RADIO FREQUENCY IDENTIFICATION

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INTRODUCTION

- **Radio-frequency identification (RFID)** is the use of an object (typically referred to as an RFID tag) applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Some tags can be read from several meters away and beyond the line of sight of the reader.

- Most RFID tags contain at least two parts. One is an **integrated circuit** for storing and processing information, **modulating** and **demodulating** a **radio-frequency** (RF) signal, and other specialized functions. The second is an **antenna** for receiving and transmitting the signal.
TYPES OF RFID`S

– There are generally three types of RFID tags: active RFID tags, which contain a battery and can transmit signals autonomously, passive RFID tags, which have no battery and require an external source to provoke signal transmission, and battery assisted passive (BAP) RFID tags, which require an external source to wake up but have significant higher forward link capability providing greater range
Block diagram of RFID

Tagged Cases and Pallets

EPC Tag

Sensor

RFID Reader

Smart RFID Reader

RFID Management Console

Event Manager

RFID Information Server

Integration and Workflow
(Seebeyond, Tibco, etc.)

ONS

ALE App

ERP

SCM

WMS

Trading Partner or Supplier

Internet

ALE

PML

XML etc.
Data exchange
HOW RFID WORKS AN EXAMPLE

- Long checkout lines at the grocery store are one of the biggest complaints about the shopping experience. Soon, these lines could disappear when the ubiquitous Universal Product Code (UPC) bar code is replaced by smart labels, also called radio frequency identification (RFID) tags. RFID tags are intelligent bar codes that can talk to a networked system to track every product that you put in your shopping cart.

- Imagine going to the grocery store, filling up your cart and walking right out the door. No longer will you have to wait as someone rings up each item in your cart one at a time. Instead, these RFID tags will communicate with an electronic reader that will detect every item in the cart and ring each up almost instantly. The reader will be connected to a large network that will send information on your products to the retailer and product manufacturers. Your bank will then be notified and the amount of the bill will be deducted from your account. No lines, no waiting.
HOW RFID'S WORK

• RFID tags, a technology once limited to tracking cattle, are tracking consumer products worldwide. Many manufacturers use the tags to track the location of each product they make from the time it's made until it's pulled off the shelf and tossed in a shopping cart.

• Outside the realm of retail merchandise, RFID tags are tracking vehicles, airline passengers, Alzheimer's patients and pets.
RFID tags
RFID tags
RFID Library management

LibBest Library RFID Management System

- Shelf Management
- Book Drop
- Self Check in/out
- Anti-Theft Detection
- Check in/out Service
- Tagging
RFID library management system

- Among the many uses of RFID technology is its deployment in libraries. This technology has slowly begun to replace the traditional barcodes on library items (books, CDs, DVDs, etc.). The RFID tag can contain identifying information, such as a book's title or material type, without having to be pointed to a separate database. The information is read by an RFID reader, which replaces the standard barcode reader. It may replace or be added to the barcode, offering a different means of inventory management by the staff and self service by the borrowers. It can also act as a security device, taking the place of the more traditional electromagnetic security strip [40]. And not only the books, but also the membership cards could be fitted with an RFID tag.
RFID library management system

- RFID has many library applications that can be highly beneficial, particularly for circulation staff. Since RFID tags can be read through an item, there is no need to open a book cover or DVD case to scan an item. This could reduce repetitive-motion injuries. Where the books have a barcode on the outside, there is still the advantage that borrowers can scan an entire pile of books in one go, instead of one at a time. Since RFID tags can also be read while an item is in motion, using RFID readers to check-in returned items while on a conveyor belt reduces staff time. But, as with barcode, this can all be done by the borrowers themselves, meaning they might never again need the assistance of staff. Next to these readers with a fixed location there are also portable ones (for librarians, but in the future possibly also for borrowers, possibly even their own general-purpose readers). With these, inventories could be done on a whole shelf of materials within seconds, without a book ever having to be taken off the shelf.
Typical RFID tags used in libraries
RFID in supply chain management
Notably, the technology provides an accurate knowledge of the current inventory. In an academic study performed at Wal-Mart, RFID reduced Out-of-Stocks by 30 percent for products selling between 0.1 and 15 units a day. Other benefits of using RFID include the reduction of labor costs, the simplification of business processes, and the reduction of inventory inaccuracies.

