Daniel Newman: Alan Baratz, CEO, D-Wave. Welcome to this year's Six Five Summit.

Alan Baratz: Thanks Daniel.

Daniel Newman: Yeah.

Alan Baratz: It's a pleasure to be here and to have the opportunity to spend some time speaking with you.

Daniel Newman: Yeah, we were thrilled to have you involved. We knew this year was the year that we needed to get quantum front and center over the last couple of years at the summit. We've had some odd and end conversations about quantum, but as we've seen hyperscalers major OEMs, startups, new IPOs in the quantum space over the last few years and a whole bunch of applications come to the surface. We knew it was the right time to really get the leaders, the companies that have been at it, the companies that are joining the fray to come along and talk to us. So, D-Wave a company that has been at it for some time and been doing a lot in this space. It was really exciting to get you here. And, I want, I'm going to start with a bigger question for you, but before I do that, only because, quantum companies still aren't necessarily household names to people unless they happen to be a very small business unit within a mega tech company, give me just the quick elevator and introduce D-Wave.

Alan Baratz: Sure. Happy to do it. And by the way, I'm really pleased to see that you all are now fully embracing quantum. So D-Wave actually began about 15 years ago. We were the first company in the world to pursue the development and delivery of a quantum computer. And in fact, we have just recently, about a year ago, delivered our fifth generation quantum computer over 5,000 qubits, the most powerful quantum computer in the world. It's accessible through our quantum cloud service called Leap. And we provide a complete set of open source software development tools for building applications to run on our cloud service. And finally, D-Wave is the first and actually only commercial quantum commercial computing company. We have over two dozen global 2000 customers, working on real business applications to benefit their business operations.

Daniel Newman: Well, first of all, congratulations. Second of all, I bet you there's some people out there that are like, wow, 15 years. It was kind of like when I talked to, I still remember talking to an executive and I didn't ask permission, so I won't name his name, but when I found out he'd gotten a PhD in AI in the 1980s, and I just remember thinking to myself, what, like that it, that people were studying this and movies like 2001 in a space. I mean, this stuff seemed so far out there. Although, whether it's that movie or 1984, the world is definitely coming for us, it feels like, isn't it? Let's start with the macro, you mentioned you've got commercial customers, you have business, you've been at this for a while, but quantum still seems newer to a lot of people. It still seems like an emerging technology. What is that current state as you describe it and kind of how is it delivering value to these customers you mentioned.

Alan Baratz: Yeah, so first of all, the market opportunity for quantum is huge. For example, Boston Consulting Group puts it at two to five billion in the near term growing to 450 to 850 billion in roughly the 20 year timeframe. Moreover, the market is ready for quantum. 452 Research a couple of years ago, did a survey. They surveyed about 1000 Fortune 5,000 companies. They found that almost 40% of them had quantum use cases that they were working on at that point in time a couple of years ago. And Iperion just did a similar survey and they found that it's now over 60% of the companies surveyed that have quantum use cases that they are working on. So the market is huge. The market is real, today. Now, in order to kind of get your arms around the extent to which there are actually customers out there benefiting from quantum, we need to spend a minute talking about the approaches to quantum because there are two primary approaches to quantum computing.

There's what's called annealing, quantum computing and what's called gate model quantum computing. At D-Wave we started with annealing and we did that because frankly, annealing is an easier technology to work with. It's easier to scale. It's less sensitive to errors and it's really good at solving optimization problems. Things like employee scheduling or autonomous vehicle routing or packing containers onto ships or rail cars. Frankly, most of the important hard problems that businesses need to solve, annealing is very good at solving. And by selecting annealing, we have been able to iterate over the course of the last, roughly 10 years to get to the point where we have quantum computers that today are commercial and solving that class of problems. Now,

Daniel Newman: No, I want, I want to stop you real quick. Can I, cause I think I want to interject. This is a little from a technical standpoint, I always say, well, there's certain things that people don't really understand, quantum is one of those things. How do you quickly give kind of a, demark between the gate and annealing because you know, I love to kind of hear how you explain that, cause I'm sure that's a question you get in many presentations.

