Patrick Moorhead: Sailesh, thank you so much for joining us today. I really appreciate you chatting here on this Six Five Summit, 2022.

Sailesh Chittipeddi: Thank you for having me, Patrick. It's fun to be here.

Patrick Moorhead: Yeah, it is. It'd be more fun to be together. Maybe that'll be next year, but it has been pretty crazy travel days for me over the last couple weeks, but it's really nice to see you.

Sailesh Chittipeddi: Same here. Same here.

Patrick Moorhead: Yeah. So Renesas is very well known for the edge and I would say most people are like, oh, automotive. Now you run a very successful division that focuses on the edge. It's different from automotive. In fact, it's IOT. So we're going to talk about the IOT edge here today, and we're going to chat about this. So first question I have for you, what is driving the demand and the movement to move intelligence at the edge? Is this short-term fad or is this something that is going to be here to stay?

Sailesh Chittipeddi: Yeah, first Patrick, thanks for having me. And it's actually pretty good to be able to have to talk to you about the movement of intelligence to the edge, which is actually a major trend that's shaping the landscape, right? And if you think about it, there's actually four major factors that are shaping the movement of intelligence to the edge. I mean the first one is obviously the need for reduced latency is an example, right? Think about the waken voice features and simple word commands that should say to your TV remote. If that went to the cloud and came back, you'd be waiting for a long time, right? So the first one is certainly the need for reduced latency. The second one is a great example is privacy needs, right? And apple watch a great example where your health information stays local and you can access it and you can track your personal improvements.

You don't want that kind of information to be on the cloud. The third thing is really minimum bandwidth requirements, right? Local sensor hubs connected via home networks don't require information to be transmitted to the clouds. So minimum bandwidth requirements is sort of important and last, but most important one last, but equally important is the low cost connectivity and digital infrastructure. Right? Now you have ubiquitous connectivity and cheap local computing. So those are kind of the four major trends, four major factors, if you will, that are shaping the movement of intelligence to the edge, right? And if you think about it a little bit more, and you say hey, where are the beginning of this journey where you have the big complex training algorithms that are looking at things like weather patterns, complex aural analysis, and so on that are always going to stay in the cloud, right?

They're fairly sophisticated kind of algorithms. And what I call the training algorithm world, if you will. But the simplified algorithm sets, if you will, which I call the inference algorithms. These chip sets are expected to grow by about 10 X, right? And the edge-based AI chip sets are growing just as a factor of two and a half compared to the enterprise based chip sets and even more interesting from a power domain perspective, right? The consumption of these chip sets is

primarily the sub what range. So overall the edge chip market by 2025 is expected to reach over $60 billion. So that kind of puts in perspective where this market is and where we're headed overall. So definitely a trend that is here to stay and not a fad, if you will.

Patrick Moorhead: Yeah. It was a bit of a loaded question. And they say, never ask a question unless the answer, but it was important to get your opinion. And I've been, I guess, looking, I've been in the tech market for over 30 years. And the interesting part is what always happens is the intelligence always drives to the edge. Right. Whether we started with mainframes and then went to mini computers, and then we went to client server and PCs and then smartphones, and then the next trillion devices that will be out in the edge. So not only does this make common sense from practical purpose, but this is the way that high tech has rolled out since I've been watching it. So I very much see it as a trend as well. So let's drill down though in the two sub markets of the edge, which is consumer and the industrial areas. Are these shaping up to be different or similar in respects?

Sailesh Chittipeddi: So both of these are actually very similar in the respect in terms of intelligence moving to the edge, right? So in both these areas, you'll actually find if you start with the industrial area, right. And you think about the industrial 4.0 is pyramid if you will. The top of the layer is really the analysis layer where complicated analysis and computing occur. The next layer down is sort of the control layer, right? Which controls what's happening at the factory floor level. And the factory floor level is really the access layer if you think about it. And at that level is where a lot of the changes are happening. When you look at the modern warehouse today. There's lots of sensors all over connected networks at the factory floor level, they're driving a significant amount of change with intelligence being adopted, sort of at the edge of the access layer.

