The Cutting Edge of Classified: Research at NSA
Episode 5 of No Such Podcast from the National Security Agency

Gil: The impact of research is able to help NSA execute its missions. We've got close to 600 scientists that actually do research, and it both enables us to do internal research, but also work with the best in academia and industry.

Kathy: We use machine translation as a way to enable humans to do triage on communications so that the humans can use their smarts to put pieces together and create intelligence for our policymakers and our warfighters.

Brian: Welcome to the latest edition of No Such Podcast. I am one of your hosts, Brian Fassler, and joining me, Cam Potts. And today we are going to talk about research and development at NSA, and we have two very special guests joining us, Gil Herrera, who is the director of research. And alongside him is Dr. Kathy Baker, who is from the computer and analytics science research group. Welcome to you both.

Thank you. Thanks for having us.

Brian: Gil, Kathy, why don't you tell us a little bit about yourselves?

Kathy: I'm a researcher in the computer science research office, and my specialty is natural language processing. I've been doing that at NSA for about 21 years now, and prior to that, I worked in industry and in academia.

Brian: Awesome. Gil?

Gil: And I've been at NSA about just under three years, although I've worked with NSA for about 30 years. I retired from Sandia National Laboratories to be director of research because NSA is a great place to work, and I wanted to end my career in service to the nation.

Brian: Outstanding. Gil, let's start with you. NSA's research organization is the largest in the intelligence community. Can you talk through a little bit about the history of it? How did it get started, and why was it founded in the first place?

Gil: In fact, it's not only the largest, but it's arguably the oldest as well. The genesis goes back to 1917, when there was something called the Army Cipher Bureau that was formed. After the war, it was located in Manhattan, and was largely civilian run. And so the initial stages of research was all around math and cryptanalytic research. The math for how you encode signals, and then cryptanalysis is kind of how you decode. Both are the two big things that NSA does. But in terms of a more broad research portfolio that expanded beyond mathematics, that came about only 18 months after NSA was first founded in 1952, when the NSA advisory board said, "Hey, you guys are too insular. You need a research institute that does unclassified work that is off of the main campus where you can interact with industry and academia in an open environment." And so in 1956, the Laboratory for Physical Sciences was founded at College Park. So it was located on the University of Maryland campus. It's had a few different locations, one of which is now Starbucks. But it's had a few locations, and it's now on the campus. And that's really the genesis of a dedicated research organization. Since then, it's expanded consistent with NSA's broad missions. We do scientific research in support of the mission, but it's targeted towards the mission. So it doesn't do all areas of science, but very select areas. Another important factor to remember in terms of why we're such a large research group is what happened when the Cold War ended. At that point in time, there was a peace dividend that the country demanded, and there was pretty much a pause in hiring in federal positions, particularly in research. But NSA was very prescient, and instead of eliminating its research organizations, it held fast and maintained research groups that actually do research. So most of the other IC elements, the research organizations primarily are sponsors of research. What NSA did was preserve the funding such that we've got close to 600 scientists that actually do research, still partner extensively, you know, with academia and with industry. But we have bench scientists like Kathy that are experts in their field, and it both enables us to do internal research, but also to work with the best in academia and industry, and more importantly, get the best in academia to send us their students so we backfill with the Kathys of the world.

Cam: So Gil, I think that's amazing that we have not only the largest, but the oldest research organization in the intelligence community. So I'd be curious to know how is the research organization organized? Who are the wonderful people and the research projects that make up this organization?

Gil: Yeah, well, I won't talk about all the research projects. They're too many to talk about. But when I think of the research organization, it's structured very much like a technical university. And so I'll go through the different academic departments. The first one is a math research organization, which as I already mentioned, is arguably over 100 years old. And it is one of the main reasons why I left my cushy National Lab job to come and serve as research director, is it really is among the top math research groups in the world, right up there with any other program globally. And there are some adjuncts that I'll talk about when I talk about partnerships, because it's not just the internal math research program, but a couple of FFRDCs, in other words, a couple of external labs that are operated for us that do math and research. So strong math department, strong cybersecurity department. You know, we have a Laboratory for Advanced Cybersecurity Research that has a broad portfolio in cybersecurity. There's the Laboratory for Physical Sciences, which I already mentioned was the first dedicated non-math research group. It was founded at the University of Maryland. And while we have people working in classified spaces, most of the work is unclassified. And with a focus on cold matter physics, quantum physics, and RF and other forms of physics, and looking at what comes beyond CMOS. Then we have a group that was spun out of our physical sciences research. I call it like our electrical engineering department, but what it really is, it's a Laboratory for Telecommunications Sciences. And it was spun out at the time that the internet was first really blossoming about 30 years ago, when we realized that communications is changing. It's not going to be analog, it's going to be primarily digital. While there is still be over-air communication, now it's going to go over cables and fiber. And that we really needed to understand the underlying physics of modern telecommunications at the physical layer. So we formed that. And then the last research organization we have is one that Kathy’s in, which is, I call it our app developers, but it's really our organization that, where computer science meets the rest of our research organization. So they have a broad portfolio where they do a lot of analytical work. Of course, artificial intelligence is part of that analytical work. But they also work on other kinds of apps for the analysts, for the young analysts, many of whom are in the United States military, and they need the best tools, and they're dedicated to making those. So effectively, that is how we're structured. We work extensively with partners, both those that we effectively own and those that we don't. And we'll talk more about that a little bit later.

