather than sharing that spectrum amongst all the users that are captured within a cell, so within the range of one antenna, what you can do is you can dedicate all of that spectrum to one user, using it kind of like a beam targeting just that one user.

**Hanish:**

Thank you for that, Jakob. It actually helps me, because I recently bought a new Wi-Fi mesh at home and it had beamforming, so now I know how I can exactly use that at home for sure, so I appreciate you breaking it down for us.

**Jakob Bluestone:**

There's an important point actually on spectrum sharing as well, which is that a lot of 5G is, at least in the early days, really just using the spectrum sharing. Now, the important point from the consumer's point of view is you can't really tell the difference between 4G using spectrum sharing or DSS and what you could call sort of true 5G. And so a lot of the 5G that we're seeing in the early days is going to be actually very similar to 4G in terms of speed.

It helps the operator; it gets them ready for launching better versions of 5G. But today, if you have a 5G device and you see a little 5G logo in the corner of your phone, chances



are the speeds you're getting are still pretty similar, and that's because it's not really using 5G-only spectrum. It's still this sort of in between shared capacity and as a result, from the user's point of view, in the early days, we're not seeing a massive step-up in speeds. That will come down the line.

**Paul Lee:**

I think, just to follow up on that, what's really interesting about 5G is it's a bit of a discontinuity. So when we look at 2G, 3G, and 4G, a lot of the benefit went through to consumers. But for 5G, the difference to the consumer, as Jakob was saying, won't feel that great. And that's partly because the increments in speed are not that much better than good LTE or good 4G, but also, some of the really high speeds that you can get from 5G just don't have any consumer applications. So if you look at like video, which thrives on LTE, the incremental speed that you can get from 5G doesn't get you much better video, because video is already good enough.

**Hanish:**

That's actually a really good point. I'm really happy you brought that up, Paul, because we do hear about the big promise that 5G will bring in the incredible speeds from a consumer perspective, so I'm glad we've kind of clarified that.

And this actually moves me on to my next question, because I imagine there's an element of infrastructure at play here and I certainly feel that, and all of us have been talking about wireless networking for some time now, but really what's different now and what are the real improvements that we're seeing at least on the infrastructure side?

**Paul Lee:**

I mean, one of the key differences with 5G is that it's a standard that's been written almost explicitly for industrial usage. So when we think of massive industries that have surged over the last decade, like logistics, one of the things that they rely on, for example, for doing the quantities of deliveries that we're at now, is the ability to send directions through to an individual and that relies on a foundation of 4G.

But when we look at 5G, a lot of the standard that's out there has been written to cope with, for example, the indoors. It's been written to cope with metal obstructions. When we think of wireless technologies, you find they're great in offices, whether it's a tolerance for failure in that, like a call could drop, but you just dial back in again, we're used to that. But in a warehouse-type environment, where you've got heavy machinery, if you are using wireless connectivity to connect a device, if that connection drops, then you have the possibility of an accident and that's just not possible in that kind of environment.

So that's one thing which is really different about 5G, is it's written to be able to address those industrial needs.

**Jakob Bluestone:**

I think Paul raises a really good point, which is a lot of this is about B2B. And one of the things we very often hear about 5G is there's no killer app in the way the video was the killer app for 4G. And I think that's not entirely true. I think on the consumer side, we don't yet have a killer app and maybe it will come at some point, some sort of, I don't know, augmented reality, social media, but the killer app that you already have today is B2B and that's exactly where a lot of these use cases will come early on. And we're all consumers, consumers account for about 70% of revenues, but you still have about 30% of mobile revenues that comes from B2B. And that's really where you're going to see a lot of the innovation coming through early on.

**Hanish:**

Jakob, your thoughts on where it may be that the tower companies play into this and the telcos themselves and the overall evolution at the network.

**Jakob Bluestone:**

In terms of the tower companies and the infrastructure side, there's a few things that are happening that are interesting. Clearly, with the deployment of 5G and very strong data usage and the usage of higher bandwidth spectrum, where the range isn't quite as good, you are seeing some

densification happening of the networks, so there is some new sites that are having to be built. It's not sort of running away in most of Europe, but it is certainly a gradual process. So there is pressure on operators to spend more CapEx to deploy 5G. In some places as well, there's security issues, so that's sort of leading to some swap-outs. The issue is that's coming at a time when operator revenues in many parts of the world, particularly in Europe, have often been under pressure. Returns have often been the low cost of capital.

