GETTING STARTED WITH UHF RFID SOLUTIONS

THE TECHNOLOGY, APPLICATIONS AND BENEFITS

MOTOROLA

WITH RFID, YOU GET CONSTANT AND EFFORT-FREE IDENTIFICATION, LOCATION AND TRACKING INFORMATION. VISIBILITY INTO THE INVENTORY AND MOVEMENT OF ASSETS AND PRODUCTS IS CRITICAL BUSINESS INTELLIGENCE.

THE CHALLENGE: BETTER VISIBILITY

Your margins and profitability are under more pressure than ever before. Shaving time out of business processes has become a constant quest — the ability to get more done in less time will ultimately reduce costs and strengthen the bottom line. Virtually every business spends an inordinate amount of time on the same initiative — obtaining the supply chain and asset visibility required to better manage the business. And no matter what industry you are in, chances are this effort is a tremendously time-consuming, manual and error-prone activity that slows down the speed at which your business operates — and adds to the cost of doing business. RFID is helping organizations across industries all over the world address these issues by automating product visibility and asset management processes. With the power of RFID, your products and assets practically manage themselves, providing constant and effort free identification, location and tracking information.

THE RFID SWEET SPOT: EFFORTLESS TRACKING OF EVERY PRODUCT OR ASSET, EVERY MOMENT OF THE DAY

Radio Frequency Identification (RFID) is a champion at providing real-time inventory, supply chain and asset management visibility, all with little or no human intervention. The real-time visibility improves operations, stripping time and errors out of your everyday processes — from inventory, shipping and receiving logistics to intelligent asset management. And RFID is so versatile, you can find it at work in practically every industry, helping:

- Distribution centers track shipments as they move in, out and through the warehouse

- Retail stores perform more efficient cycle-counting and inventory operations

- Hospitals ensure that all defibrillators and other critical equipment are in stock and in the right locations

- Manufacturers ensure raw material availability and optimize sequencing processes

This affordable, near instant and constant visibility turns into big business benefits. Fewer errors, increased automation and a more efficient labor pool reduce costs and optimize business processes, allowing you to better serve more customers — increasing sales and profitability.

How does it work? When RFID tags that contain a unique serialized EPC code are placed on items and assets, the information can be automatically, wirelessly and simultaneously captured with a fixed, handheld or mobile RFID reader. Hundreds of hours previously spent managing items are drastically reduced, yet you know where each and every item is, all the time — from inventory to returnable transport items (RTIs) to equipment, tools and back-up tapes.

RFID AND OTHER IDENTIFICATION AND LOCATIONING TECHNOLOGIES

There are a number of radio frequency technologies that are being used today to provide increased visibility into goods and assets. The most commonly used include:

- LF (Low Frequency)

- HF (High Frequency)

- UHF (Ultra High Frequency)

- Wi-Fi Locationing

- NFC (Near Field Communications)

- Ultra Wide Band (UWB)

...and others.

Most of these utilize a defined band in the radio frequency spectrum that results in different operational and performance characteristics, which in turn affects read range, cost and deployment requirements. In addition, the technologies are not mutually exclusive. Depending upon your supply chain and asset visibility requirements, you may wish to deploy multiple RFID technologies.

Read range can be extended in some of the technologies through the use of battery-assisted RFID tags. However, because of the battery cost, the longer read range comes with an increased cost per tag. As a result, battery assist technologies are typically utilized for higher-value items that warrant precise monitoring and locationing information.

WHITE PAPER
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The frequency characteristics also define which applications are best suited for each technology. For example, NFC has become the defacto standard for ticketing and payment because of its short read range and established payment protocols. Alternatively, the long read ranges and low tag costs in the UHF frequency are ideal for inventory, supply chain and asset management visibility.

UHF TAG TECHNOLOGY MAKES RFID AN AFFORDABLE REALITY

Today's Gen 2 UHF RFID tags make RFID an affordable reality. Unlike active tags, these passive tags do not require their own power source — the reader provides the power to initiate the transmission of data. Since less technology is required in the tag, their cost is very low. A low cost RFID tag means you can tag and increase visibility into more of the goods, products and assets which drive your revenue stream. The tags can be re-used, easily updated with new data. And since these tags can be read from near contact to as far as 30+ feet away,[1] you can use them on nearly any type of

asset. The result is a rapid return on investment (ROI) in as little as six months to a year — even for the largest of organizations.

