Investor Day

Company Participants

- Brian Sereda, Chief Financial Officer
- Chad Rigetti, Founder & Chief Executive Officer
- David Rivas, Senior Vice President, Systems & Services
- Despina Milathianaki, Senior Director, Department of Energy
- Eric Ostby, Vice President of Product
- Greg Peters, Chief Revenue Officer
- Marco Paini, Director Europe
- Mike Harburn, Chief Technology Officer
- Polly Pearson, Investor Relations
- Unidentified Speaker

Other Participants

- Analyst
- Krish Sankar
- N. Quinn Bolton

Presentation

Polly Pearson {BIO 22860974 <GO>}

(Call abruptly started) You'll hear from the folks. Excuse me, one second here, who have actually designed and where a building the quantum processing unit right here in Silicon Valley at our Fab around the corner.

You'll hear from the folks who are working to deliver quantum over the cloud in an integrated hybrid environment to make it very easy for user adoption. And you'll hear about the folks that are leading the go-to-market strategies, who are meeting with the earliest users of quantum computing in the world. You'll also have an in-depth review of the product -- the product roadmap, and you'll have a financial review of the company as well.

Throughout today, there will be plenty of opportunity for questions. For those on the web, you can just type it into the chat box. And for those here in the room, raise your hands. The question session will happen after just about every other session presentation here this morning.

Now in the middle of the session there will be about a 10-minute break. And at the end of the session, those who are with us will have a chance to tour the world's very first integrated quantum fabrication foundry, right here in the heart of Silicon Valley. We'll have the tours, and we'll have lunch with management as well.

Before we begin, I do want to remind you all to put your electronic equipments on silent, if you haven't done so already. And that we will also be making forward-looking statements. Because, of course, all forward-looking statements are forward-looking, they do carry certain risks and we encourage you to read our cautionary language in the paper in front of you, and then as well as on the website. We will also be discussing financial terms and non-GAAP measures for reconciliation to GAAP, please see the investor relations website or our filings with the SEC.

And now to kick it off with a little bit of fun, let's have a sizzle video.

(Audio Video Presentation)

Fantastic. Now, it's my pleasure to introduce the Founder of Rigetti, man who spent his early years as a quantum physicist in the labs at Yale, earning his PhD, and went on to join IBM's, then nascent quantum research facility, who then left to join to found Rigetti.

So, with that, Chad Righetti, please.

Chad Rigetti {BIO 21140357 <GO>}

Thank you.

Polly Pearson {BIO 22860974 <GO>}

So, Chad, it's a beautiful day here in Silicon Valley, nice and sunny. This man, I just want to let you know, is one of those rare CEOs with soul and meaning. I found out today from one of his peers, he told, he was born to actually work in quantum computing.

So, with that Chad?

Chad Rigetti {BIO 21140357 <GO>}

Thank you so much, Polly, for the wonderful introduction. And thank you all for joining us here today at Rigetti Fab-1. I started Rigetti almost 10 years ago. It'll be 10 years next June or July. And over that time, many people have asked me, why did you start such an ambitious company? What drove you to do that?

And I wanted to share with you some of my thinking on that today, because as -- I think you're about to hear from the other extraordinary people at Rigetti, that are here with me on the stage today, it's not just my thinking but it's their thinking as well.

The answer is really twofold. The first is, curiosity. That fundamental drive to pursue the limits of science and technology to build more powerful computers. And the second reason is really, meaning. The belief that ultimately, our time here on earth should be spent doing things that in the end make the world a better place. And that's why we're here today. Because we believe that quantum computing holds the potential to unlock exponential computing power at scales, magnitudes beyond what today's classical computers can do.

To ultimately decouple energy consumption from computational power, thinking of the environment, the impact that this could have. To create opportunities for profound new knowledge and accomplishments for humans. And ultimately to drive a paradigm shift for governments, for technology leaders, for research organizations, for creatives that are shaping the trajectory of human society. And that's why, quite frankly, we view quantum computing as today's space race.

For example, there are enormous geopolitical implications, with all the pressures and burdens on budgets around the world, governments, the world over are spending billions of dollars, trying to accelerate the development of this technology and for themselves and their people to carve out a leadership position in the coming quantum economy.

The technical challenges to doing this are formidable. They require deep interdisciplinary expertise systems engineering capability. Today, you're going to be meeting some of the brightest and best minds in quantum computing. And I believe, this is ultimately a fundamental human endeavor, the pole to master the laws of physics and build computers beyond the limits of current machines, I believe that's woven into us, like our innate desire to explore the stars.

And ultimately, we also believe that the winning strategy is going to be forming deep, strong and complementary partnerships between government organizations, companies-to-companies, and with researchers, and ultimately marshalling and aligning the best expertise to solve this problem and win this race. And at Rigetti, we distill and encapsulate that vision, that passion and energy in our simple mission statement, to build the world's most powerful computers, and to use those machines to help solve humanity's most important and pressing problems.

So while the challenges have been great, the possibilities almost limitless. Like using quantum computers to enable the bottom up rational design of new medicines, new molecules and new materials, to unlock cures for untreatable diseases, to enable radically more efficient means of transportation, when we have something to share about today building more accurate large scale weather models, providing insights into the forces that are driving climate change and creating wealth and prosperity through a deeper understanding of what drives risk.

In our first decade, we have made a series of early bets and strategic choices that have helped us achieve a series of industry first. The first dedicated quantum Fab that you're going to see later today on your tour. The first hybrid quantum cloud platform. The first multi-chip quantum processor. And these together along with a bunch of other firsts that we've been involved in over the past nearly decade have brought us to what we believe is today an enviable position as we pursue unlocking this opportunity.

And now the next step we are focused on at Rigetti is to grasp this potential to unlock this business opportunity in quantum computing. We are laser focused on reaching quantum advantage. We believe we've got the right strategy to do this, and ultimately, to become the standard in quantum computing.

Now here's how we think this phase of the industry is likely to unfold. Today, we're in the emerging quantum advantage era. In this phase, we're exploring use cases with customers. We're building and benchmarking prototype applications, going back to the space analogy you're building and iterating on the rocket design.

In emerging QA, you're focused on ultimately optimizing the rocket so you can get into orbit, get to the moon and ultimately build that colony. Now we believe we're beginning to get with insight of narrow quantum advantage. The next phase in the industry.

In this phase, you go beyond iterating on applications and ultimately beginning to deliver to end customers computational value beyond their best alternative purely classical solution. Delivering customer value along one of the axis[ph] of, improving the performance cost curve better -- faster time to solution, improved accuracy or lower cost of solution. That's the first step in the quantum advantage era. In the beginning of narrow QA, is what we believe will unlock unlock this era.

But going beyond narrow QA, there's another phase and another inflection point that we see coming after that, and that is broad quantum advantage. In the broad quantum advantage phase, quantum computers will begin to solve problems that are fundamentally out of reach of all forms of classical computing, no matter how big and how expensive of a classical computer, you might build.

In this phase, you start to grow the market for computing overall, because you're bringing workflows that are not currently addressed with any form of computing into a computational solution for the first time, only enabled by quantum computing. This is a phase where we believe we can start seeing new discoveries, and new creative insights that advanced human society and unlock this true deep potential that we see in quantum computing.

Not surprisingly, we believe that each of these achievements will be an inflection point in the rate of growth of the industry, in the customer spend, going towards quantum computing, and ultimately lead to an acceleration in the growth of the market and activity overall.

You may say that we've already seen an early inflection point with emerging quantum advantage with the availability, broad availability of practical quantum computers through platforms like Rigetti QCS, Amazon Web Services and in Microsoft Azure quantum platform, for example.

Now, in the narrow quantum advantage we've been working on this for many years. We've been working with the customers for five or six years now. And we have built up a lot of insights and experience as a company with as a leadership team and as a group of technologists and engineers. And what we believe is going to be required to ultimately get to quantum advantage. And I want to share with you some of those insights here today.

The first, as you see on the graph, we believe that quantum machine learning is situated to potentially be the first application to reach quantum advantage. And that's what's represented on the graph here with quantum machine learning and TL[ph] inflicting first.

The second is that quantum advantage is going to be reached on an application-by-application basis. It may be reached in QML first, then quantum simulation and optimization, for example. Now, quantum machine learning specifically is when you're using a quantum processor in conjunction with traditional classical machine learning methods in a hybrid model to ultimately enhance the performance of the integrated solution.

Now, another insight is, not only will it be application-by-application but we believe it could even be customer-by-customer, depending on the use cases and the level of investment and commitment by the customer to bring their program through all the way to quantum advantage.

A third insight is that we believe, our combination of superconducting qubit processors, the superconducting modality that has the benefit of scale, speed, very fast processing times, and fast dynamic reprogram ability, makes our technology today the best situated to unlock the opportunity with quantum machine learning.

Now, through the series of bets and investments that we've made over the past decade or so, we've brought the company to the point where we can set our sights on quantum advantage. Our choice to work with superconducting qubits, we believe that the time would be the most scalable and engineerable approach. And that bet has paid off. With today, we have the largest quantum processors publicly available over our own platform, over AWS and over Microsoft Azure as we announced earlier this week.

Our decision to be a pure play full stack company to build this facility, invest in the Fab, to ultimately own the means of production and focus our effort at the fountainhead of value creation and innovation in the industry has led us to our multi-chip processor architecture, which we'll hear much more about later. Ultimately unlocking performance at scale.

Our decision to focus on hybrid quantum-classical computing as the core architecture has allowed us to deliver consistent leadership and processing speed. And today we have according to the CLOPS metric, the fastest processors available to end users. We chose to focus on a cloud delivery model, ultimately today available over our own platform big public clouds and through Department of Energy facilities like the Oak Ridge leadership computing facility.

In order to continue to focus our effort on core technology leadership and to bring customer use cases directly in contact with our technology roadmap, we've chosen a partnering strategy at the top of the stack with our go-to-market, ultimately working with customers arm-and-arm to bring them through to quantum advantage. And the combination of those things together gives us the ability today to make quantum advantage or central focus with an emphasis on quantum machine learning.

And that brings us to today's theme, integrating quantum into the fabric of the cloud. Our strategy is to leverage the power of the cloud, to acknowledge and recognize that all advanced computing today is trending towards a heterogeneous computing mode, or not only is there a plurality of processing types available in a single environment but those processing types can be lined up to the specific needs of a particular workflow that a customer may have.

This is enabled through cloud delivery. And ultimately delivering -- regarding quantum processors as a new kind of heterogeneous processor within that environment, ultimately allowing us to develop to --and deliver a customer-centric workflow that allows them to leverage and apply quantum computing integrated into a cloud environment against their problems.

Like all cloud companies, we operate machines and serve access to them to remote users. This is our other facility in the bay area, our quantum computing facility in Berkeley where we operate our machines today in a production basis for end customers. We also operate machines now out of the U.K..

We've talked about this slide before. Ultimately, there's -- we believe there's an enormous opportunity. And on the right, I want to draw your attention to what we believe are the requirements for quantum advantage and running production workloads.

Through the series of investments and decisions that we've made and the technology development of our extraordinary team, we brought the company to the point where there are two major open items to address to unlock these requirements. Low enough error rates and large enough scale, and with our multi-chip processor technology in our next generation chips that we've recently announced, we believe that were on poised to unlock this opportunity.

And with that, I want to share with you for the first time, the names of our next generation machines. Our Ankaa 84-qubit single-chip quantum processor is on track for early 2023. This is based on our fourth generation circuit architecture designed for higher fidelities, higher conductivity, introducing tunable couplers in our processor. Our Lyra-336 cubic quantum processor will be based on a tiled assembly of 484Q Ankaa's. Ultimately leveraging, the Ankaa as a tiling unit to deliver the performance at scale on our path to quantum advantage.

I want to share with you a little bit more about the beautiful names of these upcoming quantum processors. Ankaa is a star. Lyra is a constellation. Representing our multi-chip processor strategy where Lyra is assembled from multiple Ankaa dise.

We're also sharing today a detailed technology roadmap at all layers of the stack, starting with our Fab, our quantum processing units, including Ankaa, Lyra, our 1000 qubit or plus system in 2025 and our 4000 qubit plus system in 2027 or later.

Each of these systems will be associated with the introduction of new enabling technologies that we're sharing here and advancements at other layers of the stack, including at QCS with error mitigation, we're going to hear more about today. Hybrid job management, the ability to execute dynamic circuits, a building block for error correction and ultimately unlocking logical qubit programming for our end users.

We're also excited to share with you more about our vision for building, what we're calling reference applications. Applications that put all the pieces together to allow an end customer to solve a practical problem and benchmark that performance against both quantum advantage and their alternative solutions.

We have chosen from the start as a vertically integrated pure-play company to form partnerships at every layer of the technology stack. This is what we believe is going to be the winning strategy in this space race. That includes today partnerships with some of the leading research organizations in the world, like Fermilab and the SQMS Center, one of the five United States national quantum initiative research centers.

Company organizations like DARPA, companies like Ampere, a leading classical cloud first cloud native chip company. Amazon Web Services, Oak Ridge National Labs, NASDAQ, Aspects and Standard Charter. And today, we are really-really excited to share with you additional partnerships.

We announced today a collaboration with NVIDIA, doubling down on our hybrid strategy of bringing quantum processors and classical chips directly together to solve the most important problems where we're collaborating with NVIDIA on a hybrid GPU, QPU, workflow and solution for weather modeling.

Earlier this week, we announced the availability through Righetti QCS on Microsoft Azure Quantum. Our 40 cubit Aspen-11 and 80 cubit Aspen M-2 are now available to all users of Microsoft Azure Quantum, ultimately expanding our reach and doubling down on our strategy of integrating quantum into the fabric of the cloud.

