

HP Designs Tracking System

Hewlett-Packard is testing a low-cost real-time location and monitoring system composed mostly of off-the-shelf hardware.

By Chuck Lenatti

Apr. 19, 2004—For many retailers and their suppliers, RFID means “slap and ship”: slap a tag onto a package or pallet and ship it to Wal-Mart, which scans it at a receiving dock. And that, pretty much, is the end of it. In a small demonstration area in Building 3 of its Palo Alto, Calif., research laboratory, Hewlett-Packard is simulating a system that it says will allow workers in a warehouse or retail outlet to track the whereabouts of tagged items after they are logged in.

HP's RFID tracking system consists mostly of readily available, relatively inexpensive hardware: off-the-shelf RFID readers (costing around \$1,000 each); Web cams (\$30 at consumer electronics retailers); HP Labs' prototype location-aware nodes (which the company says cost about \$100 apiece now but would be cheaper in volume); and off-the-shelf temperature, humidity and barometric pressure sensors (about \$2 each), the type HP uses to monitor environmental conditions in experimental data centers.

A typical tracking system would consist one or more RFID readers to identify tagged objects when they arrive at the dock, at least three location-aware nodes to triangulate the location of a sensor such as an RFID reader, and an array of Web cams to visually track scanned items and sensors to monitor the environment. All these sensors and nodes would be linked together wirelessly in a mesh network, and an application-level overlay network would help coordinate, filter and aggregate sensor data. Total cost: less than \$2,000.

“Our approach is to develop something that makes a difference, but if you start reinventing everything, things are not going to be cheap,” says Salil Pradhan, chief technologist for HP's RFID program and a researcher at HP Labs. “We design only where we need to and rely on commodity components for the rest.”

In HP's demonstration lab, when an RFID-tagged package arrives at a simulated dock, its tag is scanned by an RFID reader. This causes a Web cam at the dock to transmit images over a private network so that a manager can verify that the package at least looks like a box and that the tag hasn't fallen off onto a worker's shoe, says Pradhan. “These things can and do happen,” he says. At the lab, you watch on a display monitor as the camera follows the tagged item. In a real warehouse, the Web cam would follow the tagged item so that a worker could tell what section or aisle a package is in.

To locate items precisely, HP's simulated warehouse has an indoor positioning system called LOCUS that can be thought of as an indoor equivalent to a global positioning system. In place of GPS satellites, three small nodes are perched on the ceiling of the lab. The nodes use a combination of RF and ultrasound pulses to measure the distances between one another. Given this information, they can triangulate and determine their position, as well as that of additional nodes, which may be attached to RFID readers or other sensors. The nodes can pinpoint a node within a couple of centimeters of its actual location—although accuracy would decrease a bit when tracking a node on a mobile RFID reader.

HP plans to add temperature, air pressure and humidity sensors on the nodes and readers so that a warehouse

storing perishable goods would know whether the surrounding conditions are suitable, say, for produce kept in that environment. “If you are talking about temperature and how something might be affected by temperature, a few feet from a heat source can make a big difference,” says Pradhan. Information from the sensors can be passed from node to node via RF to a central control.

HP’s simulated warehouse also monitors the health of the RFID readers themselves, just as its IT team monitors the health of computers in its network or distributed computing grid. Like PCs, readers don’t have to fail entirely to be ineffective, so the network detects readers that appear to be having problems and can notify a manager or automatically delegate the failing reader’s responsibilities to a healthy one nearby. Knowing in advance if a reader is about to fail can save a company from watching helplessly as its supply chain grinds to a halt, says Pradhan.

Although HP is still testing its system, it could be ready for commercial deployment within a few years, initially in the company’s own warehouses. HP also plans to offer the system as part of a solution—including integration and management services—through its consulting group.

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