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RADIO FREQUENCY IDENTIFICATION (RFID)

Dr. Shakeel Ahmad
Associate Professor
Anjuman-I-Islam's, Akbar Peerbhoy College of Commerce and Economics,
Mumbai, Maharashtra, India

Radio Frequency Identification (RFID) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person. It uses radio frequency to search ,identify, track and communicate with items and people. it is a method that is used to track or identify an object by radio transmission uses over the web. Data digitally encoded in an RFID tag which might be read by the reader. This device work as a tag or label during which data read from tags that are stored in the database through the reader as compared to traditional barcodes and QR codes. It is often read outside the road of sight either passive or active RFID.

Radio Frequency Identification or RFID is a specific type of radio technology that uses radio waves to identify tags attached to an object and thus identify the object. The tag contains a transceiver chip which is triggered by the electromagnetic wave from the RFID reader and transmits an identification number back to the reader. The identification number is then used for the inventory of the objects with tags. Tags can be passive or active. Passive tags are only powered by the incident electromagnetic wave from the reader and thus have a shorter operating range. Active tags are powered by a battery and can have greater range, up to hundreds of meters.

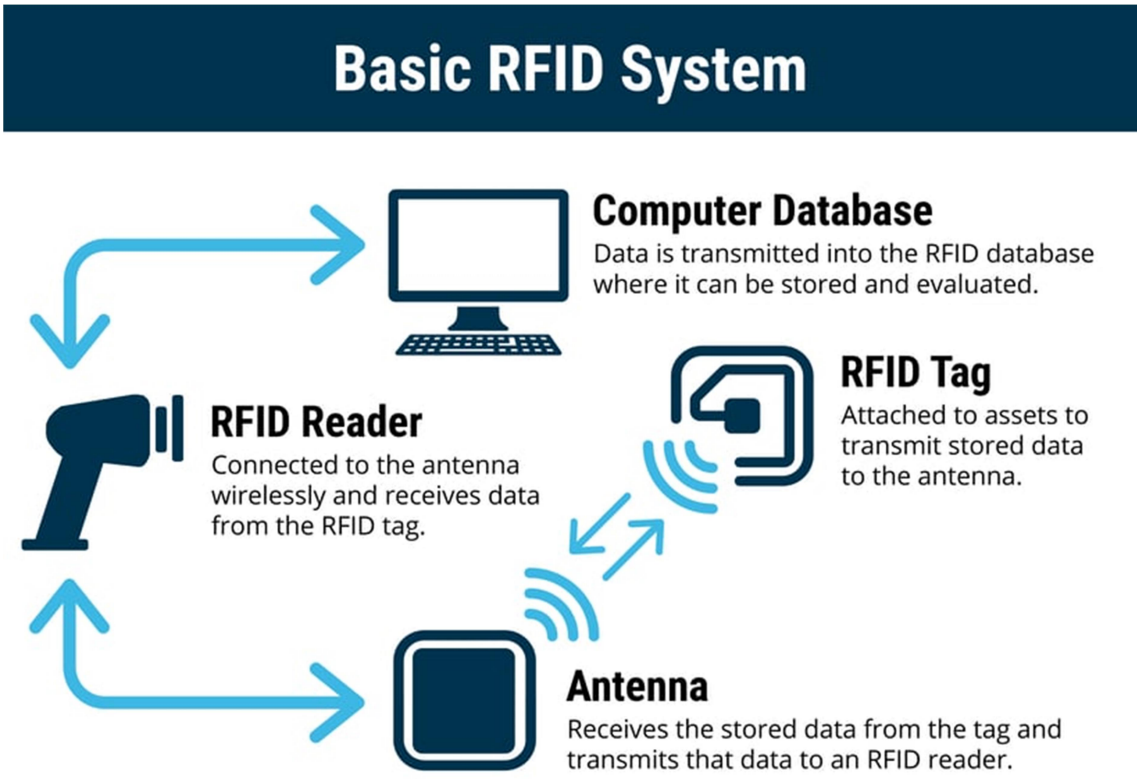
With the use of wireless technology, RFID tags do not need a direct line-of-sight to the RFID reader, which brings some significant advantages compared to the barcode scanners widely used in the industry today.