We're also excited to announce the next stage in our strategic partnership with Keysight technologies. Keysight and Rigetti are partnering to integrate Keysight error mitigation software into the Rigetti QCS platform and making it available to end users.

And finally, as we'll hear more later, we have announced a partnership with BlueForce, a leading cryogenic systems company to deliver a new modular, larger and more powerful dilution refrigerator system to power our 336-qubit Lyra, 1000 qubit and 4000 qubit quantum processing units. Putting all of these partnerships together, further strengthens our position in the industry and augments our effort in unlocking quantum advantage.

This is not easy, but we have chosen to do as an organization and as a team, is a very-very ambitious goal. We do this because it is hard, that is what draws us. We ultimately believe that for those of us who are wired this way and you're going to meet a bunch of us today working on the hardest most impactful problems is a way to spend your time here.

Next, I'm really excited to share -- to introduce you to Greg Peters, our Chief Revenue Officer, is going to walk you through our go-to-market and strategic partnerships. We're also going to hear from Eric Ostby, our VP of Product that we're really excited joined us earlier this year from the Google quantum team. David Rivas, who runs our quantum cloud services platform. Our Chief Technology Officer, Mike Harburn. And our Chief Financial Officer, Brian Sereda.

So, with that, let me welcome Greg Peters to the stage.

Greg Peters {BIO 21220187 <GO>}

Good morning, everyone. Welcome to our Fremont facility. And for those of you online as well around the world, delighted to be here. And thanks, Chad, for the great introduction.

Today, I'm going to tell you three things. The first is, how we see the market and the opportunity today. How we are addressing that opportunity today. And how we will address that opportunity in the future as the market expands and grows.

We're going to focus more deeply on strategic partnerships and to my colleagues, Despina and Marco will be up here shortly talking about respectively our work with the Department of Energy and our work in the finance industry.

One thing that I will not be covering in detail today is our cloud access through our partners, Amazon and Microsoft, that's going to be covered by Eric and David there, a little bit further on in the discussion. So in order to not duplicate, let them cover that.

So let's get started. We talked about the need to take a look at what the market looks like today. And I'm going to just show you a simple model. This is our customer journey, this is our customer path to quantum computing. And running from left to right, you see there's many-many customers, companies around the world that are simply not engaged in quantum today, that's obvious to all of us. There is, however, a growing group of customers, agencies, and organizations around the world that are starting to learn about how they may apply quantum computing technologies to solve their problems.

We work with organizations, such as the National Quantum Initiative, or Quantum Economic Development Council and through work with other associations, to help educate customers and move them from that learning mode over into the next phase proof-of-concept then to advance prototyping and eventually to operational quantum advantage. And this is our area of focus. This is the area where we can make the biggest contribution.

We have a large group of experts, many of them represented in the room, many of them in the building here just next door, who are experts in applying quantum computing. And this is a full stack approach, as you'll hear multiple times. And so we can apply not just algorithms that potentially engineers who can help to improve or speed an algorithm by going deep down into the hardware.

We engage with that proof-of-concept stage. We help move customers to advance prototyping with an eventual goal of being operational quantum advantage. What that means for a commercial customer is economic advantage and economic opportunity. We can help improve their end user KPIs. And that may be growing the top line, being more competitive, entering a new market or lowering costs. Or there's probably other metrics that you could think of up and down to P&L stack.

So, for commercial customers, that's a primary goal and why they will adopt quantum computing in their heterogeneous computing solutions. For customers that are in defense or security, it is all about mission success. So, this may be taking a look at battlefield communications, improving transportation logistics, as you know wars are won on logistics. And logistics for today's armies are incredibly complex.

So, those are opportunities to deliver a new compute power or combined with fast classic compute power and add more value. Today we're focused here. And you're going to see a couple of examples of that in just a couple minutes.

There are differences, of course, between government and commercial customers. We have been focused almost exclusively on government customers because that's where the investment has been. As Chad mentioned, this is the space race, governments around the world are investing in basic research, advanced research, prototyping for their organizations, and also providing all of that fundamental science to their citizens and building economies and activity systems, that will support quantum computing in the future.

There are differences, of course, much of the budget that I talked about like NQI, it's a five-year budget. It has a long burn cycle and as you know, it takes some time to get from allocation of budget and what you see is a bill passed in Congress till that time that money flows down.

On the commercial side, this is a different game. The most important thing that has to happen is that an executive of a company has to be engaged in quantum and support that. At this phase, it's still early research for customers as well, shorter duration. And as I said, executive. And the end goal here is of course to create mission advantage -- I'm sorry, economic advantage.

Two things we believe about this market. One is that over time it's going to transition from research and the types of activities to where today we provide expertise and knowledge and program of consulting services, is going to transition to quantum computing as a service over the cloud. And that transition over time will accelerate as commercial customers get engaged, because it is the best way for them to access the power of quantum computing. They can turn it on instantly, they can turn it off at any time, they can access the latest technology. And of course it's as easy as turning it on through one of our partners for example or directly through us.

The other thing that we believe is that this is going to transition from a largely government funded activity into commercial, and as that happens you will see an acceleration in the number of users that previous graph, and that will start to trigger as we get the first proof cases of narrow quantum advantage and can publicize those.

So, I've talked about that a little bit. Now, it's important for us to take a look at two particular use cases and deep partnerships. The first is with the Department of Energy, and Despina is going to join me on stage and then she's going to be followed by Marco, and Marco is going to talk about our work in the finance industry.

So, please help me welcome Despina to the stage.

Despina Milathianaki

Thank you, Greg. And welcome everyone. Thank you for joining us here today and online. I'm Despina Milathianaki. And my role at Rigetti Computing, I stir both our new and our ongoing partnerships with a Department of Energy. Such an exciting ecosystem and I so much look forward to telling you more about DOE.

I joined at Rigetti almost seven months ago after a 15-year career in the DOE and at national labs. I started as a researcher and a collaborator amongst several of those national labs. And in the last seven years I transitioned into a strategy and investment where I led strategic planning and investment for one of those national labs, for SLAC national accelerator laboratory here in the Bay Area.

I was so fortunate to witness and support the launch of the quantum initiative and seen materialize in the national labs and the entire ecosystem that it supports. And because of that and because of course of the bold purposeful vision of this company, I'm here at Rigetti today. I'm here to be part of this very exciting moonshots that Chad talked to you about, and help the company accelerate its roadmap, and of course, the roadmap of our partners through our technology.

So, let's talk a little bit more about our partnerships in DOE. So, Rigetti is a trusted partner in the department of energy ecosystem. And for those of you who are not familiar with a Department of Energy, it's a very vibrant research community. It consists of the 17 national labs. It consists of thousands of researchers, both that are part of those national labs and the partner with the labs from academic institutions. And most importantly, this is the largest quantum non-defense R&D supporter and echosystem in the United States currently.

Just to give you an idea from the $1.2 billion that the national quantum initiative authorized DOE on the five national R&D centers alone, allocate and supports with over half of that budget. And again as you're going to hear, we are very excited and proud to be a lead member of one of those national quantum R&D centers.

So we create value to our partners in the Department of Energy through a unique combination of our expertise across the full stack, and our unique capabilities, such as our chip fabrication, our quantum cloud services, and of course though our deep understanding and relationships of our DOE partners.

Of course, our partners create value to us too, because we work together with leading experts in scientific applications, in technology, and of course, we have access to their capabilities, their unparalleled capabilities as well.

So, let me talk a little bit more about the partnerships that you'll see here across our stack. So, first and foremost of biggest partner is very Fermilab and SQMS that you heard from Chad. Fermilab is the premier high energy physics laboratory in the U.S. And you may ask, okay, what is high energy physics?

So high energy physics, there we're looking to unlock the building blocks and the origins of our universe, super cool area of science. So we are part of Fermilab and together with our expertise in the scientific applications and in engineering, we are advancing the performance of our quantum processing units from the materials layer up, as well as we are actually co-designing processors that will help unlock quantum advantage in the scientific areas that this community cares about.

Our other partnership is with Oak Ridge National Lab. Oak Ridge is the largest office of science national lab and the home to the fastest supercomputer frontier. Super exciting. So we're very excited to be part of Oak Ridge through our quantum cloud services, to have a partnership and access to the scientific communities of high-performance computing and other scientific applications that access Oak Ridge.

And last but not least, we are a partner with Lawrence Livermore National Lab, a lead lab in fusion energy sciences and home to the national ignition facility. So together, we are developing algorithms that will impact fusion energy sciences problems and will help with quantum computing tackle fusion energy in a vastly different ways in the years to come.

So, one other thing though, in addition to this partnerships, another very important role that we play here, we are -- through our internships, our fellowship programs that are running through those partnerships as well as throughout their engagement we are contributing in the development of the future of quantum workforce. And as a woman in this workforce, I am very happy that I have the opportunity to be part and help shape that workforce as well.

So as you -- if you know DOE, diversity, equity and inclusion is super important. So being at the forefront of shaping that workforce here through our partners and their programs is so cool.

Okay. So let's talk a little bit more about two of our partnerships. So with SQMS, we are the lead and the largest by level of effort industry partner in their national quantum R&D center. Again, we are so honored to be part of this huge partnerships with 23 other distinguished institutional partners. In addition to Fermilab, there is other DOE national labs here, such as Ames National Laboratory. There are other institutions from other government agencies such as NIST, and such as NASA Ames. And there is also a very significant number of academic partners with Northwestern University taking here the lead.

Our goals is first and foremost and vast the state-of-the-art in superconducting quantum technology. And we are doing this hand-in-hand through first of all, our unique capabilities, through our foundries, and from there end they are offering as unique materials, for example, characterization services and R&D services. And through that we are tackling significant problems that are -- would that -- will help us extend qubit coherence time and with significantly extend computational performance.

Our second goal is to accelerate discovery in high energy physics. And again, we do that in a unique way by working on select high energy physics problems and informing through that the way that we're designing QPUs use that are applicable and will tackle and bring quantum advantage to high energy physics.

Another very important goal here is that by 2025 we want to deploy two quantum test beds at Fermilab that will be used to train the new generation of scientists and engineers in quantum. So -- and of course, perform all kinds of work, all the important work that needs to happen to bring quantum advantage in these areas.

So, again, very excited to be part of SQMS. And in addition to that, we're also a partner, as I said, with Oak Ridge National Lab. And there we were honored to be selected as one of the early QCS providers to the quantum computing user program. The quantum computing user program is the first program of its kind that brought to the DOE community access of commercial systems.

So, with their hand-in-hand with Oak Ridge National Lab on the high-performance computing scientists, lead experts in the field from the scientific application side as well. So we are -- together we are growing the quantum community of academia of other nationalists and I thought the National Labs and industry that are accessing Oak Ridge's facilities. And we have already some great result from this work.

So with that, and to close, I should say we have strong partnerships, tied partnerships in the DOE. We are looking forward to bring quantum advantage to the scientific applications, such as the problems that DOE cares about.

And with that, I would like to turn now to my colleague, Marco Paini, who is going to talk more with you about QML and finance.

Marco Paini

Thank you. Good morning. My name is Marco Paini. I am based in London in the U.K.. And I lead our financial services practice.

Quantum computing represents a big opportunity for financial services, for two good reasons. The first is that there are many difficult computations in finance that can be investigated with the quantum computing. These computation spend entire finance organization. And given the notional sizes involved, even marginal improvements to the computations can lead us to large impact.

The second reason is that one could argue that the financial services have the shortest path to impact. And what that means is that a quantum algorithm differently from example for the case of pharma could be deployed to a finance model in days or weeks. This wouldn't happen with pharma because even if a drug was discovered through the use of a quantum computer, of course, there is a long process before it can be rolled out to production.

Because of the short path to impact, and because quantum computing is profoundly different from classic computer and for an organization, it takes significant time to build a capability, first movers are likely to take a significant market share. As a result, we have observed several financial services organization, starting to build the capability, starting to build teams that have skills and expertise in quantum computing.

So, for Rigetti, not only the financial services is a potential -- potentially very large market. But the teams at the financial services organizations are building our ideally equipped to be the partners with us to drive towards quantum advantage.

We want a financial services practice the best serve -- the best serve as the financial service organization, and the teams the financial service organizations are building in quantum computing. We do this by finding a platform -- practice on three pillars, our people, our core technology and reusable software libraries.

The three pillars drive the growth of our customer bases. And the growth of our customer bases then enables further development of the three pillars, establishing a virtual cycle. Now, it's really important that at the center of this all, we have customers. We cannot really think of industry-relevant quantum advantage without the direct collaboration of the people that understand the business and the use cases.

So, coming back to people. We want a team with people that have deep expertise in financial services. We built and are building a team with people with several years of fast professional experiences (Technical Difficulty) in top-tier investment banks.

Core technology. So our core technology is designed to have features that are ideal for near-term use cases. And what that means is, for example, we have the fast cycle between quantum and classical resources. And we have a clear path to scaling through a multi qubit technology -- multi-chip technology. But not only our full stack approach enables us to operate at all levels of the stack, this is incredibly important as the requirements for near successful near term applications are still evolving.

Reusable software libraries. This is an important differentiator and an accelerator in our work with customers. We built libraries as classical optimizer in hybrid application financial applications. We built libraries as generative models to generate some financial synthetic data.

More recently, in our collaboration with Standard Chartered, we have made significant progress on a scalable quantum machine learning model that has applications in different areas of quantum machine learning, such as classification and regression problems in unsupervised learning.

