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Getting Started - RFID Data Capture Solutions

The Technology, Industry Applications, & Advantages

This white paper aims to educate business decision makers on the key factors and components of an RFID solution.

This paper will go on to discuss the benefits to RFID attendance tracking solutions, as well as RFID inventory and asset management solutions, give a brief overview of RFID technology, a summarization on what RFID readers and tags are and how the technologies work, and finally a summation of considerations one should take when implementing an RFID solution.

Attendance Tracking



Attendance tracking systems have eliminated many of the problems associated manual recording of attendance in work environments or at events. These systems have also gone beyond the old-fashioned clock punches seen in some of our favorite movies.[1] Today, new technology allows time and attendance systems to create a secure business and more accurate attendee tracking data by providing:

- Log records of when employees clock in and clock out
- Record meeting, class, or event attendance
- History of employee transportation usage
- Tracking student attendance in class or extracurriculars

Benefits:

Easy to Deploy

- Mobile - RFID systems can be installed in nearly any environment and do not require the use of manned stations to function.
- Fast - scanning badges or RFID tags greatly improves the time spent recording attendance when compared with a barcode scanner or manual recording.
- Easy to use - learning curve required when using an RFID system is virtually nonexistent.

Secure

- Encryption - RFID card encryption eliminates the possibility for incorrect identity.
- Reporting - RFID systems can supply instant reporting and real time tracking.

Industries

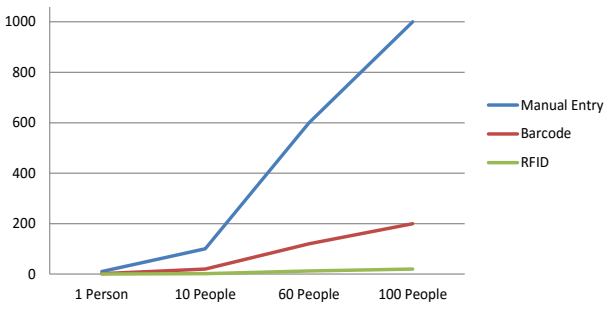
- Education
- Government
- Healthcare
- Law Enforcement
- Manufacturing
- Marketing
- Transportation

Applications

- Events / Conferences
- Emergency Mustering
- Patient Tracking
- Ridership
- Student Attendance
- Ticketing
- Trade Shows

Comparing Methods of Attendance Taking

As the graph to the right illustrates, RFID is the most time saving and efficient method of taking attendance. In this particular study, manually recording attendance for 100 people at an event took approximately 1000 seconds. When using a barcode reader, recording the same amount of people took 200 seconds, and when using an RFID reader, recording the same 100 people took approximately 20 seconds. This study clearly demonstrated the time and cost savings through the use of RFID in an attendance situation.



Reference: *IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 1, No 1, January 2013*

Inventory & Asset Management

How to Plan for an RFID Inventory and Asset Management Solution:

- **Identify your business needs**

What do you want to track? How do you want it managed? What systems should be integrated into your solution?

- **Develop a site survey and technology plan**

Understand that asset and inventory data will need to be collected and analyzed in order to determine the right solution.

- **Create a pilot program**

If asset management and inventory tracking technology is new to your organization, it is often recommended to pilot your solution in a small area of your organization. Piloting will help you to refine requirements and better understand the components needed.[2]

Benefits:

- **Multiple simultaneous tag readings**

Manual inventory or asset recordings require employees to match serial numbers with products and count individually. This method can be error prone and require countless labor hours. With RFID, this process is greatly simplified and reduces business cost and energy.

- **Reduction in shrinkage**

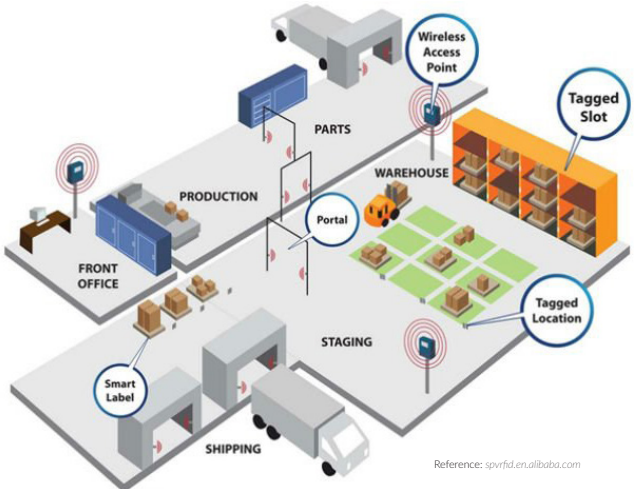
The presence of tags on items can deter shrink in the workplace. This notion can be true of both the internal workspace or in the retail store environment. Tagged items are not limited to for sale items. They can also include company assets such as laptops, tools, or other high-value items.

