PHASE VALUE

MPT's phased-array technology gives radar systems an extra edge

In *A Radar History of World War II*, considered one of the most comprehensive books on radar, physicist Louis Brown describes radar's emergence as "a completely new way to see." It was, according to Brown, an invention that altered warfare more profoundly than any other during that era.

Radar was first developed for the militaries in several different countries, but its wide range of applications now makes it a profound technology across the board. In its modern form, it guides planes and missiles, detects spacecraft and motor vehicles, identifies terrain, and helps predict the weather. Radar systems have evolved over time to meet the needs of the military as well agencies such as the National Oceanic and Atmospheric Administration.

Among the multitude of improved radar technologies is the phased array system, which is often used by warships to track and detect missiles. Key to the technology is an electronically scanned array of antennae that allow the beam to rapidly redirect, track multiple targets, and maintain big-picture surveillance. Given its importance, continued improvement of phased array radar has been an imperative for both military and commercial applications.

Enter California-based Microwave Packaging Technology, Inc. (MPT), a company which has risen to the challenge of expanding phased array radar capabilities by providing components, subsystems, and R&D services to the U.S. government.

"Our adversaries have developed technology that is able to counter some of our country's phased array capability," said Dr. Rick Sturdivant, founder and CTO of

MPT, Inc. "Our research has helped the U.S. maintain a technology and military capability edge over our adversaries."

MPT's affordable, increased-detection range system uses Ka-band phased array radar, which is a higher frequency band than K-band, where water vapor in the atmosphere absorbs the signal and greatly reduces range. With this higher frequency and correspondingly shorter wavelength, Ka-band radar can carry more information at a faster rate, and detect objects with higher resolution than lower frequency radars, such as Ku-band and L-band. According to NASA's website, the difference between Ka-band and other radar is "like the difference between the television antennas perched on houses decades ago ... and the satellite antenna dishes used today that use a much higher frequency."

In large part thanks to the RIF contract, MPT is now working with the U.S. Air Force to develop a satellite communication system similar to the one being constructed for Elon Musk's private space flight company, SpaceX.

The development of MPT's detection system was made possible through a series of Small Business Innovation Research (SBIR) awards that helped fund necessary steps in the technology's development. A Rapid Innovation Fund (RIF) award allowed the company to swiftly get the technology into the hands of the U.S. Army.

MPT develops antennas and subsystems that extend the sensitivity of the phased array radar. The subsequent Ka-band radar waves coming from the array of antennas operate at a frequency 10 times higher than cell phones and WiFi, which means they are able to detect small details. It allows U.S. warfighters to see the enemy before the enemy sees them, and it gives missiles the ability to automatically guide themselves to their targets.

Dr. Sturdivant said that most of the military's use of the technology is classified, but that there are plenty of obvious scenarios in which the phased array radar would give the U.S. warfighter an upper hand.

"One hypothetical situation might be a dogfight between two fighter planes," Dr. Sturdivant said. "For instance, our radar will allow the U.S. pilot to fire a missile that will see an adversary's aircraft before it sees the U.S. pilot. And the phased array will automatically track to the other fighter plane and protect our pilot from being shot down. That's a very realistic scenario."

An SBIR Phase I in 2012 allowed MPT to increase radar range. An SBIR Phase II in 2013 allowed the company to improve other aspects of the system including radar thermal cooling, output power, and in-flight calibration. With the 2014 Army RIF award, MPT was able to rapidly develop the technology using innovative electronic packaging. Dr. Sturdivant said, "What RIF did is it allowed us to jump start and kick into high gear our development of technology to counter those types of threats."

The success of the Army RIF contract has also allowed MPT to leverage the phased array technology for several commercial contracts they wouldn't have otherwise received, including projects with Raytheon, the Missile Defense Agency (MDA), Lockheed Martin, and several other non-DoD customers. For instance, MPT's phased array and digital receiver products have been developed for MDA systems such as the TPY-2 radar systems..

