Chris Teale:

All right. We're going to stick with state and local technology and we're going to talk about chips. Not Tostito chips, which I delve into at the end of a workday, but semiconductors. Hello. Please take a seat. Joining me is Dr. Michel Kinsy. He's the Center Director for the Secure, Trusted, and Assured Microelectronics Center at Arizona State University. Dr. Kinsy, thank you for being here.

Michel Kinsy:

Thank you, Chris. I very much appreciate. Thank you to the audience. Quickly about myself, how I end up sitting here. Now I direct the Trusted and Assured Microelectronic Center at Arizona State, but most of my career has been within the semiconductor industry. Mainly I start out my career as a researcher for the MIT Soldier Nanotechnology, then later doing signal processing for MIT Lincoln Lab, and so forth and so on. So we have always tried to have secured chips within our critical systems and that has been the evolving aspect of my career. And I'm delighted to share with the audience today the landscape little bit, what have happened over the last few decades, how the landscape have shifted, how COVID have affected or accelerate, and finally, the CHIPS Act and the starting of a new reconfiguration of the geopolitics.

Chris Teale:

Well, it's great to have you and thank you for being here. And I guess first of all, I've not heard of much of the STAM Center except what you've told me in previous meetings. So just give us a little bit of background on what you guys do.

Michel Kinsy:

Yes. Actually, Chris, this really started out again when I was still a researcher and leading a small group out of the Lincoln lab. We were doing basically synthetic radar apertures. There are a lot of critical systems. And although we are here today talking about cyber summit, what is truly your gateway to the cyber world is actually the semiconductor and the micro electronics. When I first started my career, I was also a red teaming lot of critical embedded system for the DOD.

If you cannot assure your microelectronics is almost [inaudible 00:02:38] in your system. Just imagine your pacemakers or your radar systems or your nuclear submarines and those things. It is at the heart of it. By the time we are talking about security posture from the software, the firmware and all of those things, often time is too late if you do not know the underlying hardware infrastructure that is actually supporting all your other security postures.

So looking at this even way before the CHIPS Act, the pandemic, lot of DOD agencies and the defense industrial base was also really suffering from finding talent and also processes and tools to keep innovating and supporting this particular industry. So the STAM center was actually started out as a large discussion with a MIT Lincoln Lab, Draper Labs and so forth and so on. They were asking what can we do to provide a new wave of talent pool to this particular industry? So we start out the STAM Center as a way to provide experiential learning to students, mainly graduate students that can later transition to national government labs and the DOD as a way to both research but also to support those mission. So at the STAM center we focus primarily on three areas, which is new substrate and also new devices and also prototyping for communications, edge computing. And as we are now all talking about ML and AI, how do we deploy this on the edge in a safe fashion? So this is what the center does as a whole.

Chris Teale:

Sounds good. Okay. And it's been well documented, the delays in new iPhones and all sorts of things, but where do things stand right now with the supply chain for semiconductors? What's going on out there right now?

Michel Kinsy:

Thank you for that question. It is an interesting landscape. Over the last three years, we have heard a lot about the semiconductor industry, the CHIPS Act and all, but we have to also be very cognizant of the evolution of the field. How did we actually arrive here? This is a set of slide to show how over the last perhaps three decade or five decade, we have seen transformations. Our industries has been globalizing as a way to minimize cost. There are pretty much three major component to semiconductors. The first is really labor. So where can we get the cheapest labor to facilitate? The rest are the raw materials and the processes and those. And the third is the EDA tools and the designs. So the US, Synopsys, Siemens, we have pretty much dominate the EDA tool domain, the IC design.

Before the labor and the manufacturing process, this was not some malicious or any sort, but there were just different parts of the world that provide better leverages. And so for instance, labor and processes and those, and Taiwan has for various reasons have found a niche to provide some of the best at the lowest cost at that. And that have moved the industry by keeping the IC designed in the US, most of the fabrications in talent in Taiwan and the packaging and those which are labor-intensive below overhead in China. China still dominate most of your packaging today. So those are the general actors within this particular space and again, this is another re-rendering of the evolution of the semiconductor to chain, how one time the integrated model with Intel and those were all vertical and pretty much here in the US.

Today what we are seeing is what is just in the middle, which is the IC design, the intellectual properties that are really in the US, the manufacturing are pretty much in Taiwan and South Korea. And then for the packaging you have China, which is still dominate. So this is where we are today.

Chris Teale:

All right. So you've said China and you've said Taiwan, which I have to imagine is not good for our national security. I'm curious for the impact of relying on those countries for the chips that we need every day.

Michel Kinsy:

Oh, this has been for the industry at large, like I just mentioned, it makes sense. It was to minimize cost and so forth and so on. So that is great. But when we are talking about critical systems, what the DOD needs, it has always been almost our Achilles heel sort to speak, because as industry moves and try to optimize someplace else, the ecosystem and the infrastructure to also support even what the DOD needs also disappear. And that is really the key. This has always been a weakness. In fact, they are even way before the pandemic, the duty was already struggling, for our national security is such a huge problem because you have chips, as I'm showing in this figure, that it goes all around the globes. Different vendors and providers are integrated into the same system. You have no idea truly who is touching those IC, where they're coming from and so forth and so on.

