RFID Overview

Introduction to Radio Frequency Identification

Intermec
Technologies Corporation

Introduction to Radio Frequency (RF)

RF technology is used in many different applications, such as television, radio, cellular phones, radar, and automatic identification systems. The term RFID (radio frequency identification) describes the use of radio frequency signals to provide automatic identification of items. RFID is used in applications such as:

- electronic toll collection (ETC)
- railway car identification and tracking
- intermodal container identification
- asset identification and tracking
- item management for retail, health care, and logistics applications
- access control
- animal identification
- fuel dispensing loyalty programs
- automobile immobilizing (security)

Radio frequency (RF) refers to electromagnetic waves that have a wavelength suited for use in radio communication. Radio waves are classified by their frequencies, which are expressed in kilohertz, megahertz, or gigahertz. Radio frequencies range from very low frequency (VLF), which has a range of 10 to 30 kHz, to extremely high frequency (EHF), which has a range of 30 to 300 GHz.

Overview of Radio Frequency Identification (RFID)

RFID is a flexible technology that is convenient, easy to use, and well-suited for automatic operation. It combines advantages not available with other identification technologies. RFID can be supplied as read-only or read/write, does not require contact or line-of-sight to operate, can function under a variety of environmental conditions, and provides a high level of data integrity. In addition, because the technology is difficult to counterfeit, RFID provides a high level of security.

RFID is similar in concept to bar coding. Bar code systems use a reader and coded labels that are attached to an item, whereas RFID uses a reader and special RFID devices that are attached to an item. Bar code uses optical signals to transfer information from the label to the reader; RFID uses RF signals to transfer information from the RFID device to the reader.

Radio waves transfer data between an item to which an RFID device is attached and an RFID reader. The device can contain data about the item, such as what the item is, what time the device traveled through a certain zone, perhaps even a parameter such as temperature. RFID devices, such as a tag or label, can be attached to virtually anything – from a vehicle to a pallet of merchandise.

RFID technology uses frequencies within the range of 50 kHz to 2.5 GHz. As shown in Figure 1-1, an RFID system typically includes the following components:

- an RFID device (transponder or tag) that contains data about an item
- an antenna used to transmit the RF signals between the reader and the RFID device
- an RF transceiver that generates the RF signals
- a reader that receives RF transmissions from an RFID device and passes the data to a host system for processing

In addition to this basic RFID equipment, an RFID system includes application-specific software.

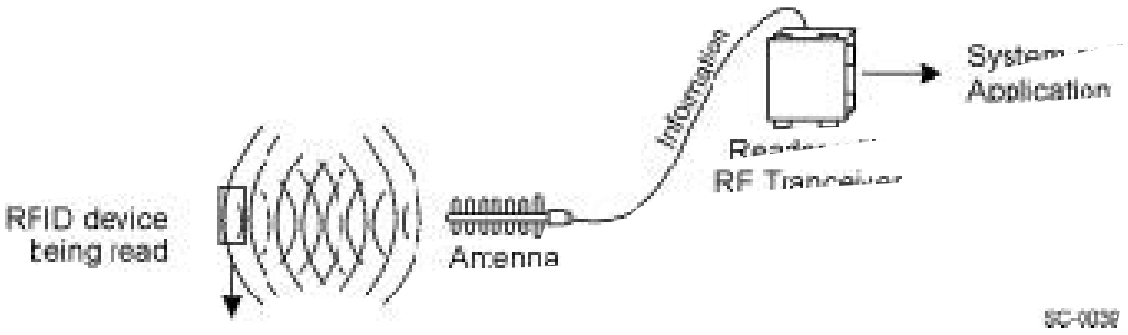

Figure 1-1 Typical RFID System Components

The following paragraphs further describe RFID hardware components.

Transponder/Tag

Historically, an RFID device that did not actively transmit to a reader was known as a tag. An RFID device that actively transmitted to a reader was known as a transponder (TRANSmitter + resPONDER). However, it has become common within the industry to interchange the terminology and refer to these devices as either tags or transponders. For the purposes of this overview, an RFID device that actively transmits to a reader is termed an "active" tag; an RFID device that only reflects or backscatters transmission from a reader is termed "passive."

The tags are programmed with data that identifies the item to which the tag is attached. Tags can be either read-only, volatile read/write, or write one/read many (WORM) and can be either active or passive. In general, active tags use batteries to power the tag transmitter (radio) and receiver. These tags usually contain a greater number of components than do passive tags. Therefore, active tags are usually larger in size and are more expensive than passive tags. In addition, the life of an active tag is directly related to battery life.

Passive tags can be either battery or non-battery operated, as determined by the intended applications. Passive tags reflect the RF signal transmitted to them from a reader or transceiver and add information by modulating the reflected signal. A passive tag does not use a battery to boost the energy of the reflected signal. A passive tag may use a battery to maintain memory in the tag or power the electronics that enable the tag to modulate the reflected signal.

