

NAVY SBIR TRANSITION PROGRAM SPOTLIGHT

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SmartBeam QRC: Forward Edge-AI's new covert communications solution fine-tuned through Naval experimentation

Electronic warfare and cyber-attacks on communications channels pose significant challenges to military operations, as adversaries attempt to disrupt the flow of information that enables coordination of troop movements, logistics, intelligence gathering and other critical functions.

Through Navy SBIR Phase I and Phase II funding, Forward Edge-AI, a small business with expertise in autonomous networks, electronic-warfare resilience, and edge AI, developed SmartBeam QRC, a compact AI-driven quantum-resilient communications system designed for uncrewed systems (UxS).

SmartBeam QRC leverages artificial intelligence (AI) and secure signal control to reduce the risk of detection, jamming, or interception, while enabling covert communications between UxS, mobile command units and even downed personnel needing rescue in contested electromagnetic environments.

As part of its Phase II SBIR contract, Forward Edge-AI participated in three large-scale Naval and joint forces experimentation events in 2025 with support from the Department of the Navy SBIR Experimentation Cell (DoN-SEC). Lessons learned and data gathered from each exercise allowed the company to refine the technology and deliver a product more closely aligned with Naval operational needs.

DoN-SEC gives small businesses exposure to warfighter needs in specific operational



environments and use cases. The DoN-SEC team supported Forward Edge-AI through the process of participating in large-scale Naval experimentation exercises, from event selection all the way up to execution.

“The experimentation cell did wonders for us,” says Kevin Jackson, vice president of Space & Digital Asset Commercialization. “They provided background on each opportunity and helped us understand that every exercise has a different focus and operates differently. They helped us identify the events that best aligned not only with our technology but also with the stage of technology development we were in. They also helped us identify the right targets, typically a program of record or specific units and organizations within the service that needed to be aware of our technology. That guidance was invaluable.”

The first experimentation event Forward Edge-AI participated in during the development of

SmartBeam QRC was Trident Spectre, held in late March and early April of 2025 in Virginia Beach, Virginia. This annual multi-agency exercise focuses on collaboration to share best practices and identify innovative technologies to meet current and future special operations needs.

At Trident Spectre, Forward Edge-AI set out to validate that its quantum encryption device, Isidore Quantum, combined with software-defined radio, could create a covert tactical communications solution for the Navy.

"The underlying concept behind SmartBeam QRC is to control the electromagnetic beam for communications. That allows us to maximize the connection with intended users while minimizing the risk of detection by eavesdroppers," Jackson explains. Using proprietary AI algorithms, SmartBeam QRC determines where to focus the device's transmission and where to place spectral nulls that block electromagnetic radiation from traveling in the direction of enemies attempting to intercept or jam those communications. "They can't see us, they can't hear us, and they can't intercept us."

During Phase I of the SBIR project, Forward Edge-AI worked with simulations to demonstrate that the concept was feasible, but at Trident Spectre the developers tested it in the field for the first time. The event also gave Forward Edge-AI opportunities to further understand the communications needs of special operations missions. At this point in development, the company intended to integrate Isidore Quantum into commercial off-the-shelf (COTS) tactical radios, says Jackson.

The team's experience at Trident Spectre proved the concept would work. Working with a Naval Special Warfare Group, the team set up equipment atop a lighthouse and attempted communications with Army and Navy special

warfare vessels operating off the coast.

"We validated in the field that we could create and modify a beam and could provide quantum-resistant encryption. The exercise confirmed many of the critical aspects of our early design." The experiments also demonstrated, however, that while COTS radios were capable of beamforming, they did not provide enough fine-grain control to function effectively for the mission. It became clear after Trident Spectre, according to Jackson, that Forward Edge-AI would need to develop its own purpose-built software-defined radio. "That led to the very first SmartBeam QRC."

Between March and July 2025, Forward Edge-AI engineered a prototype system in preparation for Silent Swarm, an annual experimentation exercise organized by Naval Surface Warfare Center Crane Division. Silent Swarm 25 focused on experimenting with new and emerging technologies employed on small unmanned systems, including unmanned surface vessels, land vehicles and airborne systems.

The two-week event held along the shore of Thunder Bay in Alpena, Michigan, featured vignette experiments that divided participants into teams with opposing goals. This gave the Forward Edge-AI team opportunities to demonstrate covert low probability of detection (LPD)/low probability of intercept (LPI) encrypted communications between different types of uncrewed vehicles, obtain independent third-party measurements, and explore how SmartBeam QRC would perform in tactical jamming applications.

