# RFID – How does it work?
An overview about the technology involved

What is RFID?

With no line-of-sight requirement radio-frequency identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is an object that can be attached to or incorporated into a product, device, or even person for the purpose of identification using low powered, high frequency radio waves.

A basic RFID system consists of a tag, or transponder, and a reader, also known as an interrogator. Even if the interrogator is called only "Reader" in the daily terminology, it has always read/write capabilities. Depending on their output power, antenna size and RF frequency, readers have field ranges from one centimeter up to several meters and more. The RFID tag is comprised of a small silicon microchip attached to an antenna and is electronically programmed with unique information sometimes as little as an ID number so the item it is attached to can be tracked. Modern RFID tags are much more sophisticated and include embedded non-volatile memory up to a size of 16kbit each. That is space enough to store around 2000 plain characters in uncompressed form on it. Like it happens in the computer industry, the memory space could rise quickly if a specific demand is generated for memory consuming applications. Around 98% of all tags in use are passive types which do not have an internal power source. They are powered by energy induced in the antenna by the RF signal. For specific applications active tags with an internal power source and an embedded sensor interfaces (for temperature, pressure etc.) are available nowadays.
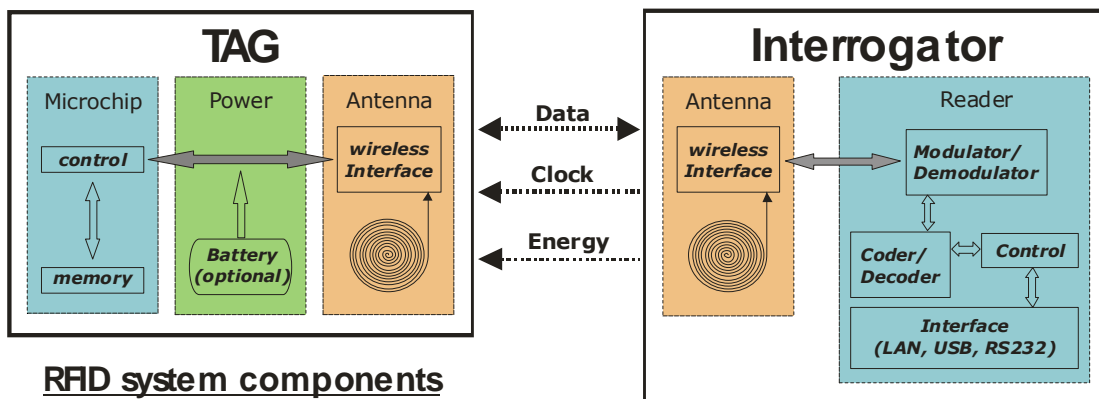

RFID system components

During operation, the reader emits electromagnetic waves. The tag antenna is tuned to receive these waves. The tag – for the purpose of this discussion, a passive tag – will identify itself when it detects a signal from a reader that emits a radio frequency transmission. When therefore a tag passes through a field generated by a compatible reader, it transmits the stored information back to the reader, thereby identifying the object. The presence of a tag modulates the RF field, and this is detected by the reader. The tag starts absorbing a small portion of the RF energy and sends modulated information back when sufficient energy is acquired from the RF field generated by the reader. In most cases, the data modulation can be accomplished by either direct modulation or FSK or Phase modulation. The reader demodulates the signals received from the tag antenna, and decodes the data for further processing.

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RFID frequency ranges and standards

RFID hardware operates over several frequency ranges, where the low-frequency (LF) range has no big impact anymore and is therefore mentioned only for historical reasons. Each of the plain tags showed below could be customized with a specific packaging where customers could select from different materials, formats and styles. In combination with other media options for brand protection and/or authentication are easy to implement.
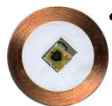
- **Low-frequency (LF)** 125 to 134.2 kHz and 140 to 148.5 kHz
  Typical applications include immobilization systems in automobile, retail, animal identification and access control. Advantages: applications for harsh environments, high immunity to electrical noise. Disadvantages: low memory capacity and reading speed, limited reading distance ($\leq$10 cm), no bulk processing.
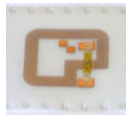
- **High-frequency (HF)** 13.56 MHz
  Typical applications include tagging and tracing of items, ideal for Lab automation and sample coding. Designed as a replacement for the LF technology. Advantages: high reading speed, large memory capacity (16kBit), multi-tag bulk reading possibilities with anti-collision features, global ISO standard, on-chip encryption algorithms. Disadvantages: higher tag price (~50 Euro cent), reading distance limited to $\leq$2 cm (depending on antenna size).

- **Ultra-high-frequency (UHF)** 860 MHz to 960 MHz
  Typical applications include fixed asset tracking, pallet and box identification and supply chain purposes. Advantages: long range reading distance of several meters, memory capacity (10kBit), cheaper tag price (~30 Euro cents) Disadvantages: challenge to detect fluids and other water containing organic materials or metals, higher reader hardware price, no harmonization of frequencies on a world wide basis, privacy and safety considerations required for far-field operation.

Today's challenge – Finding the right solution

RFID is a growing technology that is used for more and more applications. But the fact that it is based on radio waves makes it sensitive to external factors. It still requires the fine tuning of antennas and readers in order to achieve a high rate of read success. The bad news is, there is and maybe never will be a one-size-fit all solution for RFID. Implementing the right technology and developing the appropriate software is the specialty of Intelli Labs when applying RFID to laboratory problems. We provide our clients with the most adapted solution and technology to their company's reality.

Customizing the solution

Everyone's RFID requirements are specific to their needs and are generally unique in some way. Intelli Labs specializes in adapting the RFID technologies available and customizing the solution to you. We offer a complete set of solutions, from hardware to software, of course including our consultancy, analysis and implementation support to make sure the integration of automatic identification and data collection within your processes is done smoothly. Our product lines also supports the users need to have a certain mobility to do their job, by utilizing the latest and always up to date mobile technologies like Wi-Fi, mobile computers and Smartphones. These help our clients to increase their productivity and efficiency by enabling both wireless and mobile computing.
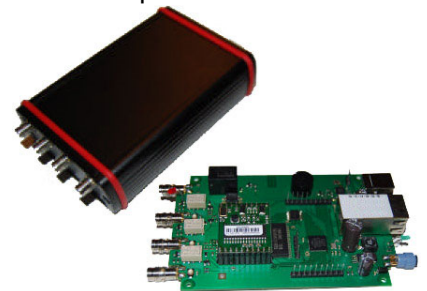
As a *Microsoft Solution Partner* we are providing a uniform way to discover, communicate and manage RFID devices on the Microsoft® Windows® platform. Furthermore our software solutions works well with existing line of business applications such as Enterprise Resource Planning (ERP) systems, Warehouse Management Systems (WMS) and more specialized vertical software. This flexibility allows it to work seamlessly and in many cases automatically with minimal modifications required.

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