Episode 5 – The Age of Quantum Banking

SULTAN MEGHJI: Welcome to the FDIC Podcast. My name is Sultan Meghji. I'm the Chief Innovation Officer and I am incredibly excited today to have a returning guest, Dr. Jimmie Lenz, from the Pratt School of Engineering at Duke, along with two of his other colleagues, Dr. Jungsang Kim and Chris Monroe, who are two of the leading minds in quantum computing here in the United States. And as those who follow me on social media know, this is an area I spend a lot of time talking about and we're just really fortunate to have these experts on.

And since you already know Jimmie, I won't ask him to introduce himself because we already did that, but I'll turn it over to Dr. Kim first to introduce himself then to then to Dr. Monroe and we can go from there.

JUNGSANG KIM: Alright, thank you, Sultan for having me on this podcast. My name is Jungsang Kim I'm a Professor of Electrical and Computer Engineering at Duke University, also in Physics, and work on trapped ion and quantum computing. I've been working on that for almost two decades now along with Chris and Chris and I also co-founded INQ. And I'm serving as the Chief Technology Officer at INQ at this at the same time. Very nice to meet all of you.

CHRIS MONROE: Thanks Sultan. My introduction will be very parallel Jungsang and I have been working very closely for a couple of decades. I'm also at Duke University in Departments of Electrical and Computer Engineering and Physics. Yes, we co-founded INQ five or six years ago. I would say Jungsang's a little more of the experienced concept engineer. And I'm a little more on the scientific research side and this field of quantum computing is a wonderful marriage between those two. I think it really demands activity on both sides, because as we'll as we'll discuss… the use cases for quantum computing, we're only hinting at, we only have a glimpse at what these things will be able to do. So there really needs to be a big community, both in the commercial space industry, but also on the university and government lab research side.

SULTAN MEGHJI: But to but to frame it just a little bit, most of our listeners are people in the banking sector, in the federal government regulatory sector…not everyone has a PhD in computer science or physics. So maybe what we could do is ask to start off by just saying, maybe talk about some of the research that you guys are going through, working on right now on the university side. And as you're doing that maybe go just a little bit deeper into some of the basics of quantum computing for some of our listeners.

CHRIS MONROE: Sure, maybe, maybe I'll dive in. The subject of quantum computing is very easy to talk about at a high level, at a low level because at its core, it's actually fairly simple. Even though it involves concepts that are completely foreign to our everyday life. And I started off as a physicist and in physics, we really teach, we really understand things through analogy…like throwing a baseball around, we can predict exactly what's going to happen there. And we can apply that to all kinds of things, remarkably… you can think of analogies to a transistor. A single transistor in your classical computer, there are analogies to a switching networks, for instance. But in quantum, even though there are straightforward rules to apply bits and information to the quantum world there is no analogy and that starts really at the core.

Quantum systems are allowed to be in a confused state of reality and people probably read this. Most people have a little inkling that there's some weird stuff going on in quantum, but when you apply it to information, the bit, which is typically a definite state of one or zero. In quantum mechanics the quantum bit can be in *both* one and zero at the same time, it's not noise. And what makes it really tricky is that at the end, you have to measure and any computer, you have to look at the output. And what does it mean to measure something that's in many states. I'm being very vague, but there are lots of problems like this that can be cast like this that we tend to ignore right now because they're too hard on a regular computer.

SULTAN MEGHJI: So on the research side, are there any, and it doesn't have to be applied to banking and, we can, I'm sure this is going to be way more interesting to the computer scientists than the bankers here, but are there questions that you guys are starting to look at, that historically we just haven't been able to look at that are top of mind?

JUNGSANG KIM: Yeah, let me actually try to take that one. I think as you mentioned the when the digital computers came about, we can start to do a whole lot of things that we didn't even imagine doing before. And now with the internet being everywhere, we're doing a lot of things today that we didn't imagine was possible…just like this, online podcast! We've been dreaming about video conferencing for many decades…from the '40s…but it's now really became a reality and it's actually adding to productivity. So the question really is, what can quantum do and that is that is not possible today? And just like in the early days of computing, when Intel first came out with the microprocessor, people thought the amazing use of it will be handheld calculators. Our imagination is limited because we don't know how to do things that we have never thought about doing.

So I think quantum is in that space. The interesting note is just in the last few years, these quantum computers have become accessible, right? We use the power of cloud infrastructure and many commercial systems. Of course Chris and I have been building research systems and collaborating with certain research community to run some small problems as proof of concept. But now the commercial systems have put these quantum computers online. A lot of people can access it at the same time.

So that actually opens up a lot of imagination space rather than, the handful of resources we can actually directly collaborate. Now there can be thousands of users around the world who have an idea or can actually try them out.