Brian: Gil, you talked about the advancements, especially in technology and math and science. How does the research organization stay ahead of this technology that can change at the speed of light?

Gil: There are really two critical elements, and it's people and facilities. So what do we do? Let me start with the second one first, the facilities and infrastructure. NSA is dedicated to providing a research environment that is at the leading edge, whether it be in the Laboratory for Physical Sciences, which, if you look from a publication perspective, is among the world's leader in quantum computing research. Or if you look at our computer science department that Kathy's in, where NSA has among the best computing capabilities anywhere in the world. So we provide the right kind of infrastructure, and then that helps us attract the kind of people like Kathy and others that want to come, not only because we have other people that are very tops in their fields and we have a reputation that attracts partnerships, but equally it's important because they have an opportunity to come into work every day on a mission that they know is important. You know, whether it be wars or balloons, you have an opportunity to see how the impact of research is able to help NSA execute its missions and do so in a manner that informs policymakers, that protects everybody who is out there working to keep this nation safe. So infrastructure, best people, best missions.

Cam: Okay, so Gil, you touched a bit on public impact. Could you now expand on the public impact of NSA's research organization?

Gil: Yeah, I wish I could expand on all the things that I can't say. I'd love to tell you about our work to understand the Holy Grail and the Ark of the Covenant. Let me focus it on the publicly available things that we do in research. There are three kind of big ones that people may be aware of. Let me start with the very first open source release of software by NSA. And yes, NSA releases open source software, some of the most downloaded and impactful software has come from NSA. And it was something called SELinux, Security Enhanced Linux, which makes sure that when you download an app, and this is for Android users, sorry for the Apple users, but that you can't take benefit of this download. It's a thing that when you download an app, it prevents that app from communicating with other apps that maybe you don't want it to communicate with, or the kernel or other aspects of it. So it makes by default that any new app cannot get information from other apps. It makes you go through security hurdles with security measures that I won't go into now, but are so impactful that every Android phone, there are billions of them, it has this NSA software. We've supported it for about 10 years, and now there's a foundation that actually manages that. So that's one example. Another one that we're just past the fifth anniversary of the release is something called GHIDRA. It has the coolest logo of any kind of app you want to see, I wish we could show it on this podcast. Research does cool things, you should see our own logo, we're a really cool place to work. So for all of you out there who are hearing this, you want to come here and work. But let me talk about GHIDRA instead of recruiting. So GHIDRA is a tool used by cybersecurity professionals to do software reverse engineering. Now why is that important? Because let's say that you have an app that you're putting on your phone or your computer, you want to make sure that that app is exactly what it's intended to do and it doesn't have any kind of hidden features. And utilizing GHIDRA, you're able to reverse engineer and see what does this software really do. And it's a tool that was announced by our former cybersecurity director Rob Joyce in the 2019 RSA convention, and announced that it was going to open source. And in day one, there were 50,000 downloads. And I don't know how many downloads have gone since then. NSA research is still maintaining this tool. And we just released, I believe it was GHIDRA version or mod 11. So we make corrections when we find their or enhancements, as does the community because it's open source. And again, it's a very effective tool. I'll mention one other way that we interact, and it deals with the science of security lablets. Now this is something we formed about 10 years ago. Research activities, focused research in cybersecurity. It first started off with about 60 universities. We've expanded it. So there's a broader impact in the academic realm. It has, I talked about research being cool at NSA, it has a cool conference name, HoTSoS. And in this conference, they discuss a number of science of security topics. And so it varies across the whole realm. But I've noticed a trend of late. And it's that there's a lot of papers on artificial intelligence. But NSA's been doing AI since before AI was cool. In fact, in presentations, give a lot of presentations on this. I could see work in the 1960s on some math advances, something called the Hidden Markov Model. And in the appendix to this podcast, we'll explain that in detail. But all the way through NSA founding with NIST in like 1984, the first intergovernmental AI workshop and working group. But the real expert in AI sitting next to me, and maybe this would be a good opportunity for us to transition. And we could talk about at least one very impactful part of artificial intelligence that NSA works in every day.

