Can You Hear Me Now?

Spectrum-enabled RFID tags store and share data

By the DON CIO Spectrum Team

Even if you have never heard of Radio Frequency Identification (RFID), you probably recognize the names Wal-Mart and Target. Both retail giants made big technology news last year. In November 2003, Wal-Mart defined a requirement for its largest suppliers to tag all cartons and pallets with wireless RFID sensors by Jan. 1, 2005. Target followed suit in February 2004, requiring some suppliers to use RFID tags on each case and pallet shipped by mid 2005.

RFID, a wireless spectrum technology that has existed for over 50 years and has been used by the Department of Defense (DoD) since World War II, has made it big in the commercial retail market. Although the commercial use of RFID made the news, the RFID trendsetter role can still be claimed by DoD and in particular by the Department of the Navy (DON).

Oct. 2, 2003, DoD issued a policy memorandum directing the immediate use of high-data capacity, active RFID technology that will affect all companies supplying goods to the DoD. But even earlier, during May 2003, the U.S. Navy Bureau of Medicine and Surgery implemented a Tactical Medical Coordination System.

Using versatile RFID technology, this custom-developed system simplifies hospital administration, reduces medical practice errors, provides better medical care, tracks common injuries and analyzes long-term trends by transferring patient information stored on RFID tags. Linking to a wireless local area network, unique data are exchanged, further eliminating manual reentry at a computer workstation.

While high cost components deserve the supply chain tracking benefit of RFID, it is notable that the DON found among its first applications, a solution to care for its most valued assets: Sailors and Marines.

Each patient admitted into Navy Fleet Hospital Three in Iraq is tagged with an RFID-enabled wristband. U.S. military personnel and other patients, including prisoners of war and the indigenous populace, are tracked by unique ID numbers embedded in the RFID tags. Medical staffs use RFID readers to scan the bracelet to confirm identity and enter information on diagnoses and treatments.

Turning from the humane to the mundane, during FY 2004, DoD will acquire more than $24 billion worth of supplies (beans, bullets, bandages) and services to support America's fighting forces, and that tangible supply chain will translate into a lot of logistics-related RFID tags.

How does an RFID system work?

A basic RFID solution is comprised of a minimum of three components – a radio frequency tag, which is actually a microchip that is an electronically programmed transponder containing unique information, an antenna device and a transceiver to communicate and decode the stored information.

When the transceiver sends out its electromagnetic waves, they form a magnetic field which "excites" the antenna on the RFID tag. A passive RFID tag accepts the magnetic field and powers the microchip's circuits. The chip then modulates the waves that the tag sends back to the reader and the reader converts the new waves into digital data.

The recent activity within the RFID industry will definitely improve the cost of components, but for the benefit of this discussion we need some baseline understanding. Passive paper tags, probably the least expensive tag in use, may be available for less than 20 cents, and hardened active tags on reusable containers are available for approximately $20. Transceivers are roughly $1,000 each.

Hospital corpsmen console a four-year-old Iraqi child with a shrapnel wound to the right foot. Note the RFID tag on the child's wrist. The child was transferred for follow-up treatment aboard USNS Comfort. U.S. Navy photo by Chief Journalist Al Bloom.

There are several spectrum bands associated with RFID use (see Table). Spectrum for RFID technology has not yet achieved harmonized international regulations, so use of specific spectrum bands associated with RFID is still a regulatory issue for each administration. Lacking a single standard, organizations could receive product tags for various spectrum bands requiring a transceiver in each of those bands to capture the tag data. In a normal operating environment, the result can be many tags and a number of frequency compatible transceivers.