A LOOK AT UHF RFID IN ACTION

UHF RFID brings value to virtually any business that has bulk items to manage — from product moving through the supply chain to inventory to equipment. In the following pages, you can see the benefits of UHF RFID solutions in:
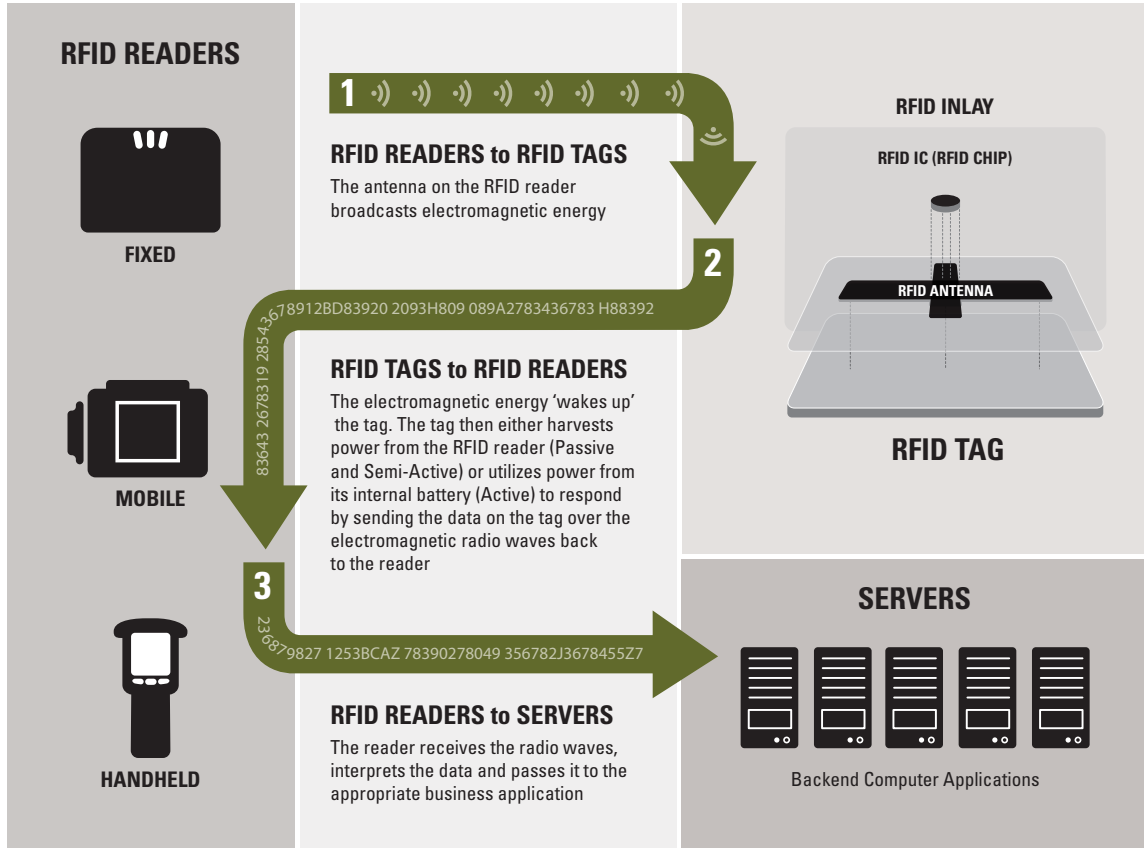
INDUSTRIES

- Retail
- Distribution and Warehousing
- Manufacturing
- Government
- Energy: Utilities, Oil and Gas
- Healthcare

HORIZONTAL APPLICATIONS

- Asset Management
- IT Asset Management
- Returnable Transport Items (RTIs)
- Track and Trace: Cold Chain/Food Safety

HOW IT WORKS: THE UHF RFID COMMUNICATION LOOP

RFID READERS

FIXED

MOBILE

HANDHELD

1 RFID READERS to RFID TAGS
The antenna on the RFID reader broadcasts electromagnetic energy

2 RFID TAGS to RFID READERS
The electromagnetic energy 'wakes up' the tag. The tag then either harvests power from the RFID reader (Passive and Semi-Active) or utilizes power from its internal battery (Active) to respond by sending the data on the tag over the electromagnetic radio waves back to the reader

3 RFID READERS to SERVERS
The reader receives the radio waves, interprets the data and passes it to the appropriate business application

RFID INLAY
RFID IC (RFID CHIP)
RFID ANTENNA

RFID TAG

SERVERS
Backend Computer Applications

PAGE 4

…IN YOUR INDUSTRY

RETAIL

Retailers need detailed inventory information to keep the right items on the shelves of the store. But manual cycle counts are too costly to be performed frequently enough to provide current information. UHF RFID's constant and accurate inventory information provides visibility into inventory levels, allowing retailers to make sure that customers find the products they want to purchase on the store shelves. And since the information is collected automatically, sales associates can spend more time with your customers — instead of managing inventory.