Brian: Yeah, that's a great opportunity to segue here. So Kathy, Gil talked about some really high level projects that the research organization is taking on. And obviously, behind any big project, there's a lot of technology that underscores the support of that. So can you talk to us about your area of expertise, machine translation? Can you tell our listeners what exactly is machine translation and why is it so important to the NSA?

Kathy: Sure. Machine translation is when a computer program translates a language that we speak into another language. So think of it as foreign language translation. And it's important to NSA because we collect vast amounts of foreign communications. And we need a way to represent those in a way that we can understand quickly and find nuggets of information in. So we use machine translation as a way to enable humans to do triage on communications so that the humans can use their smarts to put pieces together and create intelligence for our policymakers and our war fighters.

Cam: OK, so here at NSA, we have human linguists, those that specialize and have expertise in language, in foreign language. But then we also have machine translation, which is happening that actually allows computers to learn like humans. So are human linguists still needed here?

Kathy: Oh, absolutely. Our linguists, as we refer to them, our language analysts are critical to our missions. They have the smarts to understand nuance in language. And they can look at a machine translation, know that it's not good or good enough to use for a more junior linguist. And they can also make corrections that artificial intelligence algorithms can use to get smarter. So we'll never get to a point where we won't need our human linguists.

Cam: OK, so people are always in charge.

Brian: Yes, that's very reassuring. Can you tell us what is at the cutting edge of machine translation at NSA?

Kathy: Well, right now we're looking at algorithms that are called deep learning. And deep learning is a form of learning where the computer is kind of mimicking the way the human brain works. It's inspired by the human brain. And the computer will create an interconnected network based on the patterns that it observed in language. And the output of this deep learning process is something called a language model. So we're using language models to model the way that we speak. And that, in turn, leads to machine translation.

Cam: OK, so language models, could you break that down a bit more and just maybe give us an example of what a language model might look like?

Kathy: Sure. So the hot topic in our field that probably our listeners are well aware of is something called large language models or LLMs. And a great example of that is chat GPT. That's kind of the one that people are most familiar with. But there are many others. They're coming on the scene daily. It's a big area. And I'm very excited to come to work because this is what I get to tackle every day. But LLMs, what they do is they have consumed a lot of language, learned the patterns, as I said, and they're able to predict the next word or word sequence based on what it's already learned. And in fact, LLMs seem to have an innate ability to learn to translate without being explicitly told to do that. And LLMs abilities are growing every day.

Cam: OK, so will large language models or LLMs, as you explained, will they be useful for machine translation here at the agency?

Kathy: Yes, that's the area that I'm personally looking into with my team. We have certain machine translation models called neural machine translation. They came on the scene in about the year 2015, roughly, and they've been very successful. And those are the kinds of models that we use today. But LLMs are getting better and better at translation. So part of my job is to research the latest algorithms and models to see what we might be able to use at NSA and to work with academia and companies to come up with the best solution for us. One thing we're proud of in our computer and analytics sciences research group is a culture of evaluation. We're focused on evaluations to see how well our programs are working. And we have a history of doing language model evaluations going back to speech processing and now for machine translation. And what we want to do is make sure that when these programs are in use by analysts, the analysts can have confidence in them, because it's very important that we get things right. We must get things right for the nation. And so if our analysts are not confident in it, then it won't be a useful tool for them.

Brian: And I think that goes to your point of that, humans are always going to be involved in this process. So Gil, just a really basic question. What is quantum computing?

Gil: Simply stated, a quantum computer is a new class of computer that unlike today's digital computers, which can operate up one thing at a time, a quantum computer can exploit quantum mechanics and a few quantum mechanical principles where they can perform many calculations simultaneously. Now, unfortunately, when they're done computing, you take a measurement and you only get one answer. So a quantum computer wouldn't be good for things that involve like sorting. But because you get a single answer, it's good for things like searching. And there are a few other things it's good for, one of which is simulating how molecules interact. And it's really good for applications in chemistry and material science. But because of a paper published in 1994 by a gentleman named Peter Schor, it's also good for finding prime factors of numbers and for something called the discrete logarithm problem. And unfortunately, both of those two problems are difficult math problems in one direction and easy in another that serve as a basis for modern public key cryptography. So when you see HTTPS, you know, when you're going to buy something at Amazon or some other provider, then it's those two problems that are utilized to secure your credit card when you make that financial transaction. And so that's why NSA and pretty much everybody else who's worried about information security is interested in quantum computing.