We work on quantum machine learning applied to financial data sets with Standard Chartered over the last two years. And Standard Chartered is a large multinational financial services organization. We have worked on different methods, different quantum machine learning methods with Standard Chartered on different data sets. This has done -- it has enabled us and Standard Chartered to understand the limitations and the features of the different methods on the different data sets. Really starting to turn the flywheel towards quantum advantage.

In fact, on our recent results that I had mentioned, we have developed a scalable quantum machine learning method and this development has been enabled by our ability to operate at the deeper in the stack. The -- we're scalable in the method is that we have developed is really key. One key learning is that you develop an application that has the ambition to reach quantum advantage every component from the classical libraries to the quantum error mitigation libraries, everything must scale efficiently as we increase the number of qubits.

So, sorry --

(Technical Difficulty)

Unidentified Speaker

All right. Thank you, Despina. Thank you, Marco What -- I hope you saw with their short presentations was the amount of work that goes into finding, developing and executing on these strategic partnerships. This is literally man hour -- thousands of man hours worth of effort across the company and that's continuing in the case of the deal we now we're on I think year five of this effort. Standard Chartered couple of years in, applying the resources of the entire company. It's an activity system that Chad has specifically designed and built for us to reach quantum advantage. Everything we're doing is targeted at reaching quantum advantage, and I'm going to talk next about our next steps in my organization and across the company to make that happen.

So to start, Chad had mentioned, the very large amount of money that's being spent by governments around the world investing in quantum information science. This is a big deal. There's obviously geopolitical overturns here, and we're -- Righetti plans to put its footprint here's in the center of the countries here listed. As I put some flags up, that's U.S., UK, Australia, Canada, and France, and down to NATO down there.

But what you'll see is the top four which are part of the five eyes. Five eyes again, U.S., UK, Canada, Australia, New Zealand. We have a footprint established in four of those five countries, and we will maintain and grow that -- and grow our business there.

As you can imagine working with national governments, it's important that we have nationals on the ground working and integrating with their applications and their efforts, especially around areas in defense and security. We will, however, continue to expand and partner with folks not only in those countries but in other countries around the world, and our expansion plan really can be phase into three parts. Well-established in the five eyes, as I just mentioned. Next, we will be building partnerships through channels and through other partners in the industry to expand into western Europe, that's the red, and then expand into East Asia.

So these are processes underway now. The good news is that countries that haven't been identified in the previous slide are also investing heavily in quantum. So this is a big part of our strategy over the next couple of years.

We have -- and that's actually again called out here in expanding geographically. There's four things that we're going to be doing. You saw our effort on -- in our practice of selective engagements. This is really critical for us. It's our execution or operating model. We talked about quantum computing as a service focus, this is where we're going in the long run. And you would expect to see over time our QCaaS percentage of revenue grow. It will stay about the same for a while, but it will grow over time as customers move into the prototyping and eventually into the operational phases.

And then we are deliberate about our scaling, both geographically and in the applications. And you saw our first applications in finance. So these are underlying pillars of success and how we will take this company forward.

So, with that, I've completed my part of the presentation. And we're now going to take questions. So, I'm going to invite Chad back up to the stage and both of us will be up here to answer your questions.

Questions And Answers

Operator

(Question And Answer)

Q - Analyst

Hi. (inaudible). I have a few questions, try to go through them quickly. The commercial programs you said, as opposed to government are one year to -- one and half years length, what governs that lengths for the beginning and ending of it? Just what are you trying to articulate in terms of the leadership commercial --

A - Unidentified Speaker

Yes. Exactly. So, we try to communicate with that slide is that government programs especially ones that are long and deep in the scientific endeavor tend to be five-year funded programs. And so once that money has been appropriated and flow down to the appropriate department, that takes some time. And then program offices and contracting officers will get involved, put out a broad agency announcement, there'll be tenders, and then there'll be an award.

Once that awards starts, those are typically -- not always, it can be two year programs but they're five year programs. On the commercial side, what you'll find is that an engaged sea level will ask for or decide on funding and the funding model there's typically, well we need to give this a year before we review it, may be a year, 18 months. So they don't really have that same long-term horizon, but it tends to be quicker money. Once the sea level is engaged.

So what we find is when we have an engagement with somebody and let's say transportation logistics industry, they will decide pretty quickly if they want to fund that, now they may have to hit their next funding cycle. But once they do they're ready to spend the money.

Q - Analyst

And then a second question is about your main customers you mentioned, one on the DOE, one on the Standard Chartered. So DOE, you talked about customer relationship but all sounds like they're helping you develop your product roadmap. It sounds like a joint kind of development. So I'm curious if that's going to be more typically your customer arrangement or if that's exceptional. And then for Standard Chartered, I just saw the word cult[ph] getting up there. I wnat to understand if their -- equipment there versus fully serviced? Those two questions I have.

A - Unidentified Speaker

Yes. Thanks for the questions. I can talk to those. We are very selective and strategic about the partnerships that we form and that is heavily accentuated with our government partnerships. For example, our relationship with DARPA that we're going to hear much more about from Eric later on. We're working to development optimization algorithm and bring it towards quantum advantage over time.

These are relationships to bring both capital to Rigetti but also tremendous expertise on the customer or the agency side. In addition to the used cases that ultimately underpin the market opportunity in quantum computing. So that's a big part of our focus.

With the SQMS center in our daily partnerships in particular, we see opportunities to build partnerships that are aligned at all the different layers of our technology stack, and ultimately leverage a scientific and engineering capabilities of some of the labs in the DOE -- in the Department of Energy to help achieve our shared goals of bringing the industry forward and unlocking quantum advantage. So, tapping into some of the scientific development capabilities there as well. Bringing that into our roadmap is absolutely part of our strategy.

I can answer the question Standard Chartered real quick. The co-location isn't necessarily with respect to Standard Chartered but about the need to bring classical and quantum together, and ultimately deliver that in a cloud environment.

Q - Analyst

Okay. Craig Allis[ph]. Thanks so much for the information so far. I wanted to ask a follow-up on the federal government partnerships. To what extent is the engagement with each entity more siloed versus something that has collaboration or interaction across the other federal government partnerships both and how you interact with those partnerships in the way the teams here at Rigetti.

A - Unidentified Speaker

Can you repeat the question, I think you lost mic halfway through.

Is it working? Okay. Go ahead.

(Multiple Speakers)

So I think maybe I can try.

Go ahead.

Q - Analyst

(Technical Difficulty) how much interaction is there with the Rigetti teams that are engaged on the different partnerships? And then on the partner side is their interaction between the different federal government entities Oak Ridge, Fermilab, et cetera, as you're going down the quantum path.

A - Unidentified Speaker

Yes. I think there is extensive engagement across the organization within Rigetti scientists, engineers and leaders, and our major partner accounts, like Fermilab and like SQMS, for sure. And that's part of the mutual value creation there.

On the -- within the DOE, there's five centers. And there's -- under the national quantum initiative we're major partner in one of them as Despina explained, those centers are intended to be collaborative ultimately into work together, but they have their own focus areas, and their part of a portfolio approach from the Department of Energy to advance American leadership in quantum computing and their strong encouragement to work together. And to ensure that it's not siloed.

Q - Analyst

Thanks for doing the presentation. So, quantum computing is clearly very exciting space, but there's a lot of alternatives out there in the marketplace right now. When evaluating all these alternatives, what do you think customers value the most? And what do you think Rigetti was stand out the most in that kind of a (Technical Difficulty)

A - Unidentified Speaker

Yes. Ultimately, our blend of speed where today, according -- we've benchmarked our systems with CLOPS, where the fastest machines available in the market today according that metric. Speed matters in all forms of computing, and its really-really important in this era in pursuit of narrow quantum advantage, that is a differentiator for Rigetti. Our hybrid model is what enables that and hybrid makes -- we believe makes it easier to use and apply on machines and makes them available now at our customers fingertips.

And in addition, our partnering strategy. We have the ability but also the strategy to lock arms with our customers and help advance them through their journey through the different phases that Greg talked about, towards quantum advantage, and for many customers they want that and they need that and we are uniquely situated to deliver that to them today.

In terms of modalities, I believe, part of your question is also different, physical modalities of the approach, superconducting qubits today continue to be a leading technology or the leading technology, and we are very confident in our choice. And we -- we've -- as I talked about a little bit in my part, we think are starting to be very clear differentiators in the different modalities with respect to the application specifically and that superconducting in the hybrid model that we built is uniquely situated to unlock quantum machine, machine learning narrow quantum advantage.

Q - Analyst

Maybe one quick question. I might be front running at one of the speaker's here. But if you look at the AWS and the Azure partnership. AWS launching since 2019, how do you think the Azure ownership is going to be different in terms of trajectory, in terms of depth and breadth of customer engagement? Thanks.

A - Unidentified Speaker

Yes. It's a -- we're going to hear more about the Azure integration down the road. I don't want to steal -- I don't want to take too much of that. However, it is a different cloud model, right? And it's a different way of providing access between AWS and Azure, ultimately with a complimentary and different customer base.

So we believe that -- and also at the top of the stack different programming languages enabled on top of those different platforms. So ultimately, we think it's important to make our machines available and accessible for the broadest part of the market to accelerate development of the algorithms and applications, that are ultimately going to start to unlock the real commercial value. So, we think it is important to be as engaged as possible within the ecosystem with the public clouds.

A - Polly Pearson {BIO 22860974 <GO>}

Time for one more.

Q - Analyst

Good to see you, Chad. Jonathan Curtis. You frame this sort of as a space race opportunity, and I'm certainly encouraged to see the work you're doing with the various governments around the world and even inside the federal government. But where on the political side both in Congress and in the executive branch are we seeing real sort of focus on this opportunity to think of it like a space race problem? And what is -- what are you and your partners in the industry doing to try and raise that profile of quantum up even more.

A - Chad Rigetti {BIO 21140357 <GO>}

Thank you, Jonathan. And good to see you as well. I think, this is a absolutely unifying bipartisan issue. It is clear that American leadership in quantum computing and quantum technologies is existential and critical to American technology leadership and economic prosperity going forward. We haven't seen, one side -- across the aisle much distinction on that. It seems to be a very unifying issue.

Ultimately, the national quantum initiative came out of the previous administration. There's additional programs coming out now, for example, the Chips Act, which included 165 million. I think, I got the numbers exactly right, allocated to the quest program, which is designed to expand access to commercial quantum computing systems today.

So, we're seeing across at all different levels of government strong engagement and commitment to American leadership in quantum. And ultimately, the investments that are being made elsewhere, whether that's in the West or in China are a big part of that story as well in that competitive dynamics. And I think, many people are aware of the major investments that are happening in China and realize a need for ongoing investment here.

Q - Analyst

Thank you.

A - Chad Rigetti {BIO 21140357 <GO>}

Great. Thank you, Greg. And I am really excited to now welcome to the stage, our Vice President of Product, Eric Ostby, who's going to tell us much more and go into more -- let's go to slides back. Go into more detail on our quantum advantage programs and how we are bringing customers through this journey to quantum advantage.

Eric?

A - Eric Ostby {BIO 22795169 <GO>}

Okay. Here we go. Thank you very much. Good morning, everybody. Eric Ostby, Vice President of Product here at Rigetti. My entire career since I was very young, I wanted to solve problems and make people's lives better. I think a lot of us are that way.

So, I became an engineer and eventually became a product manager. And I'm passionate about improving people's lives. And I cannot think of a better way to do that today, looking towards the future that working on quantum computing. An incredibly hard task, but we are at a great juncture in the space now on the road towards quantum advantage.

Well, today, I'll walk you through our approach and a roadmap to quantum advantage, and look forward to taking your questions afterwards.

I joined Rigetti earlier this year. And the reason I did, is because I'm really passionate about solving problems. And Rigetti attracted through Google, because it has a commercial focus. So there's very few companies out there that are pure play, full stack focus on quantum computing, and seriously working on quantum advantage and bringing that utility.

Secondly, it's about our Fab capability, our flywheel with our product and engineering, allows us to iterate very quickly. It's astounding how quickly Mike and his team can go from a design to a fabrication cooldown test data and feedback to feed back into that system for the next generation improve that. And that's why you see the development on a quarter-by-quarter and an annual basis on our systems. And that will continue.

And third, it's about the people. Incredible team here led by Chad, but also the people that you don't see today, the people behind us in the fabrication, the people around the world at Rigetti, our associates that work incredibly hard every day. They have the same passion that we do for solving problems and bring you forward quantum advantage. So I wanted to thank all of them. I'm really honored and humbled to be here today.

Today, I'll walk you through our integrated full stack roadmap for quantum advantage, and tell you about how we're approaching this and the importance of the feedback cycle into this. Our roadmap is really strong, and we're executing really well. And it's full stack from the application layer down to the fabrication layer.

In application layer, we're moving from prototypes and POCs into reference applications and then into broad -- narrow and broad quantum advantage. On the access layer, we're broadening the access like we talked about with Azure. We're also bringing in new customers from around the world.

In the QCS, a central layer that David will talk about more today, we're bringing a new capabilities of error mitigation and on the road to error correction, and really in a hybrid environment that's necessary to achieve quantum advantage.

Our QPU, our quantum processing unit stack is strong. And we're excited today to announce the names of Ankaa and Lyra. Amazing developments for our processors. And these are really going to unlock that journey to quantum advantage.

We have a new 2D lattice design that tailored well for error correction, and we're improving both performance and scaling. So our fabrication capability is real class gives us that ability to iterate and focusing on performance and the scaling as well.

Regetti's approach to quantum advantage is application driven. We think it's the right time in the industry to take this approach. We're moving from the proof-of-concept and prototyping phase into building reference applications that are going to accelerate our progress and inspire partners and customers to come work with us and moving towards narrow and broad quantum advantage.

