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Aviation engineer undertaking wing inspections inside the wing of a Boeing passenger aircraft in Everett, Washington, USA



Tapping Tag Power

By Jim Del Rossi,
Sun Microsystems

Mandate or Not, RFID Technology Boosts Efficiency—and Profits

Silly Putty. Chewing gum. These are just two of the “technologies” the aviation industry has deployed in the quest for efficient aircraft maintenance.

To identify parts in hard-to-reach spaces to cross reference maintenance histories, maintenance crews would often slip Silly Putty or chewed gum into crevices to make an impression of the serial number from the plate label so that bulkheads, panels, or aircraft sections wouldn't have to be disassembled. Or they would slip mirrors into crevices and attempt to read the numbers backward.

But a technological quantum leap promises to make Silly Putty obsolete. Last year, **Boeing** announced it would use radio frequency identification (RFID) technologies on critical airframe, engine, and avionics components in its 787 “Dreamliner,” its next-generation jet scheduled for delivery in 2008. With RFID—an automatic identification technology whereby radio transceivers retrieve remotely stored data from tags >>



With RFID technologies, aircraft operators can greatly reduce human error while dramatically increasing maintenance efficiencies by eliminating the need to disassemble portions of the aircraft to pull parts for identification and inspection.

embedded in everything from farm animals to railroad cars, to shipping pallets, to finished consumer goods—aircraft operators will be able to accurately track components, such as battery chargers, avionics equipment, engine parts, wing and rudder components, and even passenger life vests. Each tag in the Boeing RFID system contains a 64-kilobit chip that stores part serial numbers, the part's manufacturer and country of origin, and repair history that can be retrieved with a pass of a handheld RFID reader that in turn shuttles the information to a central database.

With RFID technologies, aircraft operators can greatly reduce human error while dramatically increasing maintenance efficiencies by eliminating the need to disassemble portions of the aircraft to pull parts for identification and inspection. Boeing even envisions maintenance workers walking down the aisle of plane with a handheld scanner collecting critical maintenance data as an aircraft sits on the tarmac. This system represents a giant leap into sensor networks: a nervous system of wireless transponders inside of an aircraft ultimately tethered to a powerful database. Eventually, RFID readable tags will have the capability to log in-flight temperature and vibration information on critical aircraft parts, providing a robust data menu that far exceeds a simple log of air hours and maintenance procedures. This technology also represents a quantum leap in aircraft maintenance logistics. With RFID, operators can better assess when and where maintenance should be performed because they know precisely where specific parts are located and what maintenance centers can handle which procedures most efficiently. We've come a long way from chewing gum and Silly Putty.

The **Great** Tag Tug

RFID technology is gradually being woven into the commercial fabric. For example, the **American Express** Blue Card contains an HF RFID tag for cardholder identification and transaction security. The **ExxonMobil** Speedpass uses a cryptographically enabled tag for rapid fuel transactions, and the Prius, **Toyota's** successful hybrid car, offers an RFID smart key/smart start option whereby the car can be opened and started when the key approaches within three feet of the vehicle, even if the key remains tucked in a purse or pocket. RFID technology is used to track library books, shipping pallets, airline baggage, and pharmaceuticals. The technology is also used to provide building access controls and to replace magnetic strip cards in identification badges.

The successes and challenges of RFID parallel other identification technologies, most notably bar coding.

While many industries, such as the aircraft industry, can easily tease out benefits to deploying RFID technologies, for many enterprises the benefits are blurred. Yet market dynamics may force these companies to embrace RFID before this haze comes into focus.

In the early days of bar coding, the technology was quirky. If the label was dirty, or it wasn't illuminated properly, or the sight lines weren't exact, it was difficult to generate a successful read. You could read this quirkiness on the faces of cashiers in the checkout line, grimacing in annoyance as they punched product codes into cash registers manually after repeated failed swipes over the bar code reader.