APPLICATIONS

- Inventory and cycle counting
- Receiving
- Replenishment
- Item locating
- Loss detection/prevention
- Demand forecasting

BENEFITS

- Achieve near 100% inventory accuracy [2]
- Maintain real time inventory information — without any labor costs
- Reduce out of stocks by as much as 80 percent [2]
- Minimize markdowns
- Reduce inventory carrying costs by as much as 59 percent [2]
- Increase associate efficiency — associates are free to spend more time serving customers
- Increase sales by as much as 14 percent [2]

DISTRIBUTION AND WAREHOUSING

In the distribution industry, profitability is tightly tied to how fast and accurately inventory moves in, through and out of the warehouse. With UHF RFID, warehouse workers have the visibility they need to process thousands or hundreds of thousands of items every day, as fast and accurately as possible.

APPLICATIONS

- Shipping and receiving
- Put-away and picking
- Cross-docking
- Returnable Transport Item (RTI) management
- Inventory

BENEFITS

- Achieve near-100 percent order and shipping accuracy [2]
- Process orders up to 40 percent faster [2]
- Improve workforce efficiency — reduce labor costs up to 30+ percent [2]
- Improve inventory turns
- Automate advanced shipping notice (ASN) delivery and receipt
- Improve customer and trading partner satisfaction by delivering the right items on time, every time

UHF RFID AND PRIVACY

While the advantages of RFID are clear, privacy and security will be a concern not only for you, but also for your customers. Regardless of what type of UHF application you need, you can count on your data remaining secure.

Security in inventory, supply chain and asset management applications

UHF RFID tags are typically utilized to identify product and goods on the retail floor or in the supply chain, or assets utilized to conduct business — from IT assets to material handling equipment in the warehouse or machinery on a production line. The Electronic Product Code (EPC) or asset number that is stored on an RFID tag typically contains product and stocking information only — data that is not sensitive. Just like a bar code, the data may correlate to sensitive information that resides on a secured and encrypted back office database. Even if an unauthorized user gained access to the RFID tag data, the information would be a meaningless string of numbers, with no context.

To further guard against unauthorized access, transmissions between RFID readers and tags can also be protected by encryption and authentication protocols. RFID Generation-2 and ISO 18000-6 standards (most often used for RFID in retail settings) offer enhanced security. You can now add passwords to individual tags to prevent impermissible copying, much like the additional protection a personal identification number (PIN) provides when paying for goods with a credit or debit card.

Security in identity management and credentialing

Since RFID tags are nearly impossible to forge, just their mere presence can increase the security of sensitive documents, such as passports or agency ID cards. An integrated RFID tag can play a valuable role in preventing fraud and the counterfeiting of government-issued identification documents, helping thwart unauthorized personnel from entering a country or a government agency.

MANUFACTURING

For manufacturers, success hinges on the speed and accuracy of their manufacturing operations. UHF RFID provides instant and accurate tracking of information at every step inside the manufacturing plant, trimming wasted time and costs out of end-to-end manufacturing processes — from receipt of raw goods to RFID-enabling supply, sequencing, assembly and shipping of final product. The net result is a leaner and more profitable manufacturing operation.

APPLICATIONS

- End-to-end warehouse operations
- Quality assurance
- Line sequencing, raw material supply
- E-Kanban/replenishment
- Work-in-Process (WIP)/Just in time (JIT)

BENEFITS

- Improve global inventory accuracy — from raw to finished goods
- Improve product quality with increased automation of process and materials visibility
- Increase shipping and receiving accuracy

GOVERNMENT

UHF RFID helps federal, state, local and municipal governments find ways to better manage budget cuts by improving visibility into more timely information as well as the location of assets and items in the supply chain. Access to instant and accurate information can help government agencies keep city infrastructure and military equipment in good working order; reach disaster victims faster; execute more timely and accurate building code and health inspections; and more. The result is the more efficient delivery of higher quality services, improving citizen safety and satisfaction.

