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ODIN Benchmark Study Identifies Top Handheld Performers

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Handheld UHF RFID readers from Motorola and Convergence Systems Ltd. scored highest in some of the tests.

By Claire Swedberg

Sept. 8, 2010—ODIN's scientific research division, ODIN Labs, has published a new benchmark study of eight handheld readers supporting the EPC Gen 2 and ISO 18000-6C standards for passive ultrahigh-frequency (UHF) tags. Motorola's MC3090-Z reader and Convergence Systems Ltd.'s (CSL) CS101 were the top performers for distance reading. ODIN's researchers also tested the eight models for orientation sensitivity, and found that antenna arrays had a significant impact on the devices' functionality.

The study, conducted during summer 2010, also included handheld readers from Intermec, Unitech andMacS
. The researchers found that while some interrogators were clear winners when it came to read range and orientation sensitivity, the wide variety of users, use cases and features make the task of selecting the appropriate handheld more complex than simply finding the best read range. The benchmark study lists the various characteristics of each device, comparing and contrasting the various models based on those attributes.

The new benchmark study was an update to one that ODIN published in 2005, says Patrick Sweeney, the firm's founder, explaining that ODIN felt the time had come to once again examine the functionality of some of the RFID industry's top-selling handheld readers. Much has changed in five years, he says. The 2005 report examined four handhelds: LXE's MX3X, Psion Teklogix's RD7950 and Workabout Pro, and the Symbol MC9000-G, designed by Symbol Technologies (later purchased by Motorola). At the time, the EPC Gen 2 protocol had just been released and had not yet been adopted as the ISO 18000-6C standard. Nowadays, Sweeney says, there are many more handheld readers that support the EPC Gen 2 and ISO 18000-6C standards, offer better performance and are available in a wider variety of form factors, and for various use cases, such as mining versus retail. In addition, the number of industries using the handhelds has grown exponentially. "We identified 25 different industries using this technology," he says, including resorts, medical device manufacturers and aerospace.

Early this summer, ODIN identified the eight most commonly used readers out of an initial group of around 16, as well as those available for testing (as opposed to those still in development). In addition to testing Motorola's MC3090-Z and CSL's CS101 models, the company's researchers also included Motorola's MC3190-Z, Intermec's IP30 CK61 and IPCO CN3, Unitech's RHS767 and MacSema's PCE 4050, as well as the Symbol MC9000-G, a model ODIN tested for its 2005 report that is no longer being produced but was included for comparison purposes.

The team then set up testing in several European locations, as well as at ODIN's facilities in northern Virginia. Over the next two months, researchers conducted more than a dozen pretests to determine which testing methods would be the most effective, and which would mimic the real-world tag-reading environment. Based on the results of those tests, the firm selected two distinct types of tests—one for

read range, and another for orientation sensitivity. Three RFID tags were chosen for the testing, based on their own common usage and high read results: Alien Technology's Squiggle, Confidex's Steelwave Micro and Omni-ID's Ultra.

In addition, researchers gauged each reader's weight, durability and ergonomics, as well as other features each handheld offered, and compiled a list of attributes for each device. For example, one reader might provide greater durability but be heavier and bigger, while another might be more ergonomic and smaller, but less durable.

For distance reading, researchers attached tags to poles located 5 feet above the ground, then attached each handheld, pointed toward the tag, to a tripod stand at the same height. They then determined each device's outlier read point (the distance at which an interrogator can capture at least some reads) and consistent read point (the distance at which the device can read a tag at a consistent rate). Researchers gradually moved the reader closer to the tag until the outlier read was initially achieved and noted, then moved closer until the consistent read distance was determined.

For the Motorola and Symbol readers, the maximum power of operation was 27 decibels, while the others could achieve a power level of 30 decibels. The researchers, therefore, ran two distance tests: one with all readers set at 27 dB of power, and another with all of the devices set to maximum power.

In the 27 dB power distance test, the Motorola MC3090-Z could consistently read Omni-ID's Ultra tag at 30.9 feet and Alien's Squiggle at 23.6 feet. Motorola's MC3190-Z was able to reliably read at 30.2 feet with the Ultra tag and at 29 feet with the Squiggle tag. The CS101 came in fourth in the 27 dB power distance test, reliably reading both the Ultra at 26.8 feet and the Squiggle at 23.5 feet. But at its maximum power, 30 dB, the CS101 had the longest read distance, consistently reading both the Ultra and the Squiggle at 40 feet. Even the worst-performing reader of the group in the 27 dB power distance test put on a good show, able to reliably read the Ultra at 19.1 feet and the Squiggle at 5.8 feet. At its maximum power, 30 dB, that same reader could consistently read the Ultra at 22.9 feet and the Squiggle at 11.9 feet.

To determine reads in a more typical, real-world setting, ODIN's engineers then tested the readers' performance at two orientations. Squiggle tags were placed with vertical and horizontal spacing between them on a flat platform, while a handheld was then used to read all of the tags, after which the tags were reoriented (by rotating the platform by 90 degrees) and read again.

The testing compared circularly polarized antennas, designed to pick up reads from a variety of tag positions, with linearly polarized antennas, intended for high read rates for a specific orientation. A circularly polarized antenna will provide higher read rates for randomly orientated tags, but typically at lower read distances than a linearly polarized antenna. Motorola's new RFID handheld reader, the MC3090-Z, which scored high in the testing, employs a combination linear and circularly polarized antenna, known as the RFID MAX antenna.

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All readers run either the Windows CE.NET or Windows Mobile operating system, and some support both. Because there was not a single common operating system among all readers, however, the researchers had to make several software adjustments to the data. Obtaining and evaluating the reader functionality based on the data was one of the researchers' biggest challenges, Sweeney says, noting, "There was no single operating system" for the readers, "so we had to normalize the data to make it consistent." That required putting ODIN's own software application on the reader, and using that to capture reader data, or utilizing the existing reader software and attempting to normalize it to correspond with the data from the other readers after it has been received from the reader.

"One of the biggest surprises that came from this benchmark," Sweeney states, "was the variability in antenna design, and how much that can drive performance of the reader." Some of the highest-performing readers, he notes, had a large antenna surface area that proved to boost distance reading.

The complete benchmark report can be purchased for $750 at ODIN's Web site.