# What RFID Can Do for Fleets Today

**Radio Frequency expert Gregory M. Stewart explains his nominees for the top five new RFID advancements available for fleets today.**

A look at five top RFID improvements

At last, after nearly a decade of promise, many traditional fixed-base fueling facilities can tap into the efficiency of radio frequency identification (RFID). Over the last two years, breakthroughs in RFID technology have provided new options to fleet facilities, with their underground storage tanks (USTs) or in-yard mobile fueling operations.

New RFID transponder designs and operating software allow for powerful solutions that were not previously possible. The new generation of RFID devices have increased their range, which, in turn, allows for broader application and significant advantages. These advantages include: greater control and convenience; more efficient and prolific information; and, therefore, cost savings.

**Top five list**

Over the last several years, there have been many advancements in RFID technology. In this article, I will describe and discuss what I consider to be the top five improvements that, when combined, make for technological breakthrough in RFID for the fleet industry. These improvements are:

1. reading multiple transponders in the same read zone;

2. linkage and overlap of multiple read zones to create larger unified read areas;

3. ability to communicate in both read/write modes to several “smart” transponders at once (anti-collision protocols);

4. working “smart” transponders that have onboard microprocessors; and

5. exemption from Federal Communication Commission licensing requirements.

**How RFID works in the field**

The Brandt Trucking Company in Bloomington, IL, is a regional carrier with 150 vehicles. To meet new EPA 1999 underground tank regulations, the company installed a new fixed-base fueling station and took the opportunity to upgrade a card-operated fueling system with state-of-the art RFID. Brandt’s installation provided automated, hands-free vehicle ingress and egress of the automated vehicle odometer upload at the time of fueling; fuel dispenser authorization; and an automated truck wash.

Many people may think that the integration of commercial fueling facilities with RFID is an unlikely way to use passive, low frequency RFID technology. However, the design and operation of fleet fueling stations are often lacking in efficiency, and proper use of RFID can restore it. As in the Brandt example above, the goal is to achieve better fuel control, accountability and fleet maintenance.

What makes commercial fueling stations likely candidates for RFID usage? For one thing, the fuel dispensers are generally well spaced. This is important because a vehicle tag that automatically energizes a dispenser when in proximity must only energize the correct dispenser. If more than one dispenser is energized, it may be unclear which dispenser matched up with which vehicle to obtain fuel. If a mismatch results, the wrong customer may be billed for the fuel.

This “match up” is an ongoing issue with retail service stations with multi-product dispensers (MPDs) because RFID requires well-defined read zones to control dispensers. Where the definition of read zones is a problem, continued use of dispenser access cards are recommended. However, even in these cases, as we will discuss, RFID may still be integrated to improve other functions. Now, let’s go back to the first two items on my “top five” list.

**Figure 1: RFID in commercial fleet stations is easier to install than in retail stations due to easier, less complicated antenna placement.**

**First two advantages**

**RFID advancement number one—**the ability to read multiple tags in the same read zone—is very important. Only very recently has it become possible for two vehicles to fuel from a twin dispenser in the same read zone without locking up the RFID system. In fact, most RFID systems installed today still can only read one tag in the read zone. (Access to the correct dispenser with twin dispensers is accomplished with a barrier that allows for one-directional-lane-only fueling.)

Another benefit of multiple reads in the same zone is the creation of a two-tag system: One transponder identifies the vehicle and the other transponder identifies the employee. In this situation, for the dispensers to be energized, both the vehicle and the employee must be in the same read zone. Thus, greater accountability is achieved because a company vehicle must be present (not an employee’s auto being fueled for weekend fun), and the employee is positively identified along with the standard transaction statistics.

With existing card reader systems, it is often difficult to know who was responsible for the fueling as the cards are passed from one employee to another, fueling multiple vehicles. RFID provides a simple and more secure solution.

**RFID advancement number two** is the ability to overlap read zones. Previously, it was critical to space the readers in such a way that no overlap existed because the system would lock up and fail. However, in commercial fleet fueling stations, creation of directional reads (so that the dispensers are properly energized) often requires overlaps.