So to being able to not have a genuine end-to-end locally validated semiconductor supply chain represent quite frankly an existential threat to the US. I'm not trying to make it, but whoever is able to really dominate the semiconductor industry will dominate pretty much the future. It's as simple as that. So yeah, it is not good for us in a short and it goes beyond the CHIPS Act. This has to be a continuous and persistent effort of having a full-blown ecosystem, like I show in the previous. At all layers, the US needs to have a robust footprint from packaging, manufacturing and all those things to procure. So when we talk about national security and the impact, I know this is a little bit too verbose, but sometime it's important to highlight this setup point that this is not just a series of false alarms.

These are concrete observed cases where we have had a very, very compromised chips actually in the supply chain going all the way to operational submarine nuclear power plant systems. And it's pervasive. Most of, today, your pacemakers, your medical devices and all of those things, there's no well established supply chain for validation and assurance for them either. So when we are talking about the war today in Ukraine and all of those things, all of this are coming back. Basically there are some kill switches that one can do. You launch it and it come right back to you because basically there's a missile that you have the chips which is actually controlling both the velocity and the trajectory somebody else is manipulating at a very low level. So those are some of the risk. It's not just for the cost. And these are state actors. So we are talking about long-term game, a very systematic about their approaches.

And these weapon systems also have longevity. We are not talking about 10 years or 20 years from now. So the state actors also know that. They are patient and they're willing to deploy a lot of infrastructure and get that. So, and one can say, "Why can't we just trust the market to do what the market does the best?" Unfortunately national security and what make a company valuable, sometime they are some intersection, but sometime there are also divergences. For most industries, basically for them sometime you have to ship the product because. So this is a survey of many chip makers or semiconductor and they know, for instance, they were asked, "Do you know that this has compromised components or vulnerable components?" They say yes and they still ship it because I rather ship a product today and stay in the market than fail to ship and then get removed.

So we have to be cognizant that here because we are talking about national security, that the government has a bigger role to play than other segments of the economy because the economic components are not selling in the same direction. And this is to highlight that, that what industry cares about may not perfectly align what with is critical and of security. Yes. So this is again at all layers of our vulnerability from the IP design cycles and those present a set of vulnerabilities, cyber threats that we have to basically be cognizant of them.

Chris Teale:

All right. Well I'm not going to be sleeping tonight having looked at all these slides. Okay, so we've talked about the problems. How do we solve for some of these things? What are some of the solutions that you see in the semiconductor supply chain?

Michel Kinsy:

Actually, it's not all doom, I think. They are the same thing that I mentioned earlier, which is what are the components, the actors participating in this ecosystem? And so, one of the major solutions is really the CHIPS Act is an excellent start. I think this is for nothing else, it has brought to the general consciousness that this is a critical vulnerability of the country. It's a huge investment and hopefully that will translate to and growing the labor pool. So this is great. We know for instance here, certain technical solutions I have here on this slide a list of technical solutions. But in cyber and cyber security, they are technical solutions and the translation of those into functional practical solutions. Here is a laundry list. On one hand we know what the threats are. We know what are the potential solutions. Again, if we go back to the previous slides, we have some ideas, we have technical solutions to them.

But all of this is to show a comprehensive list that the problem can be fenced and solved. And furthermore, I think this is what we are showing here. There are three components that can address workforce development. The CHIPS Act have components of theirs and we can do more Again, research and development. Me myself, beside again, I have been in government doing government research, academia, I have been part of couple startups. At each of those stages of my career, my team and I have attempted to build trusted semiconductors. It is awfully hard to do it domestically, from academia to even the government and all of those things. How can we lower the barrier for small startups to being able to also participate in this ecosystem? How do we enable our universities to train with hands-on to do semiconductor tape-out and those. So we need a common research infrastructure or R&D infrastructure that will enable small businesses to be able to actually manufacture microelectronic IC locally.

So a shorter programs and those and the government has to help, because industry, again, that will go to what makes sense for them. So it is upon the government to create that local infrastructure that will allow universities, small businesses and mid-range businesses and also government lab to have access to a common R&D infrastructure for this and which is also supported with a manufacturing facility. So again, a common infrastructure, a workforce development and then basically continuous, so [inaudible 00:17:37] and technologies on enabling tracking of component bill of sales, bill of right, bill of components of all your IC. So this is what we view as a potential approach to it, which touches on all the three components that goes into it.

Chris Teale:

Sounds good. Yeah, you've mentioned the CHIPS and Science Acts which was passed in Congress to try and get the country's arms around this problem. What are the biggest impacts of that legislation that you see?