So what is quantum advantage? Everyone wants to know, and Chad talked about it in the beginning as well. It's when you have a faster, better, cheaper or more energy efficient solution, and the focus is on that durability and solving new problems. It's underpinned by subroutines, these quantum subroutines that I'll talk a little bit more about today.

And in narrow quantum advantage, what you're doing is you're achieving a solution that's better than your classical state-of-the-art at that time. But it may not be durable. So broad quantum advantage is key, because it has a nonspecific ability and the confidence that your quantum algorithm underpinning it has that exponential advantage to take duration into the future and have an application that will last.

And right now, it is an exciting time at Righetti, because we're reaching that stage where we can be on the road to quantum advantage. And let's talk a little bit about our strategy and approach for that.

But first, the optimum -- I want to talk about how we're approaching this and how we're really on track with an example for you. So optimization is a largest application types in the world. Every organization has applications in optimization that need to solve. And we've been focused on this for several years.

And just to give you an idea that we're not starting to do this recently. For a number of years, we've been building the capabilities with proof-of-concept using the QA OA algorithm, internally demonstrating that then to customers leading to a DARPA program called ONISQ, where we're moving from the prototype to advanced prototype stage. We are partnering with NASA and USRA on this. And what's exciting is that it shows our journey towards quantum advantage.

This year we're integrating error mitigation techniques that's going to advances to bring an advantage capable subroutine utilization. And it's the right time for us to start to build reference applications that's going to both focus on specific use cases, where broadly the insights that we take and integrate into an application that can be operated and benchmark continuously.

Our strategy in quantum advantage has four main components. And what the important point here is that we have a program on quantum advantage that's been going on for several years.

And number one, it starts with the reference applications. These are applications we're integrating our technology moving from prototype working with the customer. The second component inside that application at the heart is advantage capable subroutine. And these are the subroutines that's the algorithm, the quantum algorithm, that's going to give you that advantage. This is required for demonstrating the narrow and broad quantum advantage.

The third point is that you need to be able to do error mitigation and eventually leading to error correction. Error mitigation is necessary for all quantum applications, and error correction will open up a new class of applications.

And finally, I think we care a lot about this tracking progress, benchmarking. So we're rigorously evaluating our progress with our partners and customers so that we can track how we're doing, understand that gap and work to close it.

So diving a little bit more deeply into the reference applications. We're focused on a couple of categories here. Quantum machine learning is our primary focus. We're also working in optimization and in simulation as well. A reference application is integrating all the necessary components that you need to realize quantum advantage and now is the right time.

When people talk about applications in quantum computing, you're not sure what it is. Is it some libraries on a website? Is it an early prototype, that's not very functional. Our reference applications are focused on being full scale with the data input, output that has an industry known formatting, so that practitioners can use it. And inside it has the quantum subroutines and the classical subroutines rigorously benchmarked and focusing on the road to quantum advantage.

So, what's critical? This is aligning our efforts and focusing our efforts at Righetti across all of our teams. And it's inspiring our partners to join and work with us as we move towards quantum advantage. Second component are those subroutines, which you could think about is the motor of the rock, as Chad talked about. And these are critical to achieving quantum advantage.

There's two ways to think about these. Number one, it is a classically reproducible or actually can it go and be beyond classical into advantage. We've had great demonstrations in the last few years in sampling and machine learning by Google and Xanadu[ph], showing that we're on that road. Unfortunately, they're not for useful application, that is the final step, but they highlight that we have de-risk that roadmap to quantum advantage. Because we're showing they have a capability to go beyond classical.

Our focus is on the top left, when you think about the value of the problem is a commercially viable or has low to (inaudible) value. And so our focus is bringing our QML optimization simulation application areas into the advantage capable subroutine regime. And so we're focused on applications that are useful today and the subroutines that underpin that and move us into advantage.

Error mitigation is key. Think about the rocket engine as that subroutine that classical algorithm. Error mitigation gives you that boost. Everyone has errors today. There's incoherent and coherent errors. And they must be mitigated a way to reach quantum advantage. We have a superconducting platform that's really strong for error mitigation.

We've already been releasing some tools like (inaudible) that allows programmers to access lower level pulse control over devices to reduce those error rates. We have other ones we're working on with partners. But our superconducting qubit platform is really strong because it has that fast data rate allows you to make those identification of those errors and mitigate them. And it has the scalability. And so we're confident in our ability to mitigate those errors.

And we're excited this week to announce our beta of Keysight True-Q collaborating with them. This is our first third-party integration on QCS, and you'll see more to come. We want to bring the best products and features to improve performance of quantum algorithms to our customers.

True-Q uses randomize compiling to reduce the coherent errors by making modifications to the circuits before it's applied to the QPU. So, we've built the service, we're entering the beta with customers now to test that and show the improvements. Importantly, we've already benchmark this internally and showed improvements in our quantum algorithms.

I'm excited to introduce by video, Joseph Emerson.

(Audio Video Presentation)

Thank you, Joseph. So after error mitigation as you look forward to scaling what error correction brings you the ability to open up new classes of application, and it addresses long-term those errors that accumulate. So error mitigation is critical and error correction opens up new applications.

Where error correction works, is you're able to use additional qubits and fast processing to detect and correct those errors. This extends the complexity of the circuits you can run. We talked about circuit depth as how many circuits you can run or the time of computation. And then we talked about width or how many qubits you can run. Both of these are critical to advancing complexity in achieving quantum advantage.

Our superintendent qubit approach is really beneficial and works well with error correction because it has a high repetition rate, our 2D architecture, a multi-chip scaling capability, and we're able to run the surface code architecture on our devices.

So we're developing the hardware, software and tools necessary to both use and share the error correction capability in the future with our customers. And we're starting now to run those error correcting codes on our devices with the Ankaa chip that's coming early next year.

And so, what's really important to keep-in-mind here is that this is going to open up those new application classes and will advance our progress. And tracking progress is really key. And so benchmarking is core to all that we do. We have a couple government programs around benchmarking. But it's key to go beyond specific component performance metrics into solution and customer-driven KPIs that Greg talked about earlier.

And so that's what we're doing. We're going beyond just the quantum volume, and measuring our progress. Because everyone ask and our customers care, how far away are you from quantum advantage? So, benchmarking is the way that you're going to track your progress insights on what the next steps are to achieve the quantum advantage. We're engaging partners in this pursuit, and this will be something we talk about more in the future as we track our progress.

So to conclude here on our roadmap, we have a full stack integrated product roadmap towards quantum advantage. We're building that not just for Rigetti but for our customers and our partners, and will monetize that road to quantum advantage. We're offering products and services into QCS that built in the Fabric of the Cloud and sharing them with our customers as we advance.

And just to give you an example of what narrow and broad quantum advantage are like, it's as if you're going to the Moon. If you reach the moon, you land and come back, which we've done before and we're going to do again as humans. That is like narrow quantum advantage.

You've done a computational task that's better, faster, cheaper in time. But you can't stand the Moon, it may not last. So the broad quantum advantage with the underpinning of the non (inaudible) subroutines allows you to go and stay on the Moon, build a Moon base, and create an economy survive and build a great vibrant economy with quantum computing.

So with that, I'd like to thank you. And invite up David Rivas. Thank you. David is our Senior Vice President of our Quantum Cloud Services.

A - David Rivas {BIO 22740204 <GO>}

Thank you, Eric. Do I need this, microphone? Are we good? Can you hear me? Excellent.

Good morning, everybody. Thanks for being here. Thank you, Eric. Thank you, Chad. This is been a great build up to a discussion I want to have about our quantum cloud services platform. As you said, my name is David Rivas. I'm the Senior Vice President of Quantum Cloud Services.

I'm here at Rigetti because we're going to build the world's most powerful computers. Many of us here are very mission driven, but that's a statement that you don't often get to make, say something quite as big as that. So the Moon landing thing is appropriate.

The world's most powerful computers are going to be delivered on an architecture that is a hybrid quantum classical architecture. It is that architecture that is going to get us to quantum advantage. Quantum cloud services or QCS is how customers build and execute hybrid applications on Rigetti QPUs that will get us to quantum advantage.

We recently did a proof-of-concept around a medical image recognition machine learning algorithm, a hybrid algorithm. The basic idea here was, we were going to take X-ray data in, we build a quarter -- we take a corpus of X-ray data, we build a machine learning model on it, then X-ray data can be inferred and then actually what happens from that inference machinery as you get recommendations for doctors and patients as to next steps.

The point here I want to make is, it's a big application. But more importantly it's based on one of the subroutines that Eric was just talking about. It is essentially a hybrid architecture, and it requires a hybrid architecture to support it.

Now, every time I talk about this I get asked, what is hybrid quantum computing? It's actually pretty straightforward. To start, you have a a classical program that calls a quantum program and returns a result. Now practically speaking, that's going to happen many times, thousands and millions of times in many cases per second. And what you need to support that is the machinery necessary to actually run and operate that classical architecture that classical and quantum architecture into a system that is actually capable of executing that algorithm.

Now, that quantum hybrid algorithm is something that is a part of the application, but the application itself is actually much-much bigger than that. So if we're talking about the proof-of-concept application that I was just describing what we're talking about is a system that's capable of capturing all of the data, it's doing the machine learning, the inference aspects of it, the learning aspects of it. It's delivering results to doctors. It's integrating billing systems with hospitals and such.

This is an application that is going to run on a large system. A large distributed computing system in a cloud somewhere. Maybe it's a public cloud, maybe it's a private cloud, maybe it's some hybrid of those two.

What quantum cloud services does is it gives you the engine within which to execute that hybrid algorithm and then integrate that into the entire platform. So we have a hybrid algorithm running on quantum and classical computing integrated into the full system. You can think of quantum cloud services as the operating system for that hybrid algorithm that allows you then to integrate it in to the rest of the system.

Now, when you do that integration, you are inevitably doing it over the cloud. QCS integrates QPUs deeply into the cloud wherever and however our customers use the cloud. In many cases, what we have our customers who want a complete development environment for doing quantum application development and execution.

With QCS direct the configuration of QCS, we provide them that. It's in the box solution for everything you need to write and run a quantum application, including the classical processing you need to run that. However, if you think about the example that I just gave you, the customer is going to have that broad collection of classical hardware, and they're going to want to integrate the quantum hybrid part into that big classical application environment, QCS can be configured with QCS anywhere to leverage the classical resources that the customer already has, bringing our QPUs through the cloud into their environment.

Similarly with the public clouds, all of the public clouds now are slowly but surely getting the point where they're standing up quantum services. QCS integrates our QPUs into that quantum -- into those quantum services, into those public quantum services.

It's important to note and this relates to a question that was asked earlier about colocation. It's important to note that QCS is a multi-regional system. We have QPUs in United States and we have QPUs in the UK. This will become important -- this is important, and will become clear why it's important in a moment when I talk about integration.

But if you think about it, you don't really want to separate your classical resource from your QPU to much. You want to bring those things closely together. So that multi-regionality is actually quite important. The underpinnings of QCS are the stack. We think of the stack as having two fundamental components.

That system layer that I described to you earlier, this is the operating system that allows us to execute a hybrid algorithm and integrate it with a system, includes things like the ability to schedule applications, the ability to do billing, the ability to find out what kinds of QPUs are currently available and find out what their capabilities are, a user management and such. This is the core of the system.

On top of that and for the purposes of configurability we offer additional software and integrated development environment, compilers, and simulators. The things you need to do built to develop applications critically one of the elements in that packages the software development kits. These are software tools that integrate into the language of the customers choice to allow them to use the underlying operating environment.

It's important to understand that as we scale this system, the only thing we're scaling is the software that sitting on top that fundamental engine at operating system that is part of QCS is the same operating system, independent of how and where we deployed. It is one piece of software that is tightly integrating classical and quantum processing, and then running in the various modes that I just described.

We're talking about building applications. And so there's a whole set of tools for application developers that we provide. What's important to understand about the kinds of tools that we provide as we provide tools that are familiar to the customers, based on tried and proven techniques, our integrated development environment, for example, something that QML[ph] community using on a regular basis.

We also support a broad collection of programming languages. Now we have our own PyQuil and we have our own language because we are a full stack company. Because the capabilities of the processor itself need to be exposed at the -- with highest efficiency. But we know that much development takes place on other platform.

So, as a strategic point, we ensure that we can support as many of the most popular languages as we can, so currently we support Qiskit and Cirq, and on the new Azure platform we support (inaudible). I'm going to take a moment to talk a little bit about language choice for the SDKs, and I promise you this is not just geekiness. This is really important in terms of the strategic ability for the platform to expand.

Our SDKs are available in Python, C, and Russ. Python is the ubiquitous language in scientific computing today. Anybody who is doing machine learning or is doing work in quantum is using python. So, of course, we support python.

Russ is a platform that is extremely high efficiency. We build our most performance systems using Russ, so we use it internally and it's an up-and-coming language. But critically Russ gives us the ability to use the C-programming language.

Now by exposing our APIs and our SDKs in the C-programming languages we get two things. First, C is the language for supercomputing. All supercomputing codes are either written in C or its cousin C++ or some language that can integrate with C. So we naturally enable QCS to support supercomputing essentially out of the box.

Second. Almost all new programming languages support C as an integration point. So for the purposes of expanding and supporting the evolution of the platform, C gives us the leverage there. New programming languages come along, they can easily be integrated into QCS for growth.

Excellent.

So I want to talk a little bit about performance here, because an awful lot of what we've been talking about today and what we do as a company. It is about ensuring the highest possible performance. Remember when I was talking about hybrid programming, classical talking to quantum.