So there's a lot of financial pressure on these operators right as the investment needs are sort of starting to accelerate, and that's essentially led to operators looking at how can they share infrastructure more, whether it's through directly sharing with another operator or perhaps getting a sort of neutral third party coming in like a tower company where the operators will share with other operators using a third-party independent tower company. Now, if you look around the world, there's some parts of the world where this is much more advanced. So in the US, for example, around three quarters of towers are already with independent tower companies. But if you look in Europe, this is a process that's really only just started over the last couple of years, so you've got less than half of towers today sitting with the independent tower companies and most towers today are still owned by the operators.

And what you're starting to see is that as the operators need more and more sites and more and more points of presence, they are increasingly divesting towers to independent tower companies or in some cases they're carving out their own tower businesses and then basically trying to make those into sort of quasi-independent tower companies to get some of these benefits of sharing more. So it does vary where you're looking in the world, but particularly if you're looking somewhere in like Europe, what you're really seeing is this trend towards sharing more and more infrastructure and increasingly using neutral third parties in the middle to help with that sharing.

**Hanish:**

And, Paul, your thoughts on this, on the infrastructure side and what we're seeing on the evolution of that?

**Paul Lee:**

Yeah, I think it's a really exciting time because if we think about mobile, it's advanced a lot since the first generation of networks in the '80s, but the operating model has been largely the same. It's been operators which do everything, including owning the towers. Also, it's been equipment vendors, which supply everything. You have quite a closed community, but as Jakob mentioned, so what we're seeing is a divest in the way of the physical infrastructures, which hold the equipment. That's possibly phase one. Then, the next phase of that could be that some of those towers companies move along the value chain and start deploying some of the equipment themselves.

You may have this fascinating dynamic whereby the towers companies not only have higher multiples but start growing in different ways. That's one thing. Then, there is also another trend, which is quite current, in that, 12 months ago, we wouldn't have really been talking about this, which is the opening up of the radio access network. That's the bit which is visible to consumers. You've got the antennae, and then the bit that you won't see is the computing equipment that's attached to it. That's historically, and this is for decades, has all been integrated. You'd buy the antennae, the hardware, the software, all from the same vendor. In some regards, having that kind of integration makes perfect sense because everything aligns. But also you have reduction in competition as a result of that. So for operators, what they're looking at more and more is to what extent can you start procuring from other vendors? That's what Open RAN is about.

There aren't many vendors out there. There aren't many operators which are using Open RAN at scale right now. But in the last 12 months, a lot of operators have gone from this being a PowerPoint to doing trials and then to committing to deployments. There are some operators in Japan and India which

have deployed even in urban areas. It's a tumble of a lot of change. You've got a new standard, you've got new operating models, and you've got new vendors coming to the market. There's a lot of change happening there, a lot of which is invisible to the consumer, which is seeing continuity.

**Hanish:**

Just to stay on that point on Open RAN, do you see that these changes are going to lead to an acceleration of rollout of 5G and next-gen wireless technologies for us all, or do you think that it's going to take a bit more time until they get consistent with an open standard, and everyone's adhering to it, and then you will start to see the acceleration?

**Paul Lee:**

I think we need to review what's going to happen for the next 12 months. With every month, there are more data points coming through, so more proof points. A few months ago, a lot of the questions were, "Can this work for 5G, say, Open RAN?" In the last couple of months, some of these sites have gone live on 5G in urban areas. There'll always be skeptics. When we think about the telecoms industry, it's been able to be moving more or less at the pace that it wants to move at. This is a shift. This is unusual. This requires a different mindset from a telco, which is rather than just buying for one provider, moving from multiple providers. Any change is unfamiliar, and it's disquieting. But the thing is, the operators may just have to grasp this and deal with it. The next 12 months will be fascinating.

When we meet again, perhaps in a year's time, it will be great to review the status of Open RAN. It may be that it's advanced really fast and there are a lot more commitments to it, or it may be that it struggled. But I think at the moment, we don't know. But I'll ask Jakob if he's got any other views on it.