Cam: So essentially, quantum computing is in comparison to a classical computer, a supercomputer.

Gil: I wouldn't exactly call it a supercomputer because a supercomputer is generally thought of something, a computer that can solve all classes of problems. With a quantum computer, there are just a few problems that it could solve. Yeah, unfortunately, one of them is this prime factoring. You know, there are a few other algorithms that have been published. You know, I mentioned a search a little bit ago. So for search applications, it can do quantum chemistry pretty well. It's believed that you might be able to do something called optimization problems. The traveling salesman, if you're familiar with that problem, is one class of optimization problems. There's hope that it could solve a number of other problems. And there's exceptional researchers around the world looking for other applications. But right now, because of the complexity of how you operate a quantum computer, there are just a few algorithms. It's just that the criticality of those algorithms is really high. Sure, break the internet. But if you think about the material solutions, and this is one of the great optimisms for quantum computing, the real killer app from a materials perspective is something called a nitrogenase fixation. And without going into too much detail, the importance of that particular algorithm is it will show how some plants can create their own fertilizer. And right now, depending who you believe, somewhere between a few percent and close to 10 percent of the world's energy is used to make ammonium nitrite fertilizer. And so if we can crack a way to do it, where you don't have to have high pressures and high temperatures, which the present method of making the Haber-Bosch process it’s called, the present method of making ammonium nitrate fertilizer, that'd be a real great energy saver and important to climate change.

Cam: So we know that quantum computing is in the research organization's wheelhouse. This is the you all have the subject matter expertise in that area. But why would NSA care about quantum computing?

Gil: Well, after Feynman made his speculation, everybody was following quantum computing, because it seemed interesting. But it wasn't until Peter Schor published the paper that came up with an application other than doing fundamental science or doing molecular chemistry, that kind of scared everybody. And what the paper was, it found a way using a quantum computer to rapidly determine the prime factors of very, very large numbers. Now, why is that important? Because if you look at public key encryption, and at that time, public key encryption was about a, oh, maybe a 15 year old field. But once, you know, people first started using the Internet, they realized that they needed a way to secure information where you don't know the person you're talking with. So is there a way where you and I agree that we want to share information? Can we have a way where just you and I can exchange keys? It's called public key encryption. And that would facilitate commerce on the Internet, this emerging thing called the Internet. And so Schor’s algorithm showed that if a quantum computer could be built, then all of that is in jeopardy. And that would really impact global commerce. But not only global commerce, the intelligence community and the Department of Defense, within all national security systems, also used those same methodologies to share information. So it was not only a national security threat from an economic perspective, but also from a foreign intelligence perspective, a DOD perspective. So we knew it was something really, really important that we needed to follow. And so immediately we began funding research externally and then developing an internal program in quantum computing.

Brian: So Gil, what role does quantum information science play in some of the things you said?

Gil: Well, quantum information science, by definition, is a little bit broader than what we've been talking about in quantum computing. It also includes something called quantum sensing and also quantum communication. You know, sensing is more mature. It's already used in a lot of applications, precision timing, detecting these gravity waves that you've read about. They use a certain class of quantum sensing. But quantum communication is probably a bit more relevant to NSA's mission for a variety of reasons. One is, if you could find a way to create what is now called the quantum Internet, it'll develop a lot of new tools and applications that'll be important in computing, like a quantum memory, which kind of doesn't exist. The fact that there's not a quantum memory is the reason why quantum computers really can't do sorting, but they can do searching, right? Because in any application where you need to have a memory, quantum computers struggle with. But more importantly to NSA in our national security mission is that there has been proposed now for over 30 years, exploiting quantum mechanics in order to make a way to do secure communication. It's called quantum key distribution. And in this method, you exploit some of the weird quantum mechanical effects so you can actually exchange secure information with somebody. Now, you do it in the open so anybody can read it. Because of quantum mechanics, if anybody does read it, you detect that and you don't use the information. And so this is a way to do a key exchange where you either find a way to share it securely or you know somebody has listened in and so you don't use it. You don't encrypt information utilizing that key. Now, it's a really interesting field. NSA has been involved in it for over 20 years. But quite frankly, due to implementation difficulties and due to some of the vulnerabilities that exist in existing systems, and these are well known, you could look it up on the internet. NSA will not approve the use of that class, you know, quantum key distribution, that class of key exchange for any national security systems. You know, I personally have stated in public talks that I believe there are a few use cases, but they're very limited and they wouldn't involve national security information.