That early error frequency has been reduced to almost nil, to the point where grocery store operators are now comfortable allowing customers to use store scanners to check out their own purchases. Credit vast improvements in lasers, mirrors, recognition software, and technologies that help these systems adapt to unpredictable, complex optical environments riddled with brash sunlight and harsh reflections—environments that frankly would have driven earlier systems completely nuts.

RFID technologies have endured similar growing pains. It was once a challenge to get the tags, antennas, and readers to work harmoniously in specific environments. Tags would sometimes go numb and readers might fail to read tags due to placement or radio signals blocked by metal or water. But today, reliability and readability is significantly better than common wisdom often dictates. The technology has continually improved to the point where it's possible to generate successful read rates exceeding 99 percent, compared to rates of 80 percent just a few years ago.

The intrinsic value of RFID tagging or any other kind of identification technology is its ability to construct a model of the real world. The whole point of a computer system is to take real things in the real world and transmute them into a usable abstraction so that through mathematical calculations or aggregations analysis, it's possible to develop a soft model to manipulate that reality. The model might be financial, manufacturing, production, or shipping. What RFID technology provides is the ability to create accurate electronic representations of your business processes so that two vital questions can be answered: Where is it?

What do I do with it next?

If, through RFID technology, an organization has the ability to create an instantaneous snapshot of its entire operation and stuff it into a model that accurately reflects the real state of its enterprise, the efficiency improvements can be astounding as fudge factors are minimized and labor is better deployed.

Wrestling with Compliance

In 2003, **Wal-Mart** requested that its top 100 suppliers, including **Procter & Gamble**, **Gillette**, and **Kraft**, place RFID tags on pallets and cases shipped to stores in Dallas. The U.S. Department of Defense soon adopted its own RFID mandate, followed by **Target**, **Albertson's**, and **Best Buy**. Wal-Mart's next 200 top suppliers began shipping tagged merchandise to its stores earlier this year. While many industries, such as the aircraft industry, can easily tease out benefits to deploying RFID technologies, for many enterprises the benefits are blurred. Yet market dynamics may force these companies to embrace RFID before this haze comes into focus.

Mandates from large retailers and government agencies stem from process necessity: If the RFID system is to work correctly, all layers of the supply chain—manufacturer, distributor, parts assembler, and retailer—must be harmonized. But that sets up a dilemma: One link in the chain ends up bearing the brunt of the tagging operation. And tagging almost assuredly boosts manufacturing costs. So the question becomes: Who's reaping the benefits and who's forced to absorb the initial costs to make it happen? Supply chain integration always poses such challenges, and unless it's possible to illustrate a clear win-win at each level in the process, it'll be very difficult to urge manufacturers, for example, to pony-up the necessary investments for a process that's going to reap substantial benefits on an enterprise far down the supply chain. So it becomes necessary to follow the challenge with the another question: If I'm implementing RFID technology because >>



of a mandate, how else can I use it to improve my own operations, supply chain, and inventory management?

Bread & Butter Benefits

Where's my stuff? This question is critical to almost any enterprise. Not knowing the answer can wipe out a business. Yet this is precisely the question that RFID technology can help answer. And it's how the technology can provide organizations with tangible benefits within their four walls right now—mandate or no mandate. If an organization can show significant benefits internally using RFID for its own purposes, then it can start extending outward with a lot less pain.

But what precisely are those internal benefits? One is asset tagging and tracking. If a company is running a manufacturing facility, it has significant

resources tied up in operational assets. If it can tag those assets, a couple of things happen. First, inventory processes are streamlined and are less time consuming. It becomes easier to locate tagged assets and determine when and where they've been checked in or checked out of storage areas. This is an indispensable tool for companies that outsource equipment maintenance. A tag on a piece of machinery that leaves the premises for repairs can easily be identified and tracked, providing more accurate maintenance

records as it helps protect against potential asset loss.