And you can extend sort of this concept, even beyond industrial things like the agricultural area. Where sensor networks allow you to monitor things like soil conditions, water levels, salinity, et cetera. So the industry 4.0 is actually shaping up massively different as the new factories of the future are being built. And not even to mention in the connectivity side. There's a world of games that's occurring there as well. In the consumer area, there are multiple things that are actually happening. Number one, to me, one of the most transformative things, Patrick is really consumer health. It's going to be an important concept of intelligence. And this is important why? Because the population is aging globally. From an appliance site, it's pretty obvious. Yeah, you have smart washing machines today that control the amount of water. There are things that are more optimized, minimize energy, consumptions, all these are smart technologies that are taken over in terms of intelligence, but personal health is the one that's going to be the most transformative.

Today, for example smartwatches have the computing capabilities that are massive and they can track everything from your SBO2, the pulse rate heart rate, and even irregularities and heartbeats. So these are kind of things that are going to shape this, the edge network of tomorrow, where intelligence is sort of moving much more towards the end point of the network, if you will. And we have things today, Patrick we have our G shock watch from Renaissance. That is based on purely energy harvesting. So there's no battery at all in the watch. And if you think about it's a smart watch that you do.

Patrick Moorhead: I got to make sure there's no battery in the watch.

Sailesh Chittipeddi: Correct.

Patrick Moorhead: That's amazing.

Sailesh Chittipeddi: So it's based in purely energy harvesting. And it's really a neat technology that relies on things like body temperature, movement of the hand and so on to generate the kind of charge that's needed. It stores it, and then it works, but it's a pretty cool technology. So, but again, some of the transformative things that are occurring in the landscape, so you can certainly expect this to be something that reshapes the future environment of tomorrow, if you will. And the algorithms that go with it are getting ever more sophisticated. And then it just becomes a question of porting it and control.

Patrick Moorhead: So Sailesh, let's do the double click here intelligence to the edge is impacting different sub segments of the edge in different ways, specifically consumer and industrial. Can you talk a little bit about that because you're involved in both of these markets.

Sailesh Chittipeddi: That's correct, Patrick. So let me start by talking about the industrial area. So if you look at the industrial area and think about an industry four point pyramid, the top of the layer is really the analysis layer where a lot of sophisticated computing and information processing occurs. The next layer below it is a control layer, which controls the factory floor, the access layer, if you will. Some of the biggest transformations that are occurring in the industry landscape are on the factory floor level where, whether it's robotics, whether it's smart sensors, actuators, the connected networks of the factory floor, which are driving a lot of intelligence at the edge and are responding very quickly. Like when a robot stops, when a human being crosses and so on, that's really AI at the edge if you will. Similarly, you have sensor networks that are detecting things that are going on in the factory floor.

And if you take that concept further and say, okay, if I can extend the industrial environment to home appliances, you now have washing machines that can regulate the amount of water flow that can regulate the amount of heating, the amount of power consumption in the devices. All these are smart technologies that are being embedded into home appliances. And you take that even one level further into things like the agricultural arena, where you have things such as measuring the salinity level of water. You're looking at soil conditions, you're looking at temperature conditions. You're looking at humidity conditions. All these are smart sensors in the agricultural area that are starting to make a difference. And I'll take it even one level further where even for things like the optimal amount of milking of cows, now, there's actually a smart way of doing it. When you think about it.

And then after the industrial area, you can sort of talk about consumer arena. And consumer area, my personal view is the personal health is going to be a major component of intelligence at the edges of population ages globally. It's pretty obvious that today's smart watches are a long way from the watches of yesteryear. With computing capabilities to boot that can track everything from SPO to levels, to pulse rate, to heart rate, and even things like monitoring

irregularities in the heartbeat. Today for example, we are in the G shock watch, which is something that includes a device that doesn't have battery consumption.

So this is a micro controller that's a pure energy harvesting micro controller based on our SOTB or silicon and thin buried oxide technology. And it's a pretty smart watch and can perform most of the functions that I described to you earlier. So these trends are going to be transformative, the landscape, and you're going to find sensors in things like clothing and so on smart clothing, which are going to transform our landscape of the future. So very exciting. I can go on and on about the transformation that's occurring in the landscape, but we'll kind of stop at this point.

Patrick Moorhead: No, this is interesting. And not only are you changing, not only are you making a big impact to the technology, but also to people's lives and the way we live with health, with the environment, and quite frankly helping companies reduce cost, make more money, get closer to their customers. And that's what I see when I look at the very end of this whole revolution. So what is specifically your role in shaping the future of this intelligent edge we've been talking about?