The RFID tag can be embedded or hidden in the object, and several tags can be identified at the same time by a single reader.

A barcode scanner has to 'see' a barcode to gather data.

RFID is used in many applications and industries, including pharma, retail, agriculture and medical care, as well as tracking vehicles, pets, and livestock. For example, an object with an embedded RFID tag that is moving through a production line or a warehouse equipped with RFID readers, can be scanned at different production stations and thus its progress can be automatically tracked.

The technology has continued to improve over the years, and the cost of implementing and using an RFID system has continued to decrease, making RFID a cost-effective and efficient alternative to conventional optical scanning. Standard specifications have been developed for RFID technology, addressing security and privacy concerns. Such standards use on-chip cryptography methods for untraceability and tag and reader authentication using digital signature data.



Regulation and standardization

To avoid injuries to humans and animals, RF transmission needs to be controlled. A number of organizations have set standards for RFID, including the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), ASTM International, the DASH7 Alliance and EPCglobal.

Several specific industries have also set guidelines, including the Financial Services Technology Consortium (FSTC) for tracking IT Assets with RFID, the Computer Technology Industry Association CompTIA for certifying RFID engineers, and the International Air Transport Association (IATA) for luggage in airports.

Every country can set its own rules for frequency allocation for RFID tags, and not all radio bands are available in all countries. These frequencies are known as the ISM bands (Industrial Scientific and Medical bands). The return signal of the tag may still cause interference for other radio users.

Low-frequency (LF: 125–134.2 kHz and 140–148.5 kHz) (LowFID) tags and high-frequency (HF: 13.56 MHz) (HighFID) tags can be used globally without a license.
Ultra-high-frequency (UHF: 865–928 MHz) (Ultra-HighFID or UHFID) tags cannot be used globally as there is no single global standard, and regulations differ from country to country.
In North America, UHF can be used unlicensed for 902–928 MHz (±13 MHz from the 915 MHz center frequency), but restrictions exist for transmission power.[citation needed] In Europe, RFID and other low-power radio applications are regulated by ETSI recommendations EN 300 220 and EN 302 208, and ERO recommendation 70 03, allowing RFID operation with somewhat complex band restrictions from 865–868 MHz. Readers are required to monitor a channel before transmitting ("Listen Before Talk"); this requirement has led to some restrictions on performance, the resolution of which is a subject of current[when?] research. The North American UHF standard is not accepted in France as it interferes with its military bands.[citation needed] On July 25, 2012, Japan changed its UHF band to 920 MHz, more closely matching the United States' 915 MHz band, establishing an international standard environment for RFID.

In some countries, a site license is needed, which needs to be applied for at the local authorities, and can be revoked.

As of 31 October 2014, regulations are in place in 78 countries representing approximately 96.5% of the world's GDP, and work on regulations was in progress in three countries representing approximately 1% of the world's GDP.

Standards that have been made regarding RFID include:

- ISO 11784/11785 – Animal identification. Uses 134.2 kHz.
- ISO 14223 – Radiofrequency identification of animals – Advanced transponders
- ISO/IEC 14443: This standard is a popular HF (13.56 MHz) standard for HighFIDs which is being used as the basis of RFID-enabled passports under ICAO 9303. The Near Field Communication standard that lets mobile devices act as RFID readers/transponders is also based on ISO/IEC 14443.
- ISO/IEC 15693: This is also a popular HF (13.56 MHz) standard for HighFIDs widely used for non-contact smart payment and credit cards.
- ISO/IEC 18000: Information technology—Radio frequency identification for item management:
- ISO/IEC 18092 Information technology—Telecommunications and information exchange between systems—Near Field Communication—Interface and Protocol (NFCIP-1)
- ISO 18185: This is the industry standard for electronic seals or "e-seals" for tracking cargo containers using the 433 MHz and 2.4 GHz frequencies.
- ISO/IEC 21481 Information technology—Telecommunications and information exchange between systems—Near Field Communication Interface and Protocol −2 (NFCIP-2)
- ASTM D7434, Standard Test Method for Determining the Performance of Passive Radio Frequency Identification (RFID) Transponders on Palletized or Unitized Loads
- ASTM D7435, Standard Test Method for Determining the Performance of Passive Radio Frequency Identification (RFID) Transponders on Loaded Containers
- ASTM D7580, Standard Test Method for Rotary Stretch Wrapper Method for Determining the Readability of Passive RFID Transponders on Homogenous Palletized or Unitized Loads
- ISO 28560-2— specifies encoding standards and data model to be used within libraries.