- In 2004, Boeing integrated the use of RFID technology to help reduce maintenance and inventory costs on the [Boeing 787 Dreamliner](https://www.boeing.com/commercial/787-dreamliner/). With the high costs of aircraft parts, RFID technology allowed Boeing to keep track of inventory despite the unique sizes, shapes and environmental concerns. During the first six months after integration, the company was able to save $29,000 in labor alone.
Animal identification

- RFID tags for animals represent one of the oldest uses of RFID technology. Originally meant for large ranches and rough terrain, since the outbreak of mad-cow disease, RFID has become crucial in animal identification management.
Regulation and standardization

- USA: FCC (Federal Communications Commission)
- Canada: CRTC (Canadian Radio-television and Telecommunications Commission)
- Europe: ERO, CEPT, ETSI, and national administrations (note that the national administrations must ratify the usage of a specific frequency before it can be used in that country)
- Malaysia: Malaysian Communications and Multimedia Commission (MCMC)
- Japan: MIC (Ministry of Internal Affairs and Communications)
- China: Ministry of Information Industry
- Taiwan: NCC (National Communications Commission)
- South Africa: ICASA
- South Korea: Ministry of Knowledge Economy
- Australia: Australian Communications and Media Authority.
- New Zealand: Ministry of Economic Development
- Singapore: Infocomm Development Authority of Singapore
- Brazil: Anatel (Agência Nacional de Telecomunicações)
Frequency range:

- H: dBμA/m @ 10m
- ERP

- (< 30 MHz)
  - 0.01 MHz, 30000 VLF
  - 0.1 MHz, 3000 LF
  - 1 MHz, 300 MF
  - 10 MHz, 30 HF

- 100 - 135 kHz, 13.56 MHz (EU: RFID)
- 6.78 MHz
- 3.1 - 3.4 MHz
- 10.2 - 11 MHz

- 2450 MHz (EU: RFID)
- 915 MHz (US)
- 868 MHz (EU: RFID)
- 24 GHz
- 6.8 GHz (ITU)
- 5.8 GHz (EU: RTTT)
- 40.68 MHz
- 433 MHz

- (> 30 MHz)
  - 2 W
  - 0.2 W
  - 0.02 W
  - 0.002 W
  - 10 kHz
  - 100 kHz
  - 1 MHz

- MHz
- m

- VLF
- LF
- MF
- HF
- VHF
- UHF
- SHF
- EHF

- ITU
- ITU (ISM), not fully deployed
- non-ITU
- 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: 868–928 MHz) (Ultra-HighFID or UHFID) tags cannot be used globally as there is no single global standard. 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. 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 research. The North American UHF standard is not accepted in France as it interferes with its military bands. For China and Japan, there is no regulation for the use of UHF. Each application for UHF in these countries needs a site license, which needs to be applied for at the local authorities and must be renewal. For.
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. Some standards that have been made regarding RFID technology include:

ISO 14223 – Radiofrequency [sic] 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.

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:

Part 1: Reference architecture and definition of parameters to be standardized

Part 2: Parameters for air interface communications below 135 kHz

Part 3: Parameters for air interface communications at 13.56 MHz; MODE 1 and MODE 2.

Part 4: Parameters for air interface communications at 2.45 GHz
Part 6: Parameters for air interface communications at 860–960 MHz
Part 7: Parameters for active air interface communications at 433 MHz

**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.


**ASTM D7580** Standard Test Method for Rotary Stretch Wrapper Method for Determining the Readability of Passive RFID Transponders on Homogenous Palletized or Unitized Loads
Groups concerned with standardization are:

- **DASH7 Alliance**: international industry group formed in 2009 to promote standards and interoperability among extensions to ISO/IEC 18000-7 technologies[^72]

-[^73]

- **EPCglobal** – this is the standardization framework that is most likely to undergo International Standardisation according to ISO rules as with all sound standards in the world, unless residing with limited scope, as customs regulations, air-traffic regulations and others. Currently the big distributors and governmental customers are pushing EPC heavily as a standard well-accepted in their community, but not yet regarded as for salvation to the rest of the world.

