



Market Opportunities for 5G, IoT and Edge Compute

September 14, 2021

Draft Transcript

Featured Speakers:

Analyst Chair: Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData
Mikael Bäck, Vice President and Corporate Officer, Group Function Technology, Ericsson
Saratendu Sethi, Vice President - AI, GEP
Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia
Shamik Basu, Director of IoT Products, Verizon Business
Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Hello everybody. I'm very pleased to have an opportunity once again to work with the NetEvents team to have a really good and important conversation about some key issues in the industry. I'm the head of research for the technology group within GlobalData. Global Data has intelligence services in 20 different vertical industries, tech and telecom being one, so that gives our team a great opportunity to learn about what specific industries such as retail, pharmaceuticals, healthcare etc, what they need in terms of technology and how it affects your strategy which in turn is very appropriate for conversation today. I'm going to be joined on a panel by Mikael Bäck, Saratendu Sethi, Terence McCabe, Shamik Basu and Stephen Spellicy and we're gonna have a conversation about these issues, where the market is, what's happening, and we can expect in the future. They'll introduce themselves in a minute, but first I wanted to set the table and mention a few top level thoughts. So what we're talking about here, in terms of concepts, IoT is a market opportunity, edge computing and 5G really are all interrelated. Some things like IoT have been around for a very long time and are enabled by existing technologies, whether they be fixed network technologies, or various low powered network technologies, etc. This is in place and has been moving along but there are a number of different elements coming into play on the network side, and also on the compute side, as well as an analytics and AI, that are coming together to form something different. Some of this has been around for a while, like IoT, but it's complemented by new solutions, such as the 5G network services and edge computing capabilities,



- 1 -

and together they're driving a concept of an even more highly automated, cleaner, safer, and generally more productive industrial world, or business world, that's the idea that we're moving toward and this has traction with businesses worldwide. For the past several years, particularly around 5G enterprise deployments, we've been told, and by the technology developers and suppliers by the service providers by really the entire ecosystem, that, yes, this next generation of mobile networking, will make things that we do today better. But most importantly, it'll enable things that we haven't yet imagined. So we've been asked to use our imagination, again, IoT has been around for years and indeed, AI has been around for many years, machine learning, analytics, and all sorts of many forms of automation. But the question is, are we at the cusp of something faster, something more real time, more embedded in all business processes? So that's sort of what we're looking at and GlobalData look at all of these interrelated technologies, and it helps drive our research agenda. Just quickly, let me dive into the two things quickly before we get to the panel discussion. So about this idea of 5G. It's been around for quite some time now. It's been the original standards for transitioning from 4G to 5G but we still have the sense we're waiting. Well, we did have a bit of a pause because of COVID-19 in most regions of the world, but we're seeing things catch up. There's more work on the next standards that are required. There are more auctions around the world for spectrum. We're seeing lots of different service rollouts and alliances take place. So there's been a lot of activity picking up in 2021. So far some of it is involved around what are these enterprise 5G services? What do they need to look like? The focus there is on making sure it supports application priority and guaranteed bandwidth. There's this concept of slicing and all this is still taking shape, but we're seeing work toward that taking place and examples of use cases taking shape as well. Like I said, a lot of standards work. The next standard from the 3GPP, I think it's going to be called 5G advanced, I think that's been approved, take it to the next level ticket to that place where the magic of 5G, that we've been talking about for four years or so now, we're really be in place in terms of the enterprise side of things. And there's been a lot of efforts on private networking. So, private networks have been around for a while and been gaining momentum, predominantly with 4G or LTE. And that's been gaining momentum still within that realm. But then moving into 5G as well, a lot of interest in that. And what we see here some data that we have from a recent study of over 5000 Enterprises is, you know, there is interest in enterprise, LTE and 5G you know, whether it's from as a service or privately, a solid percentage, and growing of the budget they have for networking is set aside. We're thinking about spending in this way, which is an interesting to say, I'll wrap up by talking about edge, the other big hot thing that everyone's focused on, and again, a lot of developments, the big thing with edge computing, there's lots of different types of solutions involved to make this happen, and lots of different edge edges, if you will. So there's a massive ecosystem diversity, lots of different players, from your hyper-scale, cloud providers, to your network owning operators, to your compute providers to multiple types of software companies, integrators, etc. So that's all taking shape. And we're starting to see some models emerge with some consistency, what are the consumption models? Who you buy it from? How do you buy it? There's an emphasis here on as a service models that are developing? Really, what we've observed is enterprises are still pondering about what to do here. Well, how will it help them? What do they do, and of course, their supplier partners are more than happy to help them think about that. And that that's ongoing, as well. The key thing here is that the market is looking for early successes, actual implementations that have really made a difference in automation, or in real time business activity, etc. And that will drive a lot in terms of in terms of confidence and encouragement. So

- 2 -



with that, I'm going to stop and we're going to move into the roundtable discussion. There's a lots of ground to cover, and we should get straight to it. So what I like to do is ask each of the panel members to quickly introduce themselves so people know who's doing the talking and then we'll move into some questions to get things rolling. So Mikael Bäck could you please, quick introduction.

Mikael Bäck, Vice President and Corporate Officer, Group Function Technology, Ericsson

Absolutely. I'm a corporate officer in Ericsson. I've been here for 31 years now, I think living through the 2G to 3G to 4G to 5G activities, so very much following this development.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great. Thanks. And Saratendu Sethi could you introduce yourself, please?