Antenna

Each RFID system includes at least one antenna to transmit and receive the RF signals. In some systems, a single antenna transmits and receives the signals; in other systems, one antenna transmits and one antenna receives the signals. The quantity and type of antennas used depend on the application.

RF Transceiver

The RF transceiver is the source of the RF energy used to activate and power the passive RFID tags. The RF transceiver may be enclosed in the same cabinet as the reader or it may be a separate piece of equipment. When provided as a separate piece of equipment, the transceiver is commonly referred to as an RF module. The RF transceiver controls and modulates the radio frequencies that the antenna transmits and receives. The transceiver filters and amplifies the backscatter signal from a passive RFID tag.

Reader

The RFID reader directs the RF transceiver to transmit RF signals, receives the encoded signal from the tag through the RF transceiver, decodes the tag's identification, and transmits the identification with any other data from the tag to the host computer. The reader may also provide other functions. For example, ETC applications include accepting data from other input devices such as a vehicle detector and controlling gate and lights. Firmware in the reader controls reader operations. The user can change or customize the reader's operations to suit a specific requirement by issuing commands through the host computer or a local terminal.

Intellitag® Suite

Intermec Technologies Corporation provides systems solutions for a wide variety of item management applications and some 30 tags and 6 reader systems for intelligent transportation systems (ITS) applications. Intermec's Intellitag family of products includes tags, inserts, intelligent labels, readers, development software, printers, and customized antennas suited for a specific system solution.

Intellitag Inserts and Tags

The Intellitag RFID inserts and tags are designed for integration into 915 MHz and 2450 MHz solutions that require tag read range, multi-tag sort, read/write, and memory capacity not provided by older, less flexible proximity technology. These products are suitable for applications ranging from transportation and security access to item management, supply chain management, retail operations, manufacturing, logistics, and health care.

All Intermec-supplied Intellitag tags and inserts are factory-programmed with a 64-bit identification code. This code is permanently locked, ensuring unique identification for users worldwide. Remaining tag and RFID tag insert memory can be programmed in the factory or the field with the option of being permanently locked. Unlocked bytes can be rewritten more than 100,000 times. A powerful anti-collision algorithm allows up to 50 tags per second to be scanned, regardless of the number of tags in the read zone. Unlicensed RFID scanners and tags using Intellitag products can be integrated or used in applications that require read ranges greater than 6 meters.

In general, an RFID tag consists of an application-specific integrated circuit (ASIC) and an antenna that can be mounted on various substrates. Intermec designs RFID inserts to be integrated into application-specific packaging prior to use. One tag is designed as a sealed unit to be mounted to a non-metallic surface using plastic stakes (sometimes also referred to as "posts"). The tag is suitable for distribution-type applications, where situations require that items are containerized and the tag is attached to pallets or totes.

RFID inserts are available in different sizes for various applications. The smallest RFID insert can be inserted into a case or package to be applied to a videocassette. The medium-size insert may be suitable to insert into pressure-sensitive labels applied to packages for parcel tracking. The largest size insert may be suitable to create intelligent labels by laminating the RFID insert into labels and affixing them to high-dollar items. Intermec can develop application-specific RFID tags and inserts should the size and read range differ from the standard tags and inserts.

The Intellitag tags and inserts contain 1024-bit memory with capability to read, write, rewrite, or permanently lock individual bytes. The following capabilities are offered by the Intellitag RFID tags and inserts:

- scans unlimited and random number of tags using anti-collision protocol
- selects tag groups by user-defined criteria
- writes common data simultaneously to multiple tags
- provides a range of products in the microwave band and UHF frequency ranges that are suitable for a variety of system solutions

Readers

Intellitag readers and Intellitag reader board modules, FCC-certified for unlicensed use, are available in 915 MHz and 2450 MHz frequency bands. The type of application determines the frequency that is used for a specific system solution and, in turn, determines which reader/reader board will provide the best solution. As with the RFID tags and inserts, the reader boards are also offered for integration into RF solutions that require read range, multi-tag sort, read/write, and memory capacity not provided by older, less flexible proximity technology. The readers and reader boards can be programmed for read-only or read/write operation.

The various reader options are offered to provide best-fit solutions for a wide range of applications. For example, the OEM reader/programmer board, originally designed as an option for the Intermec 2100 Universal Access Point (2100 UAP), may be integrated into other microcontroller-based systems. The UAP-type reader could become part of a system solution for conveyor belt or other distribution applications, or for retail applications such as video self check-out or other self check-out applications that use a credit card to purchase or rent merchandise.