SULTAN MEGHJI: Those are great summaries. I want to double-click on two of them and maybe what I'll do is I'll turn it over to Jimmie on the applied side, because he lives in the applied side of banking and risks and artificial intelligence. And maybe ask him to talk about what that translates to, on the applied side, as we think about risk in particular.

JIMMIE LENZ: I think what Dr. Kim mentioned is spot on. That's exactly what I was thinking. Right now we're very limited when we run scenarios of different kinds, in particular multidimensional scenarios by the computational power that's out there. I think quantum provides, or may provide, a very different way of us thinking about risk, in particular risks that are occurring in dynamic environments. Right now the computational power just doesn't exist to process that. And so because of it, we're often left in the dark or we're working to remediate things where we could have actually stopped them.

And I think that's one of the huge advantages that this offers, in particular when you're talking about such an interconnected financial environment like we have now where banks don't operate in unique or in a vacuum they operate as part of a really large ecosystem. And it's a global ecosystem. Trying to monitor those kinds of things is almost impossible right now in real time. We're always doing it next day or even after that. And so the opportunities that quantum provides, I think, opens a very very different door. Very similar to, I think for on the customer side, the cybersecurity side and things like that, it opens a door that thus far we haven't even been able to approach. We haven't been able to turn the handle because we just don't have that the means to do that.

SULTAN MEGHJI: Yeah. I this is a huge challenge in the financial system, right? In many cases, the banking sector is looking at data, 60, 90, a 120 days after the event occurred. So not only is it dealing with it after the fact, you're then dealing with the cleanup, many days, weeks, months later. And one of the biggest evolutions over the last few years is moving towards more real-time systems. You know, in digital assets is just one example of that. We've got real-time payments infrastructure, we have credit cards, we have all these different things that are moving in real time and so much of the banking system is not designed for that. And as we deal with that kind of real-time risk discussion, there is a huge, *huge* risk opportunity that's beginning to present itself that this then is a potential solution set for, right?

This is not a problem you have to deal with today or tomorrow but in my job, I have to think five or 10 years in the future. Give me a readout. How are we doing? Are we training enough people? Are the ones who are coming in from other countries staying here? And I'll just, go around and I'll start with Dr. Kim first, but just, Dr. Kim, then Dr. Monroe, then Dr. Lenz. You know, tell me how you think we're doing?

JUNGSANG KIM: Great. Oh, no, that's a, that's an incredibly interesting question. I think these the technology pendulum swings. As you said, as you say today, if you look at the high-tech industry, just because over the last 20 years the biggest value have been created by writing could sell for on internet infrastructure. So I do feel like there's a lot of challenges to pull this together to really make an impact. But that also means there's a huge opportunities for a lot of our young talent to come in and get excited about this.

And I do I do feel like the expertise here will take time to train. I'm sure when we were growing up, we started poking at, basic programming language and programming languages. Those are and there weren't too many people who are programming in the ‘80s in middle school. But today I think most students are doing that. And it is those early adopters who actually have invested their time in new technologies who are actually driving the growth of the computer and the internet industry decades later. But I think over time as the access to quantum computer becomes more available we should really reach out to the K-through-12 kind of population to really think about how to do this. Although, it sounds very exotic middle schoolers in the ‘80s, those who learn how to program back, then have had a fantastic career and really moved the needle in changing the world. So maybe we should start on all fronts.

SULTAN MEGHJI: Dr. Monroe, I’ll turn it over to you for a similar question.

CHRIS MONROE: Getting people into this field. There, there seems to be a big wall and one that I, the one that I really don't like, and that is, oh, quantum physics is so hard. The math is so complicated. It's so, it's not the math that's hard. And I said this earlier, what's strange is that we don't have analogies. And this is really where the wall is and it's not needed. You don't need special expertise to imagine what it's like to have a baseball in two places at once. You can just imagine it. That's all we can do. That's all Einstein could do. He never accepted the theory really, he thought there was something else going on that we didn't yet understand. He called them, "hidden variables that we haven't observed yet." And look, if he didn't accept it where are the rest of us?

Look, the laws of physics are different. We don't live down there. I really think that people shouldn't be opposed to thinking about quantum, but just because they weren't very good at Algebra Two in high school, that's not the point. I think you know, Jungsang said that getting especially young people who are, they don't really understand how a transistor works. Yet they're doing things, they're doing amazing things in coding that I could probably not touch it at this stage. I see college freshmen who just have astounding skills in coding and programming and so forth; yet they know nothing about the physics, the underlying technology in their device.

So it didn't hold them doesn't hold them back at all. I back with Jungsang says the young people, they might not have a background in quantum physics, so what! Tteach them the rules they're straightforward. And it's almost like a cultural change has to happen. People have to start thinking probabilistically.

SULTAN MEGHJI: Jimmie, maybe say some of this as well, but I want to riff on Dr. Monroe's comment a little bit and just say like, how do we do that? What does this actually mean for the banking sector? What does this mean for the financial services sector?

