Market Hunt - Season 2 episode 9 - 1Qbit - Andrew Fursman

[Begin intro music]

Thierry Harris: Imagine a world with computers so powerful they could process problems which would take today's computers thousands of years to compute and reduce that time seconds. Quantum computing offers this possibility.–In this episode of Market Hunt we'll discuss the ideas, technology, and market opportunities behind Quantum computing.

Andrew Fursman: For anybody who's really on the sidelines looking into what's happening in hardware in quantum computing, it's a very exciting time because everything is in flux and all of these technologies are rapidly developing. It really does look a little bit like a horse race where you're trying to understand who is out in front, and do they have the ability to stay in front?

Thierry Harris: On this episode of Market Hunt, we chat with Andrew Fursman, Co-Founder and CEO of 1Qbit. Stay Tuned

[end intro music]

[begin theme song music]

Nick Quain: Entrepreneurship is hard, you need to have support there.
Andrew Casey: We fundamentally have to learn how to live our lives differently. We can't keep going the way we have.
Handol Kim: It's not like Google can come and move in and take the entire market. Not yet, right?
Thierry Harris: It's a real balancing act which requires a bit of insanity frankly. But I mean some people are into that stuff I guess.
Handol Kim: You know the size of the market, that's really all you've got.
Thierry Harris: We're coming up with some pretty interesting ideas here.
Andrew Casey: We've solved everything,
Thierry Harris: [chuckles] We've solved it all.
[End theme song music]

[Music transition]

[Begin promo music]

Narration: *And now a message from our sponsor, IE-KnowledgeHub. IE-KnowledgeHub is a website dedicated to promoting learning and exchanges on international entrepreneurship. Watch Video Case Studies, listen to podcasts and much more! If you are an education professional looking for course content, an academic researcher seeking research material , or someone interested in business innovation check out Ie-KnowledgeHub. Ie-KnowledgeHub focuses on innovation ecosystems and firms who commercialize their technologies in international markets. Let's listen in to a Video Case Study featuring Prevtec Microbia.*

Eric Nadeau: *Everything started with a need. The veterinarians called at the reference laboratory for E. coli., different veterinarians, we have a problem, post weaning diarrhea that is more severe than in the past, and the antibiotics don't work anymore. And we need a solution for this.*

Narration: *That's Eric Nadeau of Prevtec Microbia. Prevtec develops vaccines to address E. coli outbreaks in swine. Nadeau started as a fundamental scientific researcher at the university of Montreal's epidemiology department in the faculty of veterinary medicine. He understood the importance of overuse of antibiotics in treating animals. But the decision to use a live bacterial vaccine vs antibiotics isn't an easy one.*

Eric Nadeau: *When a producer faces a disease, he will look at different products or strategies. And we are calculating everything at the level of cents, not dollars.*

Narration: *To reach farmers, Nadeau had to understand their decision making process. The farmers were making decisions on costs down to the nearest penny. Prevtec's vaccine was more expensive than antibiotic solutions currently available. He needed to find a way to* *contrast the vaccine Prevtec had developed with these antibiotics. This was no easy task. He knew he had to be patient.*

Eric Nadeau: *You took the decision, let's go on antibiotics, but i'm pretty sure in six months you will call me because the antibiotics will not work anymore, you will go on the vaccine, and you will have the insurance that the problem is solved, you can sleep on it and work on other problems you have.*

Narration: *How did Prevtec, a small company born out of a spinoff of a research project at the University of Montreal's veterinary school build itself into a full blown company? Find out more at the end of the show. You can also checkout the Prevtec Microbia video case study by visiting ie hyphen knowledgehub.ca. And now, back to the show.*

[End promo music]

[Music transition]

Thierry Harris: When comparing classical and quantum computers a good metaphor could be of use. Dr. Shohini Ghose, Wilfred Laurier university physicist wants us to think of classical and quantum computers the way we think of a candle and a light bulb, she says quote: " The lightbulb isn't just a better candle, it's something completely different."

Quantum computing today is at the state where classical computers were when they were first being built decades ago. It's an exciting time. The industry is being pulled by the promise of quantum enabled technologies which will dramatically impact the fields of drug discovery, cryptography, telecommunications, material sciences and financial modelling to name but a few.

Deal making among quantum computing companies is at an all-time high. Capital invested in global companies focused on quantum computing and technology has reached $2.5 billion so far this year, according to financial data firm PitchBook. That's up from $1.5 billion in all of 2020. It's been predicted that the quantum tech ecosystem consisting of Software & consulting companies, Hardware manufacturers and quantum enabling technology companies could be worth 18 billion by 2024.