In order to ensure global interoperability of products, several organizations have set up additional standards for RFID testing. These standards include conformance, performance and interoperability tests.

Main Components of RFID Technology?

Tags

RFID tags are what stores and transmits the data that needs to be deciphered. The tags can be attached to assets to send data to the antenna. The microchip embedded in the tag is what stores the tag's ID

and programmable data related to the asset. This stored data is then transferred to the reader through antennas.

Antennas

Antennas are necessary elements in an RFID system because they transmit the RFID tag's data to the reader. Without some type of RFID antenna, whether integrated or standalone, the RFID reader cannot correctly send and receive signals to RFID tags.

Readers

RFID readers are connected to the antenna and receive data from the RFID tag. The reader is what receives and converts the radio waves into digital data on a computer database.

There are two types of readers. There are Fixed Readers and Mobile Readers. Fixed readers are typically mounted to walls or other objects and stay in one location to read data stored in a tag. Mobile readers can be installed or carried anywhere it is needed.

Computer Database

The RFID system requires a computer database to process data stored in tags. This software can program tags, manage devices and data, remote monitoring and hardware configuration.

Kinds of RFID :

There are many kinds of RFID, each with different properties, but perhaps the most fascinating aspect of RFID technology is that most RFID tags have neither an electric plug nor a battery. Instead, all of the energy needed to operate them is supplied in the form of radio waves by RFID readers. This technology is called passive RFID to distinguish it from the(less common) active RFID in which there is a power source on the tag.

UHF RHID (Ultra-High Frequency RFID). It is used on shipping pallets and some driver's licenses. Readers send signals in the 902-928 MHz band. Tags communicate at distances of several meters by changing the way they reflect the reader signals; the reader is able to pick up these reflections. This way of operating is called backscatter.

HF RFID (High-Frequency RFID). It operates at 13.56 MHz and is likely to be in your passport, credit cards, books, and noncontact payment systems. HF RFID has a short-range, typically a meter or less because the physical mechanism is based on induction rather than backscatter.

There are also other forms of RFID using other frequencies, such as LF RFID(Low-Frequency RFID), which was developed before HF RFID and used for animal tracking

There are two types of RFID :

1. **Passive RFID –** Passive RFID tags does not have their own power source. It uses power from the reader. In this device, RF tags are not attached by a power supply and passive RF tag stored their power. When it is emitted from active antennas and the RF tag are used specific frequency like 125-134MHZ as low frequency, 13.56MHZ as a high frequency and 856MHZ to 960MHZ as ultra-high frequency.

2. **Active RFID –** In this device, RF tags are attached by a power supply that emits a signal and there is an antenna which receives the data. means, active tag uses a power source like battery. It has it's own power source, does not require power from source/reader.

RFID Used For?

Examples of applications that benefit from RFID are endless. Applications extend from broad areas like inventory tracking to supply chain management and can become more specialized depending on the company or industry. Types of RFID applications can span from IT asset tracking to textile tracking and even into specifics like rental item tracking.

What sets a potential RFID application apart from applications that can use other types of systems is the need to uniquely identify individual items quickly and more efficiently where traditional systems fall short. Below are a few applications that are successfully using RFID technology.