Alan Baratz: Yep. So first of all, only D-Wave chose to pursue annealing. And so we're the only company in the world that has this technology. And, and as a result, frankly, the only company in the world that's able to be commercial today. The difference between the two is that annealing quantum computers inherently solve only one problem. That problem is finding the lowest point in a multidimensional landscape. But what's interesting about that is that many problems, in fact, all optimization problems, the problems that I mentioned previously can be recast as that type of problem. And that's why annealing quantum computers are so good at solving that class of problem. They're just native optimization engines. Gate model systems, you have to program them with the algorithm required to solve a particular problem. So you know they're programmed more like traditional classical computers.

However, what we have recently learned, new news just within the last eight months or so, is that while annealing quantum computers are native optimization engines and really good at solving optimization problems, gate model systems are not good at solving optimization problems. It's unlikely they will ever be able to deliver a speed up on that class of problems.

What that means is that we now have a bifurcation in the market. Certain applications require annealing and other applications require gate model. And so annealing will always be critically important for the class of applications that it's good at. And gate model will be important for the class of applications that it's good at.

Daniel Newman: Yeah. That was a great explanation. I think people appreciate that because I think for the very reason you mentioned that you were sort of the lone pursuant. Now I know there's a little off course, but I just got to ask you sometimes when you go alone, you go alone, because you're on your way to the top. And sometimes when you go alone, people will say you went alone, because you picked the wrong path. I get the optimization thing, but why haven't others followed suit just for the pure reason of being able to commercialize faster.

Alan Baratz: Yeah, exactly. So good, excellent question. It has to do with history. So when we started in the quantum space 10 years ago, nobody really believed you could build a gate model system, but it was believed that you could build an annealing system. So since we were the only ones trying to build a quantum computer back then we selected annealing because there was a pretty good sense that you could build such a beast. And we went ahead and did it about five years ago when everybody else decided to get into the quantum space. So we're, we are the leaders, they're the laggards, when everybody else decided to get into the quantum space, it was believed at that point that you could build a gate model system, the science and the engineering had evolved to the point where it was believed that you could.

And at that point it was also believed that a gate model system could solve any quantum problem. So at that point we knew annealing was good at certain classes of problems like optimization, but could not solve all quantum problems. Five years ago, it was believed that gate model could solve all quantum problems. So everybody that jumped in five years ago said, well, we might as well build gate because it can do everything. If we do annealing., it can just do some problems like optimization. What we learned middle of last year, and this was a big, important result, very important for D-Wave, was that gate model cannot solve all quantum problems. They cannot deliver speed ups on optimization problems. And so now we see that bifurcation in the market. And so it's kind of like everybody else kind of missed the boat a little bit.

Daniel Newman: So when you talk optimization, give me an example, let's get, let's get practical here. What are, what are some of the problems that you're able to solve right now that goes by the way that have fully committed to the gate model are going to either have to be rethinking or somehow pairing more significantly with classical computing, right? I mean, that's going to be the two routes.

Alan Baratz: Yeah. So look, don't get me wrong. There are very important classes of problems that gate model systems can solve that annealing cannot. For example, quantum chemistry or computational fluid dynamics. Those are more the domain of gate model systems, but for annealing and optimization things like employee scheduling. So we had a retail company that came to us in the height of the pandemic and they found that the additional constraints and requirements being placed on them by the pandemic, really complicated the scheduling of their employees. And what they found was that it was taking them up to 25 hours per location, per week, to schedule their employees. Using our quantum computer, they're now able to schedule their employees in less than two minutes, per location, per week. So a very significant improvement. Let me give you another example: portfolio optimization. A bank in Europe working with a partner of ours called Multiverse, wanted to determine the optimal portfolio subject to a given risk profile.

So for a given risk profile, what's the maximum return you can get on a portfolio. They had several different portfolios, small to large, and they were using several different systems to compute the solution. What they found was that on the largest portfolio, only two systems could compute the solution. Tensor networks from Google, which is classical, and it took up to 32 hours to compute the solution. Our quantum computer took less than three minutes to compute the solution. So are just two examples of important real world problems where the quantum system is delivering business value today. And there are many other examples.