Saratendu Sethi, Vice President - AI, GEP

Hi, good morning, good afternoon and good evening. It's a pleasure to meet you all virtually. I'm Saratendu Sethi, I'm a vice president of AI at GEP worldwide, a company that specializes in providing procurement and supply chain solutions across the word.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great Thanks. Terence, would you mind introducing yourself to the attendees?

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

Terence McCabe. I'm responsible for strategy and technology for Nokia in Asia Pacific in Japan, spending my time talking to our customers, both customer service or communication service providers and enterprises about their future direction carrying their voice back into the Nokia organization. So lots of lots of good conversations in the space.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great and Shamik. Over to you.

Shamik Basu, Director of IoT Products, Verizon Business

Greetings everyone. Shamik Basu, I head up the Internet of Things business within Verizon Business group. And in my role, me and my team, we're constantly looking to leverage the assets that are provided to us, the many currencies of 5G and the network assets that we have, the platform partnership and really converting them into core business value propositions that we can take to customers. So that's the focus of my team. I'm eagerly looking forward to this discussion.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great, thanks Shamik, and Steven finally.

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Thanks, Jerry. My name is Stephen Spellicy, I lead marketing within the telco cloud business at VMware part of this service provider, an edge business unit. Our products and services are focused completely



NetEvents

inter@ctive

- 3 -

on communication service providers. Specifically, we're providing telco cloud infrastructure for core and ran. And now with edge and all of the experience around that, in addition to automation, observability and AI, enabling CSPs to be more successful with their investments.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great, thanks. All right. Well, let's get into the first section. We're going to focus on level setting, where are we now? What what's really possible? What are enterprises out there looking at doing now, and GlobalData, myself personally I've had great pleasure working with a number of these companies on these panels. So I know there's a lot of activity going on, firsthand, but I want to start with Shamik and get the service provider perspective. So we've heard about capabilities, 5G, but also edge computing will be able to enable, but how do these actually manifest themselves? In logical, practical enterprise use cases? And obviously, the important follow on there is business value creation of for those for those enterprises? If you could comment on that to start things off, that would be great.

Shamik Basu, Director of IoT Products, Verizon Business

Yeah, sure, Jerry. I think at the outset it's important to get to ground ourselves on what those currencies are, you talked about the capabilities. I think no matter how you look at it, I think the discussions typically get seated in academically, one being the first turn to being massive, we're going to see many, many, many more sensors, in any sector of the sensor network. The second element is, you can see much greater levels of latency that the network can afford. And the third and the more obvious one, I guess, is, you're going to get extremely high levels of throughput delivered to your devices and through the network. And this is a primary discussion rooted in a lot of the theory around 5G and the core currency. But I think it's important for us to understand how this translates into core business value, because at the end of the day customers write checks, when they can take most of these assets and convert them into operational outcomes. So what we're finding out is, 5G for us today is it's very largely a bridging strategy, where customers are taking the technologies that we had, through carrier aggregation, through dynamic spectrum sharing, evolving into our four 5G deployments nationwide, taking that very large gamut of sensors, and bridging into the core currency, the 5G, so rapidly centralizing their environments, and really scaling that up connecting that, and we like to call this little data depicted. So if you think about the convergence that's happening, you've got data coming from sensors, being fed over cellular networks into large, hyper scalar environments, you've got, software, the service, AI capabilities running on top of them, and running business value. That is where customers are starting right now. But we can already see an evolution happening very quickly. And a lot of that is accelerated by COVID. And I'll give you a few examples. You know, one is obviously pop up locations, branch offices, customers want to take the advent of fixed wireless access, and see how they can find alternatives to broadband connectivity. First one we're seeing, it's quite obvious. The second and the third one as well. Also accelerated by COVID is things like crowd management, you're running into venues where you constantly have to determine if this venue is running on capacity, constant measurement of foot traffic in the building, that's one of them. Also accelerated by COVID. Things like cashless retail, the ability to use visual and camera to detect asset protection in retail locations. You know, those are the two other important ones that actually combined throughput connectivity, edge processing, as well as the presence of the device itself. And then kind of veering off into some other

- 4 -



enterprise scenarios, if you start to think about a large outcome in the US market is things like worker safety. So fast forward, if you think about functions that have traditionally required very intense human engagement, that moving over to robotics, and in automated guided vehicles and things like that, through the use of object recognition, the edge is a perfect use case for that, seeing some of that as well. And then finally, mixed reality. I think 5G is one of those things that really gets mixed reality off the ground, through the combination of physical assets, and being able to do the see what I see and management of those assets. And those are the four areas where we're starting to see immediate customer interaction to be to be honest with you, starting out, as I said, with massive IoT, bridging right into the other currencies, starting with fixed wireless access, and then evolving into some of these other COVID driven market accelerations that I just mentioned.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great, I want to encourage other panel members to jump in on these questions, too. But one of the things that we're seeing amongst businesses, generally across all the industries that we track is this intellectual appreciation of what could be possible. And now, it's about making that leap from an appreciation at a sort of theoretical level, to actually Okay, what's the ROI? You know, and, when and who should we work with? And Mikael, I'd like to ask you, I know, Ericsson is engaged with customers around the world on this, through service providers, and also perhaps directly as well, but what sort of deployments are you seeing? And are you seeing an acceleration in going from the theoretical to actually take taking action?

