Daniel Newman: Tony Uttley, President Honeywell Quantum Solutions. Welcome to the 2021 edition of The Six Five Summit. So pleased to have you here with us today.

Tony Uttley: It is fabulous to be here. Thanks for having me.

Daniel Newman: Yeah. I'm really excited to have this conversation. It is the only one we are going to have over 50 sessions about quantum, and I'm going to hit you up about that a little bit later, but if you feel that you are ready for what's about to come at you, just nod and I'm going to start asking you... Look at that nod, I love it. It's going to be a great session. I can feel it already.

Tony, let's go one-on-one for a minute. Quantum computing. Quantum is very complicated. I always say, when you talk to people about it, they shake their heads, they nod, they pretend to understand, but few really do. Having been through days of briefings, I can tell you, it is very complicated, but this is what you do. This is your world. You work with a huge team of engineers, peer scientists, physicists. They get it, I learned that when I spend time with you guys in Boulder. Talk a little bit about, let's start with a state of quantum. Let's talk about the problems in use cases that people are starting to see, and then finally, what should people want to know? What is important when it comes to understanding the basics of quantum?

Tony Uttley: Sure. It's a complex topic. So breaking it down, my children ask me about this all the time and I've started to get a little bit of familiarity with how to explain it. The first thing is, it's not just a faster classical computer. I think that's where most people get confused as they say, "Oh, it's just going to be faster." It's not that. It's fundamentally different in terms of how it computes. As fast as our classical computers are today, they end up being very sequential, one step at a time, one step after another, and one of the fundamental differences of quantum computers is that they do computations of multiple different outcomes all at the same time. I typically use a little bit of a math problem to explain that. If you were to have two quantum bits that have information in it, there's two different values to the two, four different values that could be created from having those two quantum bits. If you have 10 quantum bits, that's actually over a thousand different values that could all be computed at the same time.

By the time you get to only 50 quantum bits, 50 cubits, that is 1.1 quadrillion values that could all be computed at the exact same time, and that's where the power lies. It is that parallelization of looking for the right answer that allows us to start to tackle some of the most intractable problems that exist.

Daniel Newman: Okay. Actually, one of the better explanations I've heard, so kudos to you, and I love that. For everybody out there, you're thinking two to the 50th. That's the number. Get out your calculators. That's what that little... It looks like a little up arrow. What do they call those things? What's the right?

Tony Uttley: Carrot.

Daniel Newman: Is that what they actually call it?

Tony Uttley: It's the carrot.

Daniel Newman: I call it the carrot too, but I never realized that was actually what it was anyways. You mentioned some of the most difficult problems. This is where I always feel that quantum falls off the radar and gets pushed to the side in the media and circles of influence because you saved the biggest... Give me just a couple of examples of biggest problems. What could quantum start to solve that traditional computing, maybe, isn't going to be able to, or can't solve as efficiently?

Tony Uttley: Sure. I'll start with one that I think most people think actually gets it solved today, but doesn't, and that is how do we develop new molecules? How would we develop a new pharmaceutical, a drug that is necessary for lifesaving, for saving people's lives? These are very much still done as, I create it and then I test it. I create it, I alter it a little bit and then I test it. While there is some simulation that can be done, the compute power that's needed to go really understand how this molecule interacts with its surroundings is so complex. There's so many variables that it's what we call intractable. It can't be done even on the largest supercomputers. This is a problem that is runs itself really well to quantum computing, because quantum computers are quantum in nature, just like that molecule is quantum in nature.

And so how the chemicals are going to bind it together, or what's going to happen if you use a different dopant into this chemical? What's it going to change? Those are things that can be now simulated in these future computers that will allow us to understand how that drug is really going to work, or how that new material is really going to work before you ever have to actually create it. This is going to evolve over time. This isn't happening today. This is going to evolve over decades, but that is the power of something like quantum computing. The next part of that is always, well, can they be useful today? And the answer to that is, absolutely. We are in this immense era. The era is, quantum computers didn't exist and now they exist, and that's a big deal.

That is a huge moment in history, and when we have opportunity to do calculations on a simulator, what we have to remember is that that is a simulator using classical resources. It doesn't actually have a quantum output, whereas a quantum computer does have a quantum output. Why does that matter? It matters for something like cybersecurity, where you can use a quantum computer that exists today to do perfect randomness that could be allowed to be put into things like encryption keys that would help protect the data that, I think, all of society right now is really making sure that we do protect.