The OEM compact reader board set has a built-in antenna and may be integrated as part of a system solution for hand-held readers. It can be used for retail check-in and check-out, inventory control, and other applications that would benefit from a portable reading device such as the Intermec Sabre™ 1555.

The SmartPass® 500 Reader, may be suitable for low-speed transportation applications such as parking or security gate access. The reader system has been designed to be compatible with existing Intermec parking access control applications certified for licensed use. The type of application will help determine the radio frequency used, which in turn determines the reader or reader board that will best fit the system design and solution.

Antennas

Customers may supply their own antennas directly from commercial sources, or Intermec may design or provide an antenna appropriate for a specific system solution.

RF Transceiver

The design of both the Intermec Intellitag reader and reader board incorporate an RF transceiver.

Intellitag Labels

The Intellitag Label is actually an intelligent device that can transmit and store data. The Intellitag Label looks like a typical bar code label and can be printed in the same manner. Inside the label, between the face sheet and liner, there is an Intellitag RFID insert that consists of an application-specific integrated circuit (ASIC) and an antenna that is mounted on an ultra-thin substrate.

Customers can order Intellitag Labels in the same configuration and composition that they order their bar code labels today. Size will be somewhat limited based on the size of the Intellitag RFID insert; however, the majority of customers will see a seamless transition from their existing bar code labels to the Intellitag Label. The Intellitag Label design will ultimately be driven by the customer's application. The selection of the Intellitag RFID insert by the customer will be driven by the read range required. Once the insert has been selected, the label design can be completed, and a marriage of the two products will create the Intellitag Label that best meets the customer's needs.

Initially, all Intermec Intellitag Labels will be custom-made, meaning they will be designed for each specific application. In the future, Intermec's goal is to have Intellitag Labels on the shelf tuned to meet a range of application requirements.

Intellitag Printers

The advent of the intelligent label has created demand for a printer capable of simultaneously printing bar code, text, and graphics on the surface of the label and reading, programming, and verifying the RF tag embedded in the label.

Intermec bar code label printers are now available with an Intellitag option that offers users the power of the Intellitag system in a traditional bar code printer form. Based on the powerful 501XP Printer platform, the Intellitag option includes a factory-installed Intellitag board, media-path antenna, and a downloadable program that uses the powerful Fingerprint™ printer language. The Fingerprint program provides all the interface software needed to control and pass data to and from the Intellitag option board.

Intermec Intellitag printers automatically verify proper operation of the embedded RF tag. They also verify that correct data has been written to the tag, automatically adding a layer of quality control to your Intellitag system. Data may be copied to and from printed fields and RF tag fields. For instance, the tag ID may be read and copied into a bar code field, which may then be used by a combination RFID and bar code reader, such as Intermec's Sabre 1555, to uniquely address that specific Intellitag label during subsequent transactions.

For More Information

For more information on the Intellitag product family, contact a sales representative at 1-800-923-4824 or visit www.intermec.com.

Where Information Gets Down To Business™

North America • 6001 36th Avenue West • P.O. Box 4280 • Everett, Washington 98203-9280 • 1 (800) 347-2636 tel • 1 (319) 369-3324 fax • Norand Mobile Systems Division • 550 2nd Street S.E. • Cedar Rapids, Iowa 52401 • 1 (800) 452-2757 tel • 1 (319) 369-3453 fax • Amtech Systems Division • 19111 Dallas Parkway, Suite 300 • Dallas, Texas 75287-3106 • 1 (800) 923-4824 toll-free • 1 (214) 360-9436 tel • 1 (972) 733-6699 fax

Europe/Middle East/Africa • Sovereign House • Vastern Road • Reading, Berkshire, RG1 8BT • United Kingdom • +44 118 987 9400 tel • +44 118 987 9401 fax

Asia Pacific/Latin America • 6001 36th Avenue West • P.O. Box 4280 • Everett, Washington 98203-9280 • 1 (800) 347-2636 tel • 1 (319) 369-3324 fax • Amtech Systems Division • 19111 Dallas Parkway, Suite 300 • Dallas, Texas 75287-3106 • 1 (800) 923-4824 toll-free • 1 (214) 360-9436 tel • 1 (972) 733-6699 fax

Label Products and Supplies • North America • 1 (513) 874-5882 tel • 1 (513) 874-8487 fax • or 1 (800) 227-9947 tel • 1 (800) 227-1707 fax • Latin America/Asia Pacific • 1 (513) 870-7930 Int'l phone • 1 (513) 874-3613 Int'l fax • Europe/Middle East/Africa +31 24 372 3100 tel • +31 24 378 0070 fax

Worldwide Fax Document Retrieval Service • 1 (650) 556-8447 tel • 1 (800) 755-5505 (North America Only)

Internet • www.intermec.com **E-mail** • info@intermec.com

Intermec
Technologies Corporation

A UNOVA Company