-[^edit]EPC Gen2

EPC Gen2 is short for *EPCglobal UHF Class 1 Generation 2*.

- **EPCglobal** (a joint venture between GS1 and GS1 US) is working on international standards for the use of mostly passive RFID and the **EPC** in the identification of many items in the **supply chain** for companies worldwide.
One of the missions of EPCglobal was to simplify the Babel of protocols prevalent in the RFID world in the 1990s. Two tag air interfaces (the protocol for exchanging information between a tag and a reader) were defined (but not ratified) by EPCglobal prior to 2003. These protocols, commonly known as Class 0 and Class 1, saw significant commercial implementation in 2002–2005. In 2004 the Hardware Action Group created a new protocol, the Class 1 Generation 2 interface, which addressed a number of problems that had been experienced with Class 0 and Class 1 tags. The EPC Gen2 standard was approved in December 2004, and is likely to form the backbone of passive RFID tag standards moving forward. This was approved after a contention from Intermec that the standard may infringe a number of their RFID-related patents. It was decided that the standard itself does not infringe their patents, but that it may be necessary to pay royalties to Intermec if the tag is to be read in a particular manner. The EPC Gen2 standard was adopted with minor modifications as ISO 18000-6C in 2006. The lowest cost of Gen2 EPC inlay is offered by SmartCode at a price of $0.05 apiece in volumes of 100 million or more.[74] Furthermore, further conversion (including additional label stock or encapsulation processing/insertion and freight costs to a given facility or DC) and of the inlays into usable RFID labels and the design of current Gen 2 protocol standard will increase the total end-cost, especially with the added security feature
Uses of RFID

- Access management
- Tracking of goods and RFID in retail
- Tracking of persons and animals
- Toll collection and contactless payment
- Machine readable travel documents
- Smart dust (for massively distributed sensor networks)
- Location-based services
- Tracking sports memorabilia to verify authenticity
- Airport baggage tracking logistics
Practical applications

- **Payment by mobile phones**
  
  Since summer 2009, two credit card companies have been working with Dallas, Texas, based Device Fidelity to develop specialized microSD cards. When inserted into a mobile phone, the microSD card can be both a passive tag and an RFID reader. After inserting the microSD, a user's phone can be linked to bank accounts and used in mobile payment.

- **Dairy Queen** in conjunction with [Vivotech](#) has also begun using RFIDs on mobile phones as part of their new loyalty and rewards program. Patrons can ask to receive an RFID tag to place on their phone. After activation, the phone can receive promotions and coupons, which can be read by ViVOtech's specialized NFC devices.
• Similarly, 7-Eleven has been working alongside MasterCard to promote a new touch-free payment system. Those joining the trial are given a complimentary Nokia 3220 cell phone – after activation, it can be used as an RFID-capable MasterCard credit card at any of 7-Eleven's worldwide chains.\textsuperscript{[15]}

• Nokia's 2008 device, the 6212, has RFID capabilities also. Credit card information can be stored, and bank accounts can be directly accessed using the enabled handset. The phone, if used as a vector for mobile payment, has added security in that users would be required to enter a passcode or PIN before payment is authorized.

• **Transportation payments**

• Governments use RFID applications for traffic management, while automotive companies use various RFID tracking solutions for product management. Many of these solutions may work together in the future, though privacy regulations prevent many initiatives from moving forward at the same pace that technology allows.
• **Product tracking**
  • RFID use in product tracking applications begins with plant-based production processes, and then extends into post-sales *configuration management* policies for large buyers.