Valuable traceable assets might include specialty tools, computers and laptops, packaged software, office furniture, and telecommunications equipment. Knowing the location of these assets at all times also enhances security as equipment such as laptop computers often contains confidential company information. This very simple application offers a substantial return on investment: It saves labor while it conserves resources because critical equipment doesn't need to be repurchased simply because it can't be located. It also provides for better reporting and minimizes down time when annual audits are conducted.

The technology also helps organizations maintain optimal inventory levels, providing for more efficient resource allocation. Enterprises can more easily and efficiently replenish inventories at the precise time they're removed from the supply chain, creating nice, even flows: Inventory over-

stocks and out-of-stocks can be reduced, even eliminated. The technology also guards against debilitating inventory momentum collisions, where a company's inventories are swelled so that it can quickly react to a client's needs, only to be caught holding a costly inventory bag when that client's demand suddenly slips due to shifting market forces.

One issue that often gives pause to those contemplating RFID technology is the uniformity of standards. Will tags attached in Detroit be successfully read in Bombay? While international standardization covering the use of data formats currently exists, there are many regional standards in place governing radio frequencies. Such variations can pose challenges. Different countries and regions employ different regulations governing frequency usage. (In the United States, the FCC governs the radio spectrum.) Each area allocates and utilizes slightly different frequency bands. But the latest generation of tags and readers capably handle multiple frequencies within these domains, minimizing the challenges of supply chains stretched across global borders. This international adaptability will be key in getting maximum use and value out of the technology.

In addition to inventory and supply chain maintenance, RFID technology is deployable in work in process (WIP) control, providing an efficient method to track and analyze manufacturing processes in real time. For example, if a company is building a car, labels can be placed on pallets, mounting frames, or mobile parts bins that can be tracked as they move through the assembly and test lines from worker to worker or stage to stage. The tag can be included in the final assembled product so that identification information can be read by the distributor and retailer—a sort of electronic serial number. If a company is already embedding RFID tags into products and packaging, it makes sense for secondary users to leverage the technology to their advantage as well.

The technology is also useful for quality control. For example, a tagged pallet holding shipments of tagged boxes can be passed through a reader. In most cases, the reader will detect the pallet tag and an average number of box tags. If the reader registers a significant discrepancy from average in the number of boxes it detects, the pallet can be pulled and examined to see if either the boxes are under-filled or empty (a large number of box reads), or the shipment is somehow damaged or compromised (too few box reads). In this way the statistical profile of the pallet provides a quick key to quality control.

RFID has as many, if not more, real benefits within the four walls of an enterprise as it does >>

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PHOTO: ITAR-TASS / COR ZAREMBO

Assembly of a General Motors Hummer H2 at the Avtotor plant in Kaliningrad, Russia.

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outside those walls by dramatically improving the efficiency of internal work and asset flows. Should an enterprise be swept up in an RFID mandate, the question becomes not who's actually reaping the benefit, but rather, where else can the enterprise gain substantial additional business leverage by applying this technology?

Bearing the Risks

As a society, we possess a tendency to slip into a state of panic and disempowerment every time a new powerful technology is introduced, and somebody somewhere figures out some horrible way to utilize it. Remember the early days of computer networking, when people worriedly roman-

ticized about 12-year-old geniuses who could hack into Pentagon computers and precipitate a national security disaster? Only later did we learn that when a networked computer system is compromised, it's usually because someone was caught with his guard down. Proper security measures weren't in place, or if they were in place, they were sloppily administered. Most computer security breaches aren't the work of genius hackers shrewdly exploiting computer networking technologies. They're the work of clever social engineers who casually talk somebody out of a password or a

set of security protocols while posing as a technician or security administrator.