JIMMIE LENZ: I think that when we consider all the limitations in financial services today probably the most prevalent is we think about, legacy systems and legacy environments and all kinds of things like that.

But I think legacy *thinking* is probably the most the most prolific and most prevalent. And it's the key thing that keeps things in their place. I think building on what Chris said a little bit…this idea of being able to think through and thinking a little bit different way, consider problems and consider how we articulate problems. It's funny, I'm so I'm teaching a machine learning this semester and I spend two classes on articulating your problems because you can't just throw a bunch of stuff in the machine and have it articulate the problem for you. I think that having and students, young people, they do have much broader considerations, right?

They're not jaded by the legacy of experience. Younger people are more accepting, but I think a good bit of it is because they haven't been jaded by the experience that that some of us that are a little bit older may have. And I, and that is a real thing. I hate to say, I know because I'm like that.
I love when students come to me and they're using an algorithm that I, in a way that I never expected, I would have never used in a million years. And why? Because I don't have, I don't have that; I don't have those broad considerations. I don't have maybe, some of the diversity of skills that they picked up over their very young lives.

SULTAN MEGHJI: If I'm a bank CEO and I'm listening to this conversation, if I've made it this far, what's something that they should be thinking about as they think about the next couple of years in this space? Is it what they need to be proactive about in terms of getting ready to introduce this technology? Is that something they need to be maybe defensive about in terms of what happens if bad guys get access to their technology? Is it, do I just put this on the back burner and retire and wait for the next guy to have to deal with it?

JIMMIE LENZ Imagine the opportunities. I think that's what that's, what they need to do is imagine the opportunities that this provides. I think coming at it from a traditional defensive point of view, which is what banks usually operate from, is that's not an option here. I think it, using this as we spoke about before as an opportunity to move into a very different area, to provide services in a very different way, and whether that's a traditional bank or an investment bank, trading type operation, I think that this provides this allows us to, let our minds run a little bit more than maybe they have in the past. But certainly I think this is an opportunity is how they should view this.

SULTAN MEGHJI: Fantastic, Dr. Monroe.

CHRIS MONROE: Not being in the financial sector, I do know that physicists in particular probably have a bum rap from the last 30 years, on complex derivative instruments, things with CDOs, things like this. This is quite different. It's not trusting models that physicists are wowing other sectors on that…oh, we can solve this model therefore it's going to be active. It's this is not that at all. This is again, much more fundamental. It's a new way of computing. And eventually we'll get away from the physics where people will be comfortable with the fact that they can think about optimizing things that maybe they couldn't otherwise.

So I would say, my one thought is, that in the financial sector, or otherwise doesn't have to be just finances, logistics and so forth…if there are models, keep coming up with models, even if they're not, even if you can't solve them, even if you can't touch them with all the computing power in the world, it's easy to write down a model that's insoluble. Keep thinking about those and poking at it because there could be a new generation of hardware that can start to solve those.

JUNGSANG KIM: Yeah. So I think I agree with that with both of them. These new technologists, although they feel very nascent and maybe even unbelievable…they can change things! And I see an example when the Wright brothers first took off in the Kitty Hawk of North Carolina shores, that was one moment where people felt, okay, this is an entirely new understanding of how things fly. It's nothing like how, bugs or birds flew. But we today, put up 5,000 tons of metal in the air and that's how we fly. And it is actually doable. That is the way the new science and new way of understanding.

Think about what that has changed. Think about the way that banking was done in the '50s before the computers, everything was manual, written piece of papers. Think about the changes that computers have brought about to the banking industry and imagine you missed that. Where your bank would be?

Think about the internet in the '90s and how that has changed banking industry entirely today in the course of two decades. And imagine what would have happened if you felt that technology was too nascent, too early, and decided to skip on it, where would your bank be today?

Now, quantum may or may not make that kind of a change in the future. We just don't know and nobody can predict the future, but it *could*. So think about what if you miss this wave that was as big as computers or internet and what would it take to hedge against that? Then the answer should never be sit around, wait until somebody else does it.

SULTAN MEGHJI: Oh, fantastic. And that's a great way to end the conversation because there are so many banks out there that did wait a little too long, to really get into this, the more online side of the world. And it's really, you see a marked difference in the institutions who've done that versus who haven't so that's a great parallel here. And so with that I just wanted to thank all three of our guests, Dr. Kim, Dr. Monroe, and Dr. Lenz for a very, a more technical version of the FDIC Podcast than normal. So we'll probably have to put it into notes, say, listen to the left or something like that. But thank you all so much and I look forward to speaking to you all again.

CHRIS MONROE: Thank you. **JUNGSANG KIM:** Thank you so much. **JIMMIE LENZ** Thank you Sultan.