In terms of patents for quantum hardware, companies like IBM and Canada's D-Wave lead the pack. On the quantum computing software side, IBM, Microsoft and Google are out in front. Looking at overall, China dominates the U.S by a score of 2 to 1 with more than 3000 patents in the Quantum technology field.

On this episode of Market Hunt, we speak with Andrew Fursman, Co-Founder and CEO of 1Qbit. This episode is full of concepts relating to quantum mechanics which might require a bit more research to comprehend. Feel free to explore the episode transcript for links to further reading on topics discussed in this podcast. Andrew starts us off by describing the *raison d'être* of 1Qbit. Are you ready? Let's go.

[music interlude]

Andrew Fursman: 1QBit is really a company that was founded in order to answer the question of why do we need more powerful computers, and what will these more powerful computers look like, and how will we actually employ them to do meaningful work? Of course, we're extremely excited about the advances within Quantum computation and we see our long-term goal. What I would think of as success would be a future world in which a significant portion of the workload of high-performance computing is being performed on the back end by Quantum computing devices and processors that do not look like what we're using today, being able to actually draw that through-line from hard industrial problems to new types of computation. If 1QBit was the facilitator that was really enabling that work to happen, I think I would consider our work here a success.

[music interlude]

Thierry Harris: In a very mercantile sense, you're almost like a broker for picking the best Quantum solutions to solve some of the industry's toughest problems. Can you describe perhaps what problems you are attacking at 1QBit? What links you're having with the industry?

Andrew Fursman: Yes, thank you. I would say that 1QBit is very interested in performing that intermediary role, but actually we also really think about being in the middle between those new types of devices. These very hard problems also really helps us to be able to craft those solutions on the software side, but also to give insights to the architectures of these forthcoming devices in order to be able to say, for example, if your device doesn't have the ability to improve this problem then our partner at this company is not interested in this processor. We like to think that by being in the middle, we actually have the ability to shape both the applications and the hardware. We spread ourselves out from that middle position.

A very concrete example is the work that we believe will be changed around how new materials and advanced material discovery and design progresses. Most people know that Quantum computing as an idea actually dates back as early as the 1980s where famously Richard Feynman suggested that if you're going to try and do computation to understand how the physical world works, if the physical world is based on Quantum information processing then we should probably build Quantum information processors in order to simulate the real world.

Essentially saying let's cut out the middleman and instead of having to try and translate the behavior that we see in the real world into a form that's amenable to the types of computers that we've already built. Instead, we should build new types of computers that compute using the same principles that really animate the universe. Although that sounds pretty heady, you can actually take a very clear example and just say one of 1QBit's best partners and customers is the materials company, Dow.

Dow has a lot of people that it employs to work in laboratories now alongside robots and other advanced devices but really, they're doing the same work that you would have been familiar with if you were a chemist from the 1800s or the 1900s essentially answering the question of what happens if I pour this vial into that beaker. The reason that this is an interesting paradigm is because if you think about almost any other area of human endeavor, we've moved away from trying it out in the real world as a first step, and we typically will do some simulation in a simulated computer world.

An example I love to use is just thinking about building an airplane. We don't do the Wright Brothers thing anymore of building a model, throwing it off a cliff, and hoping that it flies. Instead, we have all of these advanced simulated environments where we can build a simulated plane in a simulated world that all exists in a computer, and to be able to have a great intuition and very good guidance around how to build that plane in order to make sure that it gets the best qualities of lift and flight.

[music transition]

Andrew Fursman: We don't really do that in the materials space right now because the ability for us to create simulated environments for the emergence of say, chemistry from physics is just significantly lower fidelity currently than what's necessary in order to design new materials instead of discovering them. By taking that process and really moving into an ability to simulate the Quantum world, and to simulate the emergence of chemistry from physics inside this simulated environment, we can really progress advanced materials to the same paradigm that almost every other industry has followed. That's one of the things that we see as an early win for Quantum computing.

[music transition]

Thierry Harris: You've said that Quantum computing is the first real revolution in computing. Why is this?

[music transition]

Andrew Fursman: The reason that I say that Quantum computing is the first real computing revolution is because of course, you could say that the first computing revolution was going from no computers to computers.

That's absolutely an incredible advance for humanity and the capabilities of our calculating abilities, but every advancement in computing that has really come from the first electromechanical devices through to vacuum tubes and transistors and integrated circuits, all of those different paradigms are better, faster, cheaper, more reliable versions of the same paradigm of computing. Quantum computing is not just an evolution of that same paradigm. It's really about computing with new fundamental units of computation and those fundamental units are essentially, using quantum information instead of classical information to compute.