Cam: So it's good to know that NSA has, is, and will always be on the front lines of the quantum conversation. So that leads me to my next point. You know, I can imagine that doing all this research on quantum and other subjects requires a lot of people to get the job done. I mean, I know we've been talking about how the organization is the largest and the oldest in the intelligence community, but it's important to still work with others to get the job done. So Gil or Kathy or even the both of you, could you speak to the importance of research partnerships as you continue to advance intelligence through science?

Gil: Yeah, and let me back up because we partnered a lot more than just quantum information science. So let me talk about the few classes away we partner. The first one is we actually sponsor research institutes, you know, that are external to NSA. There is something called the Institute for Defense Analysis, which is kind of an umbrella organization. It's a private sector organization, but its customers are governmental. And through them, we sponsor three different research institutes. One of them is they're not directly associated with the university, but two of them tend to be co-located with a university. One is at Princeton. It's been sponsored by NSA research since the late 1950s, and they do research in mathematics, primarily around cryptanalysis. During the 1980s, we expanded to two other research institutes sponsored under the Institute for Defense Analysis. One is in La Jolla, in a business park associated with the University of California, San Diego. And again, they do primarily cryptanalytic research. The third one is in Bowie, Maryland, and what they do is more multidisciplinary research on how you take math advances and then turn them into real applications on computing. They also do some work on edge computing. So it's not all about our big computers. It's about how can you make efficient algorithms that will run on small computers. And that's one example out of our math organization. We already talked about science and security lablets, where we sponsor cybersecurity research in a number of areas. We talked a bit about our work in quantum computing, but now's the time I think I should talk about our Qubit Collaboratory. So under the Laboratory of Physical Sciences, we probably have our largest academic program and the broadest one because we solicit everything from applications for sponsoring graduate school or a postdoc all the way through very large collaborations. And so if you Google or Bing or any other search algorithm, the term LQC BAA, or you could even say a qubit collaboratory BAA, you'll find a link to where you could make a proposal. Again, we accept proposals for PhD and postdoc programs. We accept small proposals for innovative ideas that you want to have and then full of collaboratory proposals for these multidisciplinary programs. We presently have over 40 different universities and companies, about 11 of which are outside of the United States, and it's a very large program. On any given year, we're sponsoring over 100 graduate students and postdocs. We also, though, have other research institutes that aren't associated with either math or quantum, and they principally involve in our work in analytics. So we have a Laboratory for Analytical Sciences, which is at North Carolina State University. There they work a lot in big data analysis and on artificial intelligence. It's an environment where we have government employees working side by side with academic researchers, much as the same that we do at the Laboratory for Physical Sciences. And in a kind of, in part, reflecting the importance of languages to us, we have a research institute that focuses on linguistics that does not have a lot of government employees. But if you're going to do language translation, it really starts with linguistics, which is a little bit different than languages, but understanding kind of the science of languages. And it might be a good opportunity for now for Kathy to talk to us about, you know, as a researcher, you know, how do you partner? What are the important partnerships that you see?

Kathy: So it's very important for me to partner because we can't do it ourselves, and we have an obligation, in fact, to the American people to make sure we stay current. So I do have informal and formal partnerships with academics, frequent meetings with them. And now with LLMs on the scene, we're looking at forming some industry partnerships as well. So it's important to reach outside our walls.

Cam: Awesome. Thanks for sharing that. So for the listeners that may be interested in quantum computing research or any other type of research within the organization, how would they be able to partner with NSA on that?

Gil: If you search for Qubit Collaboratory or LQCBAA, you'll find a link to how to submit a proposal. If you Google HoTSoS or science of security, NSA, SOS, NSA, you'll find links for how to apply for those proposals.

Cam: So LQCBAA and then NSA.gov/research.