Mikael Bäck, Vice President and Corporate Officer, Group Function Technology, Ericsson

Yeah, I think it's, it's very clear, if you go back to when it was started in, I guess, around 2018, we had, of course, mobile broadband, as the very key case for everyone, that was the scalable thing, and you would see the same in US in Europe and Korea. But now I think we have been experimenting since the early test system, 2015/16, with industries, from manufacturing, to ports, to automotive to transportation. So I see a lot of action over the scale, maybe with the exemption of the extremely complex cases that require a lot from the ecosystem that will take a bit longer time. But there is clearly a huge interest in all the things that we heard from Verizon, we see a lot of interest, of course, in private networks, in anything from manufacturing plants, to port to remote locations for mine, something like that. So that's a key thing that is happening. And I think, to me, that's another version of what we're trying to do with network slicing to provide something that is seen by the end user as their own network, instead of building it yourself. So I think that that whole aspect of providing control to the end user being an enterprise is quite extreme. But we see a lot of things happening, of course, also in what I would call simpler areas from either simpler ecosystem or that they are seeing from before so advancing everything you see around the smartphones, on gaming, private users and so on. Fixed wireless is another case that is well known, I think the whole area of logistics and so on have a 10 plus year history of using this. So they are also very early out, while manufacturing is happening, some parts but other parts requires a lot from the ecosystem. So we see quite a lot of experimentation that continues to happen. But the first case is clearly coming live. And we start to see real customer revenues coming in not only CSP revenues, but also end user savings, inefficiency, and so on. So I think this is this is the start of a journey that will be as big as we would ever see the smartphone revolution in 4G. It's still early days, but there's quite a lot of

- 5 -



things we can actually see now happening and I think especially in North America, Northeast Asia, and then a bit more scattered over Europe.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah, our observations are that exactly that, the momentum definitely varies by region, depending on where things are, but as more examples and use cases and successes are happening we can probably expect to see momentum more universally. So, before we move away from this, where are we now? What's really possible? Question is, does anybody else want to chime in before we move to the next phase of the discussion?

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Yeah, as Mikael is mentioning, that this massive sort of increase in device count. And the use cases in manufacturing are unavoidable, you have greater amount of sensors, but also in the industrial IoT, large and things like smart meters infrastructure, just a huge amount of actual device density, which is really pushing operators to look for that next network, that next network is 5G, so the modernization of that 5G infrastructure is really key to the customers we're working with today. So they can actually go out and deliver on the promise of these advanced use cases.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah. Great,

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

I would have to agree with Mikael's point on private, the connectedness between the private LTE case, as if you like the introductory experience for a lot of enterprises to what is possible, and what the value is. And the ultimate destination of a hybrid environment where edge computing and slicing, it comes together with 5G to create virtualized private networks, hybrid with the enterprises on the infrastructure itself. And the applications can actually migrate across that developing ecosystem. So often, starting from a private network gives the enterprise or the non-traditional ecosystem player an opportunity to develop capabilities and experience and have those first experiences without having to have the perhaps nationwide coverage footprint or universal availability of 5G technology or edge compute.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great point. Okay. Excellent. So let's move to the next phase, which is more about short term developments. Some of these sections completely overlap but that's good, that's fine. I'm going to stay with you Terence. Actually, we discussed this yesterday when we had a chat, but and I think you touched on a little bit there. But there is a question regarding the technologies readiness to support, you know, industry of 4.0. And clearly, coming from a company like Nokia and other companies out there, there's a great belief in the power of the technology and that it works well today, and you're seeing it work with your with your customers. But there also is this notion, well, are the standards really set? You know, what is? What is this? 5G advanced that's coming from the three GPP? Is that essential? Should we just wait? What about standalone versus non standalone? Can you provide your thoughts about where we actually are on the journey?



NetEvents
inter@ctive

- 6 -

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

Yes. And I do think it's, it's an interesting point. And it goes back to what I've just been talking about on private versus public networks. When you're building out a nationwide network, there's a lag between the first site brought online. And when you have a coverage footprint that they will support, it'll be in building use cases and the scale of deployment that that may be necessary to support reliable servers for these applications. Starting from the other end of the scale, private networks give you have more controlled environment that can be dedicated to specific use cases and can iterate through the standards more quickly. We do have today, a combination of carrier customers and private customers who've rolled out 5G standards. And there will be early adopters for the ultra-reliable low latency use cases as we move forward. But for right now, I would say that stand alone is table stakes for those who are interested in in a lot of the higher end low latency use cases for 5G. But many of the cases that we hear talked about, and many of the cases that we're looking at don't actually require that ubiquitous latency. Service can be built using the non-standalone networks that are more generally available today. And there is a steppingstone sort of progression in the use cases. So there are lots of things to keep the ecosystem fully occupied today, building new devices, building new services. But there are things coming within the next two to three years, which will enable a whole a whole new range of use cases and a perfect example, recently, we have been working on some research in Australia, where we're looking at how you can remove the intelligence from a robot, make the robot, if you like less autonomous, have a age cloud, where the intelligence the image processing is handled, and have ultra-low latency connectivity to a dumbed down robot, because that device will be cheaper, that device will have longer battery life. And we'll be more readily employable in let's say, a warehouse environment. Now, that needs to be proven, and the network that it's operating over, needs to be ultra-reliable. But those are the challenges that we're working to address right now. The technology exists to do that. But getting it refined and tuned to rollout at a at a mass scale, the lot easier to do that with private networks today than it is to use your general purpose sliced 5G network that's serving the whole range of use cases, we will get there. But by starting with private networks, give yourself the opportunity to build new use cases without having to transform the entire networks to do so.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great. Shamik or Mikael, any follow up comments on the on the sort of preparedness of the technology in the evolution in the short to midterm?