APPLICATIONS

- Supply chain logistics
- Identity management/credentialing
- Asset management
- Data center asset management
- Inspections and code enforcement
- Maintenance and repair
- Disaster management

BENEFITS

- Improve the delivery of government services, assets and goods through increased shipping and in-transit visibility
- Improve the productivity of government workers by automating manual processes
- Improve the security of government assets and workers with real-time location information
- Reduce the total cost of ownership of equipment through timely maintenance and better asset utilization
- Improve the speed and quality of citizen services

ENERGY: UTILITIES, OIL AND GAS

In the energy industries, the cost of unplanned downtime can be devastating to profitability. UHF RFID provides the constant visibility into the location of everything required to keep production plants up and running. Automatic and accurate tracking of everything from materials and equipment to onshore and offshore personnel as well as emissions and equipment maintenance schedules allows energy producers to increase plant uptime, better protect employees and reduce the cost of compliance with strict environmental and security regulations.

APPLICATIONS

- Industrial asset management
- Operator rounds
- Employee safety
- AMI - Automated Metering Infrastructure
- Plant security
- Accurate in-the-field inventory

BENEFITS

- Increase productivity and production uptime
- Real-time access to asset maintenance and condition records
- Increase asset utilization
- More efficient and cost-effective regulatory reporting
- Improve worker safety by ensuring any necessary evacuations are complete

UHF RFID TECHNOLOGY: THE BASICS

Radio-frequency identification (RFID) technology uses radio waves to exchange identification and tracking data between an RFID reader and an electronic RFID tag that is attached to an object, such as a shipment of products, a forklift in a warehouse or even an employee badge. A microchip in the RFID tag contains the data. In read-only tags, the data can only be captured. In read-write tags, the data can be captured, new data can be appended to the existing data set or new data can completely overwrite the existing information on the tag. The antenna on the RFID reader enables the communication between the tag and reader. The distance that an RFID tag can be read depends on a number of factors, including the environment, as well as the size and type of RFID tag.

Ultra High Frequency (UHF) RFID is especially exciting to the business world because it offers long read ranges with low cost RFID tags, allowing organizations to tag and automatically track large quantities of goods and assets. Typical read ranges for UHF passive tags are 8 to 30 feet (2.4 m to 9.14 m) and beyond.

Unique RFID characteristics

- No line of sight required
- Read many tags simultaneously
- Re-usable tags — read and write data to low-cost, flexible tags
- Rich data capacity
- Durability
- Difficult to replicate, reducing opportunities to introduce a counterfeited product

RFID reader types

- Fixed RFID readers automate data capture at key entry and exit points, such as building entrances or the door to the IT data center, and typically require external antennas to either sides of the portal.

- Handheld RFID readers allow on-the-spot reading of RFID tags, allowing workers to perform quick and accurate inventories or search for specific items on a warehouse shelf or in a store dressing room.
- Mobile RFID readers can either:
  - perform as fixed RFID readers in temporary and hard-to-install locations
  - be affixed to a cart and wheeled through a warehouse, IT data center or retail sales floor for quick and easy inventory takes
  - be used on forklifts to read every pallet and its contents, whenever the pallet is moved
- Presentation RFID readers are ideal wherever workers or customers need to present RFID-enabled items to the reader — for example, at the retail point of sale (POS), an asset management commissioning station or at an entry point (for example an airport gate or event entry point)

What application characteristics create an ideal scenario for RFID technology?

RFID is the ideal data capture technology when you:

- Need to track a large amount of unique product SKUs — such as a multitude of sizes, styles and colors
- Have high-value items to track
- Need to routinely move a high volume of items in a limited time period, for example for retail promotions or short seasonal retail windows
- Have reusable assets that have a determined or circular supply chain — such as returnable transport items like bins, totes, trolleys and carts
- Need a more automated process to track and trace items to meet government regulations and ensure timely asset availability

RFID READERS

**FIXED
INDUSTRIAL-CLASS**
Motorola FX9500

**FIXED
BUSINESS-CLASS**
Motorola FX7400

**FIXED
INDUSTRIAL-CLASS**
Motorola MC9190-Z

**FIXED
BUSINESS-CLASS**
Motorola MC3190-Z

PRESENTATION
Motorola DS9808-R

HEALTHCARE

UHF RFID provides hospitals with a constant window into the location of medical equipment, medical supplies, critical documents and even patients — without any human effort. The result is a new level of efficiency and accuracy in every day processes that drives productivity, patient safety and care quality up — and costs down.