That just gives you a very rich and diversified set of problems that are amenable to quantum computation. In our view, it's not as though quantum computers are going to disrupt all of the things that we do with classical computers, instead, we think of quantum computers as augmenting what's possible to compute in addition to all the classical computing that we have right now. The reason that we think of it as a bit of revolution is it's almost like a completely new type of computing tool that will be bolted on to our existing computing capabilities in order to make it so that humanity has more computing capabilities, or can compute different types of problems which are forever beyond the reach of our current types of computer.

[music transition]

Thierry Harris: I can see the acrobatics in what 1QBit is doing in essence because you have such a proximity to the hardware manufacturers of these quantum computers, but you're also doing the translation of what those potential computers can be doing and attempting to create software in order to solve real industry problems that are out there. Explain then the quantum hardware ecosystem as it stands right now.

Let's say, for example, if we're watching a horse race at Belmont, you've got Lucky Strike, you've got Duff Beer, you've got Carlsberg, you've got maybe Kokanee as well. I'm giving a lot of beer analogies. I don't know why, it is early, but I'm just saying that there's different technologies that are there in terms of different types of quantum computing technologies for these computers. Maybe you can give us a bit of a brief overview of what the ecosystem on the hardware side looks like, and then I'm going to ask you right after what the software side looks like.

[music transition]

Andrew Fursman: That's great. I think, what's really important to understand about quantum computers is that we're at an early stage where you could almost think about it as a bunch of organizations are all pursuing different ways to try and build these quantum computing devices. It would be like if we were back in the early days of computers and somebody was trying to build a vacuum tube, and someone else was trying to build a transistor, and someone else was trying to build an integrated circuit.

The conversations that you would have in a world like that would be well, it's probably easier to build a vacuum tube and to get that up and going but vacuum tubes are so large and are they scalable? Maybe, a transistor is a better path to go but transistors are so much more complicated to build. Even getting to one transistor is hard but once you have one transistor it's much more scalable.

These are exactly the kinds of conversations that are happening right now in the mainstream universal circuit model, quantum computing world where we have some people who are trying to essentially takes things that are already computers and make them quantum. You have other groups that are trying to take things that are already quantum and make them into computers.

Even within those two fundamentally different approaches there are all kinds of different devices. For example, if you're trying to take something that's already a very quantum, mechanical entity and turn it into a computer, you might want to start with a photon. There are a number of organizations that are trying to build photonic quantum computers where the actual fundamental unit of computing is a photon but very similarly, there are other groups that are using things called trapped ion systems where the fundamental unit of computing is the quantum information that exists in an ion that is trapped in a magnetic field.

We don't really know at this point which of those approaches will be more scalable, or which one is likely to have longevity but we do know that there is incredibly diverse efforts occurring right now to pursue both of those paths individually. At the moment, it looks like the ion path forward has been more fruitful in the short term. We're seeing some really exciting developments around organizations that are building quantum computers that gives these trapped ions as the fundamental method.

At the same time, we have groups, large companies like IBM and Google and Microsoft are thinking about trying to take what we already know about building semiconductor computers and trying to turn them into super conductors that are capable of doing the same quantum computer calculations. All of this is happening simultaneously and as you talk about the horse race, there really is the exact same psychology that goes into analyzing this industry where just because your horse is in the lead currently, doesn't mean it has the stamina to make it all the way to the finish line.

There is a who's-out-in-front-first mentality but there's also wariness of the tortoise and the hare. Just because for example, you might be further behind in terms of the number of quantum bits of information that you can put into your device, doesn't necessarily mean that your device is a worse device. It might just mean that it's harder to get the first couple of bits going but it's very scalable. For anybody who's really on the sidelines looking into what's happening in hardware in quantum computing, it's a very exciting time because everything is in flux. All of these technologies are rapidly developing. It really does look a little bit like a horse race where you're trying to understand who is out in front, and do they have the ability to stay in front.

What's really exciting is because all of these devices are in some sense, interchangeable in the same way that you can do the same kind of addition on a vacuum tube as you can do with the transistor. Essentially, you would hope that the same problems that you could run on an ion trap computer wouldn't be able to be run on a photonic computer.

From the perspective of an organization that is trying to build applications for quantum computers, as opposed to trying to pick a horse, instead, you can just cheer on the race because any progress is exciting from the perspective of actually taking these technologies and making them available to industry.

[Music transition]

Thierry Harris: Really fascinating stuff, very exciting. Maybe there will be a show just to describe this horse race as it goes along at some point for folks who are interested out there because it's tremendously fascinating, and will have a huge impact. Let's talk about the software portion right now, and explain a little bit about what companies such as yours are doing with, as you said, the different kinds of horses that you're picking with the photons, and then with the ions.