Industries

- Agriculture
- Healthcare
- Manufacturing
- Retail
- Shipping & Logistics
- Transportation
- Warehousing

Applications

- Drug Supply Chain
- Fraud Prevention
- Livestock Tracking
- Order Fulfillment
- Tool Tracking
- Theft Prevention
- Tote Tracking



RFID In The Supply Chain

Although there are many variations - a basic supply chain RFID Solution involves the following steps:

1. Manufacturer tags products or items with RFID tags

2. Throughout the supply chain lifecycle, RFID readers capture the RFID tag information as the items move from destination to destination.

3. RFID tag data is then stored and uploaded to an enterprise database or hosted cloud server.

4. Management is then able to access and view reports regarding the specific data associated with each tag scanned.

RFID Technology - An Overview

What is RFID?

Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify people or objects. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag). The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it.[3]

What is NFC?

Near-field communication or NFC for short is an offshoot of radio-frequency identification (RFID) with the exception that the NFC design is intended for use by devices within proximity to each other. Many forms of NFC technology exist today, the three most common are Low-Frequency (LF), High-Frequency (HF) 13.56 MHz, and Ultra-High Frequency (UHF) 860-960 MHz.

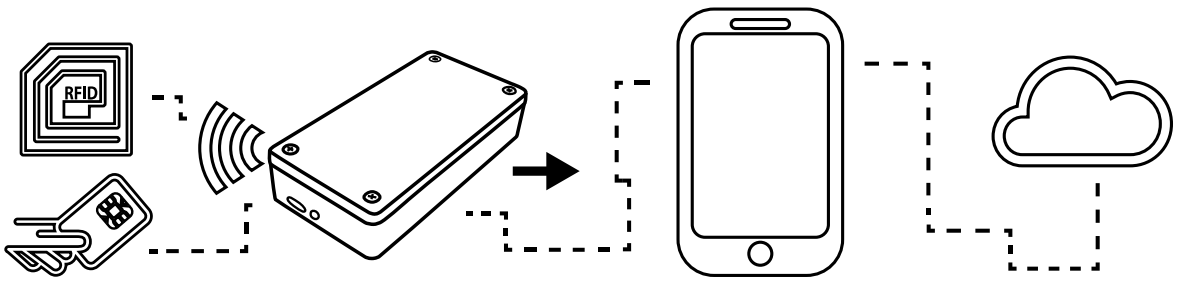
NFC-LF has two common frequencies, 125 Khz and 132 Khz. These frequencies are commonly used for access control and embedded or external identification solutions e.g. pet, livestock, or fish tracking.

NFC-HF 13.56 MHz has two common types such as ISO/IEC-14444, and ISO/IEC-15693. 14444 A&B are used for tag types such as ICODE-SLI, SLI-X, SLI-X2, Tag-IT, and more. There are numerous other types such as Seos, iCLASS, FeliCa, AWID, Casi-Rusco, Indala, SecuraKey, Kantech, Hitag, Cardax, and more. FeliCa, or Felicity Cards, for example were developed in Japan by Sony and primarily used in electronic monetary cards.

NFC-UHF is a variation of UHF RFID for tiny chips where near-field reading requires very close proximity - typically less than 1 cm - for reading. Watch video for example of this technology.

Devices using NFC may be active or passive. A passive device, such as a NFC tag, contains information that other devices can read but does not read any information itself. Think of a passive device as a sign on a wall. Others can read the information, but the sign itself does nothing except transmit the info to authorized devices.