APPLICATIONS

- Asset tracking
- Inventory management
- Identity and access management
- Document and folder tracking
- Patient location tracking

BENEFITS

- Reduce lost and stolen assets and equipment
- Right-size supplies, spares, medical equipment and instrument inventory
- Instantly locate needed medical supplies and equipment
- Ensure timely replenishment, eliminating dangerous out-of-stocks

TRANSPORTATION/AVIATION

In the airlines industry, a single incidence of lost or delayed luggage can mean the loss of a long time loyal customer as well as additional costs that pressure margins that are already razor thin. But UHF RFID-enabled luggage tags allow airlines to ensure that the right bag is placed on the right plane every time. In addition, the transportation industry is also using RFID to provide supply chain visibility and ensure maintenance and repair are performed properly and on time.

APPLICATIONS

- Baggage sorting and routing
- Exception management (rapid identification of bags that need to be removed for passengers who are not on the plane)
- Maintenance, Repair and Overhaul (MRO)

BENEFITS

- Increase in baggage throughput up to 20 percent [2]
- Reduce labor costs
- Improve security and safety
- Cost-effectively comply with security regulations
- Eliminate the many costs associated with a mis-handled bag — estimated at approximately $100 per bag [4]

…AND IN HORIZONTAL APPLICATIONS

ASSET MANAGEMENT

UHF RFID streamlines the management of all types of assets, from finished goods inventoried in your warehouse to production line equipment, tool and other critical business assets. Less time is spent tracking and managing assets, and asset visibility is increased. And since maintenance takes place on time, asset uptime and longevity are protected, improving the return on asset (ROA).

APPLICATIONS

- Asset inventory, tracking and management
- Asset inspections, maintenance and repair
- Mobile device asset management

BENEFITS

- Maximize asset lifecycle and improve asset utilization
- Minimize asset replacement costs
- Increase worker productivity
- Enable rapid and cost-effective inventory takes

IT ASSET MANAGEMENT

UHF RFID can track the thousands of IT assets that are crucial to practically every business — from the servers, hard drives and tape backups required to warehouse business applications and data to the handheld mobile computers and laptops that provide employees with instant access to information. You know where your assets are, who has which asset at all times, with a complete audit trail for every asset — all without any human effort.

APPLICATIONS

- IT asset inventory management, tracking and maintenance

BENEFITS

- Improve utilization and visibility of IT asset inventories
- Encourage frequent and easy inventory takes by eliminating hard to access bar codes and other manual asset identifiers
- Provide cost-effective 'cradle-to-grave' real-time tracking
- Improve utilization of IT assets
- Prevent loss of IT assets
- Better protect and manage sensitive customer media
- Enable cost-effective compliance with regulations that protect consumer data, such as HIPAA in healthcare and PCI in retail
- Reduce capital IT equipment costs

RETURNABLE TRANSPORT ITEMS (RTIS)

With UHF RFID tags on bread racks, plastic crates, rolling cages and many of the other types of RTIs required to move and deliver goods, businesses can track the location and status of RTIs no matter where they may be in the supply chain. Fewer spares are required, reducing the capital and operational costs associated with purchasing and managing RTIs. And fees for lost or damaged RTIs can be charged back to the accountable party.

APPLICATIONS

- RTI asset inventory, tracking and management

BENEFITS

- Reduce the annual RTI investment
- Reduce RTI shrinkage
- Recoup the cost of lost or damaged RTIs
- Reduce the size of the RTI asset pool and associated storage costs

TRACK AND TRACE: COLD CHAIN AND FOOD SAFETY

UHF RFID can automatically and accurately collect the wealth of information required to verify that temperature-sensitive products were handled properly during the entire trip, from source to destination. The errors and delays in visibility that can occur when information is manually transcribed and then entered into the computer are eliminated, improving the safety of the food, medicine, pharmaceuticals and other temperature sensitive products traveling through the supply chain, reducing losses due to spoilage and enabling cost-effective compliance with government regulations.

APPLICATIONS

- Cold and food chain asset condition tracking
- Cold and food chain track and trace

BENEFITS

- Improve food safety and better protect consumer goods
- Increase supply chain productivity through the elimination of paperwork
- Achieve cost-effective compliance with government safety and track and trace regulations
- Reduce losses due to contamination and spoilage
- Enable rapid and more narrow product recalls
- Protect brand equity

RFID FAQs

Will RFID replace bar codes?