Shamik Basu, Director of IoT Products, Verizon Business

Yeah, Jerry, so the one thing I can comment about is a first-hand scenario and example that we have in the marketplace right now. And for those that have followed the news, (inaudible) actually did an adjacent network deployment with the associated British ports in Europe, and it's a market where we actually don't own any public networks on the wireless side. And yet, what we were able to do is we were able to create that single management layer for customers that allowed us to provide a service to them purely using a private network in a market that's adjacent to us. So I see the operative word here is, what you'll see coming more and more is, is the discussion shifting to the managed layer in a very accelerated fashion. So it's not just about who's actually providing connectivity on the private bases in a



NetEvents

inter@ctive

- 7 -

certain market but how are they streamlining the experience for the customer? For them to get access to devices, the platforms that actually manage the network? And how can they actually manage multiple sites that the customers have with multiple private networks running on every single one of them? We were able to do that with the associated British ports, where we actually don't have an operator around. But we actually support the entire management layer. So I think it's important to think about the management element of this along with networks, because it will become very relevant to when you combine the multiple currencies, including, how you open doors with private networking, which lets customers step up to edge compute use cases.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great, Steven, we've had a good focus in this section on private networks and how they might interplay with public networks. But from your work within VMware, what's your view on how service providers can advance their private networking offers in the market? What do you need to be doing to take the best advantage of this opportunity that's emerging?

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Well, I think private networking in general is the first real 5G footprint. Many enterprises experience in a (inaudible). I think it starts with private networking and it moves to edge computing use cases. But to make that first plant ephemeral of 5G connectivity for in building access for more advanced use cases around things like manufacturing, or healthcare on campuses, in order to do smart medicine, anything smart is going to require an additional network. Of course, 4G provides quite a bit of capability for some of the more basic if you will services. But as you know, bandwidth and latency become constrained. 5G will be the go to network, as what we're seeing with operators is those operators who are embracing a strategy of if you will, landing and expanding their footprint with private 5G, helping those customers in specific industries getting very fine tuned on their pursuits related to industry verticals and use cases. A point Terence made as well, which is start with the use case and then start to iterate beyond that. It's not a boil the ocean scenario, private 5G isn't for everyone and also network equipment vendors and ISVs who are working in this space are instrumenting their stacks for specific use cases, in most cases, they're not necessarily just supporting all use cases. So depending on the vertical, we're talking about, like smart manufacturer or smart medicine or health care, there are going to be certain use cases, they're going to be more appropriate. For instance, in say mining and exploration, verticals, things like automated guided vehicles, which require a very low latency communication in order to control those devices. In other industries like manufacturing, you're going to require maybe more bandwidth, but you can get away with higher amounts of latency, where (inaudible) is more appropriate, if you will, something like operational surveillance or computer vision, enabling if you will, remote operators to be able to see what's going on in the shop floor in a manufacturing environment. You know, the operator has the opportunity here, the CSP has the opportunity to help bring those use cases and capabilities to the customer. In other words, give them the art of the possible. But it starts with connectivity. And in and around that the expansion play is letting them understand what they can do with the connectivity for all intensive purposes, a loss leader, you're talking about a few percentage points of profit increase from a connectivity as a service play. It's really the value add on top of that, that comes with edge application



orchestration, managed services, and lifecycle management of the infrastructure. That's where the opportunity is really going to be in the future, at least for the customers that we're working with today.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great. Okay thanks. Before we move on, any other panel members want to comment on this? You know, what are the key developments that we expect to see in the short to midterm and coming soon any other thoughts to throw in?

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

I will say one more on this this point. Acid disaggregation that's happening in the RAN is highly disruptive. It's also creating new opportunity for increasing access. So as we talked about the proliferation of 5G in order to serve new use cases for new verticals and businesses all over the world, really increasing the access footprint is really key in order to carry the signal delivered to those businesses and to be able to, if you will, be able to extend that capability to those who really need it, whether we're talking about the context of delivering connectivity to bridge the digital divide, or delivering services to businesses for, again, more advanced use cases that we've been discussing. So I think the disaggregation of the RAN is a really important piece of that which is an open round is being highly disruptive in the industry, the others this great dispersion that's happening of the users as it relates to the pandemic. But beyond that, factories are operating autonomously. They require higher levels of intelligence and autonomy, they do require a dedicated network connectivity that's reliable, that can deliver service levels that are commensurate of the kinds of tasks that those vac factories and businesses need to do. So, SLA management's very important. observability is important in overall automation driving, if you will, that autonomous experience is going to be very important. So my belief is that the higher you move up stack, as it relates to these things that are happening, that are operators going to gain greater value as they serve those customers, the enterprise as well as consumer mobile.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great.

Mikael Bäck, Vice President and Corporate Officer, Group Function Technology, Ericsson

So, just a small comment on what I say talking to a number of the possible users here is that it's not only the peak rate but I think also as soon as you can provide a predictable connection that is secure that has a certain speed and a certain latency and so on then it can read to change the way people that reduce that network. So if you talk to a gaming developer, for example, talking about this, the way that gaming is downloading a lot of things in advance, and so on, if you can really trust the network, you get away from all this kind of download, you can run streaming, you can present the same experience to all gamers, instead of having to do all these adaptations for people with bad environments. If you look at the use of edge for offloading devices, we want to gain weight and battery and size like AR glasses, but even courses on if they can rely on a network that is always there. You can offload to the roadside you can offload to the right you can, you can really get away from battery and a lot of power hungry things in the device. I think the whole predictability of performance, not always the peak performance, but



the kind of predictable average performance will lead to that many industries will dare to use the network for completely changing their indices fairly quickly. This is not so far away in time,

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

I would add just to Mikael's point on gaming, that this is a segment of at least consumer mobile that is gaining traction and actually highly monetizable. The advent of network slicing will enable those who purchase those slices, so secure and high performance slices to have an edge on other gamers. And we're not talking about any more about kids sitting in their bedrooms playing video games, you're talking about eSports, where there's actually money on the line. And if you have a few clicks and lower latency, and your clicks are faster, and you can win in that game, you can win that prize in that tournament. That's a major development that's happened within the last few years in which 5G is providing the infrastructure to enable those kinds of players who are competing in these tournaments to actually turn a profit.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah, good. Great point. Before we leave and move on to the next discussion. We're going to hear from Saratendu then as well, but Terence, I just want to know, the open Ran concept was thrown in there by Stephen. You know, do you have any perspective on how critical or not that that is to advancing beliefs that we're discussing? If you want, or don't wanna that's fine, but I thought I'd give it a shot since, before we move on.

