



DOE SBIR/STTR SUCCESS



DIRAC SOLUTIONS INC.

Imagine a tag that works similarly to a bar code but can be activated at a much larger distance and can transmit encrypted information without a battery. This is precisely what Radio-frequency (RFID) tags produced by Dirac Solutions Inc. (DSI) can accomplish, playing a crucial role in inventory management of national security items. The RFID technology was discovered decades ago, but Dirac Solutions products are different from other RFID devices. DSI technology overcomes serious technical problems that occur when many RFIDs are close together, around metals and liquids, and in the presence of interfering signals, all of which degrade the RF communications.

FACTS

PHASE III SUCCESS

At the end of Phase II Dirac Solutions totaled \$ 1.3 M in federal sales and secured \$1.9 M from DOE for further product development.

IMPACT

Dirac Solution's technology originates from research conducted at Lawrence Livermore National Laboratory and delivers battery-free RFIDs for highly secure communication in harsh environments.

DOE OFFICE

National Nuclear Security Administration (NNSA).



RFID systems are made of two components: one is the reader, which emits the radiofrequency signal and also reads the signal sent back from the tag; the other is the actual tag, which reflects back a portion of the signal sent out by the reader. By doing so the tag reports on a data set consisting of unique IDs, sensor and location information, which can be displayed on your smart phone. The tag and reader communications is highly secure with NSA approved encryption and dynamic authentication. The tag contains a microcontroller chip, which encrypts the signal and requires power to perform this computation-intensive process. The novelty of Dirac Solutions' devices is that the tag does not have a battery (passive device) and the computation power is provided by the same radiofrequency signal the tag is exposed to by the remote reader. For this to actually work, both the antennas and the signal processing software in the tag and the reader needed to be fundamentally redesigned.

“Encryption requires a lot of computation and our customized software was developed to take care of the security aspect in the most efficient way,” says Dr. Faranak Nekoogar, CTO of Dirac Solutions. The antenna was completely re-engineered to be much more efficient and directional, in order to pick up the faintest signal from various directions. A sophisticated signal processing algorithm was then developed in order to distinguish the smallest signal from the surrounding noise and eliminate interference, absorption, and obscuration effects. “It’s a bit like enabling a cell phone to work reliably inside an elevator” explains Dr. Nekoogar.

These innovations required many years of wireless research and product development, which started with the PhD work of Dr. Nekoogar at Lawrence Livermore National Laboratory (LLNL) 13 years ago. Dr. Nekoogar attained DOE research funds to develop her technology, which subsequently was selected by the LLNL Tech Transfer Office (TTO) as a mature technology with commercial potential. “The insight of LLNL and the great entrepreneurial sense of Dr. Richard Twogood, who developed a Cooperative Research and Development (CRADA) project with LLNL TTO office after retirement, were key success factors” explains Dr. Nekoogar. “Our team was a perfect match and became very strong because we both had the same mission and agenda.

We addressed the proprietary concerns of all parties in a cooperative spirit and this ultimately led to our SBIR award.”

The funding for the DOE SBIR Award was provided by the Global Nuclear Safeguards Program within the DOE National Nuclear Security Administration. Following SBIR Phase II, which started in 2012, Dirac Solutions reached a total of \$ 1.3 M in federal sales for their RFID devices for nuclear emergency response in a variation of its original technology. Dirac Solutions is now starting their Phase III, having secured \$1.9 M from DOE. Dr. Nekoogar was very pleased with the entrepreneurial encouragement from LLNL. “I think it is great that LLNL wants to keep the inventor involved in the company’s growth. I was able to take an entrepreneurial leave and become Dirac Solution’s CTO”. “In Phase III” Dr. Nekoogar explains, “we will focus all our efforts in enabling efficient mass manufacturing in collaboration with Silicon Valley companies, in order to significantly bring down costs.” Closing this gap will allow Dirac Solutions Inc. to serve many other markets, including commercial supply chain management, asset and people tracking, contactless payment, as well as internet of things (IOT).

Dirac Solutions Inc. RFID tag technology finds the most immediate application in situations in which a large number of items with their respective sensitive information need to be entered in a secure way into an electronic inventory in a short time. These items might be located in a cluttered environment, packed in metal containers, subject to radiation and/or stored for very long times. A typical situation is the deployment of supplies in response to an emergency. Dirac Solutions Inc. RFID tag system allows such a challenging inventory to be completed in a matter of a few minutes by a single person by just pointing the reader at supplies already loaded in a truck. This system is already in use by Nuclear Emergency Response facilities for inventory automation across the US.

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