This new technology makes it possible to retrofit stations because dispenser layout and spacing are not as critical. The readers are now more able to handle an overlap, and therefore, it is much easier to accomplish the retrofit.

**Next three advantages**

**RFID advancement number three**, the development of anti-collision, rapid development software, makes it possible to communicate with many tags simultaneously and, thus, to allow them to perform multiple tasks. With this technology, trucks, trailers and employees can enter the fueling station at the same time, with unique data and instructions sent to each. Also, the importance of being able to write to a tag allows for vehicle manifest information and other unique identifers to further automate the transport and handling of goods.

The quality of anti-collision software and hardware varies significantly by manufacturer. Many systems operate well with a maximum of nine tags in one read zone, while a greater number of tags significantly slows the identification and communication process. Other systems can identify several hundred in the same read zone quickly and accurately. It is important to match both the needs and functionality of the anti-collision software with the cost of each.

**RFID advancement number four** is the development of smart tags (transponders) that are active or active/passive. One such transponder is an odometer transponder, which is of significant value to commercial fleet fueling stations. The tag is affixed to the vehicle. A cable is run from the tag to the drive line near the transmission of the vehicle.

Here at the drive line, a “Hall Effect” sensor is installed. The sensors create a digital signal every time the drive line turns. The digital signal is transmitted through the cable to the RF tag. The tag stores the sum of the signals. For example, the drive line may turn 10,000 times for each mile driven.

These signals are calibrated such that the sum of the digital signals equals the current odometer reading. In this example, for every 10,000 digital signals, the vehicle has driven one mile. When the vehicle enters the fueling facility, the total of the digital signals is captured and, through software, converted to miles.

At present, the common practice is for the driver to remember the odometer reading and then to manually input this information into a keypad at the card reader on the fuel island. Input of odometer readings is an important statistic because miles-per-gallon (mpg) calculations are derived for the fuel management report. It is also essential to have accurate odometer readings to determine if fuel is being stolen.

An abnormal mpg statistic is one of the first signs of trouble. According to Sears Payment Systems, more than five percent of commercial fleet fuel is mis-fueled. “Misfueling” is a polite term for employee theft. Accurate odometer readings can be obtained using an odometer read/write transponder. Another method is to install a fuel access system called magnetic induction RF, which provides automatic stoppage of fuel when the nozzle is removed from the appropriate vehicle. This

system works well, but at greater overall cost. It includes wiring hoses, installation of special nozzles and electro magnetic rings around the fuel collar.

**RFID advancement number five** concerns licensing. The newer RFID technology does not require expensive and time-consuming FCC license applications. Most RFID readers are exempt from licensing world-wide, and may be placed whenever and wherever the customer desires. This is a big advantage and one that assures consistency of operation for quick, low cost installation. RFID might not be an advantage at all if a driver obtained fuel in Chicago with his transponder, but was unable to do so in Bloomington because the FCC would not license the readers.

Pro-active vs. post-active

Several manufacturers have built excellent magnetic induction RF systems that accomplish total vehicle identification and secure pump control. Typically, these systems require the installation of RF devices on each of the fuel dispenser nozzles and hoses. Additionally, the systems require that a magnetic ring be affixed to the fill neck of each vehicle and, if odometer information is wanted, a cable secured from the drive line and onboard computer back to the vehicle fill neck.

The benefit of these systems is that the fuel cannot be dispensed unless the nozzle is actually inserted into the appropriate vehicle. If the nozzle is removed from the vehicle, fuel dispensing automatically stops. Therefore, magnetic induction systems help to prevent fuel theft in a pro-active way.

On the other hand, the passive, low frequency RFID application described in this article takes a post-active approach to fuel theft. In exchange for ease of installation and reduction of ongoing operating expenses, long range RFID systems treat employee accountability differently. Such systems assume that as long as employees know they are being supervised and are also aware that the fuel information gathered for fuel management reports is accurate, employees will not risk theft, as they will be identified and held accountable. Proper installation of RFID both from dispensers and odometer tags insures accurate information.