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

Open ran is, is playing an important role. It's getting people thinking about how, how ran can be constructed and, there's more to open rather than just opening up the interface between the radio and the baseband unit. A lot of people have come to associate the cloudification of the ran with open run. And so, you're seeing virtualized or cloud defied baseband development, and potentially, the desegregation of who actually provide the components and who manages those components. We're seeing the new players in the business, if you like, as the (inaudible), in some countries are starting to look at hosting some of the active components and, and open round can play a role in moving the architecture forward and moving, thinking forward in that regard. I just think that the reality is today that it's still early days, and we're working on the standards, we've been part of working on those standards. And, I think that the industry as a whole will benefit from this, but it's going to take some time to get the sort of open interoperability that that people hope for and expect.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah, great. points. Okay, well, let's move to think about the future. I think, to a large extent, we've already been talking about the future to a certain degree, but I want to throw it over to Saratendu. So there's a number of different processes and industries that we expect will be dramatically impacted by what 5G will enable, and edge computing will reliable but how can you describe, let's focus on one super important moment of supply chain, describe or talk about how 5G will impact supply chain, the some of the business and technology barriers that might be that might be encountered?



Saratendu Sethi, Vice President - AI, GEP

Sure Jerry so one thing I have to say that the wonderful technology that my colleagues have just presented, I happen to be on the consumer side of things, building those initial use cases, taking those technologies to our customers to solve specific supply chain problems. So to begin with supply chain is a reality. Even before the pandemic supply chain has been undergoing a whole digitalization, and this is very common across the entire industry. So at the core of a digital supply chain, what's important is data and end to end electronic connectivity. And this is where actually the 5G comes in. The promises of 5G about accelerated data speeds reduce latency ability to connect significantly more devices to enable IoT mentor all these promises are phenomenal. And this is exactly what we are trying to work with our customers to better use cases. To quote a few examples of use cases that we are directly working with, our customers using IoT to enable just in time manufacturing by tracking parts in real time, who as they are moving from the assembly line, rather than waiting for a scheduled arrival and do a lot of scheduling. So in fact, we are building opportunities by the same time to keep these manufacturing processes running throughout. And this is meant to refer to manufacturing, but you can think of supply chain is basically this is a supply chain problem. 5G, continuing on that idea, allows that now we can connect more and more devices, we can actually track goods as they're being manufactured and moving across warehouse distribution centers at SKU level. And again, these are in very early stages, like some of the previous panelists have spoken about. But this is an area where there's a lot of interest riding at the moment, we are seeing a lot of move across automation in transporters and autonomous vehicles, automated delivery rerouting optimally, which in France, we have seen the disruptions with situations like forest fires, so things have to be rerouted. And that optimal rerouting on the fly rerouting is important, we believe that 5G will strongly enable given the low latency promise. We are also working with some large vendors and we're basically seeing the use cases, how we can leverage 5G to more back run back and forth between indoor and outdoor environments, moving from mobile communications setups to indoor like Wi Fi, so that when the goods are moving inside, the goods are travelling between cities, and then they're moving inside the warehouse, we can continue to track in real time how those things are travelling. This is not a use case of future. In fact, we see some of these large scale implementations already happening like (inaudible) or now when container ships are pulling in already, then that's technology that can communicate and give a full idea of what that ship is getting and every single container contents within it. So as 5G becomes more and more prevalent, the infrastructure gets built, these use cases will become more and more ideal because today we are speaking of one implementation here and there. And of course, when you think of all this working to the dot, then basically I would say digital supply chain is really becoming a role in supply chain management. But having said that, I want to kind of walk through what is the reality with some of our customers that we also have a view, even though my team is building this technology with these use cases at the forefront, we do find that a lot of customers are still figuring out the future. Is it 5G? Is it IoT is it a mixed play with the cloud vendors in the middle? So there's still a lot of figuring out that is going on at the moment. And of course this is expected because a lot of the 5G infrastructure is still being built as we speak. There's a handful of primary investment vendors who are making those high cost infrastructure investments. So many of the colleagues are actually part of those organizations. So basically, if we take the first top five vendors, top five infrastructure providers, they've pretty much for 95% of the infrastructure that is being built across the world right now. And given our customers, large



