

NASA to Launch RFID Test to Track Crewmember Supplies

The agency is hoping passive RFID tags using surface acoustic wave technology will help it take inventory of consumable items in space.

By Mary Catherine O'Connor

June 4, 2007—For crewmembers at the International Space Station, seemingly simple tasks such as changing clothes or brushing teeth can be time-consuming chores. Without gravity, clothing and personal hygiene items float around—as do the crewmembers themselves.

Such conditions also make taking stock of inventory another time-sucking task. Each crewmember must periodically perform an audit of his or her possessions—uniforms, toiletry items, etc.—so that NASA's inventory managers back on Earth can check the supply of these goods and determine which need to be restocked for the next mission. But zero gravity means there's no easy way for each crewmember to dump the contents of his or her personal duffle bag onto a table and sort them out. Instead, he or she must place all items in a second bag and then return each to the original bag, while listing the type and quantity. This process can take up to 30 minutes for each crewmember, says Amy Schellhase, cargo integration manager with Barrios Technology, the aerospace engineering and technology services firm that NASA has contracted to test an RFID technology solution to replace this manual system.

Schellhase and Tim Brown, a NASA integrated data systems manager, say the space agency had previously considered attaching RFID tags to the individual items in each crewmember's bag so that manual counting could be replaced by a quick wave of an RFID reader over the bag. It had also hoped RFID could replace the bar code system NASA uses for tracking spare parts and other high-value, mission-critical hardware in the space station. But after collaborating with a university research group a couple of years ago, tests showed interference from the metallic and liquid materials contained in the items NASA wanted to track made the tags they were testing—passive RFID tags comprised of a silicon chip and antenna and operating in the UHF read range—too unreliable. And the cost and size of more robust, active tags would make them impractical for tracking consumables.

The project, therefore, was put on hold until Brown says he "ran across RF SAW, and their claim to fame was that [the tags] would work around metal and water." RF SAW is a Dallas-based firm that manufactures RFID tags that employ surface acoustic wave (SAW) technology. Instead of a silicon chip, SAW tags contain a piezoelectric crystal, which—like the IC in a silicon-based tag—is connected to an antenna that receives an interrogator's RF signal and transmits a return signal. The SAW tag, however, has a transducer that converts the inbound RF signal into an acoustic one, which travels along the surface of the crystal. The transducer then converts the acoustic signal back to RF before transmitting the tag's data to the reader.

While a SAW tag is being manufactured, tiny metal reflectors are attached to the crystal. The arrangement of these reflectors is unique to each tag. As the acoustic wave travels along the crystal, it picks up a pattern produced by those reflectors, which is converted to a unique ID through the interrogator's digital signal

processor. Although metal and water still attenuate the 2.45 GHz RF signal coming from the interrogator to excite the SAW tag, the crystals in the tag do not consume as much of the signal's power as an integrated circuit does, allowing SAW tags to generate a stronger backscatter signal than that created by silicon-based tags, which helps to overcome the attenuating effects of water and metal.

Having completed land-based functionality, interference and workflow testing of the RF SAW tags and portable RF SAW readers that are attached to and powered by PDA, NASA is now preparing for the first test of the technology in space. "The International Space Station will be the test bed," says Brown.

This fall, NASA staff will attach RF SAW tags to uniforms and toiletry items placed into each duffel bag assigned to each crewmember of a six-month mission. They will read each tag's ID and correlate that ID with the item in a database. Periodically during the mission, crewmembers will be asked to scan the contents of his or her bag by waving the reader/PDA device over their bags. The reader will collect the IDs of all the tags it reads and then this data will be downloaded to NASA's information system when the PDA is placed on a cradle for recharging. The crewmembers will then also take a manual inventory of each bag. Both the inventory count pulled from the RF SAW system and the manually derived inventory count will be forwarded to Schellhase and her team, via NASA's satellite communications system.

NASA will continue to expand its testing of the RF SAW tags if this fall's tracking of consumable items proves successful. "What we are looking for in this test is consistent read range and accuracy from the tags," says Schellhase.

During the space mission NASA will also be putting the RF SAW products through its standard, internal certification testing, in order to see if its signals interfere with any of NASA's existing radio or other types of communications systems.

Schellhase and Brown say that they are hopeful that the RF SAW system will be able to improve efficiencies in tracking consumables, initially, and then later also streamline its tracking of high-value assets now tracked via bar code.

RELATED_ARTICLES "If you can take the 30 minutes a crewman takes to audit a bag, and drop that down to 20 seconds or so by using a reader to scan the bag, that is a lot of time that crewmember can be spend doing important work up there, such as conducting experiments," says Schellhase.

This project isn't the only one NASA is undertaking that involves passive RFID tags. The agency's George C. Marshall Space Flight Center is also testing several different passive UHF tags in an experiment conducted this summer on the International Space Station—the first time RFID tags have been exposed to the conditions in space (see [NASA, Intermec Partner to Send RFID Into Space](#)). The tags will be mounted to a suitcase-sized container attached to the exterior of the International Space Station.

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