What your challenge is in producing that software and then marrying it to the industry and the industrial problems that are out there in the world that you're attempting to solve?

[music transition]

Andrew Fursman: In exactly the same way, I find it very helpful to use some analogies to classical computing because people are a little bit more familiar with that paradigm. Many of the mysteries of quantum computing are actually unhelpful in terms of understanding the value of these quantum devices. I think it's really helpful to demystify the actual computers themselves and to really think about the fact that much like a classical computer way back in the day, if somebody brought you a very fundamental early-stage computing prototype, you would say, "Oh, great. You've made a device that it's capable of adding in binary, that'll be so helpful for all the binary addition that I do as a banker, or as a lawyer."

All of the people who use computers every day now are clearly not interested in the fundamental capabilities of those devices, instead, they want to use Microsoft Word, or they want to be able to play Minesweeper. That idea of being able to understand the native capabilities of a computer in the classical world, that would be something like adding in binary, and having the vision to be able to say, "Wow, if you can add in binary, you could actually make a word processor." It's a pretty big leap, but that leap happens outside of the hardware, that's really the realm of software. Understanding what are the raw capabilities of these quantum computing devices?

How can I actually connect that to an open need that industry has, essentially, where computers today are not capable of solving very complicated problems? Is there some overlap there? Is there something that quantum computers can do that classical computers are not very good at? Because, if you can do something with the classical computer, and a quantum computer, it's probably better to use a classical computer. They're more advanced, there's better ability to understand. We have many years of hardware development. We try and answer two questions. One, what can you do with a quantum computer? That's really where we started. Now we're moving I think, into a much more interesting question, which is, what should you do with a quantum computer? I'm sure that's probably an area we should dig into.

[music transition]

Thierry Harris: You also said something very interesting about the potential of quantum computing in the sense that what it does is that it allows us to focus more on what questions we should be asking as humans, which is something that we do very well with our curious minds, and our storytelling capabilities, as opposed to trying to solve those problems once we put these fundamental questions out there or very quirky questions. It doesn't have to be very serious all the time, and let the computer do what the computer does best, which is compute and then solve the problem to provide us an answer that could be of usefulness for us, really thinking of the computer as a tool.

Maybe you can elaborate a little bit on that thought, Andrew for us because I think it'll help us, again contextualize why quantum computing is something important to be working on right now.

[music transition]

Andrew Fursman: Absolutely. One of the things that's most interesting to understand about where we sit as a species in terms of producing new knowledge, especially in certain areas, like advanced materials and drug discovery, we talk today about drug discovery, material discovery. It's not too far from the truth, that the way that you find a new drug today is you go into a region of the Amazon, start licking a bunch of trees, and the ones that make you feel funny, you say, "Hey, there might be something here," and you go and explore why this thing did what it did. That's an interesting paradigm.

Of course, we're getting much more sophisticated in our understanding of the types of effects that we would like to see. You can imagine, it's pretty laborsome, laborious to have to go out into the world and just start trying everything in order to see what it does. That paradigm of discovery can be flipped into a paradigm of design. If you have the ability to say, "I can create in a virtual environment, a new material that's never actually been created in the real world. By analyzing it in this virtual world, I have the ability to understand what it would be like if I were able to produce it."

That allows me to be able to produce a whole bunch of virtual materials, analyze their properties, and select the ones that are most useful for certain applications." You're really starting by saying, "I would like a material that looks like this." Then you can go and design that material in your virtual world. Once you're convinced that you've designed something that will achieve it, then the problem becomes, "How do I produce this material that I know I want?" Instead of, "I've produced this material but I need to figure out what it's for."

I think that if you can imagine the ability to search massive amounts of potential materials without having to actually build them first, will really expand our ability to produce novel, bespoke materials that are helpful for particular engineering challenges. We think that this will start by producing really basic things like catalysts, very small pieces of matter that speed up or slow down different reactions. It will expand from these very small pieces all the way through to more advanced materials, differentiated polymers, and eventually, we think into the interactions of the human body and the material world in a way that is really what drugs are. Being able to change into a mode of saying, "I have this particular challenge occurring in my body. What do I need to produce in order to influence my body to change its behavior?"

These are deep questions that are not going to be answered overnight. The journey of the next 100 years of quantum computing is really going to be about having the tools for the first time to have a real shot at solving these problems in a very succinct and detailed way. I think that quantum computers are going to make their first mark on the world by really transforming the physical world, allowing us to build materials, for example, that are much stronger and lighter than the ones that exist today, or that have particular characteristics that exactly suit the needs of some of the most challenging applications, where our current limitation is being able to actually produce the materials that give the desired effect that we want.