NetEvents
inter@ctive

- 11 -

global multinationals, there's a lot of wait and watch to see how the geopolitical situations are evolving. A lot because of pandemic, the supply chain disruptions, their so called statistics specific happening and supply chain, rather than doing so look for near scoring options are and that's where actually a lot of that ambiguity about how much to put your weight behind 5G comes in. And when technologically, we are like, my team builds IML solutions. So we are also looking that while there's a 5G infrastructure being built, there's a lot of developments happening on IoT, like Intel and videos, they're putting out chips that are more oriented towards solving machine learning problems deploying ML models at the edge. So then, we are also moving, there's a complimentary development, not competing development that on a lot of IoT, and IOE, Internet of Everything, Smart City, those kind of implementations are sifting the workloads to the edge, process your data, if you are streaming in computer vision, if you are streaming 4k images, you rather actually process your image on the edge in the Qualcomm camera. And then basically, you only send the results back. So you can still benefit, get the best out of you can still get your use case worked out. And of course, when 5G comes along, maybe the implementation will become more real time. But we are still able to achieve a lot of those use cases already. We are doing a lot of implementations but again, what we are also observing is a lot of our customers are not there or they're also taking different routes to get to the same end.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yes. Absolutely. Excellent. That's fantastic insight, but much appreciate it. Just in terms of the future, you brought up a couple of really, really good points in there about who the supplier is going to be and where they are in terms of their connections with your customers and the solutions you're building in. So Terence I want to turn to you quickly before we do a quick round robin session, because yesterday, you and I talked to you some interesting points about service providers in the future, what will the supplier ecosystem look like? You know, we have service providers that own networks, we have the web scalars, who are becoming ever more important in this discussion in many ways. And then there are various others suppliers, what are your thoughts about what you think the future will look like in terms of the ecosystems that the tech companies, the service providers, is it all going to be sort of the way it is now? or will there be some sort of blending or convergence? Any thoughts on that before we move on?

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

Well, I think it's interesting that we got this far in the conversation without really talking a lot about what the web scale players are doing with their edge deployments. Because it isn't a simple competitive or cooperative dynamic. There's a lot of cooperation going on. And there's real ambiguity about the roles that the ecosystem players will take in the long run. We see many examples where the web skills are partnering with CSP companies at a national level and working together to deploy edge data capabilities to host applications. There are other cases where the web skills are actually working to develop telco cloud solutions to support the workloads of the CSP themselves. So when we talk about edge and the role of the web scale there I think it's very much a space to watch. The dynamics are not fixed and are going to change a good deal over the coming years. And it's also important to recognize that when you look at global network connectivity fiber under the ocean, the largest investors in that space today are the hyper scalars. So when you look at the ability to not just on the air interface, the last mile, when you look at the backhauling of data and the ability to create global footprints, they are

very well positioned to do that. But they can't be everywhere. And they certainly lacked the local intimacy that a CSP may have. I think another important point that came up, you had this greater recognition of national boundaries and the need for data sovereignty to be recognized and some of the solutions, there's a great deal of sensitivity when you talk about image processing and facial recognition, for instance, some markets are pushing back against it. Others have no hesitation whatsoever about committing to that. So I think there is very much a role in national integrators National CSPs or, or perspectives on the development of applications and services, because there are unique characteristics and unique constraints. In many of the markets we see, certainly, you know, Australia, Korea, Japan, are all moving a great deal in this direction. They're making some significant investments. But the dynamics in each one of those countries around the role of the web scale is very different indeed. So I think there's a lot to be seen there and a lot that is resolved.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah, that tremendous points. Great. So what I want to do now we have a few more minutes left before we go to Q&A from the from the audience. But I just want to quickly, do one last, round up, comment from all of you on the panel and we only have a few minutes. So if you just keep it to about a minute, but your top level thought on the on these issues we've been discussing, or your top level expectation, however you want to address it. But let's start first with Mikael Bäck, if you could give a quick summation, from your perspective.

Mikael Bäck, Vice President and Corporate Officer, Group Function Technology, Ericsson

I think what we what we see now is clearly the beginning of something enormously important, and it will take some time in some parts while others are happening early as we're seeing from Terence and others. I think it's the whole journey now from 5G to 6G will take us on the route for the 5G system, the digital systems will be the enabler of many things on society, anything from carbon dioxide, reductions to automation, saving money in many different industries. But also, I think it would be have a very wide use going forward. And then 6G will complement that with more extreme experiences being immersive being the Internet of sensors and other things we haven't really thought about yet. So I think to me, this is in the end going to be bigger than the evolution of the whole app ecosystem and so on was so for 4G. But I think in some areas, we have underestimated the time it takes due to the enormous complex ecosystem around some of the more especially advanced use cases. So I think to me, this is this is going to be an extreme journey. But the timing will, it will in some areas be a bit slower than we thought a couple of years ago.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah. Excellent point there. Thank you. Saratendu any final, final quick comment?

Saratendu Sethi, Vice President - AI, GEP

Yeah, definitely second what Mikael said, because it's an exchange journey. And we are still in the initial phases. And having said that 5G, IoT, edge computing, these are actually very crucial technologies for supply chain. But we have to think of the entire ecosystem and complimentary capabilities and how the vendors ecosystem kind of stabilizes because we also have to think about what it takes to come up with



NetEvents
inter@ctive

open standards means if there is a higher proliferation of private networks, what's the implication for openness, which is very crucial for software vendors, like GEP, but at the same time, from our customers perspective, if all these things take a long time to be figured out, then that will eventually push out some of these out of the possible use cases that we are talking about right now. And all we will be left with 5G is just taking advantage of the increased bandwidth and increased connectivity and that something will be same, in my personal opinion, because the most exciting aspect of 5G and edge computing is basically going after those new use cases, not just making meds, yes, making existing use cases faster and more reliable is important, but we also have to look at the next division of supply.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great, thanks. Terence, quick comment,

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

I think great points made to date, I do think that there is an important and complimentary role between CSP networks and private networks, just as there is a very important role to be played by the hyper scalars in the creation of globally consistent consumer use cases. But the truth here is that there is no single application, there is no single direction that this industry will take. We will see a diversity of different approaches and industries that all leverage a common set of standards for network conductivity, because that gives us economies of scale and devices, it gives us economies of scale in rolling things out. But that diversity is something that we're not traditionally used to in the telecom space. So there's quite a lot of learning to do in developing the ecosystem. So that we cooperate and don't trip over each other.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Thanks, Shamik final thought from you.