Daniel Newman: Yeah, and coming off of 2020 and COVID-19, I think everybody out there is pretty excited about the implications that quantum could have for identifying new molecules, helping develop new pharmaceuticals. Maybe 10 years from now, we could have shortened even further the amount of time it would have taken to identify a drug. Maybe not 10 years. I know we have some debates on what this time horizon is, but the point is, there's a bit of a horizon before we get there, where it's going to be that instantaneous. We even saw with some of the super computing alliances that we're trying to use, AI and super computers and training and data to identify, and they were able to do something very efficiently, but couldn't get down to that single molecule that might be able to counter the spike protein and COVID-19, which is why we shortened the cycle of a vaccination from five years to one, but the world would have wanted us to input some formula in a computer, and then Friday afternoon, you stop by the pharmacy and you get your pill.

It's not quite there yet, but we're going in that direction and that is pretty exciting. Tony, I mentioned this, we didn't have a quantum day at the summit, not because we don't love quantum, but because there's only a small handful of players. It's still a small space and the TAM is still pretty small, although it's growing and maybe in the future, we'll get there. But what happened last year that was very interesting, or actually even almost going back to pre 2020 because I remember we met in person about this, is the big cloud companies like Azure from Microsoft and AWS have been announcing quantum simulation in the cloud. Honeywell announced a pretty deep partnership with Azure to do this, but classical and quantum are finding this new symbiotic relationship where classical computing will be utilized to be able to help people visualize what the quantum computers are doing and more, and that's why I felt this was the right day to get you involved in to bring the quantum discussion to our audience.

Just talk a little bit about this marriage of classical and quantum, and really why this is so important to people starting to understand the application of quantum like we can understand the application of things that we do in general purpose computing on our devices and mobile.

Tony Uttley: Yeah. I would say not only is that tie between classical and quantum critical, it's not going away anytime soon. I'm going to go back to the example I used before, which is, imagine the quantum computer with 50 cubits. During the computation, it explodes to this 1.1 quadrillion values, but the input to that quantum computer was 50 ones or zeros. The output was 50 ones or zeros. So input, output, not real big. So where is all the rest of that processing happening? It's happening right in the classical computer that has to get tied together with quantum. These are going to be cold processed solutions for a very long time, and that's going to be important. That's why having some of these interactions with cloud providers is critical because a lot of companies already use those cloud platforms for doing a lot of their classical processing, and therefore to tie in very seamlessly so I can have a problem where, maybe that problem has 50 different components to it, but this one could be really efficiently done by a quantum computer.

So, that's sent there while the other 49 are processed by a classical cloud. That is where we are right now and that's where the industry is going to be for a while.

Daniel Newman: It's interesting, it's a really good answer and I'm glad you were able to answer that so succinctly, because I've got an interesting pivot here, but I will say, one of the best analogies in our day four of our Summit Semiconductor Day, but I like the parallel of the GPU and the CPU. A lot of people tend to not realize that you can't run an application on a typical non GPU, but the marriage between the GPU and the CPU is what enables this super powerful processor to do all this trainings. All this AI training that we're doing on GPU's requires the CPU to be able to actually run an application where you can visualize the data that's been trained. So, there is this marriage between the two items. Again, it's not exactly a perfect analogy, but it's a pretty good analogy of how these two types of computing co-exist to derive an outcome that benefits the user itself.

I like that analogy. It's succinct. It's straightforward. We talk to Darius Adamczyk, the CEO of Honeywell. By the way, everyone out there, he will be part of our event on Wednesday. This is Monday, so you're going to hang with us to hear from Darius. But the week of our recording, we're able to push our recordings a little bit because you guys had some really big breaking news and Honeywell Quantum Solutions announced a new joint venture with Cambridge Quantum Computing, CQC. Tony, I believe you were able to get Ilyas Khan, who will be the CEO and will work side by side with you as president of this new joint venture. Are you okay, I'd like to bring Ilyas for the rest of the time talking about that, because I love using our summit as a platform to expand on some breaking news. Ilyas?

Ilyas Khan: Hey guys.

Daniel Newman: What is the chance that you would be available? It is what, 06:30 in the evening there in England?

Ilyas Khan: It's two to the power of 5O chance.

Daniel Newman: Two the power of 50. I love it. We carried it, that one. Let's start out and just let's talk about this new joint venture, 54% Honeywell, 46% CQC. Give me the deal. What happened here? Tony, I'll let you start.