Active devices can read information and send it. An active NFC device, like a smartphone, would not only be able to collect information from NFC tags, but it would also be able to exchange information with other compatible phones or devices and could even alter the information on the NFC tag if authorized to make such changes.[4]



Tag consists of antenna and electronic circuit which contains data and a serial number (CSN) *

Reader has an antenna that emits radio waves which stimulates the reading of the tag data

Reader sends tag information via Bluetooth to mobile device which records the tag data

Mobile device pushes data grid to cloud storage or users back end database for safekeeping

* NFC Tag consists of antenna and chip a serial number (CSN aka UID or Unit ID) and optional user memory.
UHF tag has antenna & chip with Electronic Product Code (EPC) and unique Tag ID (TID) and optional user memory.

RFID Readers

An RFID reader sends a pulse of radio energy to the tag and listens for the tag's response. The tag detects this energy and sends back a response that contains the tag's serial number and possibly other information as well.

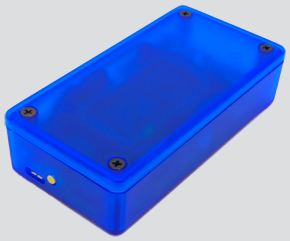
In simple RFID systems, the reader's pulse of energy functioned as an on-off switch; in more sophisticated systems, the reader's RF signal can contain commands to the tag, instructions to read or write memory that the tag contains, and even passwords.

Historically, RFID readers were designed to read only a particular kind of tag, but so-called multimode readers that can read many different kinds of tags are becoming increasingly popular. Recent modifications including Bluetooth connectivity, such as BLE or Bluetooth Low Energy options, as well as dual band antennas which allow readers to reader multiple tag frequencies within one unit, have enabled readers to become capable of being used for field or outdoor activities.

RFID readers are usually on, continually transmitting radio energy and awaiting any tags that enter their field of operation. For example, most electronic toll collection systems have the reader constantly powered up so that every passing car will be recorded. On the other hand, RFID scanners used in veterinarian's offices are frequently equipped with triggers and power up the only when the trigger is pulled.

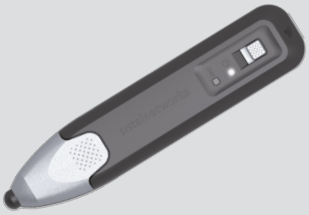
When it comes to selecting an RFID reader, the options are endless. RFID readers should be selected based on use case and tag requirements.

NFC



IDCHAMP RS3
Bluetooth Dual - NFC Reader

SCANFOB® BB2
Bluetooth Smart NFC Reader / Writer



VWAND
NFC Bluetooth Stylus

UHF

SCANFOB® ULTRA BB2
Bluetooth Smart UHF Reader / Writer

IDCHAMP 1128
Industrial Bluetooth UHF Reader

SCANFOB® QID
Keyfob Bluetooth UHF Reader / Writer

RFID Tags

A Radio Frequency Identification Tag (RFID tag) is an electronic tag that exchanges data with an RFID reader through radio waves.

Most RFID tags are made up of at least two main parts. The first is an an antenna, which receives radio frequency (RF) waves. The second is an integrated circuit (IC), which is used for processing and storing data, as well as modulating and demodulating the radio waves received/sent by the antenna.

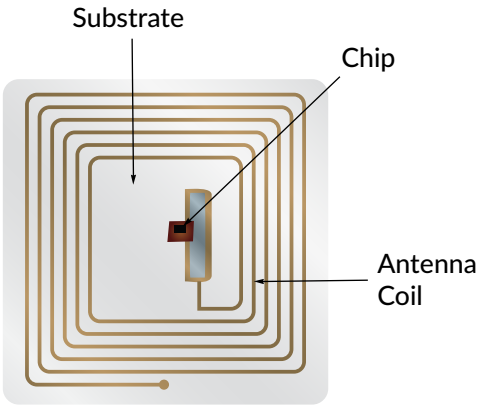
Although RFID tags have similar applications to barcodes, they are considered to be more advanced. For instance, reading information from an RFID tag does not require line-of-sight and can be performed over a distance of a few meters. This also means that a single tag can serve multiple readers at a time, compared to only one for a bar code tag.

In the context of RFID technology, the term "tag" also includes labels and cards. The kind of tag depends on the body or object to which the tag is attached. RFID systems can operate in either Ultra High Frequency (UHF), High Frequency (HF) or Low Frequency (LF). NFC Tags consist of an antenna and a chip serial number (aka CSN, UID, or Unit ID) and optional user memory whereas UHF tags have an antenna and chip with an Electronic Product code (EPC), unique tag ID (TID), and optional user memory.