The choices between these fuel systems will depend on a customer’s priorities, preferences, functionality and cost.

**Mobile fueling, the paper trail**

Up until now, we have been discussing RFID used in traditional fixed-base fueling stations. Another application is the use of RFID technology for in-yard, or mobile, fueling of fleets.

Changes in underground storage requirements have transformed the way many fleet vehicles are fueled. In the past, significant numbers of medium and large companies owned and operated in-yard fixed-based fueling stations. Due to the significant cost of keeping such sites in compliance with EPA regulations, some fleet operators have been forced to explore alternative fueling systems. One such

alternative is mobile fueling.

For petroleum marketers, mobile fueling is a new and growing market. A recent survey in the State of Washington found that 245 fleets, consuming 11.8 million gallons of diesel per year, were taking advantage of this new service. Due to explosive market growth, petroleum marketers are searching for methods to automate, reduce fraud and streamline their deliveries.

RFID can replace, and in some cases is replacing, a widely used itemized meter recording system favored by mobile fuel distributors. The typical system is a pen-and-paper based delivery accounting system that works as follows:

The mobile fueler arrives at the fleet yard with a 3,800 gallon tank truck equipped with reel, hose and nozzle that meet the Universal Fire Code and appropriate City or State amendments (if any). The delivery driver inserts a meter ticket to start the fueling, pulls the hose and nozzle to the first truck to be fueled and delivers diesel.

The driver walks back to the truck meter and notes with pen and paper the number of gallons delivered and then walks to the second fleet vehicle to be fueled and makes another delivery. Again the driver walks back to the meter, makes a notation and goes back to the third fleet vehicle to continue fueling.

This process is repeated until the fleet vehicles in the yard are fueled. After all fleet vehicles have been fueled, the driver removes the meter ticket with the totalized amount. Attached to the totalized meter ticket is a hand-written breakdown that accounts for the individual vehicle fuelings.

**Mobile fueling, RFID**

Because the pen-and-paper system creates obvious time-and-error inefficiencies, passive RFID systems have been developed to automate the process. These systems save delivery time because accounting automation is achieved and the delivery driver is able to move directly from one vehicle to the next. The metered delivery ticket prints a detail of each vehicle plus a summary total.

Vendors of the equipment estimate that drivers save a minimum of 30 seconds per vehicle being fueled, with an improvement of delivery efficiency of 20 percent per night. According to the Washington State mobile fueling survey, the average fleet consists of 15 vehicles with 13 visits per month with an average fill of 20.5 gallons.

Here’s how RFID can work with mobile fueling:

The passive system employs a hand-held RFID front-end reader with an RF local area network (LAN) data communicator (DC). The back end RF/DC communicates with a truck computer that operates an electronic solenoid, which controls the valve and meter. A roll printer and electronic register are also part of the packaging.

Each vehicle fuel tank is tagged with a unique passive transponder. The delivery driver takes the hose and nozzle to the first vehicle and scans the bar-code-activating solenoid, which opens the fuel valve on the petroleum delivery truck. Diesel is delivered into the fleet vehicle and, at the same time, the truck computer documents the vehicle being fueled. Once the delivery driver releases the fuel nozzle, additional fuel cannot be dispensed without another passive tag being read. This ensures that each fueling is accounted for properly and minimizes fraud or waste.

**Mobile fueling, passive and active**

Passive RFID tags have unique identifiers, and improve read rates because passive tags operate effectively in wet or dirty environments. Passive tags do not have batteries and are relatively low in cost. One tag must be attached to each fleet vehicle.

There are two types of passive tags: contact tags and contact-less tags. Contact tags must be touched for the unique identification number to be read by the hand-held device. Contact-less tags, which do not need to be touched, have a read range of one to six inches, depending on the quality of the tag and reader.