- Race Timing
- Supply Chain Management
- Pharmaceutical Tracking
- Inventory Tracking
- IT Asset Tracking
- Laundry & Textile Tracking
- File Tracking
- Returnable Transit Item (RTI) Tracking
- Event & Attendee Tracking
- Access Control
- Vehicle Tracking
- Tolling
- Hospital Infant Tracking

- Animal Tracking
- Tool Tracking
- Jewellery Tracking
- Retail Inventory Tracking
- Pipe and Spool Tracking
- Logistics Tracking (Materials Management)
- DVD Kiosks
- Library Materials Tracking
- Marketing Campaigns
- Real-Time Location Systems

Working Principle of RFID:

Generally, RFID uses radio waves to perform AIDC function. AIDC stands for Automatic Identification and Data Capture technology which performs object identification and collection and mapping of the data.

An antenna is an device which converts power into radio waves which are used for communication between reader and tag. RFID readers retrieve the information from RFID tag which detects the tag and reads or writes the data into the tag. It may include one processor, package, storage and transmitter and receiver unit.

Working of RFID System :

Every RFID system consists of three components: a scanning antenna, a transceiver and a transponder. When the scanning antenna and transceiver are combined, they are referred to as an RFID reader or interrogator. There are two types of RFID readers — fixed readers and mobile readers. The RFID reader is a network-connected device that can be portable or permanently attached. It uses radio waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data.

The transponder is in the RFID tag itself. The read range for RFID tags varies based on factors including the type of tag, type of reader, RFID frequency and interference in the surrounding environment or from other RFID tags and readers. Tags that have a stronger power source also have a longer read range.

Features of RFID :

- An RFID tag consists of two-part which is an microcircuit and an antenna.
- This tag is covered by protective material which acts as a shield against the outer environment effect.
- This tag may active or passive in which we mainly and widely used passive RFID.

RFID vs. barcodes

Using RFID as an alternative for barcodes is increasing in use. RFID and barcode technologies are used in similar ways to track inventory, but there are some important differences between them.

RFID tags	Barcodes
Can identify individual objects without direct line of sight.	Direct line of sight required for scanning.
Can scan items from inches to feet away, depending on type of tag and reader.	Require closer proximity for scanning.
Data can be updated in real time.	Data is read-only and can't be changed.
Require a power source.	No power source needed.
Read time is less than 100 milliseconds per tag.	Read time is half a second or more per tag.
Contain a sensor attached to an antenna, often contained in a plastic cover and more costly than barcodes.	Printed on the outside of an object and more subject to wear.

RFID vs. NFC

Near-field communication (NFC) enables data to be exchanged between devices by using short-range, high-frequency wireless communication technology. NFC combines the interface of a smart card and reader into a single device.

Radio frequency ID	Near-field communication
Uni-directional	Bi-directional
Range up to 100 m	Range less than 0.2 m
LF/HF/UHF/Microwave	13.56 MHz
Continuous sampling	No continuous sampling
Bit rate varies with frequency	Up to 424 Kbps
Power rate varies with frequency	<15 milliamperes

Advantages of RFID :

- It provides data access and real-time information without taking to much time.
- RFID tags follow the instruction and store a large amount of information.
- The RFID system is non-line of sight nature of the technology.
- It improves the Efficiency, traceability of production.
- In RFID hundred of tags read in a short time.
- Rapid check-out / check-in
- Simplified patron self check-out / check-in
- High reliability
- High-speed inventorying
- Automated materials handling
- Long tag life.

Disadvantages of RFID :

- It takes longer to program RFID Devices.
- RFID intercepted easily even it is Encrypted.
- In an RFID system, there are two or three layers of ordinary household foil to dam the radio wave.
- There is privacy concern about RFID devices anybody can access information about anything.
- Active RFID can costlier due to battery.

Conclusion

- RFID technology is an essential tool for logistical applications and is being used to optimise supply chains and production processes across different industries. While this technology isn't brand new, many new ways that are being explored to optimise it for new purposes. RFID smart labels, as well as various elements such as RFID printers and the microchips and antennae, are likely to see an increase in demand as more applications are developed.

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