The business of running that a thousand or a million times a second implies that we have to bring those things closely together. We have to tightly integrate those two components. By virtue of us being a full-stack computing company, we actually have the ability to touch all of the parts that go from the classical to the quantum and ensure and optimize those parts for speed and efficiency and overall performance. And we think we've done a really good job here.

You've heard us talk already about circuit layer operations per second or CLOPS. I know it's a mouthful. It's just how it is. It resembles something though called FLOPS. FLOPS is floating point operations per second. I bring that up because that is one of the key metrics in supercomputing marking performance, and CLOPS is a similar metric.

I've described to you so far today a system for executing hybrid applications app -- hybrid application execution engine. CLOPS is a measure of the performance of that hybrid execution engine. And today by virtue of the work that we have done, we can say that we are the highest performing execution engine in the quantum industry.

Let me say that again, we have the fastest quantum hybrid execution engine in the industry measured by CLOPS. You saw the roadmap here earlier, Chad talked about it. Eric did a fabulous job of talking about each of the components here.

What I want to say here is that first half of the QCS roadmap is what got us here today. We are capable of building of -- giving our customers a full-stack development environment to both build and execute quantum programs, integrate them into their systems and integrating them into the cloud. But we're not done. There is inevitably going to be work done in hybrid. Eric already talked about the error mitigation work in the roadmap that we're talking about there.

Error correction is critically the next step. One of the next on our road to quantum advantage. A component of error correction, dynamic circuit execution implies deeper integration than we've currently done, but we have -- what we have a path towards. And enables the actual implementation of those error correction codes that Eric was explaining how they work. This is fundamental software technology and integration technology to perform error correction.

We work with the best partners in the industry. I'm particularly proud of our integration with Azure quantum. Eric talked a bit about Keysight Technologies and the integration of their error mitigation technology into our platform.

I want to underline something that Eric just said. That integration, that's the first integration of a third-party product into QCS. We believe that the integration of the best of breed technologies into our product only makes our product better and QCS is ready to accept, and we proven that they can accept those kinds of integrations.

Now I want to talk a moment more about another partner that we're working very-ery closely with. Ampere Computing is a semiconductor metric, CPU manufacturer, that optimizes for the cloud. Not only do they optimize for the cloud, but Ampere Computing is got a high core count CPU that they're also optimizing for machine learning.

So we have CPUs optimized for the cloud, CPUs optimized for machine learning, quantum processors to integrate with those, and execution environment provided by QCS. It's a pretty good sweet spot for us to be in when it comes to partnering with somebody. Ampere and Rigetti can do tremendous things with bringing quantum computing to existing customers, joint existing customers, and provide solutions to problems they have now but certainly problems that they will have in the future by virtue of our innovation.

I'd like to queue you that I'm going to about to play videos, I'm going to need audio. And then introduce you to Jeff Wittich, the Chief Product Officer of Ampere Computing to tell you a little bit more about our partnership.

Volume?

(Audio Video Presentation)

(Technical Difficulty) QCS and hybrid computation on Rigetti's QPUs will get us to quantum advantage. Thank you.

And with that, I'd like to invite Chad up for some questions-and-answers. And Eric, of course.

Operator

Please raise your hand if you have a question.

Q - Analyst

Great. Thanks, everybody for the great presentations. Really appreciate it. I'm trying to -- I'm trying to make an analogy, so that I can understand what are the challenges that you guys are tackling right now. I understand the full stack approach, and I think the analogy I'm hoping that you can help make to like the X86 computer or something like that. I understand a full stack would be a transistor at the bottom and then applications at the top and it sounds like you guys are prosecuting the systems and APIs. And I think, those are probably very well understood. Kind of problems and I imagine that.

On the technology side, there might be, my mental model would be like, okay, you got a transistor, you got a micro architecture, you got an instruction set architecture, and then you have a machine language on top of that and can you make it -- like is the qubit, the transistor and then you're trying to solve the things on the top of that. If you can make that model, I think that would -- that would be helpful for me at least to understand what the challenges you're prosecuting right now. And then I had one other follow-up if that's okay.

A - Unidentified Speaker

Yes, sure. Let me start David. If you've got something to add, I'm sure you can add.

Sure, I will.

So, I really view the -- I mean, the qubit is like the transistor, right? So, that's the clear analogy.

Q - Analyst

Great.

A - Unidentified Speaker

We -- I believe Intel is a great mental model in the early days of what they achieved and ultimately going from the design and fab of the chip, building a processor getting to market and going all the way through to software and the libraries to make those chips and that technology broadly impactful, broadly useful and integrated into technologies around the world.

So, ultimately, that is a from an operating perspective, we believe that's the kind of scope of how we think of it. Now, the specifics obviously are a little bit different. We don't use semiconducting materials, we use pure silicon and superconducting materials in our fab process. Feature sizes are vastly different, but ultimately it's semiconductor style a manufacturing that -- as we're going to hear from Mike Harburn who has 30 years of experience in this and to tell you much more about that, but it's semiconductor style manufacturing at that level. Now going up the stack, there's a lot of software and David just very beautifully walked us through all of that, that we build and deliver to our customers to ultimately unlock the computational power of this technology and solve high value problems.

So, David I want to hand over to you to talk a little bit about maybe some

The instructions at architecture analogy, for example, and how an operating system fits into all of that kind of thing. So, it turns out we actually have an instruction set architecture. It's made up of the gates that operate on the qubits. And in fact, there is a call in the APIs to get access to that instruction set architecture. On top of that, we end up building compilers to actually compile the final solutions. Now it's a hybrid -- it's a hybrid system. So, there's a classical component to it and there's a quantum component to it and they need to be integrated. The compilers job usually is to ensure that the -- that division is well understood and different executables are produced in the process and the leverage, the instruction set architecture of the quantum in the instruction set architecture of the classical to produce those artifacts.

And there's translation steps in each of the stages of the stack to do that. Once you have that you build on top of it with APIs. So what we have now is we have a distributed operating system that is integrating over the cloud with the rest of the system that integration I was talking about is a big part of what QCS actually does, it ensures that can happen and you access it through a set of a of what are essentially operating system like APIs. Did that help?

Q - Analyst

Yeah, I'm slowly getting there, and so is the -- I mean it seems like the software challenges would be fairly well understood is that it's a matter of prosecuting cranking out that software and iterating that to make sure that you're compiling properly in Europe. You're getting the most optimized versions of that. And it seems like that the technology portion of the stack is where you're putting a lot of the things that are maybe not as well understood. And that's what your -- you -- when you talk about like the error correction and things like that. And that's what we do in and integrating like the classical and non-classical instruction set or it sounds like that's where you're prosecuting the most.

A - Unidentified Speaker

Indeed.

Q - Analyst

Like, okay.

A - Unidentified Speaker

Indeed. And one interesting thing. So we have talked about this publicly, but there is a partnership that we have with Microsoft around an intermediate representation, so deep in the compiler to help solve some of these problems. So the business of multiple architectures all engaging at the same time to perform a computation has been predominantly research-oriented until very, very recently. So there is work to be done there and we're doing it and we have this phase in QCS to execute against that. This is something that many of our competitors can't say. We have the platform with the places for all this technology to go into.

Q - Analyst

Got you. And then is -- in a -- I could have a follow-up question if I may. If you were to like -- if you would like to kind of make a comparison you talked about Intel, and I imagine that you're doing -- you're doing the whole system kind of from scratch and introducing a new computing approach to the whole world. And so I might -- I don't know if like the PC is the right analogy or a supercomputer or a mainframe computer back from the 50s like, where would you say that you are, what's the right analogy to think about? Are you -- are you kind of like making UNIVAC and then doing everything from there or like are you -- is it kind of you use the Intel analogy? You're making Lotus 1-2-3 or something like that you got the semiconductor already kind of like down, like is there an analogy that you can help us with there? Thank you.

A - Unidentified Speaker

Yeah, we --it's a good question, I really appreciate it. We might need to crowd source it with all the expertise we've got in the room, but I really think of this as kind of an Intel or NVIDIA like kind of full stack company. Intel actually do the manufacturing obviously is a good one, but in a cloud era right where you can build machines and deliver them directly to end customers will operate in them from your own data center.

And where those machines are not 2x, 10x generation-over-generation, but have the potential to be a thousand and a million times more performing for those high-impact workloads and that gives it a blend of the big, the high-performance computing or even the space energy if you will the space kind of approach, because it's so impactful when you start to unlock those capabilities. And so that's really how we think of it. I don't know if there's a clean and simple analogy, if there is I would love to hear your suggestions.

One further comment, one of the good things about developing these machines now. We have 80 years of classical computing. We have Open Source software, we have networks, we have cloud. We're in a position to apply all that to the development of this very new technology.

Q - Analyst

Okay. Mark, we got a -- yeah, it's and we absolutely no, absolutely. So we just want to -- we have a question from the audience that we also want to feel to hear. So one of the audience members is asking, he appreciates that Quantum volume and AQ benchmarking have limitations. So when might we expect further communications regarding how the company would like to benchmark themselves towards success?

A - Unidentified Speaker

Yeah, thank you for the question. Great one. So the benchmarks are really driven by that solution, specific to the reference application. And so, we're developing these now and we're working closely with partners and customers. So we expect that these benchmarks are beginning to be used case specific. We'll come out with our customers, and so will support that development as we work closely with them those will be shared.

Q - N. Quinn Bolton {BIO 3192909 <GO>}

It's maybe a longer-term question -- sorry. Quinn Bolton with Needham. But when you look at the applications for quantum computing, how much of those applications need to be real-time versus non-real-time? There's an example in the financial services industry, where quantum may be able to accelerate applications by I think about something like securities pricing that sounds like that's got to be a real-time application or it's not very useful on the other hand scientific stimulation probably doesn't need to be real-time.

And I guess ultimately where I'm going with this is, if you need to be real-time cloud service model sounds like it may not be ideal to optimize and be able to do something in real-time. And ultimately do you think there's a model that says big organizations whether they're commercial or government need to have quantum computers on site rather than delivered over the cloud? Thank you.

A - Unidentified Speaker

So yeah. Maybe I can start. I think as David walked us through our strategy is to enable access to our computers by leveraging, the power of the cloud and integrating our quantum into that computational fabric that heterogeneous compute fabric. Right now the vast majority of the applications we see benefit from that and require that. I think there are different kind of computing models that we enable through our platform, whether it's the reservation-based or on-demand access that we believe we're going to be able to serve much of that in that model.

Now, going forward, there are going to be certain organizations when you start to reach quantum advantage. This is so essential to their workflow into their business that they're going to want to own and operate their own quantum computers. We believe that ultimately that infrastructure will still be talking cloud like environment, whether its private cloud or hybrid cloud into that, what we've built -- what we're building today will ultimately apply into that phase of the industry.

And in addition, a critical capability needed to unlock that specific opportunity is the ability to situate QPUs where the customer may need them. And by building out our connectivity and facility in the UK, with our one already here in Berkeley. We're beginning to develop that muscle as an organization, be able to meet that need as it arises in the industry.

Q - Analyst

Just like this is a quick follow-up. You highlighted there's an emphasis on quantum machine learning is one of the first applications. Is that mostly focused on the training or be both training and inferencing?

A - Unidentified Speaker

In fact, we're seeing application or the possibilities to integrate quantum circuits and quantum programs with various aspects of what you think of more broadly as AI and ML today, whether it is at the training stage or the inference stage or in generative models where quantum we believe because of the fundamental properties of quantum mechanics can have advantage over traditional -- over purely classical approaches. It's kind of a -- there's multiple different insertion points if you will in a machine learning framework, machine learning model where we believe we're seeing evidence that quantum can lead to increased customer value, increased end user performance.

It's also when one thing like it's a very vibrant field. If we believe AI research is moving fast, this is also moving very, very fast and it's a really exciting, it's a really exciting time as the kind of practitioners across traditional AI approaches, deep learning starts to work together with it with quantum algorithms folks. It's really exciting time and evolving quite quickly.

We're taking a break.

So of that were -- we've got one more question, please. Yeah.

Q - Krish Sankar {BIO 16151788 <GO>}

Hi there Ravi on behalf of Krish Sankar from Cowen. Thanks guys for hosting us. Just double-clicking on the challenges question. Would you classify building the qubits themselves as the main obstacle and reaching quantum advantage within the financial industry or is it more the application layer? And two, you guys want from stacking two chips on as many 11 to 4 potentially with Lyra. Does it get exponentially more difficult to add more chips and achieve low error rates or is it basically the same challenges?

A - Unidentified Speaker

Thank you for the question. We're going to hear much more about our multi-chip processor architecture from Allison in the session after the break. At a high level the core of our multi-chip scaling strategy is that we believe it's going to allow us to very quickly reach the performance at scale, by leveraging a tiling unit where the performance is established and optimize over multiple -- over a period of time and quickly lift it through a multi-chip processor architecture into ever larger quantum computers. And we don't see today evidence or indication that this is going to be an exponential challenge as we scale, but that is ultimately solved by the multi-chip approach that we've developed and heavily patented.

Q - Krish Sankar {BIO 16151788 <GO>}

Okay. And with that, we're going to wrap up and take a 10-minute break and we'll meet back here. Thank you much.

A - Unidentified Speaker

Welcome back, everyone for second half of our Investor Day. I am thrilled to introduce Mike Harburn, our Chief Technology Officer and welcome him to the stage. As well as two of our very best and brightest engineers and leaders Allison and Andrew who are going to tell you much more about the hardware roadmap. So with that, welcome, Mike Harburn.