Odometer information from each vehicle may be obtained by the installation of an odometer tag mounted in each vehicle. This odometer tag would have an optional active capacity. The odometer information may be retrieved with an RF antenna on the mobile fleet fueling truck. This information may be merged into the computer data for the truck to produce a miles-per-gallon statistic for each fleet vehicle.

Understanding the difference between active and passive systems can be confusing because active systems are sometimes called “passive” for marketing reasons. A simple way to understand the difference between active and passive tags is that active tags have a battery and passive tags do not. Wired into the vehicle’s electrical system, active RFID systems use communication cables, which run together with the delivery hose to a receiver imbedded into the delivery nozzle.

An RF receiver coil is mounted with a unique vehicle identifier as a ring around each vehicle’s fuel tank. Another communication cable may be installed that t connects the RF coil to a vehicle’s data computer, thus recording engine hours and odometer readings.

Activation of the solenoid that controls fuel flow is done automatically when the fuel nozzle is inserted into the vehicle tank. If the fuel nozzle accidentally fails, the solenoid is automatically shut and fuel flow stops. Equipment costs for such a system are more expensive than either bar code or passive RF.

As the market for mobile fueling grows and regulatory authorities create more requirements to safeguard the environment, continuing developments in RFID technology will become more and more important. The days of pen-and-paper delivery control systems are about over. With the recent announcement of the Bluetooth RFID effort (see glossary), we can expect rapid changes in RFID to continue—and even to accelerate. Note: Some RFID applications and methods may be subject to patent claims. A good source of patent information is found on the Internet at

www.patents.ibm.com/ibm/html

**Glossary**

**Bluetooth:**
a low cost, short range cellular effort being undertaken by Intel, Toshiba, Erickson and many others. It promises to provide many changes in office automation and vehicle data capture. Bluetooth is expected to complement rather than to replace recent developments in RFID. More information may be found at www.bluetooth.com

**“Hall Effect” Sensor:**
a component in today’s vehicles that opens and closes a circuit electronically, based on changes in magnetic flux. It is typically used for RPM or position measurement.

**Magnetic induction RFID:**
An RF system that accomplishes total vehicle identification and secure pump control. Typically, RF devices are installed on each of the fuel dispenser nozzles and hoses. The system requires that a magnetic ring be affixed to the fill of each vehicle and, if odometer information is wanted, a cable from the drive line and onboard computer back to the vehicle fill.

**Mobile fueling:**
also known as fleet fueling, wet fueling or wet hosing—is the practice of filling fuel tanks of vehicles from tank trucks. This fueling takes place where the tank trucks are driven to the yards or sites where the vehicles to be fueled are kept when they are not in use. Mobile fuelers may only dispense diesel, as mobile fueling of gasoline is prohibited.

**Reader:**
A “reader” incorporates an antenna and generates the radio frequency signal. This is transmitted to a transponder. The reader may include an optional computer that allows it to operate on its own without the need to communicate to a central host computer. They are the size of small stereo speakers and are easily mounted on canopies, poles or fuel dispenser tops.

**Transponder:**
The “transponder,” or tag, is a device that is tagged to an asset or an object. Transponders may be as large as a credit card or as small as a toothpick. The exact size depends on the power supply and antenna. Antenna size is largely determined by the wave length selected for transmission by the readers. Transponders come in a variety of sizes and functionalities. In this discussion, there are three types of transponders (see below).

**Passive transponders**
obtain power from radio frequency wave energy alone, and do not have batteries or an outside power source. Two-way communication from the reader to the tag is done by reflecting back the energy of the incoming radio wave to establish two-way communication. New passive technology has read ranges in the area of three to six feet.

**Active/Passive transponders**

have a battery used to power an onboard transponder microprocessor, but it is not used for radio transmission. The return radio link is accomplished by reflecting the same radio wave back that has been used by the passive tags. Read ranges are 12 to 40 feet.

**Active transponders**

use a battery or outside power source for the transmission of a radio wave back to the reader. These have extended read ranges of greater than 60 feet.

Gregory M. Stewart, a Principal in the partnership of Grenley-Stewart Resources, Inc., a company that provides cardlock services.

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