• **RFID mandates**
  • Wal-Mart and the United States Department of Defense have published requirements that their vendors place RFID tags on all shipments to improve *supply chain management*. Due to the size of these two organizations, their RFID mandates impact thousands of companies worldwide. The deadlines have been extended several times because many vendors face significant difficulties implementing RFID systems. In practice, the successful read rates currently run only 80%, due to radio wave *attenuation* caused by the products and *packaging*. In time it is expected that even small companies will be able to place RFID tags on their outbound shipments.
Some other applications

- Telemetry
- Identification of patients and hospital staff
- Human implants
- Ski resorts
- Race timing
- Social retailing
- Museums
- Schools and universities
- Passports
Complement to barcode

- RFID tags are often a complement, but not a substitute, for **UPC** or **EAN** barcodes. They may not ever completely replace barcodes, due in part to their higher cost and the advantage of multiple data sources on the same object. Also, unlike RFID labels, barcodes can be generated and distributed electronically, e.g. via e-mail or mobile phone, for printing and/or display by the recipient. An example is airline **boarding passes**. The new **EPC**, along with several other schemes, is widely available at reasonable cost.

- The storage of data associated with tracking items will require many **terabytes**. Filtering and categorizing RFID data is needed to create useful information. It is likely that goods will be tracked by the pallet using RFID tags, and at package level with Universal Product Code (**UPC**) or **EAN** from unique barcodes.
The unique identity is a mandatory requirement for RFID tags, despite special choice of the numbering scheme. RFID tag data capacity is large enough that each individual tag will have a unique code, while current bar codes are limited to a single type code for a particular product. The uniqueness of RFID tags means that a product may be tracked as it moves from location to location, finally ending up in the consumer's hands. This may help to combat theft and other forms of product loss. The tracing of products is an important feature that gets well supported with RFID tags containing a unique identity of the tag and also the serial number of the object. This may help companies to cope with quality deficiencies and resulting recall campaigns, but also contributes to concern about tracking and profiling of consumers after the sale. It has also been proposed to use RFID for POS store checkout to replace the cashier with an automatic system which needs no barcode scanning. In the past this was not possible due to the higher cost of tags and existing POS process technologies. However, Industry Standard, a couture shop and recording studio in Ohio has successfully implemented a POS procedure that allows faster transaction throughput.\[66\]

An FDA-nominated task force concluded, after studying the various technologies currently commercially available, which of those technologies could meet the pedigree requirements. Amongst all technologies studied including bar coding, RFID seemed to be the most promising and the committee felt that the pedigree
Problems and concerns

- **Data flooding**
  Each tag generating a message each time when passing a reader may be a desired outcome. However, event filtering is required to reduce this data inflow to a meaningful depiction of moving goods passing a threshold. Various concepts [examples needed] have been designed, mainly offered as **middleware** performing the filtering from noisy and redundant raw data to significant processed data.

- **[edit]Global standardization**
  The frequencies used for RFID in the USA are currently incompatible with those of Europe or Japan. Furthermore, no emerging standard has yet become as universal as the **barcode**.[75]
• To address international trade concerns, it is necessary to utilize a tag that is operational within all of the international frequency domains. An example of such a tag is a Sentry-M WW from RCD Technology. This mount on metal asset tag provides typical read range of 2 meters (6 ft.). It is functional across the worldwide UHF frequency bands between 860–960 MHz. It exceeds the Financial Services Technology Consortium [76] RFID Basic Functional Requirements for Data Center Assets in the North American, European and Japanese frequency bands. As a mount on metal solution, the Sentry-M WW is used for tracking many metal assets, such as IT Assets, tools or metal containers.[77]
Security concerns
A primary RFID security concern is the illicit tracking of RFID tags. Tags, which are world-readable, pose a risk to both personal location privacy and corporate/military security. Such concerns have been raised with respect to the United States Department of Defense's recent adoption of RFID tags for supply chain management. More generally, privacy organizations have expressed concerns in the context of ongoing efforts to embed electronic product code (EPC) RFID tags in consumer products. EPCglobal Network, by design, is also susceptible to DoS attacks. Using similar mechanism with DNS in resolving EPC data requests, the ONS Root servers become vulnerable to DoS attacks. Any organization planning to embark on EPCglobal Network may cringe upon discovering that the EPCglobal Network infrastructure inherits security weaknesses similar to DNS'
he RFID Security and Privacy Lounge.
A second class of defense uses cryptography to prevent tag cloning. Some tags use a form of "rolling code" scheme, wherein the tag identifier information changes after each scan, thus reducing the usefulness of observed responses. More sophisticated devices engage in Challenge-response authentications where the tag interacts with the reader. In these protocols, secret tag information is never sent over the insecure communication channel between tag and reader. Rather, the reader issues a challenge to the tag, which responds with a result computed using a cryptographic circuit keyed with some secret value. Such protocols may be based on symmetric or public key cryptography. Cryptographically-enabled tags typically have dramatically higher cost and power requirements than simpler equivalents, and as a result, deployment of these tags is much more limited. This cost/power limitation has led some manufacturers to implement cryptographic tags using substantially weakened, or proprietary encryption schemes, which do not necessarily resist sophisticated attack. For example, the Exxon-Mobil Speedpass uses a cryptographically-enabled tag manufactured by Texas Instruments, called the Digital Signature Transponder (DST), which incorporates a weak, proprietary encryption scheme to perform a challenge-response protocol for lower cost.
• Still other cryptographic protocols attempt to achieve privacy against unauthorized readers, though these protocols are largely in the research stage. One major challenge in securing RFID tags is a shortage of computational resources within the tag. Standard cryptographic techniques require more resources than are available in most low cost RFID devices. RSA Security has patented a prototype device that locally jams RFID signals by interrupting a standard collision avoidance protocol, allowing the user to prevent identification if desired. [80] Various policy measures have also been proposed, such as marking RFID-tagged objects with an industry standard label. RFID security is a very active research field for a few years, with more than 400 scientific papers published since 2002. An extensive list of references in this field can be found at the RFID Security and Privacy Lounge.
Exploitation

