

# Theft and Terror Threats Push Sensors into Supply Chain

Smart containers and cold chains wrestle with wireless communications.

BY TOM KEVAN

**T**he deployment of sensor-based systems in supply chain applications often hits a wall when high-level wireless communications are added to the mix. In cargo container security and cold-chain management applications—the most mature users of supply-chain sensors—the impediment is usually cost. But this fact has not deterred wireless sensor system vendors from pursuing the market opportunity created by continued theft and growing terror threats (see Frontline Solutions' online table comparing wireless sensor products).

## Safeguarding Containers

Some 200 million intermodal containers carry merchandise worldwide, and the Technology Asset Protection Association estimates that nearly \$50 billion a year is lost in high-value-cargo theft. Cargo container security systems, or smart containers, are devised to deter theft—and to minimize terrorist threats. Vendors like Savi Technology, RAE Systems, Science Applications International Corp., and GE have demonstrated in government-funded trials in New York, Seattle, Thailand, and China that these systems work.

Cost remains an impediment, but an even bigger issue is who will pay. "The shippers who are sending the product say it is not their responsibility—the carriers need to provide a secure infrastructure," says Ian McPherson, principal analyst at Wireless Data Research. "Port owners say that they are concerned with what happens in the port, but what happens on the ship isn't their domain."

This leaves the carriers with a difficult business issue. "What I hear time after time is that the carriers—such as APL Logistics or Matson Navigation—don't see a true return on investment from installing these systems," says Peter Fuhr, chief scientist at RAE Systems. "They're already working on very tight margins, so they are reluctant to add cost."

## Managing the Cold Chain

Like cargo security, cold-chain management is another mature application of sensor technology in the supply chain. Cold

chains are complicated because products lose their quality (in the case of food) or potency (in the case of drugs and biologicals) if they're not maintained at specific temperatures.

Temperature and humidity sensors have long been used in these applications, so their value is well proven. But as with cargo security applications, users balk when wireless sensors increase system cost.

"We have used wireless sensors many times, but we have found that there is a cost premium that goes with them," says John Felty, spokesman for Lat-Lon LLC, which provides cold chain management systems. "You have to power the sensor, so they must have a power supply that adds cost."

"We have looked at using wireless sensors, but our markets are very price sensitive," says Rupert Schmidtberg, chief technology officer at Sensitech Inc. "Bluetooth and Wi-Fi are high-data-bandwidth protocols, and they have high battery consumption. Our device has to be battery powered and inexpensive, and it needs relatively low power and long range. The low power and long range eliminates Bluetooth and Wi-Fi from consideration. And the cost of the chip technology used to implement them is too high."

## Alternative Wireless Technologies

Sensors provide data on conditions inside cargo containers, trailers, and railcars, but both cargo security and cold-chain management systems need a way to communicate the information to those monitoring the cargo. Embedding wireless communications in the sensor package currently appears too expensive for widespread adoption, but the availability and low cost of passive and active radio frequency identification (RFID) tags and cellular communications offers an alternative with added functionality.

"RFID is a very economical technology, so we are focused on this approach," says Gary Gilbert, chief security officer at Hutchison Port Holdings.

With passive RFID tags, you can give an inanimate object an identity. "When you do that, you can assign attributes to it, in terms of where it was made, how old it is, and the tolerances within

which it must be handled—temperature and shock,” says McPherson of Wireless Data Research. Information can then be passed through open access to standards-based RFID tags.

So by layering these technologies, vendors have created a system that delivers a greater value than any technology alone could offer.

## Safer Cargo Containers

RAE Systems develops and manufactures multisensor systems for cargo container security. RAE's solution includes four RAEWatch modules. These battery-powered units are the size of a chalkboard eraser and are mounted in intermodal containers. The system allows for the placement of radiation, chemical, biological, temperature, motion, tilt, and vibration sensors throughout the container.

RAE's sensors use Ember Corp.'s IEEE 802.15.4-compliant 2.4-GHz radios with mesh networking software. This gives the modules self-organizing, fault-tolerant distributed communications that enable the networked sensors to perform collaborative condition monitoring.

“Our system relies on a base station, which requires custom installation on the vessel before there is a conduit for the information to flow across the ship and up to the satellite for distribution to carrier, port authority, and government offices,” says Fuhr at RAE Systems.

Savi Technology offers another sensor-based cargo container security system, called the Sentinel. But unlike RAE's system, this one includes RFID tags.

Savi's device clips into the container door. It uses pressure and light sensors to detect when the door is opened and alerts operators to the possibility of tampering or theft. Environmental sensors manufactured by other vendors integrate with the system to monitor temperature, humidity, and shock throughout the container and also detect the presence of chemicals, biological substances, and radiation. Sentinel's active RFID tag captures historical information, such as time stamps and location, as well as sensor data, which can be captured by readers at port facilities.

## Cold-Chain Systems

Lat-Lon offers two cold-chain management systems, RailRider and RoadRider, which serve both railroad and trucking applications and are based on the same architecture. Within each self-contained unit, Lat-Lon has combined global positioning satellite devices, cellular radios, power supplies, and sensors. The system can include a variety of sensors, including

temperature, chemical, and vibration devices.

Lat-Lon's system can use wireless sensors. Most customers, however, prefer the implementation that uses Aeris.net's Microburst technology to communicate over existing cellular networks because the cost is significantly lower.

These systems' temperature sensors protect perishables, and their vibration sensors can provide information to determine if assets have been mishandled. If anything goes wrong with a shipment, the GPS devices can tell exactly where the event happened. When a condition exceeds a threshold, an alarm is sent. Union Pacific Railroad placed 2,400 units in its refrigerated railcars and has been using them for more than a year.

Acceptable cost and a clear need preclude the hesitation to invest in cold-chain management systems seen in cargo container applications. “We sell our product to shippers who own the railcars,” says Felty at Lat-Lon. “When things spoil, they pay. So they're motivated to protect their shipments to retain good customer relations.”

Sensitech Inc. has developed a radio frequency-enabled temperature monitor, called TempTale RF. This monitor records the condition, time, and location of products in near real time. Each unit contains a temperature sensor, radio chip, and antenna. The radio chip falls into the general category of what standards group EPCglobal envisions as Class 4 RFID tags.

“What you add to the tag is not only the ability to identify the item but also to sense environmental conditions,” says Schmidtberg at Sensitech. “By RF-enabling these devices, we are making the amount of labor that companies have to expend in handling significantly less. And more importantly, we are enabling a reliable flow of information. You can now aggregate the sensor data . . . and give companies oversight into their supply chains.”

Class 4 tags are battery powered, incorporate a microprocessor, and can be used in a mesh network. Traditional RFID applications, by contrast, include a reader; the only thing a tag can do is respond to a request for information from a reader. In a mesh network, the tags can talk through each other to get to a reader, or the tags can talk to an intermediate called a repeater. This capability lowers the cost of deployment because it requires fewer readers.

TempTale RF is in pilot test, but it will be available by the end of the year. “The first units that we will be commercializing will contain temperature sensors, and at some point in the future, we will also be commercializing humidity units,” says Schmidtberg. **FS**

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