Shamik Basu, Director of IoT Products, Verizon Business

Yeah, you know, I would only say that as we start thinking about 5G, I mean, think about 5G is not another 4G. 5G is actually a quantum leap in terms of the amount of devices that will be in a square kilometer, or any of the other parameters that we've talked about measuring. And the other thing I would also emphasize is if you're someone that's looking to realize outcomes via 5G, it's critically important that you start looking at your entire solution stack, and start identifying who the right partners are going to be in each part of the stack because traditionally, it is not something that people have looked at with much diligence, because they've looked at an operator differently, and a hyper scalar differently, and a solution provider differently. I think this is an opportunity where you really have to start looking at who are the best solutions providers in each layer of the stack, and make those choices and decisions just to make sure, I wouldn't even call it the ecosystem, I would even say, the stack solution when it comes together, because if you're looking for more turnkey, that's an investment that people have to start making right now as to how they put the power of 5G into realizing those business outcomes. I mean, we talked about network, we talked about, Software Defined Networks, we talked about hyperscale, we talked about the specific service providers, let's say in an area like automotive, that are bringing solution to market, then we're talking about the system integrators that are sitting on

- 14 -



top of that, that are pulling it all together. So I think realizing the players in each part of the stack and how advanced they've been in bringing 5G solutions, or at least envisioning 5G solutions, it's going to be critically important for anyone that's trying to put the power of 5G into a solution.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah, great point. Okay, finally, Stephen, quick thought before we move to the Q&A.

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Jerry, I'd say edge is not the final frontier. It's the next frontier. And I think that CSPs need to recognize very quickly that this is the opportunity they've been waiting for in order to monetize and deliver new services and capabilities to their customers. As Terence mentioned a little while ago about the last mile sort of syndrome, or the issue of connectivity and the gap between the enterprise and that point I think it's not at a last mile issue. It's the last quarter mile issue. And I think, as we collapse and increase the bandwidth and capability of the network, the distance between the two points are getting smaller and smaller and smaller, and we need to have resources closer and closer to where the action is. And to Saratendu's point, when you think about what are we delivering the network is a table stake. It's really what we do on top of that to achieve business outcomes, which is going to be far greater in value for our enterprise customers and ultimately, for our own businesses. I'd say also the last thing that CSPs need to really think about as they look at the 5G and AI, IoT opportunities and future is have a solutions mindset, really think through the partner ecosystem. And to echo an earlier point, you really need to think through what do you want to build and bring to market that will drive the greatest value for the next generation two use cases and opportunities for your business.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah. Okay. Super wrap up. thank you very much. Okay. George, we're going to start taking questions, I believe, right?

George Rickman, NetEvents

Hi, yes. So just to remind everyone, if you're a member of the press and you want to ask a question you can raise your hand, virtually, which is the blue hand I believe on your menu bar. And I will unmute your microphone and allow you to ask question. And you can also use the Q&A function to ask questions. I can see a few people have asked that question in the chat feature, which is a little bit harder for me to keep hold off to keep a handle on. So I'm going to ask Jan Guldentops to ask his question first.

Jan Guldentops, BA Test Labs

As I always understood, the main advantage of 5G is the sub millisecond latency we have. But always forgotten in my opinion is that means you have to have the same connectivity to what your data center and your applications? How? What's happening in the development of edge datacenter technology, is this happening? And what are the new developments there? because not a lot of people are talking about that?



Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Any volunteers to take that one? Perhaps. Stephen.

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Part of the journey is obviously as applications are developed today be looked at in modern methods like microservices, where portions of the applications can be separated and designed to be run more closer to the actual source where the user consumes the application versus parts of the application, which can benefit from massive processing power, say in the cloud. The other is data sovereignty, making sure that certain information gets if you will kept close to where the user is for security and privacy release, privacy related issues, but also access to information, real time processing for it real time insights and to drive real time outcomes. So when application developers look at developing for edge, they need to consider all of these things and much more the response and resiliency of the application, the security and privacy. And then if you will the long term lifecycle the data that's generated, and what are you going to do with that data? So modern application developers are doing that now as they embrace the new paradigms that that 5G and edge bring to the table.

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

I think it's probably also worth noting that, yes, we talk a lot about 5G and low latency. But you know, there's that famous triangle of the facets of 5G, there are legitimate 5G use cases that are all about delivering massive enhanced broadband capabilities. There are other use cases that are perhaps not low latency and not massive bandwidth, but are all about massive numbers of endpoints. And in rolling out 5G network are looking at a particular application, you were somewhere on that triangle. And the standards of 5G have you know have been developed in order to allow the either or tuning of the network experience. So not all networks are built equally and not all networks will offer exactly the same quality of service. And I think that's one of the important points that was raised earlier in the conversation. It's important that that quality of services expose to the application and that is understood by the consumer in the enterprise space.

Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Great, George, next question.

George Rickman, NetEvents

Sure. I've got an email here from Phil Keys, who writes for Nikkei Industrial Journal, and he's a contributing editor to Forbes. Phil says, edge computing devices will inevitably process a lot of sensitive data in less than six, less than secure environments. What are some of the best practices for securing the data held by these devices? And that's an open question to any of the panelists.