Gil: Yeah, and you can find links to all those. But it behooves me to add something in partnerships because I failed to mention one of our major partners. In the United States, there's a broad network of what are called federally funded research and development centers. Okay. And there are FFRDCs, and they fall into a couple of classes. There are those that are run by the Department of Energy, which are called National Labs. And then there are those that are run through the Department of Defense and other agencies, and they're just called FFRDCs. And we have broad programs leveraging all these other government investments. So like if the Department of Energy, which now has an exascale computer, then we could leverage that by partnering with these FFRDCs. There are also a class of academically oriented, but government sponsored major research institutes, and they're called University Advanced Research Centers. An example is right near where NSA is located, the Johns Hopkins Applied Physics Laboratory, and we have extensive partnerships with them as well. Because we want to be able to reach out to where the best research is being done. We have a good internal team, but it's kind of small compared to the broad world of research. So we want to reach out to academia, but also to other government agencies that have very, very strong research programs. And we want to leverage those people and talents as well.

Cam: Okay, so those resources for our listeners that may be interested in quantum computing research or any other research for that matter is LQCBAA, HoTSoS, which is H-O-T-S-O-S, and NSA.gov/research. Is that correct?

Gil: Yes, it is. I encourage everybody to go there. I should mention one other site for our listeners. And that is intelligencecareers.gov because we want you to apply for a grant, but we also want you to apply for our jobs.

Cam: Perfect, thank you.

Brian: All right, so Gil, Kathy, we talked a lot about some really important topics that research is involved in. Let's talk about the future. What are research's biggest priorities? What are your care abouts? And what are the challenges that you foresee in the future?

Kathy: Well, our biggest care about really is the mission and getting the mission done and serving the folks who do the mission every day. So one of our challenges is being able to anticipate what research is coming down the pike that will be most applicable to our analysts and analysis in general. Another challenge we face, which I know a lot of technical workplaces face is, hiring and getting a technical workforce that is equipped to meet the challenges.

Brian: So Kathy, it sounds like a really exciting place to work.

Kathy: Yes, I really look forward to going to work every day. First of all, there's so much happening in artificial intelligence right now. I just hit the ground running trying to catch up. And the second thing is that I have some great colleagues that I work with. And so we're a great team and I look forward to working with them every day.

Gil: Yeah, as research director, I really need to think strategically about the future, right? And obviously there are a lot of emerging areas. We talked about two of them today, AI and quantum and there are others. There's what comes beyond 5G, a number of them. But what I really struggle with every day is how do we balance the very short-term applied work, which there's a lot of emergencies and crises and you always want to help, but while still maintaining focus on kind of what comes next. And then, of course, the very long-term strategic items. And that goes for not only what kind of work we do, it influences our hiring program, where we hire, and our infrastructural investments, what are the right tools to invest in. And so I spend a lot of time thinking of that. But also, another main challenge is it's one thing to do the research, but research only matters when it goes to mission, right? We're a mission organization. The research needs to be tightly focused. There's a lot of really cool areas to think about in some of these emerging fields, but we really need to focus on what's going to make a difference to the warfighter, what's going to make a difference to our national security systems. Those are where we need to place our focus. And then, of course, making sure that they're compatible with the broader needs of our operational groups and the groups that maintain our capabilities to be successful. But let me reiterate a point I made earlier about it's all about the people, ultimately, right? Ultimately, the single most important thing is the people. So we need to create an environment within research that is both intellectually fulfilling, but also something you want to come to do every day. You've got to make it fun and exciting. And the way you do that is by hiring the best people, getting the best place to work, enabling the kind of partnerships that are going to allow people to do incredible scientific work. And that's something that we offer in NSA research today, and I'm committed to sustaining well into the future.

Brian: Outstanding. Gil, Kathy, thank you so much for joining us today and sharing some just outstanding information about the important work that you do. And as Kathy alluded to earlier, you know, we can't do this alone. It's the partnership that we have with organizations outside of NSA. And Gil, as you spoke to, the people are super important. So with that being said, Gil, tell us people that want to get involved and come and work and be a part of this great mission. Where can they apply? What do they need to do to get more information?

Gil: Yeah, I'd recommend you go to NSA.gov/careers. And there you could find about all the cool different kinds of things we do, you know, STEM, language, other great things that we do here. And then when you're ready and decide which job you want, go to intelligence careers.gov and apply. And rest assured, you won't regret that decision.

Brian: Well, thank you again for joining us. And thank you to our listeners for joining us for the latest episode of No Such Podcast. Once again, I am your co-host, Brian Fassler. And I'm Cam Potts. Thanks for tuning in.

John: Thanks for watching this episode of No Such Podcast from the National Security Agency. If you enjoyed the show, please leave us a review and make sure you're subscribed so you don't miss our next episode. For show transcripts and other information, please visit NSA.gov/podcast.