**Jakob Bluestone:**

Yeah, I think Open RAN's one of the most interesting topics right now in mobile. As Paul rightly says, there's still a lot of questions on how exactly it's going to play out. I think Paul's actually written some of the best analysis on the topic in the industry. I think what I'd add is, you have Open RAN

entrance in several markets, in the US, in Germany, in Japan, and a few other places as well. Clearly, it's something which will have the potential to change the structure of some markets, depending on, what are the economics of these new businesses.

You also have many existing players who will also be using Open RAN. I think for them, it's really about two things—how big is the saving that they can get in their business from using Open RAN, and then also what are some of the new revenue models that it opens up? I mean, Open RAN is essentially a bit like taking your cable subscription and picking and choosing a bit where you want to get your content from. It's breaking up the bundle. Potentially, there are some substantial savings from that. We've seen numbers of sort of 30 to 40% CapEx reductions potentially.

I think on the revenue side as well, as we touched on earlier, there's a lot of flexibility that comes with 5G. Again, I think operators moving more towards Open RAN will ultimately create some more flexible business models, as well.

I think it's an incredibly exciting topic because it's one of those things that could actually have some real impacts on the industry. Now, exactly how long it takes to play out I think is harder to say. I'm sure it will vary a lot from market to market. It's one of those things that could really change as you move more towards into 5G being more widely adopted.

**Hanish:**

Jakob, you mentioned market to market. Paul, you also mentioned some of the differences across the countries. It'll be interesting to give our listeners an insight into what you're seeing, say, in the US versus Europe versus other regions across the globe, in terms of just what's happening and the differences around just the evolution to 5G.

**Jakob Bluestone:**

I mean, I think if you sort of look at some of the major markets, I mean, there are very different stages of 5G deployment and adoption. I think the differences, in large

part, depend on some of the government policies and the timetables around when spectrum is actually being released.

Some of the markets that are most advanced would include places like China and South Korea, where you've got 10 to 15% of subs already on 5G devices. That's basically been helped by enhanced prices coming down, early spectrum releases, and some other industrial decisions made in those countries.

If you look at places like the US and Europe, we're far behind that. You're probably looking at 5G adoption of less than a percent of subscribers. I think it's really only kicked off particularly with the latest iPhone release. I think it's been a much slower process. Some of that's been tied up with the time it's taken to release enough spectrum for 5G to be available. There's a big auction that's recently started in the US. You still have a few European markets that haven't made all the spectrum yet available. As I say, without spectrum, you can't really launch the service, or you can only launch it in a more limited fashion. I think in Europe and the US, we're still far behind what we're seeing in Asia, but I think that will probably start to kick off fairly soon.

The first step, as I say, is releasing spectrum. Then, the second step is really making the network deployment sufficiently wide, so having decent coverage. Then, as we touched on earlier, it's a bit of a debate of what kind of 5G is it actually, is it really just 4G with a different name, so where you've got 4G type speeds of 40/50 megs per second, or is it true 5G that you're getting. But I think these things will develop over the next two or three years. Our forecast is that globally, in about 2024, so just over three years from now, you should be at about 2.3 billion 5G users. We do think you will see pretty rapid adoption over the next few years.

**Paul Lee:**

I think one of the interesting trends in Europe has been in the industrial space in that individual companies have been able to apply for spectrum specific to a geography. What that means is that a company can

have a private, self-contained network using spectrum which isn't going to be encumbered by public usage. There wouldn't be any interruption to the availability of that spectrum from other users.

This is something which Germany pioneered, the UK followed quite soon after. This is back in 2019, with making 5G and 4G bands available for private networks. One other thing to add about this is that a private entity when applying for one of these local licenses pays an admin fee. It's not an auction. But the idea of this is to encourage companies to experiment with new wireless technologies and to see what flows from it. Because whenever you can deliver productivity benefits, that's good for economies. Companies are always looking to improve productivity.

**Hanish:**

Paul, I'm really fascinated by what you just highlighted there, in terms of the companies being able to apply for a specific spectrum. Any examples that you've got of that that can really bring it home to our listeners.