RFID could eventually replace bar codes in some applications where bulk counting is routinely performed. But as a rule, RFID and bar codes are not mutually exclusive — they each have their strengths and will continue to exist side-by-side for many years to come. The differences between the two data capture technologies include:

- Line of sight — a bar code scanner and bar code must be visible to each other to enable a successful scan, where RFID tags need only to be within a read range to be read.
- Simultaneous tag capture — Bar codes are captured one at a time, where RFID tags can be captured in bulk.
- Type of data — Bar codes can only hold static data, while RFID tags can be written and re-written as needed.

RFID limitations: does RFID work in the presence of metal and water?

Metal and water have traditionally affected RFID read performance, but new engineering breakthroughs have shown that issues created by metal and water can be overcome with good system design, specially designed RFID tags and proper tag placement.

What is the difference between passive and active tags?

Active RFID tags have their own transmitter and power source (generally a battery) utilized to power the circuitry and broadcast the signal to the reader. Passive tags do not need a power source. Instead, they draw power from the RFID reader.

What is the difference between LF, HF and UHF RFID technology?

Low frequency (LF) is tuned to 125 KHz, high frequency (HF)
is tuned to 13.56 MHz, and ultra high frequency (UHF)

is in the 860-960 MHz range. Your application needs will drive the frequency that is right for your RFID application. UHF tags work over a larger range and can provide the longest read ranges of these three technologies. HF tags have a maximum read range of roughly three feet (one meter). LF tags have the shortest read range (less than a foot/0.33 meter).

What is the EPCIS standard and why is it important?

EPCIS is a common interface that allows supply chain partners to easily share and exchange EPC-related information. Integration between different enterprise computer systems and applications is greatly simplified with EPCIS. Supply chain partners can confidently share data, yet retain ownership of their data, able to ensure its security.

What is the EPC Gen 2 standard and why is it important?

The EPC Gen 2 standard is a set of global standards that enables international compatibility as well as features that improve RFID performance. For example, dense reader mode is a Gen 2 feature that prevents interference and duplicate reading when readers are placed in close proximity.

Do RFID and its associated radio waves pose any health risks? [3]

RFID Journal, one of the preeminent sources of RFID information, states that "The World Health Organization's research, as well as many other scientific studies, have shown that EMF exposure below the limits recommended in internationally adopted guidelines has not revealed any known negative health effects." Readers and active tags are low power devices that emit very little RF energy. (For more information on potential health issues, visit www.rfidjournal.com)

RFID GLOSSARY

Active tag: An RFID tag that has a battery that powers the circuitry and transmits the signal to a reader. Active tags can be read from 100 feet away or more and are used for tracking expensive items over long ranges.

Antenna: The element built into both RFID readers and tags that radiates and receives radio energy.

Automatic identification (also called automatic data capture): The ability to collect and enter data directly into computer systems without human involvement through technologies such as bar codes, biometrics, RFID and voice recognition.

Backscatter: A method of communication where tags reflect back a portion of the radio waves that are emitted by the reader to transmit tag data to the reader.

Battery-assisted tag: These RFID tags contain batteries that provide direct power on the tag itself to increase read range (sometimes called "semi-passive RFID tags.")

Circular-polarized antenna: This omnidirectional UHF reader antenna emits radio waves in a circular pattern and is designed to easily capture RFID tags that are presented in different orientations.

Contactless smart card: A credit or loyalty card that contains an RFID chip that can automatically transmit information to a reader — no 'swiping' required. Such cards can speed checkout, providing consumers with more convenience.

Chipless RFID tag: An RFID tag without an integrated microchip. Materials in the tag reflect back a portion of the radio waves beamed at them from the reader. The waveforms are utilized much like a fingerprint to identify the object that is tagged. Although chipless tags are inexpensive, they are not useful in the supply chain since they cannot transmit a unique serial number that can be stored in a database.

Closed-loop systems: RFID tracking systems set up within a company, where there is no data sharing with other companies required to enable the application. One example is a railroad that issues its own RFID-enabled tickets.

Die: The silicon block onto which circuits have been etched.

Electromagnetic interference (EMI): Interference caused when the radio waves of one device distort the waves of another. Cells phones, wireless computers and even robots in factories can produce radio waves that interfere with RFID tags.

Electronic article surveillance (EAS): Simple electronic tags that can be turned on or off. When an item is purchased or borrowed, the tag is turned off. When the item passes a gate with a tag that hasn't been deactivated, an alarm sounds, helping prevent theft.

Electronic Product Code (EPC): A 96-bit code created by the Auto-ID Center that contains a unique number that identifies a specific item in the supply chain. The code contains digits that identify the manufacturer, product category and the individual item. It is backed by the United Code Council and EAN International, the two main bodies that oversee bar code standards.