Daniel Newman: That's great. And I'm sure there's a lot of people, at least, at the time of filming that wish they had a three minute portfolio optimization tool. Based upon what's been going on in the, in the markets the last couple of months.

Alan Baratz: But it's interesting.

Daniel Newman: It's a, it's a very pragmatic thing though that I think people can relate to because that is one of the big deltas. And that is also by the way, one of the reasons that I think classical and quantum are going to end up being symbiotic in many ways is that there are certain problems that one is great at doing and there's certain problems the other is great at doing. And that in very few cases, are they both, competing to be great at something, but in more cases it's A plus B equals C or even one plus one equals three.

Alan Baratz: Yeah, that's exactly right. In fact, even today we do use hybrid quantum classical computing. So our, our Leap quantum cloud service provides not only direct access to our quantum system, but also access to hybrid solvers that are combining classical with quantum. And so, depending on the specific application, you'll either run natively quantum or through one of the hybrid solvers.

Daniel Newman: Yeah, that's great. That's exactly the kind of example I'm hoping that people are paying attention to. It's classical, and quantum, and together they're doing things faster and very meaningful things that are going to be practical and addressable by everybody in the market at some time in the near future things like drug

Alan Baratz: Well and in, and in many cases right now, today,

Daniel Newman: That's what I mean right now and in the near future. But I'm saying like things like the ability to, more rapidly discovered drug compounds, if anything we learned in the, during the COVID era was, we have a need to be able to speed up and expedite the process of identifying medications that could solve new and complex diseases that we aren't even aware exist right now. And of course,

Alan Baratz: One of our customers has used our system to develop new peptides that are being used today in clinical trials for COVID therapeutics. So you're absolutely right.

Daniel Newman: I like that. Say that again? No, I'm just kidding. I got it. All right, well, let's wrap up here. What I'd love to kind of talk about is you've talked about where we're at now. We've talked a little bit about where things are heading, but you as one of the earliest and one of the first, if not the first to commercialize quantum, talk about what you expect the next few years to look like in this space.

Alan Baratz: Yeah. So, so yes, THE first to commercialize quantum. So first of all, there are two classes of applications. There's what I call evolutionary applications and what I'll call revolutionary applications.

Evolutionary applications are the kind of applications that I've been talking about up until now, employee scheduling, peptide design, portfolio optimization, autonomous vehicle routing. These are applications that companies are actually solving today without quantum, but they are so hard to solve that they're using heuristics to try to come up with good enough solutions. But with quantum, we can now give them optimal or better solutions, which allows their business to operate better. Those are the evolutionary applications.

Then there are the revolutionary applications. These are applications that we can't even start to tackle until we have quantum. And some of these would include things like designer drugs. So you mentioned drugs, designer drugs, where I'm designing a drug specifically for you and your collection of ailments or issues. Or global weather modeling to be able to do much more accurate disaster prediction. Or new materials design, for example, long lasting or forever lasting batteries. I mean, wouldn't it be great if you never had to charge your cell phone again? So, these are the applications that are revolutionary that are, we can't even work on today, but will be made possible by quantum.

Daniel Newman: Yeah, it's really exciting. It's going to be a really interesting few years and interesting or exciting might be the best word, but it's definitely going to be a big next decade for quantum computing and, for people that have kind of watched on the sidelines and said, ah, I don't know, or, I've actually heard pundits talk about how investable it is or isn't. I do think that a lot of times, sometimes at that kind of peak of where people start to think something won't happen is exactly when it will. We have a very interesting habit, Alan in society that when things are good, we think they can never get worse. And when things are bad, we think they can never get better. And we tend to always get that wrong. Perhaps there's a quantum algorithm or some sort of quantum application we can build to solve that as a society.

But there's a fascinating discussion. I'm always really interested in hearing where it's going. And of course from someone like you, that's been in this space really for a long time, making real meaningful impacts to what's going to happen in quantum. So Alan Baratz, thank you so much for joining me today at the Six Five Summit.

Alan Baratz: Thanks Daniel. It was a pleasure.