We often know what we would like, we just don't know how to actually produce those things. That's one of the big changes that I think we'll see coming from quantum computing.

[music transition]

Thierry Harris: You're describing this with regards to materials, but it can also, as you said, be materials for drug discovery. You've talked a lot in the past about the financial world, a little bit earlier in this podcast as well, in terms of some of the problems that they have in terms of predicting markets, and high finance, risk assessment, and analysis. And very interesting when you were talking about physics and finance going together.

It's quite beautiful and eloquent to see the math there, behind that. Again, great stuff we're looking now at what 1QBit is within that realm. You've said that 1QBit acts as a bridge between the technology at the fundamental level, the new hardware that's being produced, and the real-world applications. Outside of Dow, can you give us a few more industries or sectors that you're interfacing with and what kinds of problems that they've been presenting you, just so we can, as students studying the business portion of this understand the potential of your market?

[music transition]

Andrew Fursman: Yes, I really like exactly the setup that you just gave. I think that the analogy of computational finance, the traditional method of computational finance is a great allegory for how we could see the development of quantum computing. That is to say, many of the initial uses of traditional computers within the finance world came from repurposing algorithms that were designed in order to simulate the physical world. For example, a lot of the work that was done in options pricing, which is a computationally expensive, or a challenging form of calculation that's helpful to know how much you should pay for a particular financial instrument, is really all about repurposing algorithms that were initially designed in order to correct the trajectory of rockets.

In the same way that you could say, back in the day, computers were used to simulate the physical world in order to help to guide rockets. Then, that form of mathematics was repurposed into the financial market in order to provide capabilities that seemed very far from the initial area of exploration, but that opened up entire new areas for computation and new areas of human understanding. We think that some of the algorithms that are first developed in order to do the simulation of the physical world through a quantum information lens can then be repurposed into different areas in order to provide real value outside of physically simulating the physical world.

A great example would be, we believe that some of the fundamental calculations that are helpful to simulate the physical world can also be used to animate new forms of machine learning. In some cases, old forms of machine learning where the bottleneck to wider adoption was just that the computational capabilities of classical computers didn't mate nicely with the problems that were necessary to solve in order to harness these forms of machine learning.

If we can take some of the interesting sampling capabilities of quantum processors that are developed in order to do material discovery and repurpose that into a more abstract information processing to animate forms of machine learning, you could imagine similar algorithms being deployed in order to produce much more robust artificial intelligences, for example. That's the exciting work that really, you can only make those connections if you have both a great understanding of, say, the materials industry, and a very detailed understanding of the quantum devices that are going to be applied to solving those problems.

Then comes the third step of being able to take those technologies and apply them to an adjacent field. 1QBit has actually developed as a very inter-disciplinary, multi-disciplinary collaborative approach where we try and bring together researchers from very different fields in order to understand where those real points might be, and to really help produce innovation at those edges that are between different spaces. That's been an exciting part of the 1QBit journey.

Thierry Harris : I asked Andrew to unpack how we got from the idea to quantum computers in the 1980s to where we are today, and what 1Qbit’s relationship was with one of their quantum hardware suppliers, D-wave.

Andrew Fursman: Quantum computers, as an idea, have been around since the 1980s in the same way that you can say time machines have been around since the 1800s in that people have thought about them. It's only really right this moment that we're starting to see the first realizations of that idea come to fruition. The first devices that could really be called quantum computers in the way that people imagined that quantum computers might evolve.

This moment is really the fulfillment of a journey that started in the 1980s, saying, "I think you could probably build a machine that looks like, for example, an IonQ, iron trap device." Now, we're just starting to see those things emerge. When I was speaking earlier about the different types of quantum computers, I intentionally really spoke about what people usually mean when they talk about a quantum computer, which is a universal circuit model quantum device. But you can also do many different types of calculations utilizing these same types of quantum information processing fundamentals.

For example, in traditional computing, there are digital computers, which are the types of computers that most of us are familiar with, but there are also analog computers, computers that really operate less in the binary, 011 realm, but instead operate on a continuous spectrum. These are much less common, but the history of traditional computing is one of both analog and digital computers. We have the same distinction within quantum computers. An organization like D-Wave made a decision early on to try and say, "Maybe universal circuit model quantum computers will emerge in the distant future, but D-Wave really has its roots all the way back to 1999."

They made a very conscious choice to say, "Let's try and see if there's something that you can do with quantum information processing, which isn't as challenging as building a universal quantum computer, but which can still solve very specific problems. You could think of it as an application-specific quantum information processor. That concept shouldn't be too foreign to your listeners because, for example, the rise of machine-learning has been heavily advanced by GPUs or graphic processing units, which are themselves application-specific computing components.