**Paul Lee:**

Yeah. I'll give you some examples of car factories. You've got companies like Mercedes and also Ford, which have been provided with local licenses for 5G. They are deploying applications, which rely on 5G connectivity, to make large files move faster but also to enable some innovations. For example, for the Mercedes factory, to enable the introduction of automatically guided vehicles, so reducing the need, for example, for a person to move stock physically in a trolley from one part of the warehouse through to the assembly areas. That just moves to automation using facets of 5G, which enable indoor navigation. For the example of Ford, what they're doing is using 5G as a way to iterate the process of manufacturing electric vehicle batteries. What it involves is sending photographs of the welds which have been done to attach elements of the battery together. Of course, for an electric vehicle, a core competence of the car is the assembly of that battery.

I think what's fascinating is that connectivity is a raw technology. When it's conceived,

when it's designed, there isn't always the application for it. But when it gets released out into the open, then the applications attract themselves to that raw capability. That's a process that we're going to go through over the next few years, and just seeing what sticks, when do you have that additional capacity. I think, generally, as of now, there are so many things that we want to be able to do, at a commercial space, at a private space, that we had no idea that we wanted to. When connectivity becomes available, with the right performance and at the right price, then applications appear. But they were always there. It's just that they were latent.

**Hanish:**

Thank you. Appreciate that. And one thing I'm seeing is that both Credit Suisse and Deloitte have recently released reports on this topic. So, Jakob, could you tell us a bit more about what we might expect to see from 5G globally and some of the impact it's having on European revenues from the report you recently released?

**Jakob Bluestone:**

Absolutely. So I think initially what we're seeing with 5G is that in the early days it's largely a marketing tool and it really just slots fairly neatly into what are the commercial strategies and sort of setups in each market. Generally, if you've got markets where the competitive environment is fairly healthy, essentially, operators are using this as a sort of tool for what they call more for more pricing, so giving you a bit more speed or a bit more data in exchange for a bit more revenue in your bill every month. In markets which are perhaps a little bit more difficult, generally what you're seeing is that 5G is essentially just being given away at no extra premium, and it essentially doesn't have any sort of positive impact on revenues. That's the sort of short-term answer.

Now, I think it is coming at a time when a lot of other things are happening in mobile. So we're actually quite optimistic about the outlook for mobile revenues over the next year or so. And we think actually in 2021, you could see the strongest growth in mobile revenues in Europe for over a decade. And some of that is because of

things like roaming coming back post-COVID. We'll obviously see at what pace that happens, because it's still not clear how much travel there really will be, but essentially what's happening is that revenue growth should accelerate, should grow a little bit as a result of more for more strategies in some markets, operators pushing more unlimited data, and then separately, the sort of aftermath of coming out of lockdowns and travel resuming.

Longer term when it comes to 5G, I think that's when it starts becoming more interesting because then you start getting all these new use cases that start to develop. So things like fixed wireless access, things like augmented reality, virtual reality. There's a lot more sort of use cases that come once this is more fully up and running, and as we touched on earlier, there's probably a lot that could happen on the B2B side as well. So for the next couple of years, it probably doesn't make a massive difference to revenues because the adoption is so long. Longer term, though, it does open up the potential for a lot of new business models and revenue streams that you don't really see today.

**Hanish:**

And, Paul, could you tell us a bit more about Deloitte TMT Predictions report?

**Paul Lee:**

Sure. So we've just released our predictions for 2021 and the prediction we've got around 5G—we've had one, I think, for every year for the last four years, looking at different facets of 5G—is around Open RAN. So it's specifically looking at the opening up of the market. And the focus that we made at a European level was that by the end of 2021, we would expect 90% of the major operators to be trialing or to have committed to deployment of Open RAN. And 12 months prior, we would never have written that, because it would have just been too rash a prediction to make. So it's fascinating to see the market moving fast. It's also worth reviewing we predicted a hundred deployments of 5G to be underway in some stage. And we think that that's what's happened across multiple industries around the world, enabled by the release

of Spectrum, which is vital to kindling this market, as Jakob mentioned.

I think connectivity really thrives is where it converges with other emergent technologies. And we're always looking at what is it that we can't do because we don't have enough connectivity? And one of the biggest applications around mobile is photos, but what about 3D photos? And there is a capability in some of the latest smartphones, which is to create 3D photographs using something called LIDAR, which is a light form of radar, and what it enables is depth perception. And so I was just trying out at my home office just capturing the dimensions of the room I'm working in, and it can catch all the mess on my desk and it's really messy. So I'm glad you can't see this, but all the different seats and the windows. And I can sort of move around the room. And that file in reduced form is 13 megs and its raw form is a hundred megs, but a hundred megs over a really fast connection can move really fast. It goes back to industrial uses of 5G. You can make large files, usefully large files, move very fast.

