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Mojix Takes Passive UHF RFID to a New Level

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The startup draws on RF expertise from deep-space signal processing to create a system that it says will offer improved performance, new capabilities and lower deployment costs.

By Mark Roberti

April 14, 2008— Newly emerged from stealth mode, Mojix, a startup company based in Los Angeles, plans to launch a new type of RFID system at this week's RFID Journal LIVE! 2008 conference in Las Vegas. The system uses techniques developed for deep-space communication to significantly boost the read range of passive UHF tags, as well as identify their precise location in three dimensions.

The Mojix STAR system reads passive ultrahigh-frequency (UHF) RFID tags based on EPCglobal's second-generation air-interface protocol. According to the company, a single STAR receiver can cover an area of up to 250,000 square feet, pinpointing tags in 3-D space.

"This is a breakthrough that renders all applications in the supply chain more economical," says Ramin Sadr, Mojix's founder and CEO. "The technology is based on signal-processing techniques developed to detect communication from deep space. We use a completely new architecture. This is the first time that anyone has been able to read tags at 600 feet or more, and identify their location in three-dimensional space with great precision."

The signal-processing techniques employed by Mojix center on an antenna technology known as phased array, which uses a group of antennas that are able to focus on the signals being received, thereby strengthening desired signals and canceling out noise. Sadr, a former NASA scientist and telecommunications industry entrepreneur, formed Mojix in 2004 and assembled a team of scientists and engineers to apply steerable phased-array antenna technology to RFID interrogator antennas, enabling them to pick up faint backscatter transmissions from passive tags that would be missed by conventional RFID systems.

In addition, Mojix's system takes a different approach to powering an RFID tag. Most conventional RFID systems are monostatic, using the same reader antenna to transmit energy to power up a tag and receive its signals back. This makes it difficult to read the signal reflected back from the tag, since that signal is much weaker than the one emitted by the reader antenna. Even bistatic systems, which transmit energy to power up a tag with one set of antennas and receive the signal back from the tag with another, typically place the send and receive antennas in the same general location.

Mojix has separated the transmit and receive functions geographically. Its system consists of a distributed network of transmitters, known as eNodes, to power up the tags, and a single STAR receiver to pick up the tags' signals. The STAR receiver has four patch antennas, designed to form an RF beam that can be electronically steered and adjusted in width, depending on the area of coverage required. The STAR receiver also controls the eNodes, which are connected to the receiver by coaxial cable (the eNodes can be daisy-chained, and the company plans to create a version that can be linked wirelessly via a standard Wi-Fi network).

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Each STAR receiver can be connected to 512 eNodes. Every eNode has its own antenna for emitting RF energy, and can excite hundreds or thousands of tags within a 30-foot radius; the STAR reads the energy from tags as far as 600 feet away, and because it can focus on receiving signals from various directions, one STAR can cover a 250,000-square-foot area. Within a single STAR's coverage area, a retailer could have eNodes covering, for instance, handbags at the front of a store and designer jackets at the back.

The Mojix system can provide coarse or fine location data. The system can be set up to simply indicate to back-end software that a tagged item is in a particular eNode's read zone (coarse location data). Because Mojix uses steerable phased-array antennas, the system is also designed to be able to identify tags' locations in 3-D to within a 1-foot radius (the actual precision varies depending on the environment, as well as on the nature of the tagged item).

Companies would need to map this location to a particular shelf location. But the ability to locate a tag in 3-D space, combined with the ability to cover a large area, makes the system suitable for organizations that need to cover large numbers of dock doors, a sizable warehouse, a store's back room or an entire sales floor. The eNodes could be set up in several areas of a warehouse or retail outlet to power up tags on high-value goods in those locations.

A single STAR receiver could read the signals from tags in those areas, informing employees where items are located to within about a foot, or indicate which items are in the wrong location. And more eNodes could be added to create additional coverage areas over time, without requiring additional STAR devices (provided the new locations are within the STAR's 250,000-square-foot read range).

Additionally, Mojix has developed the concept of "eGroups" to address the problem of being unable to read tags attached to cases in the middle of pallets of RF-unfriendly materials, such as water or metal. The eGroup approach—which uses conventional EPC Gen 2 UHF tags—can also be employed to secure shipments, for electronic proof of delivery and as an anticounterfeiting measure.

The eGroup uses combined source and channel coding, based on mathematical algorithms often utilized in error correction for such applications as recovering corrupted data on a hard drive, or rectifying errors in noisy communications channels. Mojix employs source and channel encoding, in conjunction with the ability to encode tags that are pinpointed in 3-D space, to confirm all boxes are on a particular pallet. If 60 percent of the tags are read, the company says, it can confirm the presence of all tags because if a case were missing, the positions of some of the other cases would change, which the eGroup technique would recognize.

This, the company claims, gets around the need to read every tag in the center of a pallet. It allows a user to determine if a pallet has been tampered with, and can be utilized to provide electronic proof of delivery. It can also help prevent counterfeit goods from entering the supply chain, because only the goods' receiver has the key to unlock the eGroup data and recover the original serial numbers. (The

same process could be applied to secure a population of tagged items on a store shelf, or on a display case.)

Mojix intends to unveil the Mojix STAR system this week at RFID Journal LIVE!, being held April 16 to 18. To demonstrate STAR's performance capabilities, the company plans to read standard passive UHF Gen 2 RFID tags from across the length of the Venetian Hotel exhibit hall—a distance of approximately 300 feet.

Kevin Duffy, Mojix's senior VP, says the STAR system will be sold as a solution for managing warehouses, back rooms and retail stores. "We're following the infrastructure need," he says. "There are a lot of applications, such as dock doors operations, where we can offer a turnkey solution."

Analysts who have already seen the Mojix STAR system describe it as "game changing," claiming it offers greater coverage and the ability to locate tags in 3-D. The company has not yet revealed pricing, but Duffy says he's confident the STAR system, available starting April 16, will be 20 to 25 percent cheaper for covering dock doors.