A - Mike Harburn {BIO 22740137 <GO>}

Thanks. Was it quicker? Well, thank you. Good morning, everyone. Thank you, Chad for the introduction. Good morning, everyone for everyone who's in attendance and everyone attending virtually. As Chad mentioned, my name is Mike Harburn, I'm the Chief Technology Officer at Rigetti Computing. I've been fortunate to be at this fantastic company for now going on about 4.5 years. We're going to hear from this section, is really the strategic investments that the company has made over the course of the past many years at the chip level, that helps to underpin our performance at scale road map.

As Kevin mentioned, I'm lucky to have two distinguished physicists with me today Andrew Bestwick and Alysson Gold, they're going to. After I'm done, they're going to go a little bit deeper into both the scaling and performance thrust that we have ongoing at the company. So this is the roadmap, similar roadmap, same roadmap that you saw from both Eric and David. What I really want to focus on for this talk is really at the bottom chip fabrication and the things that lie to the right of that Alysson -- or sorry, the Alysson and Andrew would go a little bit deeper into, but we really want to focus on chip fabrication how that underpins the above quantum processing units and how we're going to achieve not only the 336, but also the 1,000-qubit, the 4,000-qubit and beyond QPU systems.

So the quantum processing unit or QPU as we call it is really one of the cores to our full-stack approach. And what I really want to do is give you a couple images to kind of lovely sight you for the critical hardware that goes into the QPU. On the right-hand side is the inner workings of a functioning QPU system. A lot of the components are cooling related, there's wiring from top to bottom. And what I really want to draw your attention to is at the very bottom of this structure lies the heart of the quantum computing system, that's really the quantum chip.

On the right-hand side, there is an image of a quantum chip. At first glance, you may say that looks a lot like a semiconductor chip, uses standard semiconductor chip and visually it does. And luckily, we've been able to really draw on the past 60 plus years of semiconductor and wafer processing, knowhow expertise pull it into our fab to be able to produce our quantum devices. But there are distinct differences and nuances that goes into a quantum chip versus a standard semiconductor chip really in terms of specialized processing and the materials that we utilize for building our quantum devices.

Later on for those of you who are in attendance, there's going to be a facility tour of the fabrication and we'll have a dilution for just QPU systems open up, so you can actually look at them much closer and we're also going to have quantum chips, quantum devices that you can actually hold in your hands and get a better view. We actually have some examples on the back table, so during the breaks you can actually look at them also.

So underpinning the ability to supply the heart of the quantum computer, again the quantum chip lies Fab-1. Fab-1 was officially online in May of 2017. Now after 20, so I've been involved, I have been working for 30 years Chad. I'm not that old, but I've been involved a little bit over 25 years, heavily on the semiconductor or working around the semiconductor industry. And what I've seen in those two and a half decades there's so much of the nation's technology has been sent offshore to foreign countries, foreign foundries. So, I found it so refreshing when I was being interviewed to come to Rigetti that facility like this was landed on U.S. soil. I'm not passing the box of manufacturing in the U.S., especially for such critical technology. And I mean, we're better to have the world's first dedicated quantum facility than in Silicon Valley. I mean, this is the heart of the semiconductor revolution that took place in the early 60s, with their Fairchild's, with Hewlett-Packard's.

And I would make an analogy, we're at the forefront. Again, we're better to do this than in Silicon Valley. I mean, whether this has really helped us and is really attracting some key world-class talent, not only from Tier 1 commercial entities that's in the Valley, but also world-class academic institutions. When you couple that with the global talent, we've been able to collect. I think we have representations from 23 or 25 countries around the globe. We've been able to harness that pull together a fantastic team of highly educated, highly talented quantum physicists and engineers to form a very symbiotic team.

With that, I'm really excited to announce that at the beginning of the year, we took on a really major undertaken to expand Fab-1. The completion is well -- is on plan to be completed by the end of this year. When it is completed, we're going to almost double the space of the current Fab-1 clean room capacity. And this additional space is going to be what really underlies our ability to supply the future 1,000-qubit and the 4,000-qubit products in the 2025 and 2027 time periods.

A key aspect of our fabrication capabilities is that we can take an end of the line product device, whether it's a product device or test device and actually get final metrology test data at the environment that the quantum computer actually operates. We have dilution fridges as I think, Chad has mentioned up in Berkeley and in Fremont. And have these - the other take end of the line device testing has allowed us to really augment the fab with really quick cycles of learning. We can literally take a completed device, walk 20 feet, put into a dilution fridge and get end-of-life -- end-of-line data.

And what's really -- this has really helped in cycles of innovation. We also use this data to feed back to the fab as key metrics. How is it working. We can track on a weekly, on a monthly is fab progress. Are we stable, or are we having issues and that is only made available by having the dilution for this coupled with our quantum fab.

So, outside of the talented people, I would say the most vital asset the company has invested in over the course of the year is Fab-1. Now, what was a good -- what I would say it was a good investment, good decision back in 2015, 2016, I would say is now a phenomenal investment, fantastic investment when you take into effect that not only has captured fab (inaudible) where we're at now. It's really shielded us from the last 2, 2.5 years of the global supply chain effort -- global supply chain issues.

Sorry. Apologies. So, it's really allowed us to be shielded by the supply chain issues that have hit so many industries and companies. We've really been able to continue hitting on all cylinders, because we control our own destiny. We have our own quantum fab, we're not relying on outsiders to provide any of the key quantum chips to us. The other thing I mentioned earlier having this quantum chip really helps innovation cycles learnings. What we call the flywheel -- we call the development flywheel. We can take a design, fabricate it, test it. And the quicker we can turn that flywheel, the quicker we can innovate.

And at this moment, we can take from bare silicon to finish product depending on the complexity, we can take that and finish it in 5 to 15 weeks. The other areas that this Fab-1 really allows us is capital efficiency. And we're really going to capitalize on that for how we're going to take our multi-chip scaling architecture and meet the future 1000-qubit, 4000-qubit systems.

So, when you couple Fab-1 with again, the talented the people I had mentioned that the company has been able to attract. Fab-1 has been able to generate a tremendous amount of intellectual property for the company. And last, what I'd like to leave you with is, I don't consider Fab-1 just a Rigetti entity. We've been able to have strategic partnerships with world-class academic institutions with national labs from around the world. And I'd almost -- I don't want to say Fab-1 is a national asset, a national treasure that isn't just accelerating Rigetti's quantum speed forward. I think it's the entire world quantum initiative that we're hoping to fast-forward.

And with that, I would leave you with-- we firmly believe Fab-1 serves an entry to barrier. What do I mean by that? So, whether you're a startup on an established company, if you want to consider opening up a similar facility, you're going to be spending tens of millions of dollars and it's going to take you years to do, because you've not only got to build the facility, you got to staff it with the right people. You've got to staff it with the right equipment. And then it takes you years to get those processes developed. So, I think in the end, we find ourselves in a very enviable position having a Fab-1 facility at our disposal.

And with that, I would like to hand this off to Andrew Bestwick. Andrew has been here for almost seven years, so he was here pre-Fab-1.

A - Unidentified Speaker

I was. That's right. And I like it much better now. So, I'm Andrew. I work on the design, the fabrication and the packaging of our -- of the chips that power our quantum systems. All I do all day is think about how to make these chips bigger and better, which is why I'm really excited to talk to you about how the investments that Mike was just describing are going to power our roadmap going forward. So to reach quantum advantage, our chips need to provide our customers with two things. We need a large number of qubits on the chip and the fidelity of those qubits operations needs to be high. The error rates, in other words need to be low. That's important for reaching quantum advantage. Eventually, you can reach a point where those Fidelity's are above some minimum threshold and you have enough qubits that you can start treating them away for a higher effective fidelity's that's error correction.

Either way, the bottom line is, we want to get as many high-quality qubits to our customers as possible. So to tell you how to do that, how we're doing that. I want to start with where we're coming from. On this graph I'm showing on the horizontal axis the number of qubits on the chips that we have deployed to customers over the last five years. And on the vertical axis, the median fidelity of the two qubit operations, kind of the most important low-level metric of the quality of the circuits.

As you can imagine, in the early years, we were kind of in the lower left part of this graph, just a handful of qubits Fidelity's in the 90% range and then as we started deploying systems to our customers, we got to the 15 qubits to 20 qubits scale and really worked our way up infidelity moving vertically up on this graph.

In recent years, we've taken a big turn towards scaling all the way out to our most recent 80-qubit multi-chip Aspen-M series systems.

Now, it's time to take a turn to performance again, and that's why we're excited to talk today about our new circuit architecture, the fourth generation architecture as -- and that's going to -- that's expected to give us a big leap in fidelity and then we turn to our multi-chip scaling strategy, which is designed to take the chips at that performance and rapidly scale them at the same or at better performance.

So, the fourth generation, our circuit architecture designed for quantum advantage. The most important aspect of it is that we're taking the way we do qubit-qubit interactions and bringing in our latest technology. We're going to replace the fixed qubit-qubit couplers and our third generation architecture with tunable couplers in the fourth generation architecture. These tunable couplers allow us to turn the entanglement, the interaction between qubits completely off or completely on. And when we turn it on that interaction is strong, strong interactions means fast gates. Fast gates mean low error rates and high fidelities. The other really nice thing about this architecture is that it's denser. Every qubit has four nearest neighbors it can interact with that means more efficient and higher performance algorithms and most importantly it's really, really well optimized for error correction.

Now, we've been working on this for a couple of years. We've seen really great performance along the way. Fidelity's into the 99.5% range and we're really excited to get this to customers. Our engineers are excellent at getting the best possible performance out of these chips, which is why I think our customers are really going to like to see these.

And it's real. We are putting this architecture at the 84-qubit scale on our Ankaa chips. This is a picture of a real life Ankaa chip a prototype version. What you're looking at is primarily the inputs and outputs on the top of the cap, the circuit is actually kind of buried inside. But nonetheless, that's it in the flash right there. We're making these in the -- in our in this building in the Fab-1 facility. Those of you who are here today will get to actually see that in action.

And most importantly, we've got this chip cold. We're testing it and we're doing all the last mile optimizations tuning up, all the design parameters to get maximum performance. So we're excited to be on track to get this to customers in early 2023, and that's going to be a big moment for the company. But even more exciting, I would argue then that is what comes afterwards. We're going to be able to take these 84-qubit chips, place them side-by-side and extend the qubit lattice continuously to larger and larger systems. So to talk about how that works, how that multi-chip scanning technology works. I'm going to introduce Alysson Gold, who's one of our lead quantum engineers. He's been working on this technology.

Thank you, Andrew. So, you've heard about our next generation circuit architecture. How this is designed to give us a leap in performance. What I would like to share now is how without compromising on that performance. We can scale these systems up to the sizes needed for commercial applications and fault tolerance. And this is powerful.

We've been working on this problem for over six years now, having identified it as one of the key engineering challenges to overcome to scale these systems. There are and we have a solution now, we have a robust elegant solution in the form of our multi-chip architecture. This is underpinned by three key technological innovations. Starting with signal delivery, how do you get your information onto and off of the chip? Traditionally, this is done in the same plane as the qubits, so you have signals that are routed from the perimeter down into the core of the chip.

Now, this works fine if you have a couple handfuls of qubits, but as you start to scale these systems that becomes absolutely intractable. What Rigetti engineers have done is opened up an entirely new dimension with vertical signaling. This gives us high density IO. You saw that picture of that Ankaa chip with all of those input output pads in the top. It also gives us a very modular approach to signal delivery. We can tile this directly and as a consequence much happier engineers, our teams don't have to spend their time redesigning the system or that the signal delivery for every generation of processor especially as we start to scale these systems.

Getting to the chip level, very much in alignment with recent trends in high-performance classical computing, we have pioneered quantum chip technology, where we have individually fabricated dies that slot into this carrier die and it's this overall modular assembly that forms the processor, so we have a continuous integrated quantum circuit over all of these die.

This gives us advantages in fabrication yield. This is a great example getting back to your question about exponential scaling, yield is a problem that scales exponentially with a chip -- with the die size. Here, we've overcome that by keeping, our die size as fixed and we can directly scale. It has benefits in terms of performance improve, our processes, our performance. And looking to the future we'll enable heterogeneous -- and could enable heterogeneous integration with specialized chips for compute memory and networking. Of course, this only works if you have intermodule connectivity, which is virtually indistinguishable for your - from your on-shift connectivity. This is something the problem that I personally really enjoyed working on and we came up with a solution, it is both low latency and high fidelity in terms of the quantum entanglement across modules a first in the field.

Now if you take all of this together that gives you Rigetti's multi-chip architecture a very direct approach to scaling where we can tile these chips, we have good connectivity between them and really leads to underpins our future roadmap. Now, I've gotten a little bit into the technical weeds here, you'll have to pardon me. I am an engineer. But taking a step backwards, if you only take one thing away from this, let it be this. This is not an R&D project. This is a mature technology. We have 32 patents pending and it issued over this technology and it forms the core of our Aspen-M series. Our biggest and best processors to date which are publicly available on AWS and as we heard this morning, Microsoft Azure Quantum.

So where does that put us in terms of our product roadmap? Well as I mentioned, we have tiled our 40-qubit platform to get us our multi-chip 80Q Aspen-M series. This has given us not only equivalent performance, but in some areas higher performance than our 40Q, so we've demonstrated that you can tile all these directly. We are now ready to couple this in with that fourth generation circuit architecture that Andrew spoke of and the anticipated performance benefits there to give us our future product offerings, starting with the Ankaa system, 84-qubit chip and that's going to form the fundamental building block, which we will then tile to get us our Lyra 336Q in late 2023, our 1000Q+ system in late 2025 and the 4000Q+ system in 2027 or later.