When we move into new technologies, we lose track of such pedestrian oversights. We become fascinated with the dark, science fiction potentialities swirling around them. There are innumerable ways of obtaining information illicitly, and most have nothing to do with the brilliant defeat of high-tech security measures. We also tend to forget that the people who hack and exploit new technologies by stealing or manipulating confidential information are committing prosecutable crimes. The fact that someone is clever enough to pick the lock on someone's front door, enter and browse his household, and then close and lock the door again without detection, doesn't negate the criminality of the act. Too often the core of the crime is briefly obscured by the fact it's committed with new technology.

So it is with RFID technology. RFID has spawned controversy among consumer privacy

advocates who often refer to the tags as "spy chips." These advocates warn tags embedded in consumer products can be read at a distance unbeknownst to the purchaser, that tagged items can be tied to the identity of the purchaser, that the tags can be used for surveillance or other nefarious purposes unrelated to supply chain management. Indeed, the Gillette Company was boycotted after it conducted a "smart shelf" test in which security cameras were triggered by an RFID system to photograph shoppers taking tagged razors off the shelf in an effort to determine if the technology could be used to cut down on shoplifting.

In theory, RFID technology is vulnerable to illicit tracking. Employing an RFID reader, a thief might be able to instantly read the contents of a warehouse or truck to reach more effective pilfering decisions. Yet while such scenarios are possible, they're unlikely and will become more unlikely with new technology. New generations of tags won't talk to just any reader after a passive scan. Newer RFID systems won't release tag information until the tag receives a validation sequence, and even then the information is encrypted.

Concerns about tracking individuals and obtaining confidential information through consumer purchases are even less of a disruptive worry. The tags simply don't contain enough data to offer any meaningful information other than perhaps the shirt one is wearing is from Target and the pants are **Levis**. Explicit branding labels already accomplish the same thing and are even coveted as status items (**Versace**, **Gucci**, **Maybach**). In fact, RFID tagging actually enhances copyright protection by potentially exposing knockoffs. While some privacy advocates appear fixated on new RFID technologies, they seem to forget that far more explicit identification and activity trails are already strewn across the landscape. For example, cell phones report a person's location at all times as cells register the identity and location of users continually. Who owns the data? How many entities across the network have legal and legitimate access to that information? What happens to the computers/records/assets of that company in case of bankruptcy liquidation? It's safe to say that RFID is not the big one.

Yet one of the most significant benefits of RFID technology also poses a significant vulnerability if the system isn't carefully implemented. For example, an enterprise may want to provide suppliers with RFID visibility within its warehouses. With such access, suppliers can generate an accurate picture of the distribution center inventory to determine how rapidly the product the supplier has shipped is being depleted so that supplier pro-

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YOSHIKAZU TSUNO

A sales clerk at Tokyo's Mitsukoshi department store displays a mobile phone-shaped multimedia terminal, which shows her customer's positional information on the women's wear floor during a demonstration of the "Future Store Project" (which took place on January 31, 2006). Mitsukoshi and Fujitsu (Japan's electronics giant) started the operation of customer service and stock control in order to use radio frequency identification (RFID) tags and information devices.

duction can be quickly adjusted to meet a client's needs without the client expending the effort to calculate orders.

Of course, there's information a company may not want exposed to a supplier, such as data that might give the supplier leverage over the client. It's advantageous for a company to let a supplier know it's in the market for its products, but a company is placed at a disadvantage if the supplier discovers a company desperately needs its products.

The answer is to provide suppliers with secure-based access. An enterprise will have to decide how much and what information is to be provided to which suppliers via RFID technology. What are the desired work flows? What's the financial impact of inventory visibility provided to suppliers? What's the financial impact of having the ability to know where your inventory is at all times? This is where technology ends and business rules begin. The interesting point about this portion of

the discussion is that it's not an RFID access and information issue. It's an information security, identity, and access control issue that would be the same no matter the origin of the data.

The circle of potential RFID users congregating around this big pool of RFID opportunity is expanding rapidly. As the number of users taking advantage of this powerful pool increases, the costs of entering drops for all users, which further lowers barriers to entry. So come in. The water's getting warmer all the time. [s]

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