*Ars Technica* reported in March 2006 an RFID buffer overflow bug that could infect airport terminal RFID databases for baggage, and also passport databases to obtain confidential information on the passport holder. \[81\]

**Passports**

In an effort to make passports more secure, several countries have implemented RFID in passports. However, the encryption on UK chips was broken in under 48 hours. \[82\] Since that incident, further efforts have allowed researchers to clone passport data while the passport is being mailed to its owner. Where a criminal used to need to secretly open and then reseal the envelope, now it can be done without detection, adding some degree of insecurity to the passport system. \[83\]

**Shielding**

A number of products are available on the market that will allow a concerned carrier of RFID-enabled cards or passports to shield their data. In fact the United States government requires their new employee ID cards to be delivered with an approved shielding sleeve or holder. \[84\] There are contradicting opinions as to whether aluminum can prevent reading of RFID chips. Some people claim that aluminum shielding, essentially creating a Faraday cage, does work. \[85\] Others claim that simply wrapping
an RFID card in aluminum foil only makes transmission more difficult and is not completely effective at preventing it.[86]

Shielding is again a function of the frequency being used. **Low-frequency** LowFID tags, like those used in implantable devices for humans and pets, are relatively resistant to shielding, though thick metal foil will prevent most reads. **High frequency** HighFID tags (13.56 MHz — smart cards and access badges) are sensitive to shielding and are difficult to read when within a few centimetres of a metal surface. **UHF** Ultra-HighFID tags (pallets and cartons) are difficult to read when placed within a few millimetres of a metal surface, although their read range is actually increased when they are spaced 2–4 cm from a metal surface due to positive reinforcement of the reflected wave and the **incident wave** at the tag. UHFID tags can be successfully shielded from most reads by being placed within an anti-static **plastic bag**.[dubious — discuss][edit] Temperature Exposure

Currently, RFID tags are created by gluing an integrated circuit (IC) to an inlay. This poses a problem as vibration and high temperatures will loosen the connection. If the IC loses connection with the inlay, the RFID tag will no longer transmit. A new design was filed for patent[87] (currently pending approval) where the IC is soldered to a circuit board and the circuit board is then soldered to the inlay. This process replaces the adhesive
CONCLUSION

• RFID is very useful but it also have a lot of limitations

• WE WILL LOOKING FORWARD TO DECREASE THE NEGATIVE EFFECTS AND HAVE AN PERFECT TECHNOLOGY SOON..............
THANK YOU

PLEASE DO WATCH THE VIDEO

ANY QUERIES