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DOD Completes Large-Scale Tests of Mesh-Networking Tags

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The technology is being considered as a means for tracking high-value or mission-critical items, even in remote locations.

By Laurie Sullivan

July 27, 2009—The U.S. Department of Defense (DOD) recently completed large-scale tests of mesh-network location-tracking asset tags from ARINC and Impeva Labs. The tests involved hundreds of battery-powered asset tags that formed secure local mesh networks spanning up to half a mile in length.

With the ARINC-Impeva system, dubbed Next Generation Wireless Communications (NGWC) for Logistics Applications, each tag on goods being transported serves as a network node, transmitting its unique ID number and GPS coordinates. The tag also forwards other tags' ID numbers and GPS coordinates, encoded in signals it receives from neighboring tags. The tags employ a proprietary 2.4 GHz mesh communication protocol to form a network with each other, as well as with mobile RF gateways that transmit each tag's ID number, GPS location and sensor data over secure long-range communications channels, such as satellite, cellular or other available networks, including WiMAX or Wi-Fi. Fixed locations, such as shipping ports, would require only one or two gateways, because the tags communicates with each other, thereby reducing the need for a great deal of infrastructure.

According to Dave Evans, a consultant in the technology group at LMI Government Consulting, a nonprofit organization set up by the government in 1961 to provide research and advice regarding logistics, a DOD official has been in discussions with numerous U.S. Armed Forces divisions and business units regarding the adoption of mesh-networking tags to track cargo. At the DOD's request, Evans and LMI have been working with U.S. Army government personnel to find a better technology to monitor the movement of goods, and to build a system to manage logistics for their transport. As part of that effort, LMI evaluated the ARINC-Impeva NGWC system.

"We now have a working system that we can take to the rest of the Armed Forces," Evans says. "We'll transfer it from a test to a production environment, but there's still a long process to get the software certified by the Department of Defense Information Assurance Certification and Accreditation Process, to make sure it's kept secure and reliable."

The biggest test to date of the NGWC asset-tracking system was conducted in March 2009 at Moffett Field, operated by NASA's Ames Research Center in California, for ARINC's customer, the U.S. Army Logistics Innovation Agency (LIA).

The key, Evans says, is the "mesh tag," a relatively inexpensive battery-powered tag enabling military organizations and commercial companies to monitor and track goods and assets through terminals and seaports or airports, in boxes and refrigerated containers. The NGWC system can provide continuous visibility of assets anywhere on Earth, without the need for ground infrastructure.

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The mesh network has the potential to eliminate the need to change business processes, Evans says. Most RFID technology requires fixed interrogators at every gateway, but this mesh network, he claims, provides visibility from virtually any location—without requiring it to remain in a fixed position. "We're not going to replace passive RFID with this technology," he states. "It's really for high-value items that range from $5,000 and up. Sometimes, the item isn't that expensive, but it's critical for the mission."

Jim Potter, ARINC's program director, says the tags are similar in size to a conventional active RFID tag (a bit larger than a pack of cigarettes), but can talk to each other until they pinpoint the infrastructure to transmit the information. "You can arbitrarily push stuff out in the field and introduce a gateway, which forms the mesh," he says. The gateway transmits an encrypted RF beacon, after which the tags receive the message, decrypt and authenticate it, and join the mesh network. "Once formed, mesh doesn't need anyone's help to communicate the information—it forms itself."

Multiple self-assembling NGWC configurations were deployed during the tests at Moffett Field. One test involved a network of 930 tags reporting through a single gateway. The tags, attached to the sides of buildings, were deployed to simulate asset storage at a large military depot, or on board a ship. A second network was also tested, with 54 nodes stretching half a mile, to simulate the transportation of assets by a railroad or truck convoy. LMI and U.S. Army personnel found that the mesh worked well, and there seemed to be no scaling limitations at the routing level. The DOD indicates that it is convinced the team met all major milestones, such as mesh security, reliability and speed.

As part of the 2009 Joint Logistics Over-The-Shore (JLOTS) exercise in mid-June, the U.S. Army utilized the NGWC logistics system to track hundreds of individual military assets—from cargo containers to Humvees—as they were loaded onto U.S. Navy transport ships at Norfolk, Va., and then shipped down the Atlantic coast and offloaded onto the beach at Camp Lejeune, N.C.

According to ARINC, the JLOTS exercise marked the Army's third successful major test of the system, in a series that commenced in 2008. Later this year, the company reports, the 36,000-acre Sierra Army Depot (SIAD) in California plans to deploy the NGWC logistics system for additional performance testing. The Army is also considering other potential deployments within the coming months.

The DOD's decision whether to deploy this system permanently is still pending. According to Evans, the department's effort could result in the use of mesh-networking tags by other U.S. governmental branches, such as the Department of Homeland Security (DHS), for use with electronic seals on shipping containers.