**Hanish:**

I'm actually fascinated by LIDAR, but that could probably be a whole episode in itself. So I won't dig in there, but what I will do, I mean, I kind of asked you guys what you see on the horizon with predictions and also, Jakob, of what you're seeing going forward with revenues globally and in Europe, but let me bring us back to something that's probably been bubbling for a while and something we should definitely address, and that comes to health. And the reason I say that is some have definitely continued to raise the concern about health risks that have been associated with 5G technology. So, can you guys share some of the fears that you've heard from consumers, as well as maybe debunk a few of them for us?

**Paul Lee:**

If we go back over decades, there have always been worries about any form of wireless networks. So that includes radio networks, TV networks, the first mobile networks. And the way in which mobile networks work is they use radio waves to carry information, and there is a transfer

of energy in that process. It's a very small transfer of energy when it comes to mobile networks. It's a really, really small transfer of energy when it comes to 5G networks. So to give you an idea, when you are using a 5G network in a busy area, the amount of power a base station will emit is about 0.1 of a watt. That is a fraction of power that you may require. So if you think of how fast does the slowest mobile phone charge at? It's at five watts. So that's 50 times what a base station is emitting, and a mobile phone connecting to a 5G network, particularly to a picocell, emits a tiny, tiny amount of energy.

Now, what people worry about is that if you take some of that energy and multiply it massively, you could cause damage, but mobile phones just don't get anywhere close to that. So something like the sun, not in London, because it's always raining, such as today. But where you are in Los Angeles, you've got that, that is far more worrying and far more powerful than most mobile phones. So that's one cause of worry. And there's also been in the last 12 months worries caused by a sometimes deliberate, sometimes mistaken conflation of COVID and 5G. So, one theory which is put around is that 5G's rollout has coincided with COVID, and what 5G does is it weakens the immune system to make people more susceptible to COVID, which is not true. The power is just of a completely different scale for that to be remotely possible.

And the second thing that's even more absurd, which is that 5G base stations spread COVID. And when you've got a frightened population spending more time at home, looking more at social media, sharing information, when you've got lots of people in authority not really understanding what's happening because this is brand new, that's where you can get myths really spreading. So according to the research that we've done around the world, looking at the extent to which misinformation around 5G has landed, what we found was that in the UK, about 14% of respondents, so that's people aged between 60 and 75, believed that there was a connection between 5G and ill health.

In other countries, such as Belgium and Austria, it's a third. So it's that high. But when we look at how can that happen, often it's associated with people getting a lot of their news from unregulated sources, and effectively that means social media.

**Jakob Bluestone:**

I think the important points are a lot of this using mobile phones has been around for many, many years. This is not something that suddenly has appeared with 5G.

The basic impact of how electromagnetic emissions interact with the body is a very, very well-researched topic, where you've got thousands and thousands of studies that have been carried out. So there's a huge body of science behind this that's been built up over many, many years. I think a lot of the sort of misunderstandings partly are based on this idea that you're going to have a 10- or a 20-fold increase in the number of base stations, and that simply isn't what seems to be happening.

I mean, if you look across Europe, for example, over the next 10 years, you'll probably have a 50% increase in the number of micro-sites. So you're not seeing massive densification. I think also a lot of the concerns focus on the use of very high bandwidth spectrum, so what's called millimeter wave. But again, particularly if you're looking at Europe, that's not something you're seeing being used very much, and most of these network deployments are essentially at frequencies very, very close to 4G. So there isn't really this big shift from 4G to 5G. And there is a vast, vast body of science. It's a very well understood topic. There are emissions limits in countries, there are clear guidelines, operators follow them. And I think ultimately, a lot of it's unfortunately that we're in a sort of healthcare crisis right now in the world and as a result, some of the cool nerves have perhaps been lost.

**Hanish:**

Appreciate both of you guys going through this. As you guys mentioned, there's a fair bit of doom scrolling around just some of the health concerns. So it was good to allay a couple of fears and debunk a number of

those kinds of things that we're hearing. So I want to actually move to something and just ask both of you a personal question here. You've talked about 5G as a whole, the evolution, the most light usage from a B2B perspective, some of the deltas between, or the nominal Delta between 4G LTE and 5G in certain areas, but what are you most looking forward to seeing in the future enabled through 5G?