At that stage of development, the physical form of the SmartBeam QRC system was still unrefined. The hardware, mounted on a developmental board, was housed inside a Pelican equipment transport case.

"We weren't quite mission ready, but that's the

whole purpose of going to the exercise — to figure out what it takes to be mission ready,” Jackson says. Working out of a temporary “lab” in a hotel room, the Forward Edge-AI team prepared the system for installation in a variety of locations throughout the event. At one point, SmartBeam QRC transmitted from atop a 100-foot manlift to an unmanned surface vessel in the bay. Later, a passenger vehicle and a pickup truck were used to simulate communication between unmanned surface vehicles.

Finally, in the most challenging integration of the event, SmartBeam QRC was installed on a Havoc USV and deployed into the bay to successfully complete a mission involving the collection and transmission of tactical information to teammates.

In a final twist, the Havoc USV sank while returning to shore, destroying Forward Edge-AI's developmental system. “Yet another lesson,” Jackson notes. “When we're going out on the water, we've got to be careful.”

Despite these challenges, he says, Silent Swarm was a great success and verified that the new system design worked. “We learned a lot, we did a lot, and we even drew the attention of the U.S. Army during the exercise.”

Seeking additional verification, Forward Edge-AI next set its sights on Northern Edge, a large-scale joint training exercise held in Alaska in August 2025. The exercise focused on multi-

domain operations in the arctic environment and featured more than 100 aircraft; intelligence, surveillance, and reconnaissance (C-2 ISR) platforms; aerial refuelers; mobility transports; and maritime assets including the Navy's USS Abraham Lincoln Carrier Strike Group operating in the Gulf of Alaska. More than 6,400 service members from the U.S. and Canadian armed forces participated.

Forward Edge-AI's experimentation exercises

took place at a mock airfield established near Eielson Air Force Base. With the nearest city, Fairbanks, approximately 50 miles away, the location was remote and conditions were rugged. “We were in the middle of nowhere. Our cell phones didn't work, and we'd see moose walking across the street,” Jackson recalls.”



Peter Bayley from Forward Edge AI demonstrating the Smart Beam QRC at Silent Swarm, installed inside a USV from Havoc AI Inc.

Working through rain and snow, the team fine-tuned the Isidore/SmartBeam integration and executed experimentation plans while collecting system range and beam coherence data to further verify SmartBeam QRC's effectiveness. The system even withstood attempted jamming from a Navy F-18 aircraft, marking a highlight of the event for the team.

In the months following Northern Edge, Forward Edge-AI continued refining SmartBeam QRC, focusing on reducing system size and improving packaging for easier installation on unmanned platforms. The current version of

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SmartBeam QRC is approximately five inches wide and 20 inches long and features a new 16 element phased-array antenna design that enables powerful low-distortion transmission.

Compared to standard software-defined radios available on the market, the system is four times harder to detect thanks to its adaptive beam steering and agile waveforms, and it provides three times better LPD/LPI communications performance. Forward Edge-AI plans to participate in additional experimentation exercises in 2026 to continue advancing the technology.

In addition to the support the company received from DoN-SEC as it participated in Naval experimentation events, Forward Edge-AI also participated in the Navy SBIR Transition Program (Navy STP) during Phase II of the SmartBeam QRC SBIR project. Jackson believes the two programs complement each other in the support they provide to Navy SBIR-funded small businesses.

Navy STP helps small businesses create marketing materials, identify potential transition opportunities within the federal government and commercial markets, and promote their technology by attending trade shows and meeting with decision makers within defense programs and large contractors. "These traditional marketing channels are critical because that's where people look for new technologies and capabilities," says Jackson.

Since winning its first SBIR award in 2019, Forward Edge-AI has built a portfolio of technologies and capabilities based on expertise in cutting-edge business transformation, cybersecurity, and AI, machine learning, and inference. To date the company has been awarded eight SBIR Phase I contracts and converted seven of those to Phase II awards, an 87.5% conversion rate.

"Forward Edge-AI is an SBIR company. That's what we do," says Jackson. "We identify new technologies, develop intellectual property, and apply those technologies to unique challenges across not just the defense sector but the public sector writ large. Our work supports the defense and

intelligence communities and public-facing organizations like the Department of Homeland Security. We're here to support our whole society, making it better, safer, and more secure."

For more information, visit the company's website at www.forwardedge.ai.



The Forward Edge-AI team from left, Peter Bayley, Melissa Pugh, and Kevin Jackson, at Northern Edge.

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