The D-Wave machine, the D-Wave quantum annealer is an analog quantum computer that is specifically designed in order to answer what are called quadratic unconstrained binary optimizations, but which really just mean answering an optimization problem. They're not able to perform things like Shor's algorithm that might be used in the future to break encryption. It's not particularly useful for doing the chemistry applications that we were talking about previously, although there are some simulation capabilities of these machines.

In general, it's about saying, "What's the low-hanging fruit and how do I try and take a shortcut to a useful device by making a specific thing for a specific purpose, instead of trying to build a device that does all of the rich capabilities that we anticipate for future quantum computing devices?" There's actually an entire subset of the quantum computing market that is all across the spectrum that goes from-- For example, one of our partners, Fujitsu, has built an application-specific integrated circuit, which simulates the annealing process, so we call it a digital annealer. This is the most classical exploration of the capabilities of near-term quantum computing devices.

The D-Wave machine is again one of these analog machines, but there is other work that is being done that has the capability to do some of that analog computing, including our partners at NTT has some very exciting devices which utilize exotic forms of computation in order to answer these same problems. Even ion trap computers are capable of doing analog computation.

I think the journey from no quantum computers through to universal fault-tolerant error-correcting quantum computers is one that we don't know exactly what that path might look like, but some organizations have said, "Let's try and take a minimum viable product approach as opposed to going for a waterfall approach of, step one, build a big quantum computer." Instead saying, "How couldn't we build a specific quantum calculator?"

Even aside from the types of distinctions that I drew at the beginning, where we were talking about the difference between, photons, ions, and superconducting machines, there are different types of devices that you can make with those different components. The D-Wave machine is one exploration of a specific type of machine. Of course, D-Wave is a company who could build or which could build many different types of devices. The current D-Wave processors have really been looking at this niche and specific idea of optimization and a few other adjacent fields as a toe-hold into this wider world of quantum computing.

What's nice is with such a diversity of approaches and the diversity of fundamental units of computing, we really have a whole bunch of different ways of trying to build these initial devices that make it so that's there's this plurality of approaches that's really exciting for someone who is trying to harness these new capabilities because each of these different machines have different strengths and weaknesses and time horizons. As somebody thinking about applications, we really cheer on that diversity.

[music transition]

Thierry Harris: I asked Andrew to clarify the idea of using quantum computing to that of using a utility.

Andrew Fursman: Yes. I think about the distinction of a computing utility versus a computing product as something that we're all actually intimately familiar with now. If you use almost any application on your computer today, you're not just using your local computer; you're using the computing of the cloud. For example, I actually have very little understanding of what types of computation happen on the backend of making a request to something like Google Maps. You just want to know, "How do I get from here to there?" You're able to clearly articulate the problem. You say, "I am currently in this location. I would like to get to that location. Please give me the steps that I need to take in order to go there."

You send that off to the cloud. They do some processing on the backend. It might be done with CPUs or GPUs or FPGAs or in the future quantum computers. The important thing is I don't really care as a consumer. I just want to make sure that I'm getting the best directions, and that I'm able to get from here to there with the least number of turns, spending the least gas, et cetera. That's how I think that quantum computing is actually going to be most widely deployed into people's lives. It's in a way where it's almost invisible. Meaning, the applications, if we do things well, you're not going to be excited about utilizing a quantum computer because it's a quantum computer.

You're just going to be excited that you get better directions from Google Maps, for example. That's a purely hypothetical example, but I think it illustrates the difference between buying a computing device versus just getting the utility that comes from that knowledge. The way that we imagine interacting with quantum computers in the medium term is actually exactly the same way that 1QBit interacts with computers today, which is if we're interested in solving a chemistry problem, then we engage with a cloud-hosted quantum computer. We take the industrial framing of the problem and convert it into a form that the quantum computer is able to understand.

We then pass that information to the quantum computer, which solves the problem in its native form. We then take that solution and interpret it back into the language of the industrial problem. Ultimately, the industrial user just gets a solution to the problem that they're looking at, whether it's something like, "How should I build this material?" or "What are the properties of this material?" or "What should I trade in a financial market?" Ultimately, the reason that these things are useful is not because they're using quantum information to solve those problems. It's because they're providing better answers than the next best alternative that we have available.

The idea that the product is really the answer from the computer as opposed to the computer itself is that distinction. Of course, because cloud computing already works this way and actually the initial architecture and use of computers was many people sharing time on these big mainframes. This is not really a departure from the longer history of computation. In fact, it's more the norm as opposed to the exception.