EPCglobal: The non-profit organization that manages standards and numbering schemes associated with EPC and the successor organization to the Auto ID Center. EPCglobal is a membership-driven organization and is a subsidiary of the

European Article Numbering (EAN): The bar code standard used throughout Europe, Asia and South America. It is administered by EAN International.

Excite: The reader is said to "excite" a passive tag when the reader transmits RF energy to wake up the tag and enable it to transmit back.

Frequency: The number of repetitions of a complete wave within one second. 1 Hz equals one complete waveform in one second. 1 KHz equals 1,000 waves in a second.

GTAG (Global Tag): A standardization initiative of the Uniform Code Council (UCC) and the European Article Numbering Association (EAN) for asset tracking and logistics based on radio frequency identification (RFID). The GTAG initiative is supported by NXP, Intermec, and Gemplus — three major RFID tag manufacturers.

GTIN (Global Trade Item Number): A GTIN is a GS1 identification key that enables global identification of an item anywhere in the supply chain. No matter in the supply chain an item may be — from manufacturer to distributor to retail store to end consumer — a scan of the GTIN enables any partner in a given supply chain to accurately identify the product and obtain pricing. The result is highly efficient ordering and invoicing across the supply chain.

Harvesting: A term that describes how passive tags gather energy from an RFID reader antenna.

High-frequency (HF) tags: HF tags typically operate at 13.56 MHz and can be read from about 10 feet away. They transmit data faster, but consume more power than low-frequency tags.

Integrated circuit (IC): A microelectronic semiconductor device comprising many interconnected transistors and other components. Most RFID tags have ICs.

Interference: Anything that prevents radio waves from traveling between a tag and reader correctly and causes the tag to be read incorrectly. Can be caused by other radio signals or by some physical objects metals and liquids that absorb or reflect the radio signals.

Interrogator: See RFID reader.

Linear-polarized antenna: A UHF antenna where the radio energy is focused in a narrow beam to increase read distance and enable the signal to penetrate dense materials. Unlike circular-polarized antennas, the linear-polarized antenna requires tags to be aligned with reader.

Low-frequency (LF): The range of frequencies between approximately 30 kHz to 300 kHz. LF tags typically operate at either 125 kHz or 134 kHz. These tags can be read from less than three feet away and have a slow rate of data transfer, but can withstand more interference than the typical UHF tag.

Memory: The amount of data that can be stored on a tag.

Microwave tags: Radio frequency tags that operate at 5.8 GHz. They have very high transfer rates and can be read from as far away as 30 feet, but they use a lot of power and are expensive.

Middleware: Computer software that connects software components or applications. It is used most often to support complex, distributed applications based on XML, SOAP, Web services and service orientated architecture (SOA). Middleware can include web servers, application servers and content management systems.

Nominal range: The read range at which a tag can be read reliably.

Object Name Service (ONS): An Auto-ID Center system that allows the look up of unique Electronic Product Codes (EPC). ONS is similar to the Domain Name Service, which points computers to sites on the Internet.

Orientation: Refers to the relative position of the tag to the reader. If tags are aligned (or 'oriented') with the reader, read ranges are generally longer.

Passive tag: An RFID tag without a battery. When radio waves from the reader reach the chip's antenna, it creates a magnetic field. The tag draws power from the field and is able to send back information stored on the chip.

Power level: The amount of RF energy radiated from a reader or an active tag. The higher the power output, the longer the read range, but most governments regulate power levels to avoid interference with other devices.

Radio Frequency Identification (RFID): A method of identifying unique items using radio waves. Typically, a reader communicates with a tag, which holds digital information in a microchip. Chipless forms of RFID tags use material to reflect back a portion of the radio waves beamed at them.

Read rate: The maximum rate at which data can be read from a tag expressed in bits or bytes per second.

Reader (also called an interrogator): The reader communicates with the RFID tag via radio waves and passes the information in digital form to a computer system.

Read range: The distance from which a reader can communicate with a tag. Active tags have a longer read range than passive tags because they use a battery to transmit signals to the reader. With passive tags, the read range is influenced by frequency, reader output power, antenna design and method by which the tag is powered. Low frequency tags use inductive coupling (see above), which requires the tag to be within a few feet of the reader.

RFID (Radio Frequency Identification): A technology that uses radio waves to uniquely identify tagged items.