These tags can be attached to almost any object. Although the usual target objects are apparel, baggages, containers, construction materials, laundry and bottles, they also may be attached to animals, humans and vehicles. Some RFID tags are designed for rugged, outdoor-based applications.

These are built to endure natural and incandescent light, vibration, shock, rain, dust, oil and other harsh conditions. They are normally passive in that to function, meaning they do not require batteries and can operate 24/7 without risk of power loss. Such heavy-duty tags are usually attached to trucks, cargo containers, and light rail cars for cargo tracking, fleet management, vehicle tracking, vehicle identification and supply container tracking, among others.[6]

EPC Global Tag Classifications	
Class 0	"Read only" passive identity tags.
Class 1	Write once passive identity tags
Class 2	Passive tags with added functionality, e.g. memory or encryption
Class 3	Read-write tags which contain onboard sensors capable of recording sensory data such as temperature, pressure, and motion; can be semi-passive or active
Class 4	Active tags - communicate with readers and other tags on the same frequency band
Class 5	Similar to class 4 tags but with added functionality; can provide power to other tags and communicate with devices other than readers



RFID Tag

Considerations When Choosing An RFID Solution

• **Tag Cost** – This should not be confused with chip cost. Although the goal is to bring the cost of the tag (chip and antenna) down to 5 cents, this goal is in the distant future since it both assumes manufacturing breakthroughs and is predicated on consumption in the hundreds of millions of tags per year. Today, the cost is closer to "less than 60 cents" for a tag solution in high volume. Ultimate tag price will be very much dependent on the type of chip required (read-only versus read/write), the size of the antenna needed and how it is packaged to meet a particular use case's requirements.

• **Tag Size** – Tag size is dependent on the read range desired. Although the chips are very tiny, they will not operate without being mounted to an antenna. The size of the antenna will determine the read distance performance of the tag so understanding the scale of the antenna needed for the application is more important than the size of the chip alone.

• **Infrastructure Cost** – more focus seems to be placed on the tag cost since it is a recurring expenditure. Reader cost and infrastructure costs for implementing RFID need considering as well. Both the software systems requirements and physical environment in which the RFID hardware will be are significant factors in quantifying a successful solution. For example, most RFID tags and readers are unable to produce a successful scan through metal objects. Other forms of electromagnetic interference could also affect the performance of the technology and may require changes made to the physical environment where the RFID hardware is. The number and types of readers can also impact the cost of implementation depending on the application needed.

• **Read Distances** – Read ranges for RFID are very much dependent on the frequency selected for the application. Tag orientation also affects the read range as the range diminishes as the tag rotates from being perpendicular to the path to the reader. Read accuracy is quite good when labels are alone in a direct scope of an RFID reader, like cases on a conveyor line, but less precise when the labels are at random. The antenna size (both on the tag and the readers) will also be a determining factor. Handheld readers are not capable of using as much power as stationary readers, and as a result provide shorter read distances.

• **Government Regulation** – Governments around the world regulate the use of the frequency spectrum. Different countries have already assigned certain parts of the spectrum for other uses and as a result, there is virtually no part of the spectrum that is available everywhere in the world for use by RFID. Therefore, an RFID tag may not work in all countries. As an example, if you choose the Ultra High Frequency (UHF) frequncy that operates at 915MHz in the U.S. and you ship your product to Europe; they may not be able to be read it since European frequencies operate at a UHF spectrum of 869Mhz. These slight differences should be an important consideration when working in a global environment.

• **Anti-Collision** – This is an important aspect of RFID chips/readers since it will allow the readings of multiple tags while grouped in one reader field. It is not available on all RFID tags but is an important feature if you are planning to use RFID for inventory counts, or in shipping and receiving where the reading of multiple tags needs to occur at the same time.[7]

About Serialio.com

For over 23 years, Serialio.com has helped hundreds of thousands of customers worldwide through their innovative development and deployment of mobile RFID, NFC, Barcode Scanning & Sensor based solutions. Their customers include some of the biggest names in education, government, technology, retail, and manufacturing industries. Serialio.com is located in Cedar Park, TX.

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