

RFID White Paper

What is RFID?

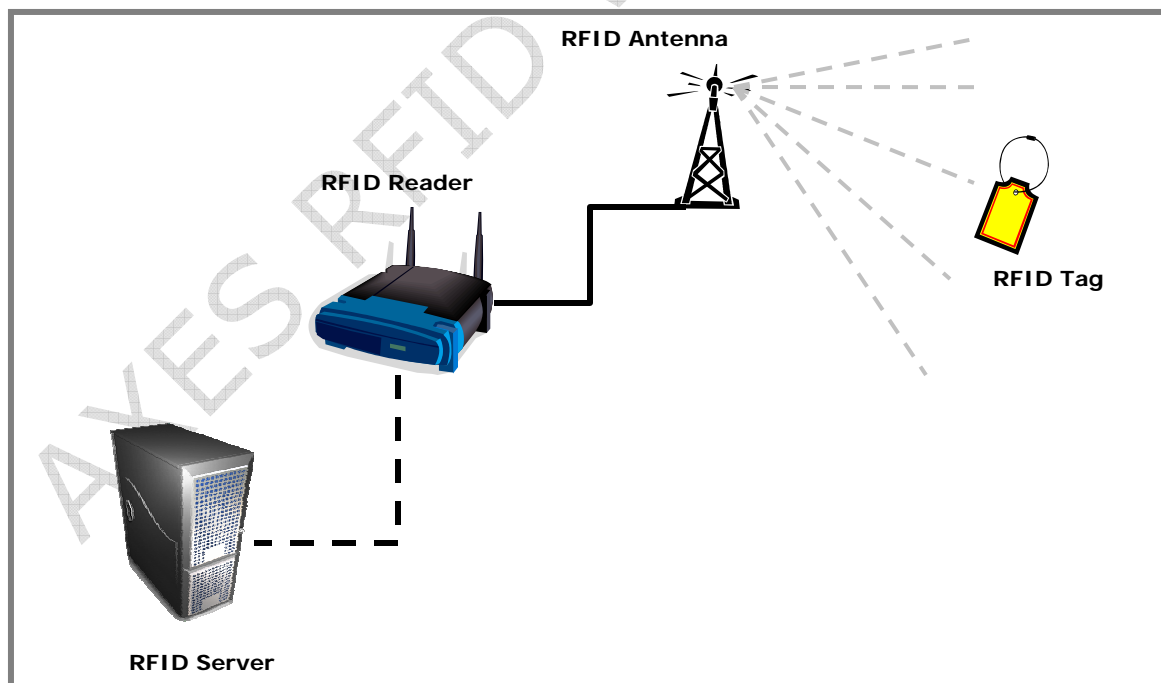
Radio Frequency IDentification, or RFID, is wireless exchange of electronic information between the carrier (tag) and the interrogator (reader).

Technology Background

RFID's birth dates back to 1920 with the development of the radar systems. But, the real development of the technology took place during World War II in which a combination of radar and radio broadcast technology was used to identify enemy warplanes. The technology was put to commercial use in the early 1970s.

Technically, it is pure physics. The tag and the reader talk to each other over a certain frequency using a particular language (protocol). Over a period of time, this protocol has been standardized by the governing body, EPC Global (www.epcglobalinc.org), which sets the standards for the development of this technology. The latest RFID hardware from different manufacturers follow a common protocol, thereby making it possible to have a heterogeneous combination of readers and tags in a single deployment.

How it works?



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Types of RFID

RFID can be broadly classified into three types, viz.,

1. *Passive*

Passive RFID involves tags having no power source. Rather, the tag derives its power from the reader's RF field. This means, these tags can operate only in the presence of a reader. The communication range is limited by the need for the reader to generate very strong signals to power the tag, which therefore limits the reader-to-tag range. These tags have a limited read range (about 5-10 m in UHF), but have a much longer lifecycle and are cheaper as compared to active tags.