Tony Uttley: Yeah, I'd love to. CQC and Honeywell Quantum Solutions. We've been working together for years. The last three years, we've been collaborating and there's something about getting deep into the science over the entire period of time where you really get to know another party. No company outside of Honeywell itself has used Honeywell quantum computers more than CQC. In fact, the first company ever outside of Honeywell to use one of our even beta versions of a quantum computer was Cambridge Quantum Computing. What we found was, we had some things in common, which is, we had some really brilliant people that when you give them access to these incredibly powerful tools, they can

make incredible things happen. This is something that we've been talking about for a while here, and it allows the two organizations to come together into this new formed company to be really the inflection point of quantum computing. So, hugely exciting.

Daniel Newman: Yeah. Ilyas, this broke hard. It broke fast. I saw it all over the news. One of the bigger stories in quantum, I imagine you must be thrilled, and I have to say, too, I really like how the accountability got split up. I see Honeywell holds a little larger interest, but you maintain the CEO spot. This feels like a good deal for you?

Ilyas Khan: Look, I think it's a fabulous deal. It's a fabulous deal for the sector more than anybody else. I think no one person or organization or company or group of companies is really bigger beneficiary than the impact on the sector, which is really finally for real. So, I'm thrilled and it was a fairly easy process. I first met Tony and came across the Honeywell quantum project, which was still in stealth actually, in February of 2018, up in Broomfield, in Colorado. At that point in time, the world was dominated by three or four players and we very quickly realized that actually the best machine in terms of performance was the human machine. Actually, Honeywell had been investors in CQC. We were a startup. We had raised capital. We had a small number of shareholders. We were bootstrapped from the beginning in Cambridge. Darius Adamczyk called me, the CEO and chairman of Honeywell, at the end of February and he said, "Hey, let's merge our operations," and I said, "Yes, let's do it."

I don't know if this is a world record, but it went pretty smoothly and I'm really thrilled at the coverage. The point you made about coverage, I've never seen anything like it. So, we've been really happy.

Daniel Newman: Well, I think that's part of the benefit of having one of the world's largest industrial tech nouveau, and we'll talk to Darius more about that conglomerates as part of this deal, it definitely drew a lot of attention. I think everyone's going to be watching this deal really closely. Tony, I'm going to swing back in your direction. We worked together. The confidence that was coming out of Broomfield, I want to say Boulder, but we, we had dinner in Boulder when we came out there, but the offices are in Broomfield, quite a stealthy little operation there for a company like Honeywell. I think there was maybe a sign, can't even remember, but why now? It seemed like Honeywell has this tech narrative. It wants to be more known as a tech company. The quantum was obviously one of its most innovative areas that it was like, I think, a lot of people when you said Honeywell is building a quantum computer, people are like, "What? Honeywell?" It was more like, you've got IBM, you've got Google, you've got this company that you'd expect.

Honeywell was less expected, but you were making big moves. You were making big strides. You were having some really big success. What does this mean? What does this say? Does it say this is an all in thing, or does it say that Honeywell got nervous?

Tony Uttley: Not at all. This is absolutely an all-in thing. I think one of the things is, we have been able to do some really incredible work over this time since we've even let people know we're doing quantum computing. One of the things that we did, I'll go back a little bit was, March of 2020, we said within three months we were going to be releasing the world's highest performing quantum computer. Despite a pandemic, three months later, we released the world's highest performing quantum computers. We said we're going to be increasing the capability, what we called the quantum volume, by an order of magnitude every year for the next five years and then just systematically, almost month after month, we let the data become visible to the world that we were doing exactly that. What was happening was we were becoming an entity that the people could trust and said, "Wow, you guys are actually doing in this new industry what you're say you're going to go do." What happened was companies were coming to the Honeywell to ask to invest directly into Honeywell Quantum Solutions.

This is a as financially innovative as we are technically innovative as a company and be able to come together with these two organizations in this new standalone, private, full stack quantum computing company, it really becomes the Genesis of driving the entire industry. Not only is Honeywell excited about this as a big shareholder of this new company, but we have a long-term agreement with Honeywell Aerospace to continue to support manufacturing of our ion traps, which is one of the core pieces of the trap line technology, as you might imagine. Honeywell's going to be a big customer of quantum here. Honeywell is putting in 270 to $300 million of cash right away to be able to ensure that this is supported, and Darius himself, the CEO and chairman of Honeywell is going to be the non-executive chairman of this new company. This is the way you can go create that next inflection of technology for the world. So, this was a pretty cool way to do it.