Since RFID is based on proximity, unlike bar codes and their line-of-sight associated readers, the transceiver can process and analyze all of the "packages" as an entire pallet transits a loading dock. The

Frequency Band	Benefits	Concerns	Typical DoD Applications
100-500 kHz (Low Frequency)	• Inexpensive • Better penetration of non-metallic items	• Short to medium read range • Slow reading speed	• Access control • Inventory control
10-15 MHz (High Frequency)	• Short to medium read range • Medium reading speed	• Potentially inexpensive	• Access control • Smart cards
850-950 MHz (Ultra-High Frequency)	• Long read range • High reading speed	• Line of sight required • Expensive	• Vehicle Identification and Entry Control Systems
2.4-5.8 GHz (Microwave)	• Long read range • High reading speed	• Line of sight required • Expensive	• Vehicle Identification and Entry Control Systems • 802.11 generation of WLANs

A comparison of the benefits, concerns and applications related to different spectrum frequency bands.

time savings by not requiring visual contact with the tag are significant.

Tag Types: Passive, Active, Semi-passive

In the commercial implementation it is likely that passive RFID devices will be the norm. However, DoD's current policy anticipates supporting both active and passive devices. Passive RFID tags weigh less than active tags, are less expensive, and their operational lifetime is not dependent upon battery life. But they have shorter read ranges, more limited data storage than active tags and require a higher-powered reader.

Active RFID tags come with a battery and transmit a signal to a reader. Active tags can be read from 100 feet or more away, but at present they are significantly more expensive than their passive sibling. They are used for tracking expensive items over long ranges. Currently, the U.S. military uses active tags to track containers of supplies arriving in ports.

Active RFID tags are typically read/write, i.e., tag data can be rewritten and/or modified. Some active tags operate with up to 1 MB of memory. This flexibility supports variable application requirements. Semi-passive RFID has an internal power source to monitor conditions, but, similar to passive tags, requires RF energy from the reader/interrogator to power a response.

Tag Physical Form

Forms, shapes, sizes and protective packaging for tags vary with the article transit and storage environment. The common antitheft hard plastic tags deployed in stores are really RFID tags that also track inventory. Other RFID functions include credit card-shaped door access systems and animal tracking devices about the size of a pencil lead, which are inserted beneath the animal's skin.

Tag Coding – Standards for Clarity

The Electronic Product Code™ (EPC) is a number composed of four distinct elements – a header and three sets of data. The header is the key indicator identifying the tag version number. That version number keys the reader for the expected data length or other features that would be version specific.

The first set of data, actually the second part of the number, identifies the EPC Manager, which logically correlates to the manufacturer of the product. The second set of data, known as object class, refers to the exact type of product, most often the Stock Keeping Unit. The final data set is the serial number, which is unique to each item.

The Electronic Product Code stored on the RFID tag offers IT systems a method of matching the EPC to information about the associated item. Similar to the Internet's Domain Name Service (DNS), the EPC world has the Object Name Service (ONS), which provides a global lookup service to associate an EPC with an automated referral service that directs enquiries and applications to one or more Internet Uniform Reference Locators (URLs) where further information on the object may be found on the World Wide Web.

Currently the tags are available as either 64- or 96-bit electronic product coded units; the 96-bit EPC number is the most common. Using an EPC, the identity of the manufacturer, the product class, and specific instance of the individual product can be stored in a single tag. Today's most robust EPCs can be used to identify up to 268 million unique manufacturers, each with 16 million types of products. Each unique product can include up to 68 billion individual items, meaning the format can be used to identify hundreds of trillions of unique items.

With emerging requirements, the Uniform Code Council and European Article Number Association have endorsed proposals to expand EPC capacity, while other standards organizations are still reviewing the proposal. The draft EPC-256 is a 256-bit representation of the Electronic Product Code. The EPC-256 is designed for the long-term use of the Electronic Product Code as a universal identification scheme, not just a physical object.

DoD Specifications for Tags

The specification for EPC tags is relevant, since under the Defense Federal Acquisition Regulation Supplement Rule titled "Unique Item Identification and Valuation" published in December 2003, the government's tag requirement can be satisfied with the commercially adopted EPC standard.

The rules further state that DoD unique item identification, or a DoD recognized unique item equivalent, is required for defined acquisitions. Important to note, the

rule also stipulates that any commercial identifier can be considered by the DoD for use as a DoD unique identification (UID) equivalent if it meets all of the following criteria:

- Contain an enterprise identifier
- Uniquely identify an individual item within an enterprise identifier, product or part number, and
- Have an existing Data Identifier (DI) or Application Identifier (AI) listed in American National Standard (ANS) MH10.8.2, Data Identifier and Application Identifier Standard.