Now, this process looks inherently serial in this chart, but as engineers, we are definitely tackling this problem in parallel for all of these leaps you see here. We are anticipating the engineering challenges and going after them now already. And with this in mind, I am very excited about our recent announcement of our strategic partnership with Bluefors to build and/or to develop the fridges that will support our 336Q, 1000Q+ and 4000Q+ product offerings. We will be combining Bluefors' world-leading expertise in cryogenic refrigeration with Rigetti's excellence in quantum systems engineering and operations. To develop this fridge you see here, the KIDE fridge. You'll note, not only is this beautiful and big, this is going to be one of the biggest commercially available fridges, if not the biggest, you see the person to scale there, but in line with Rigetti's own modular approach to scaling. Bluefors has designed these so that they will be able to be tiled so you can actually connect multiple of these KIDE fridges together to support larger and larger QPU systems.

So, bringing it back to Mike's original message, Rigetti is investing strategically in our Fab-1 facility you find yourselves in today, and our chip architecture, our hardware. In this system, you see here to deliver our customers performance at scale. Thank you.

And I think now we have Q&As. So if my colleagues can join me here?

Q - Analyst

Thanks, Sam. I only have one question this time in 14 parts. Is there Moore's law applied to qubit or something like Moore's Law, looked like the tiles that you had shown on that last slide were getting smaller. I am just wondering if there's something that you guys scaled down, and does the -- and can you stack these things? And then, the third question is this performance scale with the number of other system performance scale with the number of qubits. Thank you.

A - Unidentified Speaker

Yes. So, the first question Moore's Law is not a law of nature, it's actually an economic arrangement that everybody collaborates with together to create a roadmap that tool manufacturers and fab facility manufacturers and process engineers all can align to. We're still in the very early stages I'd say on quantum computing, and we certainly are eager to get on to that kind of trajectory. And we think the ability to scale this quickly is the kind of thing that can kickstart that sort of law. So, in other words, we're trying to make it happen ourselves I would say.

One thing I would clarify maybe is that we're not seeking to shrink the size of our qubits.

That's the big distinction.

As a strategic objective to minimize -- maximize the number of qubits per square millimeter. What we were trying to do is maximize the number of high-performance qubits, ultimately deliver performance at scale. And, if we can get on a Moore's Law of doubling the number of qubits and increase in performance on a regular basis, that's what we want to unlock, but that -- it's not about shrinking the components per se.

Do you want to talk about 3D Alysson?

3D chips, I think.

Yes. Our current roadmap we believe can be completely satisfied through just lateral scaling, but we're definitely going to be, we're definitely evaluating those kinds of scaling techniques all the time.

Q - Analyst

Yeah, thanks. I'm just trying to understand the scale of your manufacturing operations. How should we think about the volume that you are producing? Are they -- how many QPUs are needed persistent for example? And there any customization that vote the QPU for different customers from different applications? And then, I'll follow the portion.

A - Unidentified Speaker

Mike, do you want to take that?

A - Mike Harburn {BIO 22740137 <GO>}

Yes. So, what was the first part?

A - Unidentified Speaker

The scale of -- like how many?

A - Mike Harburn {BIO 22740137 <GO>}

So, I mean, I'll classify ourselves as a low volume high mix type of fabrication facility. I mean, we're not in a place where you have to run 100,000 wafers a month. We're much, much lower than that and we're looking to get handfuls right now, but really high powerful high-performing QPUs or devices out of the facility at this point. And most likely, we're always going to be what a traditional semi-factor would say, we're always going to be a low volume type of a fab.

Q - Analyst

And in terms of customization for customers?

A - Unidentified Speaker

I think.

I can take that question. So, at least on the -- so the hardware, and maybe Andrew can speak to, but operationally, we can actually do a lot to customize for individual applications and individual customers. We have an entire team that actually focuses on that, and yes, one of the benefits of Rigetti's architecture in fact is that we have multiple different gate schemes that we can use and we can configure to enable targeted performance per application.

Q - Analyst

Okay quick one, looking at the chart that shows there's a chart in one of the slides that shows there are more than 10 chips being introduced in the past five years. Are they just different spins of the same chip with different qubit count in fidelity and should we think about similar cadence of new chips going forward with your newest SAD fortune.

A - Chad Rigetti {BIO 21140357 <GO>}

Yes, I figured. I was talking about Andrew slide of the increasing qubit count and increasing performance during the step. So as Mike talked about one of the incredible benefits of our investment and strategic decision to build the fab is the focus on these flywheels. The design fab test flywheel. A lot of our effort and our culture is aligned around accelerating that flywheel. But that has led to when you combine that with our cloud deployment model or able to do is turn that flywheel design fab test cycles improve in the current architecture or take a leap for next step of the architecture. And that is light over time to multiple different instances of a similar -- of the same generation with increasing performance or different attributes that we may choose to make available to customers and that's a lot of what you saw in that chart with the Aspen ultimately one all the way through 11 and evolution now, within the Aspen series, we also scaled that from the 16-qubit all the way up to 40-qubit within the third generation circuit architecture. So going forward, I think it is reasonable to expect that. There's going to be multiple deployments of within generations going forward. It will ultimately unlock ever higher performance or variations in the processor to meet the specific needs that we're targeting.

A - Brian Sereda {BIO 5582338 <GO>}

One thing I would add is that, we believe the fourth generation architecture is going to get us through the quantum advantage era, but we're always going to be looking to get the best possible performance at all times.

A - Unidentified Speaker

And one thing I would elaborate on what Alysson had mentioned, happy engineers, we're making the engineers happy by really focusing for the next few years on this, 84-qubit building block, where we've never had that ability in the past, so this is going to give us month after month that we can focus on the same design to really hammer out the yields and performance, and I think that's a fantastic a building block that's going to support us for the next many years to come.

Q - Analyst

Given the wealth of knowledge, you're accumulating with your iterative process in the Fab-1. Do you see any sort of foundry in the street partnerships, foundry style industry partnerships in the future?

A - Brian Sereda {BIO 5582338 <GO>}

Yes, thank you. It is absolutely something that we think about and we have engaged in part of our ability to form. We talked about the ability to form partnerships at all the layers of the technology stack. That includes at the fab level and by working with partners. For example, through SQMS and fermilab we're able to both provide chips into the SQMS Center, and then those scientists and engineers assess our chips and help us understand their performance limitations, and we were able to feed that back into the fab process. So we think it's really important to do that. In terms of a commercial model, we don't have any plans in that regard today, but we're able to supply chips under some government programs.

Q - Analyst

Yes, I wanted to ask on the fourth generation 2-qubit or 2 gate medium fidelity up at 99% and 99.5%, that's a big jump from the 94%, 95% level of Aspen-M today. And so I guess my first question is, how confident are you that in a production system, you will be able to get to gate fidelity's in that 99% and 99.5%? And how does that compare to folks like Google and IBM with their superconducting architecture, because I think gate fidelity seems to be the one, push back on superconducting. If you guys can fix that, it seems like that's the biggest challenge facing superconducting today?

A - Chad Rigetti {BIO 21140357 <GO>}

Yes, thanks Quinn. I think we have been developing the fourth-generation circuit architecture with intention to specifically address what we view as a leading kind of error channels if you will or error sources within the third generation. The introduction of the tunable coupling technology is the technology approach that Google has used to demonstrate those high fidelity, is ultimately developed at Lincoln Labs and MIT. And so by introducing the tunable coupling approach, we are confident that we're ultimately going to be able to bring the Ankaa performance to the level of 99% and 99.5%. Eventually over time as we continue to iterate on those machines in that process technology and the circuit design even beyond that.

And I think it is also likely that you're going to see success of deployments with increasing performance over time within that Ankaa generation. So ultimately, last thing I would call back to is on our last earnings call we talked about testing for silicon of the Ankaa processors and we will continue to see performance in line with our targets and expectations.

Q - Analyst

Just perhaps a more general version of Quinn's question. Just a framework for comparing your performance versus other qubits out there, qubit coherence or just what inputs go into error correction because the qubits are more reliable, but there's also efforts to correct the errors. Just give us a framework for how to think about yours versus others and what are the important else?.

A - Unidentified Speaker

Specifically around error correction?

Q - Analyst

Qubit performance really right because that this is an important aspect of it in my mind, if its incoherent, it's hard to get any information out of them, right?

A - Unidentified Speaker

So yeah the way we really think about it is to run valuable applications, your quantum processor at the chip level needs to deliver the combination of speed scale and fidelity. And you can't, you can't do without any one of those. You need all three for it to truly perform -- provide the provide the benefit and superconducting qubits specifically are, we believe are very clearly best positioned around the combination of those three axis. So, the speed is industry-leading, the fidelity's with we're at 94% and 95% today. There's many demonstrations, we've done internally as well as other superconducting qubit players have clearly shown the ability to get well beyond 99%.

And it's really been a choice about what order we tackle scaling versus a very high fidelity in and ultimately you blend that with the multi-chip scalability that Alysson described and we're confident that we're going to be able to put all the pieces together on this roadmap we've shared to unlock home advantage. With respect to error correction the single most important thing in making error correction work is the ability to scale your physical qubit lattices. So you have enough qubits that you can actually run error correction because there's an overhead rate and the scalability of superconducting we believe makes it best situated for error correction going forward. The preponderance of error correction demonstration so far have taken place in superconducting qubit systems and we're confident it's the right approach going forward.

Just very quickly one from the audience, 99.5% fidelity seems a little bit lower than any other industry targets. Could you maybe speak to the appropriate level for effective overhead?

99.5% is our current median rate that we've demonstrated that we're talking about today. Our goal is ultimately to make those error rates as low as possible, error correcting thresholds and assessments for where advantage may appear. All kind of a line is being likely north of 99% maybe two and a half or three nines, 99.9% We are confident that ultimately, the fourth generation architecture, can get us there and then we've got the processor design and strategy in place iterate and achieve that performance over time.

Q - Analyst

Hi, thanks so much for the very edifying presentation so far today. This is Steven Chen from Calhoun Company. Quick question on sort of coherence times across the different types of modalities. So I know you guys from a superconducting modality standpoint are far ahead in terms of gate performance, but I think one of the performance parameters that we often hear about is the coherence times for gate-based methods. Just with the fourth generation chip technology and also the multi-chip scaling architecture any thoughts on how that might help to bridge the gap from a coherence time standpoint as well?

A - Unidentified Speaker

Coherence time is a very important metric for all quantum computing, but even more important than coherence time itself is the ratio of the gate operation time to the coherence time. That is what actually determines the level of coherence induced errors in the system, how fast you can operate and how many gate operations can be executed before errors as a result of the decoherence start to accumulate.

Super acting qubits and our processor technology, Andrew talked about the faster gates that we expect to unlock with the fourth generation circuit architecture. Doing that while maintaining the coherence times that we have today, we believe is going to be where we need it to be in terms of achieving the error rates ultimately and we also are the lead and as (inaudible) talked about the goal of the SQMS center. One of the five United States national economy of research centers. The overarching goal that entire center of the 23 research institutions with Rigetti as a lead industry partner is to systematically understand and eliminate the sources of decoherence in superconducting qubits. And that work is flowing into our process technology, into our fab at Rigetti and into our research. So we're ultimately confident, we're going to be able to continue to improve our coherence times and deliver the performance needed.

I would add one other point, which is that the important thing is performance at scale. That's true on basically every metric including coherence. It's easy to demonstrate high coherence is on a very small test chip, what's important? And what we built our roadmap around is getting the best possible performance that includes coherence in a system that can be scaled to large qubit counts.

Q - Analyst

Craig Alice, B Riley Securities. And I'm going to try and ask an even more complex question then Mark, so get ready, do your best. Actually, it's pretty straightforward. So I wanted to go back to one of your slides, Alysson that showed in our module connectivity because that seems like it's really, really important for the roadmap as an enabling technology and the question is this is we look at that capability. How extensible is it from the roadmap we're seeing, today through 4,000-qubit systems up through systems that would be even much greater than that over time whether it's 16,000 or 64,000, or whatever the number is. And what would be the technology challenge is to scaling that capability about high?

A - Unidentified Speaker

We believe it's directly accessible. I think one of the key advantages of the approach that we've taken is it's actually very similar to the way we do it the way our on-ship connectivity works. So, I don't see any challenges to using that to continue to scale. There's nothing about it that's tied to the system size.

I think, when we look out, I agree with all of that and when we look out beyond the roadmap through 2027 that we share today, ultimately we anticipate continuing to drive improvements in scale and performance more and more qubit to trade off an error correction and we are confident that ultimately will be able to go well beyond 4,000 qubits. We're also very pragmatic and those are the steps that we feel like we need to execute on over next handful of years to deliver quantum advantage to our customers to unlock QML for finance and these other application areas that you've heard about today.

Okay. And with that, I think we're ready to move on. So thanks so much everyone and I'm going to thank you. And with that, I am pleased to welcome Brian Sereda, our Chief Financial Officer to the stage.

A - Brian Sereda {BIO 5582338 <GO>}

Thank you. Now, for a little change in pace. What I trust by now that you've gained a new appreciation for just the depth of the technical requirements, the passion, the interdisciplinary, engineering and scientific minds that it takes to propel this like any company involving quantum forward. I'd like to thank that Rigetti not only has the right vision, but has made the right economic decisions historically and continues to make them going forward. And we also understand the absolute need to remain focused on our roadmap going forward. And by that, I mean, we're absolutely laser focused also on good capital stewardship. How's that? Can everybody hear me now? Thank you.