Daniel Newman: Yeah. And if anybody has any doubt on the intent, I think some of those points you just made clearly show. As I said to myself, I felt at times that HQS got a little lost inside of the bigger Honeywell, not because you weren't doing great things, but just because Honeywell's that big. When you have a company that's doing everything from making PPE to building, management solutions and then has a quantum group, but from a revenue standpoint was still very much in its incubation period. I felt at times you weren't hearing much about it on earnings calls. Now with this new venture, as I see it, you're going to become accountable. What I loved about it, and I'm someone you know, Tony, that talks to markets a lot, as well as to industry, I'm looking at it saying, "This is something that, at some point, you guys could take public. People could invest in. This is something that could become its own opportunity for the market to see what the desire, ambition and opportunity is for quantum investment."

Because like I said, you were just starting to see it. Despite the fact quantum has been around for years, decades, as a topic, we're really only seeing the first opportunities for the public markets to even participate right now. This could be an opportunity. Of course, I won't ask you about that as much as I'd might like to, but Ilyas, I'd like to ask you and I only have a few minutes, but the final

question, the one thing I saw right away, and I talked to a lot of media about this myself was, Honeywell was doing the hardware and was doing a really good job in embracing the ion trapping technology, reducing error rates and Tony beat this into us as analysts every time he'd brief us as to why ion trapping was such a good technology, but ecosystem and the full stack approach are what I saw in this. You got to have software, meaning it's just like AI. I mentioned about the GPU. You can have a GPU, but you got to have a framework. You got to have software, you got to have models. Well, with quantum, it's the same.

You can have a machine, whether it's ion trapping, superconducting, but you need to be able to build software to be able to actually perform any of those use cases Tony talked about. Is this the reason? Is this the big opportunity of bringing the hardware software together, being able to do all that in house, but concurrently, and I'm sorry for the long question, but you guys obviously work with everybody. Is that a good thing? How do you make sure that continues to be valuable to your customer base and to your investor base?

Ilyas Khan: Yeah, I think I see despite the fact that it's fairly long question, that it has a simple, fairly fundamental greatness, which is platform [authenticity]. I think that that is one of the reasons that we are so excited by this. Look, I think the DNA of the firms are very similar. We're very grounded. We do what we say we're going to do. We publish, we don't jump up and down and pretend something might be the case. That DNA that we share with Honeywell Quantum Solutions, and they share with us, I think also allows us to be full of confidence about the two points, which I think are important. Number one, we sit right at the center of the ecosystem. CQC has open access and global access to something called tket, which is a software development toolkit. We made this open access earlier this year.

We have developers all over the world and not just all of the world, but of diverse types. People in large corporations, people in universities, people in startups, other hardware companies, because we make their machines better. That is not going to change. That is absolutely not going to change. The other thing is in these early days of quantum computing and quantum computational tasks being done by a quantum processing unit, there's a lot of overlap between the different platforms. One of our shareholders is IBM. They have a superconducting platform. One of our great partnerships is with OQC a company in England, Oxford Quantum Circuits. We have a fantastic relationship with AQT, which is another iron trap business. All of those are critically important to the one element that matters, which is providing the solution for the client, but the client may be indifferent to the platform. That's not going to change.

Daniel Newman: Absolutely. I think that's a really great answer to a great way to wrap this up. This was such a big announcement and having the chance to have both of you here with me to bring it to our audience, I'm sure they're so appreciative, but like I said, 50 sessions, only one on quantum. Tony, great insights on the overall state of quantum. Couldn't be more appreciative of you running through. For those that knew very little about it, they know more. For those that knew a little

bit more, I'm sure hearing from you guys only deepen their expertise. Both of you, Tony and Ilyas, thank you so much for indulging my line of questioning. This is one of those things where, as an analyst, you really do have to break down a deal like this and say, pros cons, but I see a lot more pros, that's my takeaway, and I see the acceleration of quantum into the mainstream as the big goal, the big ambition, and then of course, proving its investability to those that are looking at it through the lens of the markets.

With that, I got to say thank you. Ilyas, Tony, thanks for joining us today. Thanks for being at the Six Five Summit. You guys were great.

Tony Uttley: Thank you.

Ilyas Khan: Thank you.

Daniel Newman: All right, everyone out there. That's your quantum session for the Six Five summit, but that's not the end by any means. We've got the rest of today and we've got four more days of sessions. Remember, all of these sessions are available on demand. We appreciate you tuning in, checking them out, sharing them with your friends. It's a great week. So many great minds have joined us here. Thank you all for tuning in. We'll see you later.