RFID Applications

The myth and reality of commercial RFID technology converge when manufacturers use the tags to monitor movement in a factory environment or distributors can track deliveries and inventory in a warehouse. This ability to monitor items has baseline applications in asset tracking, inventory management and supply chain automation. These are all standard technology applications that can benefit from wireless data collection.

Consumer products manufacturers like Proctor & Gamble Co., Johnson & Johnson, Kimberly-Clark and Kraft Foods Inc., focus on the RFID benefit of keeping products on shelves as a contributor to profit margins and evaluating new product success or failure. For DoD, implementation of RFID reduces inventory processing time, and improves asset visibility and maintenance of materiel. Thus within the DoD environment this technology will experience a rapid acceptance.

A cautionary note is that as RFID is introduced into the commercial and consumer market, there may be social issue debates about privacy rights and technical options for tagged products.

Efforts are underway to reach international associations and increase involvement by international ministries of defense. The following countries have been engaged to participate in the proposed system: United Kingdom, Canada, Republic of Korea, Australia, France, Sweden, Italy, Germany and NATO Allied Committees.

A DoD-wide application called Wide Area Work Flow-Receipts and Acceptance (WAWF-RA) is proposed to eliminate paper from the receipt and acceptance process. The goal is to enable authorized Defense personnel and contractors to create invoices and receiving reports, and access all contract related documents electronically.

Navy and Marine Corps RFID Applications

The Navy and Marine Corps are conducting extensive shipboard testing to determine whether emissions from RFID tags will interfere with ships systems or whether ships systems will affect the function of the RFID system. The tests successfully used RFID tags to automatically track material movement around the ship. Proof of concept projects underway at the Navy Automatic Identification Technology (AIT) Project Office include:

RFID Early Entry Deployment Support Kit (EEDSK): RFID capability anywhere in the world within a week, requiring no permanent RFID infrastructure.

Smart Stores: RFID Inter-ship stores and inventory tracking system.

Advanced Technology Ordnance Surveillance (ATOS): Real-time surveillance and inventory updates for ordnance.

DoD RFID initiatives will invariably impact Navy and Marine Corps information technology. The expanded scope of logistics management enabled by RFID will assist the warfighter, the command and control elements, and the essential support team members.

The impending change in DON business processes due to RFID adoption is not likely to be disruptive, despite the scale of the effort, because at critical stages the technical and policy decisions embraced a standard shared in the commercial world.

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New DoD Enterprise Software Initiative Agreements

Department of Defense Enterprise Software Initiative (ESI) Blanket Purchase Agreements (BPAs) were recently established for Systems Integration Services with Accenture, BearingPoint, Computer Sciences Corp., Deloitte and IBM.

The BPAs include the procurement of configuration, integration, installation, data conversion, training, testing, object development, interface development, business process reengineering, project management, risk management, quality assurance and other services for commercial-off-the-shelf (COTS) software.

Benefits include a streamlined acquisition process, standard terms and conditions, fixed-priced services tied to proven methodology, and reduced risk by following proven methodology and best practices. Estimated annual cost avoidance to the DoD is $160 million or $800 million over five years. These BPAs are open to all DoD Components, the U.S. Coast Guard, the Intelligence Community and authorized Defense contractors.

This groundbreaking program marks the first time that the DoD ESI negotiated technology services on a DoD-wide basis, and presents an opportunity to reduce the government's average implementation-to-software cost ratio, currently at 15 to 1, toward the industry average of 5 to 1. In addition to achieving substantial cost avoidance, these BPAs provide a performance-based approach with factors tied to the customer's key business priorities and fixed-priced configurations.

Finally, these agreements will contribute toward achieving the Navy's net-centric vision of Web services and support the Navy's Sea Enterprise initiative by the deployment of enterprise applications.

Go to http://www.itec-direct.navy.mil for more information..