[music interlude]

Andrew Fursman: 1Qbit's perspective is that exactly as I just described, people ultimately won't want to use quantum computers for the sake of quantum computers. They'll want to use applications that harness quantum computers to provide better answers because they care about better answers. 1Qbit's approach is to say, we have some visibility into the types of industries that are likely to be augmented by, or disrupted by quantum computers. Our interest is in getting into those industries, getting out in front of quantum computers as opposed to the capabilities coming along, and then saying, wow, we should really think about getting into quantum chemistry.

Instead, we're getting into quantum chemistry, knowing that success within quantum computers will provide a really unique advantage. To the extent that we believe that quantum computers or exotic forms of computation might augment machine learning capabilities, we have been doing a lot of work to be able to commercialize current methods of artificial intelligence within industries that we think are relevant to quantum computers, so that if quantum computers provide new capabilities, we're already in the industries that can benefit from those capabilities.

That's what we've tried to do over and over again, is to be positioning ourselves, to be the best-positioned organization, to harness the capabilities of these devices while at the same time, using those insights to partner with the hardware organizations and to do our own fundamental research, to understand how could you build better devices that are more capable of accelerating these industries.

[music transition]

Thierry Harris: 1Qbit received funding from Canada’s Digital Supercluster. A government sponsored program focused on fostering innovation in digital technology companies. Andrew elaborates.

[music transition]

Andrew Fursman: One of the things that we believe is that there's a real capability for quantum information processing to augment the capabilities of artificial intelligence and machine learning. In order to prove that there is real industrial value, we think that it's very valuable to be out in the marketplace, selling products and services that take advantage of that fundamental artificial intelligence capability. In the case of the supercluster work, we have produced a software suite that is capable of providing a co-pilot for radiologists, essentially helping them understand and to point out more abnormalities.

Our first product was a chest X-ray anomaly detector that's useful for detecting the types of pneumonias that can come from things like the current COVID pandemic. By essentially having a product that harnesses the state-of-the-art in machine learning capabilities, we know that to the extent that that state of the art is advanced by any of the technologies that we work within our hardware innovation lab. We now have a path all the way from the hardware, right to the industrial output, which is, in this case, better outcomes for people in the Canadian health system. We have the ability to say, if I swapped out my current processor for this new device, does that further improve the outcomes?

To the extent that that answer is yes, that we know that that's a useful advancement on the hardware and to the extent that the answer is no, we know that that hardware is not yet ready for commercialization. Essentially, we use the industrial reality as the measuring stick by which we judge the meaningfulness of any of these advances on the hardware side.

[music transition]

Thierry Harris: While the market adoption of the technology is a key measuring stick for 1Qbit’s success. The advancement of pure science is also important to the company.

[music transition]

Andrew Fursman: As a geek, I think and I should say as a team of geeks, I think all of us really have a soft spot for advancing technology just purely from a scientific perspective. Because we're doing this in the context of a business, of course, the real measuring stick is, are you able to produce more value than what it costs to get there? I think we love to produce technology because we believe technology produces value and utilizing our market success as a measuring stick is a very helpful way to ensure that we're not just climbing Mount Everest because it's there.

[music transition]

Thierry Harris: The development of Quantum computing will come from partnerships from core Quantum companies like 1Qbit with various industry players to help solve problems in their respective fields and to find new opportunities to develop applications using the power of quantum technology.

In this spirit of collaboration, I asked Andrew to put out a question for our audience to ask them what he would like to see people studying 1Qbit to be working on. Here is what he had to say.

[music transition]

Andrew Fursman: Well, back to your point previously of how long people have been thinking about quantum computers it's very interesting that some of the most important algorithms in quantum computers were developed before those quantum computers really existed. A great example is Shor's algorithm, the procedure that you would take with a quantum computer in order to improve the factoring capabilities of our computational capabilities as humanity. This is very exciting because it shows that even without access to a quantum computer if you understand the fundamentals of quantum computing, you can develop applications without even having access of these machines.

What's really different today than when Peter Shor was first thinking of Shor's algorithm is now we actually have fledgling quantum computers that we can use to test those assumptions. What I would recommend is that as opposed to trying to think about quantum computing in this abstract, it's just a more powerful computer, if you really want to make an impact in this field, the first thing you need to do is to put in the work to understand how these machines really operated at low level, and then you can use your creativity and imagination to expand the fundamental computing capabilities at these low level of what you might think of as the building blocks upon which you can build applications.

At the moment, we actually have a very small number of these building blocks and I think that as more people put their minds toward this, we're going to see that, although there's maybe five or six really exciting fundamentals that we're aware of right now, there are probably thousands more that just haven't been discovered because not enough people have been thinking about this.

[start end music]

Andrew Fursman: I love the idea of more people first learning about how these machines work at a low level and then imagining what other things they could do. That's going to really blow up this industry and help expand the usefulness of quantum computers to many different areas that we can't even imagine today.