2. *Semi Passive*

Semi-passive Tag Systems use battery power for the on-board digital circuit, but still use harvested power from the reader for communication. Semi passive tags are far more reliable and have greater read ranges than purely passive tags, but they also have shorter lives (due to their reliance on battery power), are more fragile, and are significantly more expensive.

3. *Active*

Active RFID involves tags having their own on-board power source. Read range increases (up to several kilometers) and reliability improves; active tags can be read while in high-speed motion as well. They are costlier than the passive tags, but have high reliability as well.

RFID Generations

Since the commercialization of the technology in the early 70s, it has seen constant evolution. Each phase of its market deployment has been termed as a generation in itself. Below is a brief background of these generations:

Generation I (Gen 1)

This generation saw manufacturers providing hardware with their own protocols. Thus, an RFID tag from a particular manufacturer would only work with the RFID reader from that manufacturer.

This type of setup had a major limitation when it came to large scale RFID deployments (like in case of DoD and Walmart), where the customer was permanently tied with a single RFID supplier only.

To overcome this problem, the EPC global, in association with major adopters of the technology, set the standards for the next generation of RFID.

Generation II (Gen 2)

Gen 2 saw a common language being spoken by the worldwide RFID hardware. An amazing leap in the development, promotion and adoption of the RFID technology across a broader platform. Walmart and DoD drove the standards development for this generation and derived great benefits from this.

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RFID Classification

RFID tags are classified based on their functionality, which has been defined in an RFID Class Structure by the Auto-ID Center (and later through EPC Global). The basic structure defines the following classes of RFID tags:

Class	Type	Functionality
0	Identity Tags	<ul style="list-style-type: none"> Purely passive, identification tags. Tag IDs programmed in at the time of manufacture
1	Identity Tags (modified)	<ul style="list-style-type: none"> Purely passive, identification tags. Tag IDs can be programmed at a later date, after manufacture
2	Higher functionality tags	<ul style="list-style-type: none"> Purely passive, identification tags. Read / write memory
3	Semi passive tags	On-board battery power
4	Active 'ad hoc' tags	Communication with other active tags
5	Reader tags	Able to provide power for and communicate with other tags i.e. can act as a reader, transmitting and receiving radio waves

Frequency Considerations

Band	LF Low Frequency	HF High Frequency	UHF Ultra High Frequency	Microwave
Typical RFID Frequencies	125–134 kHz	13.56 MHz	433 MHz or 865 – 956MHz	2.45 GHz
Approximate read range	less than 0.5 m	Up to 1.5 m	433 MHz = up to 100 m 865-956 MHz = 0.5 to 5 m	Up to 10 m
Typical use	<ul style="list-style-type: none"> Animal ID Car immobilizer 	<ul style="list-style-type: none"> Smart Labels Contact-less travel cards Access & Security 	<ul style="list-style-type: none"> Specialist animal tracking Logistics Supply Chain Item Level Tagging and Tracking 	<ul style="list-style-type: none"> Vehicle Toll Collection

Advantages

RFID offers numerous advantages over traditional data collecting mechanisms like Barcodes:

- No requirement for line-of-sight
- Dynamic information carrier (read/write)

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- High memory capacity if needed
- Anti-collision (many tags can be read at the same time)
- Robust and reliable
- Performs in rugged, harsh environment
- Cheaper in long term
- No human intervention
- Reader virtually maintenance free

Hardware Elements

A typical RFID scenario comprises of the following hardware:

- RFID Reader
 - Fixed Readers
 - Mobile / Handheld Readers
- RFID Antenna
- RFID tags
- RFID Printer

Application

- Asset Tagging and Identification
- Asset Locating and Tracking
- Employee Tracking
- Anti-counterfeiting
- Library Management
- Laptop Tracking
- Supply chain management
- Mass transit
- Postal and courier services
- Food industry
- Healthcare, pharmaceutical industry
- Access management
- Toll collection
- Airline baggage handling
- Animal identification
- Document tracking
- Cashless Payment
- And many more....