RFID Chip: The small computer, almost as small as a grain of sand, which is the heart of every RFID tag. The two main parts of an RFID tag are the chip and the antenna.

RFID tag: A microchip attached to an antenna that picks up signals from and sends signals to a reader. The tag contains a unique serial number, but may have other information, such as a customer's account number. Tags come in many forms, such as smart labels affixed to boxes; smart cards and key-chain wands for purchase transactions; and a box that is affixed to your windshield to enable you to pay tolls without stopping. RFID tags can be active, passive or semi-passive.

Semi-passive tag: Similar to active tags, but the battery is used to run the microchip's circuitry and not to communicate with the reader. Some semi-passive tags sleep until they are woken up by a signal from the reader, which conserves battery life.

Smart label: A label that contains an integrated RFID tag that is considered "smart" since it can store information, such as a unique serial number, and communicate with a reader.

Tag: See RFID Tag.

Transponder: A radio transmitter-receiver that is activated when it receives a predetermined signal. RFID tags are sometimes referred to as transponders.

Ultra-high frequency (UHF): Typically, tags that operate between 866 MHz to 930 MHz. UHF tags can transmit information faster and farther than high- and low-frequency tags. But radio waves don't pass through items with high water content, such as fruit, at these frequencies. UHF tags are also more expensive than low-frequency tags, and they use more power.

UHF Generation 2: The current EPC standard for factory-programmed tags.

Uniform Code Council (UCC): The nonprofit organization that oversees the Uniform Product Code, the bar code standard used in North America.

Uniform Product Code (UPC): The bar code standard used in North America. It is administered by the Uniform Code Council.

Write Range: The distance where a tag is written by a reader/writer without any object between the tag and the reader/writer. Normally, write range is lower than read range.

Write rate: The rate at which information is transferred to a tag, written into the tag's memory and verified as being correct.

FOR MORE INFORMATION ON HOW YOU CAN DRIVE COSTS DOWN AND PROFITS UP WITH UHF RFID IN YOUR ORGANIZATION, PLEASE VISIT:

www.motorolasolutions.com/rfid

FOR INFORMATION ON THE BENEFITS OF UHF RFID IN YOUR SPECIFIC INDUSTRY OR APPLICATION, PLEASE VISIT:

www.motorolasolutions.com/rfid/retail

www.motorolasolutions.com/rfid/manufacturing

www.motorolasolutions.com/rfid/assetmanagement

www.motorolasolutions.com/rfid/government

www.motorolasolutions.com/rfid/transportation

www.motorolasolutions.com/rfid/distribution-warehouse

www.motorolasolutions.com/RFID/healthcare

www.motorolasolutions.com/energy-utilities

MOTOROLA — YOUR IDEAL RFID PARTNER

When you partner with Motorola for your RFID solutions, you get an industry leader that can help you plan and deploy mobility solutions that help you make the most of your data. When it comes to RFID, we offer the broadest portfolio of readers in the industry, with the most types of readers designed to support the most applications and industries. Known for ongoing innovation and leadership in RFID, Motorola was the first to market and deploy EPC multi-protocol fixed RFID readers, EPC handheld RFID readers and EPD RFID portal systems. We go beyond innovation to offer you proven product — we have the most EPC fixed readers and EPC handheld readers deployed in the field today. Our world-class partner channel offers best-in-class proven applications that integrate easily with your existing processes and technology architecture. And our services and support offerings are the broadest available, providing total lifecycle deployment — from planning, site survey, installation and custom RFID read point installation to Motorola's on-site, go-live support.

ADDITIONAL RESOURCES:

EPCglobal official web site – http://www.epcglobalinc.org/home

Information on the Department of Defense and RFID http://www.acq.osd.mil/log/rfid/index.htm

Articles on the impact of RFID on supply chain: Achieving Supply Chain Excellence through Technology (ASCET) – http://www.ascet.com/welcome.asp

RFID technology basics from the Association for Automatic Identification and Mobility (AIM) – http://www.aimglobal.org/technologies/rfid/

Current RFID news: RFID Journal – www.rfidjournal.com

Footnotes:
1. Dependent upon antenna, type and size of tag, environment and other factors
2. Benefits realized by Motorola and Motorola partner deployments
3. Are there any health risks associated with RFID and radio waves? http://www.rfidjournal.com/faq/30/25
4. SITA; Air Transport IT Review - Issue 2, August 2008, http://www.sita.aero/node/1074

NOTE: Unless otherwise notes, the statistics cited in this brochure reflect the results from Motorola and/or Motorola Partner deployments.

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