Thierry Harris: All right, well, let's make that happen.

Andrew Fursman: Absolutely.

That's very exciting, Andrew. Thank you so much. Anything else you would like to add?

Andrew Fursman: I just want to say thanks for the opportunity to connect with your listeners. To the extent that people are interested in learning more about this, of course, they can visit our website at [1QBit.com](). For people who are very excited to dig in and maybe think a little more, 1Qbit's always bringing on interns and practitioners. We're expanding all across Canada, from Vancouver into Calgary and Edmonton. We have great partnerships with the Saskatchewan Health Authority. It's been important for that supercluster work that you've talked about.

We have new offices opening up in Quebec and we have a deep partnership in Sherbrooke. We're trying to take a Pan-Canadian approach to quantum computing for the benefit of all humanity and if you're excited about that, we'd love to hear from you.

Thierry Harris: That's all for today folks, there is so much more we could discuss with quantum computing, and we haven't even touched upon adjacent topics such as quantum communication networks and quantum sensor technologies. If you'd like to share further research on the quantum ecosystem, write us at solutions@ie hyphen knowledgehub.ca and we'll add links to our episode page to keep the conversation going.

[end music]

[begin promo music]

Narration: *And now a final word from our sponsor, the IE-KnowledgeHub. IE-Knowledge Hub is a website dedicated to promoting learning and exchanges on international entrepreneurship.*

If you are an education professional looking for course content, an academic researcher seeking research material , or someone interested in business innovation check out IE-Knowledge Hub.

Let's pickup where we left off for Prevtec Microbia, a small biotechnology company creating live bacterial vaccines to help counter E. Coli in swine.

Eric Nadeau: *We had to take a decision what to do with it? At that time we were thinking more to, to, to develop and to provide to, to the veterinarians, it was not a business sense. It was ok then we have this the veterinarians need it, what we can do to transfer this to the veterinarians?*

Narration: *That's Eric Nadeau, co-founder of Prevtec Microbia. Nadeau is describing the ideation behind creating Prevtec. He had developed the coliprotech vaccine as a post doc student under the supervision of Dr. John Fairbrother, a world expert on E.coli. He knew his technology could work. But how could he get from the university science lab to building a business?*

Eric Nadeau: *We went through all the process into the university. We have to do a declaration of invention, and after that to convince the dean of the faculty that our project is solid. And it was difficult for them, because we had John Fairbrother as a fundamental scientist, and not a business person, and his dolphin, a young post doctoral student. and it took two years to convince the faculty and the university by itself, the University of Montreal.*

Narration: *To help them get up and running the firm hired an experienced CEO, Michel Fortin. Fortin knew that to be able to make Prevtec into a profitable business he had to get the regulatory approval in the right markets.*

Michel Fortin: *When I started with the company we had the first vaccine which is coliprotec f4 which is for specific disease in the swine industry. And our objective was first to get this product approved in Canada to distribute it in Canada which is our home base, which was easier for us to do all the tests and do everything that is required to get to that license or regulatory approval. With the objective that after that once we get the first product out in Canada is to take this product to other countries to have a global approach.*

And one of the first opportunities was going to be in Brazil. Because brazil has a very large production of swine, and also the regulatory people work very closely with the regulatory people of Canada. So with our Canadian dossier, we were able to start the regulatory process in Brazil, without incurring very very expensive costs. Then after that we decided to get our product distributed in Europe. Why europe? We are an alternative to antibiotics, which is getting controlled and/or banned. So it was a prime market for us.

Narration: *You've been listening to segments of the [Prevtec Microbia video case study](). Learn more about how to take a technology from the laboratory to the market by watching their full case available for free at [IE hyphen knowledge hub dot ca]().*

[End promo music]

Thierry Harris: Market Hunt is produced by Cartouche Media in collaboration with **Seratone Studios** in Montreal and **Pop Up Podcasting** in Ottawa. Market Hunt is part of the IE Knowledge Hub network. Funding for this program comes from the **Social Sciences and Humanities Resource Council of Canada.** Executive producers **Hamid Etemad**, McGill University, Desautels Faculty of Management and **Hamed Motaghi**, Université du Québec en Outaouais. Associate producer Jose Orlando Montes, Université du Québec à Montréal. Technical producers Simon Petraki, Seratone Studio and Lisa Querido, Pop up Podcasting. Show consultant JP Davidson. Artwork by Melissa Gendron. Voiceover: **Katie Harrington**. You can check out the IE-Knowledge Hub case studies at Ie hyphen knowledge Hub dot ca. For Market Hunt, I'm Thierry Harris, thanks for listening.