Michel Kinsy:

Okay, that is great. And also one last point before I answer that. This for instance is the current state of the art. If you wanted to build a trusted micro electronics for one of the critical US defense systems, you need to rely on 20 years old technologies. Those are the numbers, by the DOD itself, so this is worth the expense today. So the CHIPS Act is indeed needed, really. So this, if you wanted to do it at Lincoln lab where I was, you can get your 99 nanometer that was commercialized around 2002. 20 years old if you want a truly end-to-end domestic trusted manufacturing supply chain. If you are willing to go overseas, then of course you can get your five nanometer.

So I hope that this help us and also you can see the decrease, how many folks have disappeared out of this ecosystem. We need to rebuild that to have diversity in suppliers, diversities in the ecosystem. And so the CHIPS Act, my hope is that it will reverse this trend down, which is keep pushing it down. So the CHIPS Act again, some of the solutions and what we have, I think it helps in term of, again start the conversation, it brought in a lot of folks. Different regional hubs now have been elected either through the DOD commons call, also the commerce department is also having bunch of initiative that is coming online.

All of that has energized lot of our small and mid-range businesses in the semiconductor industry that for the longest were lost or not supported. So it have energized a lot of people. Also a major component of this has been the workforce. Every meetings and talk or briefing that I have been to, the workforce has been critical and the center point. So the CHIPS Act at least I will say in spirit is an excellent start. Lot of folks who are involved do care and have a deep understanding of this problem. I think we have to make sure that it's not just the big companies that have access to the tax break and those, but really I hope that in translation, the CHIPS Act look at the education.

Early panelists make a lot of emphasis on tribal universities, community colleges, how do you get domestic students early on interested in the field? Because we need a robust pipeline of talent to actually create the ecosystem. So the CHIPS Act for all the education thus far has, at least pressing the right button, but that needs to be translated into action and that is where we all needs to help, is to be consistent. That this is not just tax break for the major companies because they are often global already, they have access. It's really the small mid-range companies that do not have offices at all places of the globe. And how do we get domestic student interested in this general field?

Chris Teale:

That does lead me nicely as well to ask about how do we encourage a robust pipeline? How do we get students interested in this field because we have a shortage of workers in this area, do we not? How do each fix that?

Michel Kinsy:

Thank you Chris for that question. I will answer by yes and no. We have a shortage but is as a consequence of how we have always tried to present semiconductor and microelectronics. I believe that a lot of students are interested in the field, the applications of it and those they don't get introduced to it early on in their career. They do not. They have been introduced to semiconductor in the most abstractor of just the gates and all of those things, but never to the capabilities that enable and how that support everyday applications. Me, myself, I will give my personal how did I came to semiconductor in my career. I'm originally from the Virgin Islands, so I did not know starting high school that I will be in semiconductor. But early on in my career I got exposed to radar signal processing and it was fascinating that you can be able to process as undergrad, and from that it was just the light went on.

And I said "This is very exciting. I can literally process any image in the dark when it's raining, fog." And one of my high school freshman project was actually to minimize the power utilization of a radar signal process. And that has just been one problem. The DOD for me, I have been in the field because they have some of the most challenging problem and it's so exciting to be part of it. You are sitting on the front row of very amazing problem. So how do we tell lot of youngsters that there are just great problems out there that you can actually go and solve, that is not just about how can I order the pizza on the five minutes? And so as to how do we present this national security problems to a younger generation that they can see that, "Okay, what you are learning have a larger connection."

Not everything just come down to how much you will make with your first job, but rather there are things of meaningful importance that you can be part of, is to show them that there's a career and there's a journey and be part of it. I think if we can introduce student early on to that process, we will not have the shortage that we are talking about. So for instance, at ASU, one of the things that we do is we have a summer programs, we have an undergrad and graduate. The summer programs we go around finding different set of students and my whole goal for them, and I was doing the same thing even when I was in the government, is how do you demystify the environment for them? I like to bring them to spend a whole week just working on various project as a way to say there's nothing else to it.

If you stay here long enough, you actually find out it's cool, it's nice and you can also do it. So how do we demystify even the field of semiconductor to upcoming from high school level? By the time students come to mid-range by junior or senior, by that time they are already starting having certain constraints around what there wants to be. They already heard how many their peers are making and all of those, "I want to go to Silicon Valley." So by that time to bend them become harder to see that there's a larger field to play in. You can actually be an architect and design your chip end to end. That means to start with clear problem statement. And on the government side I will say they are rich set of problems. How do we get student interest in those?

What are some practical critical problem of national importance that they want to be part of? And that is a key, and this is right now how we are approaching the problems in our own. This is an example of experiential learning, reaching all the way to high school and get even professionals, like in the audience, whom has been on the software framework side of cybersecurity, if they want to see how does the semiconductor or the hardware root of trust approach to cybersecurity can supplement their own career, because we need it at all levels. So that is basically for me, what I see as we will be able to get the US leadership in semiconductor is really if we go back and revisit through all this range.

Chris Teale:

Get people started earlier and we'll be good.

Michel Kinsy:

Exactly.

Chris Teale:

All right. That sounds good. Well we are at time, so please join me in thanking Dr. Kinsey for his insights.