A - Unidentified Speaker

So building on is going public, it's going to allow us to build on our earlier investments as a new public company. We've made strategic investments across the board not only in the operation side, on the engineering side, but also on the administrative side, but going public is going to allow us to continue to recruit and build world-class global engineering teams. It's going to allow us to advance our ultimate business model as QCS is going to allow us to continue to make investments along that continuum. And by that, I -- we will be able to enjoy the economic benefits that come from ultimately building out our QCS platform. It also allows us to build out a very sophisticated user base or ecosystem of users around the world and I believe that Rigetti is helping drive that.

And we're also growing revenue through our high-value partnership and use cases that Greg has highlighted. I'll talk a little bit more about it, but it's more than just growing commercial relationships. It's actually selecting those partnerships that you can extract value from not only economic value, but critical engineering value.

And finally, expanding our gross profit and operating margin profile is we work towards QA and part of that is building out and reinforcing our QCS model. But also thinking of ways that we can start building in cost reduction initiatives into the equipment, into the systems that will ultimately power our QCS platform. As Alysson pointed out, running in parallel not only occurs on the engineering side, but as we look at putting these systems together inputs from the finance team on how we can start looking at cost reduction ideas and how these systems may ultimately come together.

Just a quick snapshot of our first half performance. I'll talk a little bit about our cost structure, but right out of the gate as a new public company. There are a lot of costs associated with coming out of a SPAC supporting the initial setup costs to go public the compliance costs, building out the teams et cetera, but just starting with revenue year-to-date through June $4.2 million in revenue for the first half $3 million of operating of gross profit pardon me, generating about 70% gross margins.

$52.4 million of GAAP operating expenses, translates to $232 million of non-GAAP operating expenses and you can see the differential there just how much is layered on top of our non-GAAP operating structure, and that produced about $29 million of adjusted EBITDA loss. Our balance sheet remains very strong. We have $184 million of cash at the end of June. We also announced a committed equity facility to further show up our balance sheet given the current economic conditions that we're all facing for up to $75 million of through an equity -- potential equity raise. And year-to-date we have $0.24 EPS loss.

So our year one expense profile and I call that as an expense profile, not an operating profile. Our ultimate goal here is to get into a true operating profile that underpins maturing operations, maturing technology. But just a quick overview of our expenses, talent and headcount remain the bulk of our spend on the operating expense side about 60 % of our overall cost structure. We expect that to continue.

Through -- throughout the R&D, SG&A, and SM side, we see a lot of the public company costs layer on top of that, stock compensation, D&O insurance. Just those go public expenses that have created quite an overhead as a first year public companies, young public company.

On our Q2 call we gave an update on our outlook for the year. Let me just go through that real quick here. On the revenue side we're still estimating $12 million to $13 million for the full year. As we highlighted on the call, we are in discussions right now with a major U.S. government agency. It's been a long-time customer, very important customer, it's a major driver of quantum initiatives in the U.S.

And we feel those discussions are progressing. So we're going to maintain our guidance of $12 million to $13 million on the revenue side. Adjusted EBITDA, like most companies, we're still experiencing supply chain, supply chain cost pressures that's not unusual given the high inflationary environment we're in and again higher headcount costs. We have to attract and retain and recruit the best and brightest minds in quantum. It's a very narrow population, it is expanding, but it still remains a narrow population and that is like most companies and deep tech face similar cost pressures.

On the CapEx side we expect to spend about $33 million to $35 million this year. It's spread across mainly our fab expansion and tools initiatives this year, additional facilities expansion as well as building out our cryo capabilities and adding more dilution fridges.

As I discussed, we put it a committed equity facility or CEF and we announced that on our Q2 call and in that it gives us up to about $75 million of additional cash that we could raise. We believe this is a prudent response given the current geopolitical macroenvironment -- macroeconomic environment. No one knows really just how long the cycle will go or how deep the cycle will go? So we thought it'd be very prudent to put something like that in at this time. And we also think it's a vote of confidence for the capital markets to be get to get a capital committed facility in times like this is a good, it speaks volumes to just how much people think what Rigetti has done and what it's capable of doing.

It allows us to remain focused on our key priorities. We don't want to deviate from our roadmap. We know what we've got to do. We want to stay focused and we believe having access to additional capital and ensure that. And it's discretionary so it's not a one-shot, we don't go out and raise $75 million, we'll spread this over a period of time. Our goal is aligned with our shareholders. We don't want to unnecessarily pressurize the stock if we don't have to. And again, it's a very discretionary low cost way of putting additional capital on the balance sheet.

So, just to point back to Greg's presentation, on the revenue side, generating revenue at a -- for a company at this stage is two main parts. One is, obviously commercial aspects putting being able to generate additional cash demonstrate that the technology has commercial value at this stage, but more importantly it's creating that feedback loop to the engineering teams which is invaluable. Being able to establish relationships with the agencies and ultimately commercial partners that are going to be driving the ecosystem going to be the sophisticated users of quantum and being either ones that are going to pay for quantum advantage in the future is key.

And we believe it's just a vote of confidence with the revenue that we've been generating. And the growth that we demonstrated that we are in a position to be selective with those partnerships that we want to throw our resources against. Keep in mind that when you generate revenue also generate costs. And the last thing we want to do with this precious and expensive capital that we've been able to raise is to build up a revenue generating team or throw valuable engineering resources at revenue that doesn't really move the needle forward on the engineering side.

So just to close before you go on the tour and you see some of this technology first hand. We're true pioneers and innovators in quantum. Our full stack approach are differentiated scalable architecture which we believe hopefully is the envy of other major players that are in the quantum space. We'll continue to differentiate the company and lead us forward, but just pointing out some of our investment highlights here. We have a proprietary fab that we've talked about. We're full stack a pure play, it gives us incredible flexibility and very, very flexible or high-speed ability to pivot, if we have to in terms of innovating. We possess leading-edge technology. You've heard the wonderful stories, you've met some of the key technologists involved in it. We have an extensive patent portfolio of over 150 patents and that continues to grow. We believe that's a very defensible moat and very important as there are more entrants coming into the space. And on the superconducting side, we believe it's one of the strongest patent portfolios out there.

We have very strong leadership team not only in being able to manage as a public company, but also leading the engineering team the development cycle. And we have top-tier commercial and technology partners out there that we've talked about that we will continue to grow in numbers and depth very critical to helping us evolve the technology going forward. And also, we believe -- we truly believe that this is industry transformative potential for our technology. Every major industry today stands to benefit from superconducting quantum technology and we at Rigetti believe we're at the forefront.

And with that, we'll open it up for questions. Thank you.

Q - Analyst

Obviously, talent is a critical part of the equation here. Talk about your ability to attract and retain talent against involving landscape of public companies and obviously the big guys as well? Thank you.

A - Unidentified Speaker

I think it's the testament to just how attractive Rigetti is to engineers and scientists and just give them the roadmap that we've already laid out and progressed against and given the fact that we are commercial company, we are a public company, we've been able to track the best mine.

Q - Analyst

How is the -- your win rate against other competitors changed since you've gone public or over the past couple of years?

A - Unidentified Speaker

In terms of.

Yeah, (inaudible) I think we have - we've seen today some of the talent that has joined the company over the last year or so. We've attracted the folks from not just competing against other quantum companies for talent, but also drawing talent from other quantum companies. Ultimately as the -- like the technology continues to mature and the market continuous to mature, we have seen, I think of last couple years that kind of -- what I characterize as an inflection point and the talent base, and what I mean by that is we now see people coming out of a PhD where their entire PhD was done on quantum algorithms on real quantum computers. And the availability of that kind of application algorithms level talent with the hands-on experience is something that wasn't there a few years ago, and it's a really strong, I think indication of the industry overall, from a competitive basis, John. I think we do really well against the other players, obviously would be able to share specific numbers, but we've got a strong talent team, a strong value proposition, I think as an employer.

Q - Analyst

This is a follow up to the last question with the stock currently well below the spec and dollar price, has that had any influence on your ability to attain -- sorry to retain and attract new talent, do you have to re-price or user options?

A - Unidentified Speaker

I think, as you heard from the folks today, people are here because it's a mission-driven company and for the long-term impact and potential of this technology and of the path that we're on. We haven't seen any impact to that in that regard.

Q - Analyst

Okay, great. And the second question I have that gotten this from a couple of investors, following the second quarter comment about the deferred negotiations on the government. When you look at -- I guess 18 to 60 months, typical contract period on the government contracts. Do those contracts get renegotiated every year? How sensitive do they to the September 30 fiscal budget for the U.S. government, are those negotiations if you don't get it done by September 30, does it then have to go into the next year's budget which introduces further delays?

A - Unidentified Speaker

Yes, go ahead Brian.

A - Brian Sereda {BIO 5582338 <GO>}

Yes, I have not seen any sort of pile up on the September 30, or variability created by September 30. I think it's an important step though in negotiating, probably new contracts. There are series of discussions going on around the year with regards to government agencies, and that produces variability I think in the timing of closure, produces the variability in the timing of negotiating the milestones, but haven't really seen anything in terms of seasonality, that's what you're referring to in negotiating cycle.

A - Unidentified Speaker

And for the specific risks and we called out in the last earnings call. We continue to make progress, we believe we need to make to be on track to -- for the $12 million $13 million for the year.

Q - Analyst

And it's just that the multi-year if you have a multi-year contract, is that negotiated once? And then, you're done or does it get renegotiated every year if the budget is set by the government?

A - Unidentified Speaker

Yes, it's program-by-program.

Q - Analyst

Okay.

A - Unidentified Speaker

Is the answer, and I think some programs would have a three or four-year program with may be an option at year or two for something like that, others might be year-by-year, and others would be full lifecycle contract. And so, it really depends program-by-program.

Q - Analyst

Okay, thank you.

A - Unidentified Speaker

And while we're with (inaudible) I did want to make a clarifying comment as to some of the Q&A. Last time we -- with respect to the fidelities on the 84Q and Ankaa, as we've said we continue to see very high performance in our tested development systems, and we're confident that the Ankaa platform, the 84Q and the Ankaa platform is ultimately going to achieve the 99%, 99.5% and beyond over time, but we're not currently setting any specific expectations for the first release of Ankaa in early 2023.

Q - Analyst

Thanks, is there a timeline we should be thinking about EBITDA positive? I understand a lot of that has to do with revenue projection. So that's one. The second question is related capital spending, you talked about $33 million or $35 million this year with the number of things including Fab-1 expansion. How should we think about capital spending going forward?

A - Unidentified Speaker

I think we'll undoubtedly continue to invest in CapEx. I think the CapEx, the mix will shift from for example, this year, first year out of the gate, a lot of our focus was building redundancy and additional capacity into our fab facilities here, and showing up some of our other facilities up in Berkeley. That will shift to more building capacity as the technology grows, as we start to build up more commercial systems. So, I would expect that the CapEx expenditures will continue, perhaps we don't run out of prepared to give any long-range guidance right now Sydney, but I think we would expect to continue to invest in capital expenditures.

Q - Analyst

In terms of the EBITDA, I think the roadmap that we've laid out today with detail at the different layers of the stack ultimately allowing us to put together all the pieces to reach quantum advantage. We believe ultimately that's what we got to execute on. And as we do that, the revenue opportunities is the inflection points in the industry are going -- we're going to see those and that's what's -- that's what we need to do and that's what we're focused on.

A - Chad Rigetti {BIO 21140357 <GO>}

Yes, I'll just add a little bit to that too is it. We're all really thinking about preserving. We do have fairly strong gross margins now, and so it's as a younger company. But finding ways to preserve those gross margins going forward and making ensuring that our QCS model will deliver on that promise as well.

We're already thinking about that, and how we build out some of these future generation systems, and how we can ensure that we can get the costs in line to do so? So, forward-thinking on the EBITDA side, I think is going to assist us in allowing us to drive that maximum benefit on EBITDA predicting that inflection point will depend on the technology maturity and uptake on quantum.

Q - Analyst

Okay. And with that, I think we're ready to close out the Q&A. So, thanks so much Brian.

A - Brian Sereda {BIO 5582338 <GO>}

Okay, thank you again everybody for being here today. All the wonderful insightful questions. We've really enjoyed the time and I hope you've enjoyed the meeting the extraordinary team that we have with us here today. I want to recap and provide some highlights from the day. First we are on track to deliver on our detailed technology and product roadmap. We've walked through it all layers of the stack and we've announced a deepening and expansion of several partnerships including, NVIDIA. We highlighted our partnership with Ampere. We announced our -- from earlier this week -- our announcement of Azure, we're get QCS available over Azure, as well as our partnership now with Bluefors to deliver the next generation dilution refrigerators the power QPU roadmap going forward.

We are selectively partnering, the key takeaway from Greg's presentation. We are selectively partnering with the right folks at the application layer, and on the customer side, to work with them arm-and-arm and work with them to bring them through their quantum journey ultimately to operational quantum advantage. We heard from Eric, wonderful description of our detailed and thoughtful quantum advantage program. Our approach leveraging reference applications built around quantum advantage capable subroutines with an emphasis on working directly with customers and benchmarking, as the key ingredients in the flywheel driving us towards quantum advantage.

We heard from David, about our quantum cloud services architecture. The emphasis on hybrid quantum classical computing, integrating our quantum processors into the fabric of the cloud and making them available to end users in a user-centric workflow.

Our quantum processor team for targeting performance at scale, the key ingredient needed to unlock advantage and how we're going to get there. We talked about our

QCaaS model and the importance of that to our business going forward. Ultimately, we believe that we are poised to reach quantum advantage with the roadmap that we shared with you today and truly begin solving some of humanity's most important and pressing problems. And that's what has brought us all together and that's why we're here at Rigetti.

So with that, I want to wrap up and thank everyone on the webcast. Everyone joining us around the world, wherever you are and everyone here who traveled here today and being with us in-person. Thank you so much for spending the time with Rigetti today.

(Audio Video Presentation)