**Jakob Bluestone:**

At a personal level, I think it's got to be autonomous vehicles, given that I live in London, the traffic's terrible, the drivers are even worse. And I think when that comes one day, I think driving in London is going to become a much more enjoyable experience than it probably is today. And I think that's probably the bit that will make the biggest difference to my quality of life with 5G.

**Paul Lee:**

So what I'm looking for from 5G is all the applications that will appear once 5G networks, whether they're public or private, become more widespread. And it was fascinating seeing how 4G was appropriated by different parts of business. So staying on the transport theme, the ability to have ride sharing was only possible with 4G. On 3G it was just too cumbersome, too clunky to work.

And every now and then, it's not very often, there is like an outage of mobile networks and people panic, and it just shows how dependent multiple facets of society, whether the consumer or enterprise, have become on that layer of connectivity, that layer of technology.

So I can't wait to see the range of applications that emerge, and they will surprise us, they will delight us. They may frighten us as well, but I'm looking forward to seeing that value creation from 5G.

**Hanish:**

Perfect. I appreciate you both sharing that. To round out the episode, any key takeaways you want our listeners to go away with?

**Jakob Bluestone:**

I think from my point of view, what I'd say is, as I said at the outset, mobile follows a cycle and we're at the beginning of a new cycle right now. There are periods where you see a lot of changes at consumer, but actually the underlying technology has changed in the years ahead of that.

And then there are periods when the technology is changing. And I think you're at that point now where the consumer doesn't really feel much difference and probably won't for the next couple of years, but there's a huge amount happening behind the scenes.

And I think once you fast forward two or three years, that's probably when we, as consumers, will start to really notice these things. So I think it's an exciting point because you're at the beginning of something new. We're not quite sure exactly how it's going to play out. And I think over the next few years, that will start to become a lot more clear.

**Paul Lee:**

One last comment I'd make is often we think about 5G versus other wireless standards, particularly Wi-Fi. And the reality is that cellular mobile is one approach to using spectrum. And so is Wi-Fi, and both are in a constant state of evolution, both have their pros and cons.

So to give one example, which is close to your heart, Hanish, so when we look at a football stadium, they could be deployed or upgraded, augmented with 5G or with Wi-Fi, both for the consumer experience, but also from an operational perspective.

And in the US, there are lots of stadium which have been upgraded with 5G. There is a new football stadium by a club called Tottenham Hotspur, which you may have heard of. And that has one of the most advanced deployments of Wi-Fi networks anywhere in Europe. So it's one of the most modern stadiums. It's just a shame that it can't be used right now.

But it's one approach to addressing a need and that need is to provide wireless connectivity to as many people as possible, either for entertainment purposes or for operational purposes.

**Hanish:**

Paul, extra points for you for mentioning the lovely Tottenham Hotspur, and a little tear in my eye, because I recall back in February being in the stadium and experiencing it when it was a full stadium. So can't wait for that to come back as well at some point. But yeah, I was pretty blown away.

**Paul Lee:**

As of now they're doing very well, because of their Wi-Fi network. That's why they always win.

**Hanish:**

Long live that Wi-Fi network then. I know it's a phenomenal stadium, and it's interesting to start to see some of these deployments taking place where consumers go and starting to experience that benefit. And certainly, as both of you have highlighted, it's probably waiting for that killer app from a consumer perspective, but we're starting to see that from a B2B certainly be a more utilized at these early stages, Jakob, as you mentioned, earlier on in the cycle.

So, there's certainly a lot to unpack here on this episode, and I really want to thank the both of you for coming on and helping our listeners understand where we are with 5G. Some of the evolution that's taken place, what's taken place in an infrastructure perspective and really importantly, debunking some of those fears that people

have heard around in terms of the impact of 5G.

And with that, I really do want to thank the both of you, Jakob and Paul, for joining me today in a fascinating discussion around 5G. And again, we touched upon some topics around LIDAR and other areas, which could probably be an episode in itself. So hold tight. I may be calling you guys back for a part two or part three. So hopefully you guys are on for that, and again, thank you so much for joining me today and until next time, happy listening.

**Jakob Bluestone:**

Thanks for having us.

**Paul Lee:**

Thank you.

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