Dr. Rick Sturdivant

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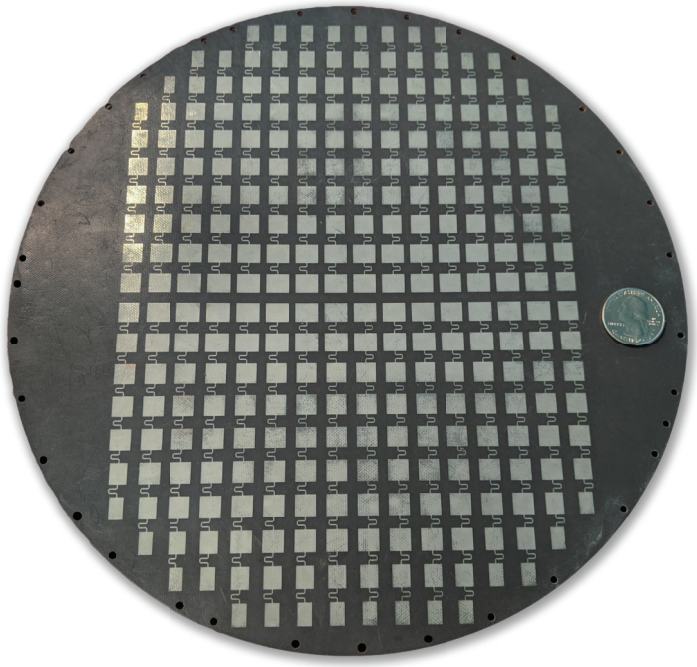

A Ku-band phased array system from Microwave Packaging Technologies is similar to the Ka-band technology supported by the SBIR and RIF programs.

for Elon Musk's private space flight company, SpaceX. The system will improve the data rate for internet access from space.

"These satellites are going to be used to provide high-speed internet access around the world," Dr .Sturdivant said. "It's technology that a lot of people will be able to access."

Access to high-speed internet could be especially transformative for remote communities that don't have much infrastructure, including rural areas and third-world countries. Dr. Sturdivant co-authored a 2017 paper for the peer-reviewed journal *IEEE Access* in which he cited statistics from the national nonprofit Next Century Cities stating that 39 percent of individuals living in rural areas and 41 percent of people living on tribal lands lack high-speed internet. For Dr. Sturdivant, as a member of the Lumbee Indian Tribe of North Carolina, that issue is personal. He knows how access can affect Native communities.

"One of the more underserved groups for internet access in the United States are American Indians," he said. "And it affects their ability to have access to education. It affects the businesses they start. It puts them at a disadvantage. But our technology will allow them to make contact through these satellites for high speed internet."

Based on its long experience researching and developing technology in the field, MPT is uniquely positioned for success with its phased array technology. One of the company's engineers holds 75 patents related to the technology, and Dr. Sturdivant has written several books and papers on phased array systems. But the SBIR and RIF programs gave MPT the boost the company needed in order to fulfill its potential. Dr. Sturdivant said that MPT is now projected to grow somewhere between $20 to $40 million in the next couple of years, and that boost translates to innovative technologies the DoD may harness in future crises.

"The success of the SBIR program and the RIF award has propelled and accelerated the growth of MPT," Sturdivant said. "Because of the SBIR and RIF awards, we are able to provide additional value to our customers and help them meet their goals on phased array programs."

Modernization Priorities: Microelectronics, Space, Fully Networked Command, Control, and Communications (FNC3)
RIF Award: 2013 Army AMC/RDECOM: "Affordable, Increased Detection Range Ka-Band Radar" (W911W6-14-C-0014) – SBIR Phase III **Supporting SBIR:** Army topic A11-074 "Affordable Active Phased Array Sensor Systems" (Phase II contract: W31P4Q-13-C-0021)
N]ational Defense Strategy Pillar: Force Readiness and Lethality