Shamik Basu, Director of IoT Products, Verizon Business

I can take that one, I think the first element here is don't cut corners on security during design. So following the security by design practices are essential. And then also look at both elements around what you're doing to protect security at rest, and device security in motion or device security in transit, as well as the application security and what you can do to actually build the necessary framework.



NetEvents

inter@ctive

- 16 -

Even when you're taking a workload, and deploying the workload to the edge, I think the secure by design parameters when you're building out the sensors, considering that in the development of both data at rest and data in motion. And then the final thing I would say is that when you start to think about a framework, the way we've seen some success with customers is when we start to talk about this as protect, detect and respond. So you protect the device, by putting the right levels of security around it, so you're preventing side channel attacks and things like that. You're putting adequate instrumentation, where you're able to detect something very, very quickly when a compromise occurs. And then you've got respond whereby when that compromise does happen, does the delivery of new software or new configuration becomes so seamless that you can actually react to that event very, very quickly. So I would say secure by design and the protect, detect, respond mental framework in your application would be would be essential as you're looking at.

George Rickman, NetEvents

Okay, thank you. So, the next question I have is from Bob Emmerson, who is the contributing editor for IoT Now, he says, surely the market opportunity is there with 4.9 G, there is no need to wait for 5G and the key to ultra-low latency service, which will enhance the edge compute and the intelligent edge isn't on the horizon? And that's, again, an open question.

Mikael Bäck, Vice President and Corporate Officer, Group Function Technology, Ericsson

I'll start, I think it's clearly that we will save (inaudible) a lot of times because it's been the key word in many discussions. But of course, the one of the key strength is that 5G builds on the installed base on 4G and (inaudible) in many occasions, you will not have complete 5G coverage initially, or you will not have devices for everywhere. So I think it's very clear that 4G and 5G will work together in many areas for a long time, of course, initially even more with NSA. But I think that's very key, then I think, actually, when it comes to deploying or not deploying, I think it's a very good idea to deploy modern infrastructure. That means you wouldn't really deploy your old infrastructure. But then of course, there is a lot of infrastructure out there. So I think it's the kind of borderline between not five and five years maybe overstated in some of these areas. But of course, there are key aspects of 5G that will be needed going forward. But I think you're right in that 4G is also capable of standard days, serving most of the IoT and other users today, of course,

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Just an added point to Mikael's comment in the interoperability across the various layers in the network, as well as the applications and infrastructure will really be key to adoption. So as we look at four to five, non-standard understand alone, as we look at the ecosystem that will support a full 5G end to end we need to look towards interoperability to guaranteed levels of service reliability, resiliency of those applications. None of that happens in a vacuum. There's a number of lab efforts that are you know, many of us are involved in things like the 5G, interoperability labs, which in drive out if you will, the bugs in the systems to make that end and experience work as designed across the new network. So that has to happen in order for us to achieve success in this industry.



Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Just the comment from me, the integration, let's not forget, didn't get mentioned once. But in many environments, if not most, there's also the requirement to interoperate and work with some sort of fixed network environment or Wi Fi mix to go along with all of these others as well. So there's a lot of a lot of complexity and the need to work together and make sure everything does interoperate, as you said.

Terence McCabe, Chief Technology Officer for Asia Pacific and Japan, Nokia

And let's not forget a lot of the industries we're talking about here, whether it's manufacturing or transportation, have regulatory friends, and you don't introduce new technology into something like the rail network without there being a long life cycle management process. So it's not something we're unfamiliar with. We've worked with that, it's with LTE in the past, and it's rolling forward, but it's, you know, all of these things feed into the time it takes to introduce a new technology.

George Rickman, NetEvents

Okay, thank you. Does anyone else have an answer for this question? Or we can move on to Vladimir Vladkov's question. He writes, do you think the proposed regulation for AI ethics will block the technology development? Now, again, is an open question.

Stephen Spellicy, Vice President of Solutions & Product Marketing, Service Provider & Edge, VMware

Certainly makes it more complex. I mean, obviously, is what was mentioned earlier, things like Terence mentioned, facial recognition as being an issue. We have cities, states in the United States in which facial recognition is banned. So we're down not just to a sovereignty of a country, but we're down to a zip code. So it's very complex. So that as we look towards utilizing AI, to drive more of the experience and an application or a network, we have to be aware that there may be constraints to the legal and compliance level that we need to contend with.

Saratendu Sethi, Vice President - AI, GEP

This data perspective, and a couple of minutes ago, we talked about building everything right from a cybersecurity perspective. So it is crucial that every technology can be put for good use and questionable, ethically questionable purpose. So that will be figured out as more and more AI technologies are being rolled out. But when you talk about these networking aspects, I think as an application developer it's very critical to design it right. It has to be security first, whether when that's our data angle involved, it has to be security. First, whether the data is in rest, or data is in motion. Things near privacy needs to be respected. So it's actually a concern. It's an aspect of application development to begin with, as well.

George Rickman, NetEvents

Okay, thank you. Would anyone else like to answer that question? Okay, well, it looks like we're a little bit over time. And I just like to apologize to the press that I've got questions from, that we haven't been able to get to. We will send them over to our panelists today, so we can maybe perhaps get some answers offline. So I'm gonna hand back over to Jerry now.



Jeremiah Caron, Global Head of Research & Analysis – Technology Group, GlobalData

Yeah, really, I just want to I just want to say thank you to the panel. The team at GlobalData study these activities very, very closely. But I definitely learned a lot today from hearing your thoughts on your observations of dealing out there in the real world. So very much appreciated. Thank you very much. And thank you to the audience, as well.