Sailesh Chittipeddi: Right. So Renaissance. At the highest level, our CEO is kind of outlined the vision of making our lives easier by complimenting human capabilities. As a part of that vision the IOT industrial and infrastructure business unit role is enabling intelligence from the cloud to the edge sustainably. While that encompasses many domains, let's just focus purely on the edge for the moment. We certainly have the largest micro. We are the largest micro controller supplier in the world, and we have a major role to play in this transformation. At the most basic level. If you think about it, some of the inference sets, which we have that are poured onto the micro controllers, as well as our microprocessors for example, look for simple things like anomalies versus normal patterns. That's what you typically look for. When you're looking at AI workloads, simple example, they can perform the most basic.

Our microcontrollers can perform the most basic of recognition features. So they can tell the difference that this sort of looks like a pattern of a human being. You get a little bit more sophisticated and you go to the 64 bit microcontrollers. Now you sort of get into the ability for detecting faces in a crowd and think about that. You're now able to do things at the very edge of the network that you had to rely on the cloud before to do the processing. So now you have very quick access to the information and the nice thing about this, Patrick, it is a very low par consumption. So it makes a significant amount of difference relative to the access to information that's readily available to you, which couldn't have been done in the past. and then you sort of take the next step and you say, okay, you have the microcontrollers, you have the microprocessors, but increasingly, the world is moving much more towards AI type workloads, which are specific for certain and applications.

So with the new generation, we have certainly our microcontrollers, which are getting most sophisticated. We have our microprocessors, which are getting even more sophisticated. And then we have processors that are dedicated for AI workloads and a combination of the two. So for, for example, our latest devices, which will come out later this year will not only have a microcontroller. It'll also have an AI processor that can do things to compliment what's happening on the microcontroller side. And beyond that one of the problems with

microcontrollers, if you will, is they're single threaded. Single threaded basically means you're just looking at one particular sequence of operations at a given point in time. We're now coming out with ultra low power FBGAs that are sort of optimized for the problem of multi-threading, especially for IOT applications. And these are sort of for less than 5,000 gates and less than 50 MTS of power consumption.

And it compliments our MCU portfolio extremely well. So we have a slew of solutions starting with the low end micro controller to mid-range, to high range, micro controller, a microcontroller with an AI processor, microprocessors, AI dedicated microprocessors, and then last but not the least FPGAs that can handle more complex workloads. And multi-threading, for example, that's needed for sense of fusion. So the complete set of solutions, and then we work with partners in the front end for giving the AI work tools for porting that on seamlessly onto microcontrollers and microprocessors. But think of it as a suite of applications for addressing whatever set of problems you're encountering.

Patrick Moorhead: Yeah. I like the fact that you have a broad array of that goes from top to bottom and you're using different kinds of accelerators as well. That's impressive. And I think that's unique. So you've been very strong industrial markets and I'm curious, what's the role of the company as the intelligence moves from the cloud to the edge?

Sailesh Chittipeddi: So that's a good question. I mean, look, Renesas has been a leader in the industrial environment for quite some period of time. We've had the name of the large customers that you have, if you will, to now the emerging customers that are moving at a fairly rapid clip in the market. So two things that are happening at the landscape one is that market used to be very, very ASIC mindset. That's changing over time, it's becoming more a microprocessor centric and a micro controller centric, especially at the access layer level which is at the bottom where you have these networks, people are recognizing that you don't need an ASIC for controlling a lot of things that are occurring in the factory floor. So as that discussed earlier, one of the things that shaping the landscape in the industrial environment is the ability to make the devices that you used before smarter.

And that's where our microcontrollers and microprocessors start to play a very, and we have solutions today that can connect multiple sensors using sensor fusion. We have sensors ourselves. We have, for example, flow sensors, humidity, sensors, temp, temperature, sensors, name it. If you will, that can be used on the factory environment itself. We have connected sensors that allow you to gather information locally. We also have the ability to process information with a robotics based NPUs as well, that are very good for things such as precision handling and as well as actuation kind of appliances. So a range of solutions for the industrial landscape. And this is going to be very important for us as we increase our presence in this domain over time.

Patrick Moorhead: This is super exciting. And I'm so glad that the company is taking a more active role in communicating in certain markets. You're really stepping up thing. It's one thing to have great strategy, great products. And that's another thing to be telling a broader story. And I think your

story is unique and I really appreciate you coming on and sharing it with the Six Five Summit audiences.

Sailesh Chittipeddi: Thanks a lot, Patrick. It's great to be with you as always.

Patrick Moorhead: Yeah. Thanks again.

Sailesh Chittipeddi: Thanks.